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PALYNOLOGICAL INVESTIGATION OF NEOGENE DEPOSITS IN THE NOWY TARG-ORAWA BASIN (WEST CARPATHIANS, POLAND)

Analiza palinologiczna osadów neogeńskich z Kotliny Nowotarsko-Orawskiej (Karpaty Zachodnie, Polska)

ABSTRACT

The pollen-analysis method was applied to investigate short profiles of Neogene deposits from the western part of the Nowy Targ — Orawa Basin. Five forms new in Polish Tertiary were determined. The examination of the floristic composition of pollen spectra permitted the distinguishing of two consecutive stages in the development of local vegetation. During the older stage the greater part of the investigated area was overgrown with marshy woods of the *Taxodium*-type which, during the younger stage, gave way to gallary-like shrubs and peat-bog communities. In the drier habitats mixed forests grew during both stages. Through comparison with Neogene floras from the neighbouring regions, the flora under examination has been attributed to the Upper Miocene age.

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INTRODUCTION

In the western part of the Nowy Targ — Orawa Basin a prominent part is played by dusty fresh-water deposits of the Neogene age, which, for a number of years now, have been an object of research at the Department of Palaeobotany of the Institute of Botany of the Polish Academy of Sciences in Cracow. So far, the following results of research conduced on the Pliocene deposits from Domański Wierch have been published: the results of palynological investigations (Oszast 1973), a study of foliaceous flora (Zastawniak 1972), and a part of fruit-and-seed material (Łańcucka-Środoniowa 1965). Now work is being conducted on deposits from deep geological borings at Czarny Dunajec (partly published, Oszast 1973), and Koniówka.

The present publication comprises the results of investigation of three shallow profiles in the western part of the Nowy Targ — Orawa Basin from the localities of Chyżne, Lipnica Mała and Lipnica Wielka. The investigation was carried out at the Institute of Botany of the Polish Academy of Sciences, under the guidance of Docent Dr hab. Leon Stuchlik, to whom I wisch to express my great indebtedness for introducing me to the problems of palynological research on the Tertiary age, for discussing the subject at issue with me, and for his aid in my work on the typescript. I also wish to thank Dr hab. J. Oszast for her help in determining some of the sporomorphs, and Docent Dr hab. M. Łańcucka-Środoniowa for showing me the — as yet unpublished — results of her investigations on the fruit-and-seed floras from Orawa. I am equally indebted to Prof. Dr J. Dyakowska and Prof. Dr J. Raniecka-Bobrowska for their critical comments introduced into the typescript; my thanks are finally due to Mr Z. Dzwonko for helping me with the microphotographs.

The documentation materials (microscopic slides preparations, sporomorph microphotographs, plates and records) have been filed with the Museum of Palaeobotany at the Institute of Botany of the Polish Academy of Sciences.

DESCRIPTION OF GEOLOGICAL PROFILES

Chyżne

Neogene deposits occur in natural outcrop upon the Chyżne stream, and are covered with a layer of soil and sand with gravels. Material for palynological investigations was collected from the outcrop situated ca. 300 m south of the church (Fig. 1).

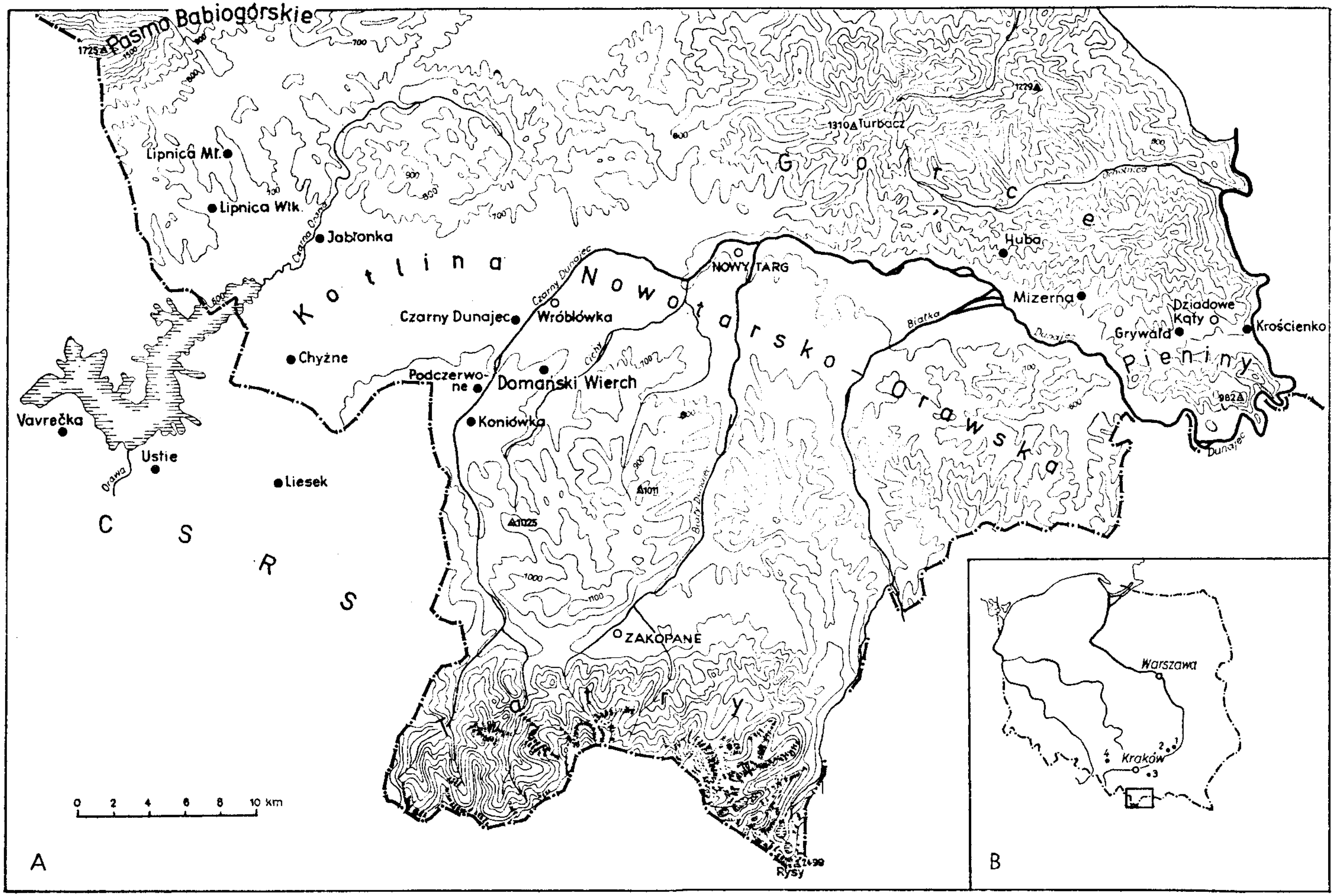

Fig. 1. A. Localities of Neogene floras in the Nowy Targ—Orawa Basin; B. Localities with Miocene floras from South Poland examined with palynological method: 1 — Piaseczno, 2. — Świniary, 3. — Kłaj (Gdów-Bay), 4 — Gliwice Stare

Geological profile:

0—0·22 m	soil
0·22—0·60 m	thick-grained sands with gravels
0·60—1·25 m	brown clays
1·25—1·55 m	lignites
1·55—1·90 m	dusty and blue clays
1·90—2·10 m	strongly sanded yellow loam
2·10 m	water horizon in the stream

Lipnica Mała

On the left bank, 7 m high, of the Sylec stream, there is a natural outcrop where Neogene deposits are exposed in a 40 m long sector. Samples for analysis were collected from the bottom part of the profile, which comprises 3·15 m of the whole deposit.

Geological profile:

0—0·30 m	soil
0·30—4·00 m	yellow thick-grained sands with gravels of varying diameter and clayey inserts
4·00—4·17 m	grey clays and brown sandy clays with gravels
4·17—4·62 m	grey and brown clays
4·62—4·82 m	grey-brown clays with carbonized plant remains
4·82—5·11 m	lignite interbedded with grey-brown clays
5·11—5·20 m	grey clays interbedded with brown clays
5·20—5·30 m	lignites
5·30—5·50 m	grey clays interbedded with brown clays
5·50—6·00 m	lignites interbedded with brown clays
6·00—6·25 m	grey clays interbedded with brown ones
6·25—6·32 m	lignites
6·32—6·45 m	grey-brown clays with sand
6·45—7·15 m	grey clays
7·15 m	water horizon in the stream

Lipnica Wielka

On the right bank of the Lipnica stream, a small exposure of Neogene deposits.

Geological profile:

0—0·20 m	soil
0·20—0·80 m	brown sands
0·80—1·15 m	grey and brown sandy clays
1·15—1·50 m	grey clays
1·50 m	water horizon in the stream

METHODS

Material for analysis was collected at intervals of 5 cm, at Lipnica Wielka of 10 cm. The samples were prepared by Faegri and Inversen's hydrofluoric method (1964), by Knox's flotation method (1942), or alternately were simmered in KOH and acetolized by Erdtman's method (1960, 1969) dependent on the composition of mineral components in the deposit. After the acetolysis the material was dehydrated by compound of alcohol with water in a 3 : 1 proportion, and then by 96% alcohol, absolute alcohol and benzene. This material served as basis for microscopic preparations (slides) in silicon oil AK 2000.

Out of each sample, at least 500 sporomorphs were determined. In low-frequency samples all sporomorphs found on 5 preparations (20 × 20 mm) were determined.

The results of analyses are shown in tables of the absolute numbers of sporomorphs and by pollen diagrams. The sum total of pollen grain of trees (AP) and non-trees (NAP), with the exclusion of the *Polypodiaceae* and *Sphagnum* spores, was taken as basis for percent calculations. The curves for the respective taxons are shown in the diagrams according to their ecological requirements, commencing with the plants of wet and ending with those of the dry habitats.

The sporomorphs were described using the terminology and diagnostic system established by Erdtman (1952, 1965, 1966, 1969) for palynotaxonomic purposes. Further, every recorded form was included in the morphographic system of sporomorph classification: Erdtman and Straka's NPC-classification (1961).

In determining the sporomorphs, recourse was made to the set of comparative slides at the Institute of Botany of the Polish Academy of Sciences, more than 10 000 in number, of ca. 6000 species of plants. Use was also made of contemporary pollen floras: of Scandinavia (Erdtman et al. 1961, 1963), the Hawaian Islands (Selling 1946, 1947), China (Wang Fu-Hsung et al. 1960), Japan (Ikuse 1956); various monographs on different plant families or systematic groups (Kuprianova 1965; Petrosyants 1967; Chanda 1962; Stachurska 1961; Grichuk and Monoszon 1971), and atlases of fossil pollen grains and spores (Krutzsch 1962, 1963a, 1963b, 1967; Pokrovskaya et al. 1956a, 1956b).

In all, 152 forms were distinguished, of which 57 were assigned to their species or the rank of organ species, 71 to their genus, 19 to their family, while 5 microplankton forms could be traced only to the respective units of an artificial morphographic system. The list of the determined sporomorphs of cryptogamous and angiospermous plants was drawn up according to Wettstein's system (1935), and that of gymnospermous plants — according to Florin's system (1931). The nomenclature of the distinguished morphographic taxons was founded upon Krutzsch's (1962, 1963a, 1963b, 1967) or Thomson and Pflug's system (1953).

DESCRIPTION OF THE DETERMINED SPOROMORPHS

Bryophyta

Musci

Sphagnaceae

Sphagnum — five various form of spores belonging to this genus have been distinguished. All spores are trilete (NPC-112), with a tetrad mark on the proximal face.

Stereisporites (*Stereisporites*) *minor* (Raatz) W. Kr. (Pl. I, Figs 1—2), diameter up to 25 μ, leasura arms nearly reach the equator of the spore. Exosporium 0·5—2·1 μ thick, psilate or finely rugate. Sporadic.

Stereisporites (*Stereisporites*) *stereoides* (R. Pot. & Ven) Th. & Pf. (Pl. I, Fig. 3), diameter 24—30 μ, amb rounded triangular, leasura arms occasionally reach the equator of the spore. Exosporium 0·8—1 μ thick, on the apices of the triangle somewhat swollen, surface psilate. Sporadic.

Stereisporites (*Stereisporites*) *megastereis* W. Kr. (Pl. I, Figs. 4—5), diameter 25—30 μ, leasura arms slightly undulated, extend to the equator of the spore. Exosporium 2—3 μ thick, psilate. Known from various Tertiary deposits (Krutzsch 1963b), common in all our samples.

Stereisporites (*Stereigranisporis*) *granulus* W. Kr. & Sontag (Pl. I, Figs 6—7), diameter 22—30 μ, amb circular, leasura arms straight, reach to barely 3/4 of the area between the pole and the equator of the spore. Exosporium about 1 μ thick, irregularly granulate. Granula less than 1 μ in diameter. Sporadic.

Stereisporites (*Structisporis*) cf. *intrastructuris* W. Kr. (Pl. I, Figs. 8—9), diameter 34—40 μ, amb circular, leasura arms straight with somewhat broaded ends, reach the equator of the spore. Exosporium 1·5—2·5 μ thick, finely granulate. Known from Miocene and Pliocene deposits in Germany (Krutzsch 1963b), in our profiles sporadical.

Pteridophyta

Lycopodinae

Lycopodiaceae

Lycopodium — in the examined material 4 various form of spores belonging to this genus have been distinguished. All spores are trilete (NPC-112), with a tetrad mark on the proximal face.

Lycopodium t. *annotinum* — *Retitriletes* fsp. (Pl. I, Figs. 10—12), diameter about 35 μ, amb rounded triangular, leasura arms always reach the equator of the spore. Exosporium about 4 μ thick, with a distinct reticulum on the distal face. Lumina polygonal, diameter 4—6 μ, muri about 1·5 μ broad, simplibaculate. Proximal face fragmentimurate, near the pole surface psilate. Very common in Tertiary deposits, in our profiles only sporadic.

Lycopodium cf. *inundatum* — *Camarozonosporites* (*Inundatisporis*) fsp., diameter about 47 μ, amb rounded triangular, leasura arms nearly reach the equator of the spore. Exosporium thick with fragmentimurate (hamulate) sculpture on the surface of the distal face, on the proximal face surface granulate. Known from various Tertiary sediments (Krutzsch 1963a; Stuchlik 1964), in our material only sporadic.

Lycopodium cf. selago — two types of spores belong to this group.

Selagosporis selagoides W. Kr. (Pl. I, Figs. 13—16), diameter about 30 μ, amb triangular with markedly concave sides. Leasura arms reach to 4/5—5/5 of the area between the pole and the equator of the spore. Exosporium 1—1·5 μ thick, faveolate on the distal face and more or less psilate on the proximal. This type of spore is common in various Tertiary sediments (Krutzsch 1963a; Stuchlik (1964), in our profiles only sporadic.

Selagosporis fsp. B. W. Kr. (Pl. I, Figs. 17—19), diameter about 40 μ, amb triangular with straight sides. Leasura arms do not reach the equator of the spore. Exosporium 3—4 μ thick, irregularly faveolate, diameter of the faveolae 1—1·5 μ. Sporadic.

Selaginellaceae

Two type of trilete spores (NPC-112) found in the investigated profiles belong to this family.

Echinatisporites cycloides W. Kr. (Pl. I, Fig. 20), diameter about 40 μ, exosporium about 1 μ thick, spinate. Spines up to 5 μ long, usually curved. Sporadic.

Echinatisporites miocenicus W. Kr. & Sontag (Pl. II, Figs. 1—3), diameter 26—30 μ, exosporium about 1·5 μ thick, along the leasura arms somewhat swollen, spinate. Spines 5—6 μ long, straight or slightly curved, more loosely spaced than in *Echinatisporites cycloides*. Sporadic.

Filicinae

Osmundaceae

Spores circular, trilete (NPC-112) with a tetrad mark on the proximal face. Leasura arms straight, reach to 2/3—3/4 of the area between the pole and the equator of the spore. Exosporium 1·5—2·5 μ thick. The following types may be distinguished:

Osmunda t. *claytoniana* — *Baculatisporites primarius primarius* W. Kr. (Pl. II, Fig. 4), diameter 35—45 μ, surface verrucate. Verrucae 1—2 μ hight, diameter 2—4 μ. Sporadic.

— *Baculatisporites nanus gracilis* W. Kr., diameter up to 35 μ, surface baculate. Bacula 2—3 μ long, diameter about 1 μ.

— *Baculatisporites nanus* cf. *baculatus* W. Kr., diameter about 40 μ, surface baculate. Bacula of the same size and shape as in *Baculatisporites nanus gracilis,* but loosely spaced. Spores belonging to *Osmunda* t. *claytoniana* have often been reported from Tertiary sediments in Europe (Oszast 1960; Krutzsch 1959; Stuchlik 1964, and others). In our profiles common, especially in the profile of Chyżne (up to 19%).

Osmunda t. *regalis* — *Baculatisporites quintus regulatoides* W. Kr. (Pl. II, Figs. 5—7), diameter 46—53 μ. Exosporium baculate. Bacula 1—2 μ long, diameter about 1 μ, densely spaced. Sporadic.

Schizeaceae

Two various forms probably belonging to the genus *Lygodium* have been distinguished. Spores trilete (NPC-112), with a tetrad mark on the proximal face, without perine.

Corrugatisporites nutidus (R. Pot.) Th. & Pf., diameter about 35 μ, amb rounded triangular, leasura arms reach to 3/4—4/5 of the area between the pole and the equator of the spore. Exosporium about 2 μ thick, on its surface small flat verrucae. Known from Paleogene (Doktorowicz-Hrebnicka 1961) and Miocene (Stuchlik 1964) deposits, in our material only sporadically in the lower part of the profile at Lipnica Mała.

Triletes microvallatus W. Kr. (Pl. II, Fig. 8), diameter about 25 μ, amb triangular, leasura arms reach the equator of the spore. Exosporium about 1 μ thick, surface loosely verrucate. Sporadic.

Gleicheniaceae

Spores trilete (NPC-112), with a tetrad mark on the proximal face. Amb triangular with concave sides. Leasura arms reach or nearly reach the equator of the spore. Exosporium about 1 μ thick without perine. Known from various tertiary sediments (Krutzsch 1962; Stuchlik 1964; Nagy 1969), in our material sporadic. Two various type of spores belonging to this family may be distinguished:

Concavisporites obtusangulus (R. Pot.) Th. & Pf. forma minor Pf. (Pl. II, Figs. 12—13), diameter about 28 μ, surface of exosporium psilate.

Concavisporites fsp. (Pl. II, Fig. 11), diameter 25—30 μ, surface of exosporium with small verruca-like processus.

Cyatheaceae

Spores trilete (NPC-112), amb triangular or rounded triangular with concave sides, leasura arms reach the equator. Without perine. Known from various Tertiary sediments (Stuchlik 1964), in our material only sporadic. The following forms may be distinguished:

Cyathea cf. propinqua (Pl. II, Figs. 9—10), diameter about 40 μ. Exosporium 1—2 μ thick, in the area of leasura arms thickened, surface granulate.

Cyathea cf. *vestila* (Pl. II, Figs. 14—16), diameter about 35 μ, exosporium 2—3 μ thick, verrucate. Verrucae circular, diameter about 3 μ. Distal face conical, proximal flat.

cf. *Hemitelia* sp. 1. (Pl. III, Fig. 3), diameter about 60 μ exosporium 1·5—2 μ thick, the proximal face concave, area of leasura arms undulated. Surface of the exosporium psilate.

cf. *Hemitelia* sp. 2. (Pl. III, Figs. 4—5), diameter about 44 μ, leasura arms short and broad. Exosporium on the proximal face thicker than on the distal. The thickened part of the spore has a triangular contour with rounded apices and concave sides. Surface of thickened part verrucate.

Cyatheaceae forma 1, diameter about 30 μ, amb triangular with markedly concave sides, exosporium about 1 μ thick, regularly fine verrucate.

Cyatheaceae-Schizeaceae

Spores belonging to this group are trilete (NPC-112), amb triangular. Tetrad mark on the proximal face, leasura arms straight and narrow, reach, or nearly reach, the equator of the spore.

The following forms have been distinguished:

Leiotriletes neddenioides W. Kr. (Pl. III, Figs. 6—7), diameter about 40 μ, exosporium about 1 μ thick, psilate. After Krutzsch (1962) those spores occur in Miocene-Oligocene sediments; in our profiles sporadic.

Leiotriletes wolfi brevis W. Kr. (Pl. III, Figs. 1—2), diameter about 29 μ, amb triangular. Exosporium about 1 μ thick, psilate, finely granulate in the area of the tetrad mark. Known from Miocene and Pliocene deposits (Neuy-Stolz 1958; Krutzsch 1962), in our profiles common in low percentage.

Polypodiaceae

Spores of this family are very frequent in all investigated profiles. The following two groups may be distinguished:

First group — spores trilete (NPC-112), with tetrad mark on the proximal face, usually without perine. Most of spores of this group are to be found only sporadically.

Aspelniopsis sp., diameter about 38 μ, leasura arms not of the same length, exosporium about 1 μ thick, finely granulate.

Cryptogramma sp. (Pl. III, Figs. 8—9), diameter 29—37 μ, leasura arms straight, reach only to 2/3 of the area between the pole and the equator of the spore. Exosporium 2—3 μ thick, verrucate. Verrucae polygonal, diameter 4—8 μ, flat on the top.

Microlepia sp. 1. (Pl. II, Fig. 17), diameter about 33 μ, amb rounded triangular, leasura arms reach to 3/4—4/5 of the area between the pole and the equator of the spore. Exosporium 1—1·5 μ thick, finely granulate.

Microlepia sp. 2. (Pl. II, Fig. 18), differs from sp. 1 in the thickness of the exosporium (2 μ), and granulate-verrucate surface. Our forms are somewhat similar to those described by Krutzsch (1962) as *Leiotriletes microlepioides*.

cf. *Polypodiaceoisporites cyclocingulatus* W. Kr., diameter about 38 μ, amb triangular. Exosporium on the distal face with two thickened folds running parallel to the sides of the spore. Breadth of the folds 2—4 μ, surface psilate.

Polypodiaceae forma 1, diameter about 40 μ, amb circular. Exosporium about 2 μ thick, verrucate. Verrucae polygonal, flat on the surface, diameter 3—7 μ, densely spaced.

To the second group of the *Polypodiaceae* belong spores bilateral, monolete (NPC-113), with one leasura arm.

Cystopteris sp., size 22 × 13 μ, leasura arm reaches to 4/5 of the longer axis of the spore, usually with perine. Exosporium about 1·5 μ thick, perine with spines 1—4 μ long. Known from Tertiary deposits of the USSR (Pokrovskaja 1956b); in our material sporadic, in the lower part of the profile at Lipnica Mała more frequent.

Laevigatosporites gracilis Wilson & Webster (Pl. III, Figs. 10—13), diameter about 30 μ, leasura as long as the longer axis of the spore. Exosporium 0·5—1·5 μ thick, psilate. Frequent, especially in the profile at Chyżne.

Laevigatosporites haardti haardti W. Kr. (Pl. III, Figs. 19—20), size 33 × 19 — 37 × 27 μ, leasura arm shorter than the longer axis of the spore, exosporium 1—2 μ thick, psilate. This is the most common type of spore in all investigated profiles. It occurs in all samples in large quantities, reaching its maximum in the upper part of the profiles at Lipnica Mała and Lipnica Wielka, and in the lower part of the profile at Chyżne.

Laevigatosporites haardti haardtioides W. Kr. (Pl. IV, Fig. 15), diameter 30—35 μ, amb more or less circular, leasura arm 3/4—4/5 of the longer axis of the spore. Exosporium 0·5—1 μ thick, psilate.

Laevigatosporites haardti crassicus W. Kr. (Pl. III, Fig. 14), size about 43 × 25 μ, leasura arm reaches 4/5 of the longer axis of the spore. Exosporium 1·5—2·5 μ thick, psilate. This species differs from the *L. haardti haardtioides* in having a more elongated amb and thicker exosporium, and from *L. haardti haardti* by a greater diameter. Known from Upper Oligocene up to Upper Miocene (Krutzsch 1967).

Laevigatosporites nutidus nutidus W. Kr. (Pl. III, fig. 15), size 57 × × 35 μ, leasura arm to 3/4 of the longer axis of the spore. Exosporium 1—2 μ thick, thickened in the area of the leasura, surface psilate. Common in Tertiary deposits (Doktorowicz-Hrebnicka 1956a; Mamczar 1960 and others).

Laevigatosporites? bisulcatus W. Kr. (Pl. IV. Fig. 1), size 37 × 18 μ, amb oval elongated, leasura arm as long as the longer axis of the spore. Exosporium 1—1·5 μ thick, sulcate along the longer axis, surface psilate. Common in old Tertiary sediments (Thomson and Pflug 1953; Krutzsch 1967), in younger Tertiary sediments only as relicts (Krutzsch l.c.).

Extrapunctatosporis fsp. (Pl. III, Figs. 17—18), longer axis 20—27 μ, leasura arm short, reaches only 2/3 of the longer axis of the spore. Exosporium about 1 μ thick, punctate. Puncta rounded, diameter less than 0·3 μ, regularly and densely spaced. This type is somewhat similar to *E. seydaensis* W. Kr., but the puncta are smaller and the exosporium thinner. Known from Oligocene-Pliocene sediments (Krutzsch 1967).

Verrucatosporites alienus (R. Pot.) Th. & Pf. (Pl. IV, Figs. 2—3), size 55 × 45 μ, leasura arm short and narrow. Exosporium about 3 μ thick, verrucate. Verrucae big, diameter 4·5—8 μ, regularly and loosely spaced. Common in Tertiary sediments (Couper 1953; Pacltová 1960; Krutzsch 1967). After Raatz (1937) and Couper (l.c.) this type of spores probably belongs to *Polypodium*.

Verrucatosporites cf. *bockwitzensis* W. Kr. (Pl. IV, Fig. 4), size 62 × × 54 μ, leasura arm short and narrow. Exosporium 2—3 μ thick, verrucate. Verrucae polygonal, diameter 3—8 μ, largest on the distal face, smallest on the proximal one.

Verrucatosporites tenellis W. Kr. (Pl. IV, Fig. 6), diameter 22—33 μ, leasura straight, narrow, reaches to 2/3 of the longer axis of the spore. Exosporium about 1 μ thick, verrucate. Verrucae small and circular, densely spaced. Known from older Tertiary sediments (Krutzsch 1967), sporadically in Miocene; in our material only in the profile at Chyżne.

Verrucatosporites rugufavus W. Kr. (Pl. IV, Fig. 5), size 60 × 42 μ, leasura straight and narrow. Exosporium 2—3 μ thick, verrucate. Verrucae polygonal, diameter 5—6 μ, flat, regularly and densely spaced. Known from Tertiary deposits of the USSR (Pokrovskaja 1956) and central Europe (Krutzsch 1967).

Verrucatosporites arctotertiarius W. Kr., size 39 × 25 — 29 × 19 μ, leasura straight, reaches to 4/5 of the longer axis of the spore. Exosporium 1—3 μ thick, verrucate. Verrucae of various size, smaller on the proximal face, bigger on the distal one, spaced.

cf. *Reticulosporis oligocaenicus* W. Kr., size 90 × 55 μ, leasura straight and narrow, reaches only 2/3—3/4 of the longer axis of the spore. Exosporium about 4 μ thick, foveolate-reticulate. Foveolae circular, diameter about 2 μ, densely spaced, forming a reticulum like sculpture with rather thick muri up to 2 μ.

Spores of unknown botanical appurtenance

Spores trilete (NPC-112) with a tetrad mark on the proximal face.

Laevigatisporites neddeni regularis (R. Pot. et Ven) Th. & Pf. (Pl. IV, Figs. 7—10), diameter 15—27 μ, leasura arms straight and narrow, reach the equator of the spore. Exosporium about 1 μ thick, psilate. Sporadic.

Punctatisporites? punctatus (Pf.) Th. & Pf. (Pl. III, Fig. 21), diameter about 27 μ, amb rounded, leasura arms straight and narrow reach the equator of the spore. Exosporium about 1 μ thick, psilate or very finely granulate.

Punctatisporites? punctatoides W. Kr. (Pl. IV, Figs. 11—12), diameter 24—30 μ, amb rounded, leasura arms straight and narrow, reach to 4/5—5/5 of the area between the pole and the equator. Exosporium about 1 μ thick, finely punctate. Puncta densely spaced. Known only from Upper Oligocene (Krutzsch 1967); sporadic in the profile at Lipnica Mała.

Microfoveolatisporites fsp. (Pl. IV, Figs. 13—14), diameter about 38 μ, amb rounded, leasura arms straight and narrow, reach the equator. Exosporium about 1 μ thick, foveolate. Foveolae diameter about 0·5 μ, densely spaced. Known from Pliocene deposits (Krutzsch 1962).

Toroisporis (Toroisporis) cf. *pessinensis* W. Kr. (Pl. V, Figs. 1—2), diameter about 34 μ, amb triangular with rounded apices and concave sides, leasura arms reach the equator of the spore. Exosporium about 1 μ thick, thickened on the proximal face forming a torus, surface granulate. Known from Miocene deposits (Krutzsch 1962; Stuchlik 1964).

Gymnospermae

Ginkgoales

Ginkgoaceae

Ginkgo sp. (Pl. IV, Figs. 16—17), pollen grains monocolpate (NPC-133), elipsoidal, size 26 × 17 μ, colpus along the polar axis on the distal face.

Exine about 1 μ thick, finely granulate. Leafs known from Jurassic-Pliocene deposits (Takhtadjan et al. 1963; Tralau 1968; Wąs 1956; Szafer 1961), pollen sporadic.

Coniferae

Podocarpaceae

Podocarpus — pollen grains 2-saccate, bilateral, or 3-saccate radiosymmetric, analept (NPC-141), leptoma not well defined. Corpus circular, sacci larger than the body, more or less circular with very thin, reticulate exine.

Two different pollen types may be distinguished:

Podocarpus sp. 1 (Pl. V, Fig. 3), diameter of the corpus about 26 μ, sacci circular about 35 μ broad with exine 0·5 μ thick. Somewhat similar to that described by Stuchlik (1964) as *Podocarpus* sp. 1. Sporadic.

Podocarpus sp. 2, (Pl. V, Fig. 9), diameter of the corpus about 42 μ, sacci oval, longer axis about 55 μ, with reticulate exine about 0·5 thick. Diameter of the lumina 1—3 μ. Somewhat similar to that described by Doktorowicz-Hrebnicka (1964) as *Podocarpus forma eccepta.* Sporadic.

Pinaceae

Two groups of pollen grains belong to this family: 2-saccate bilateral analept (NPC-131), and atreme (NPC-000), radiosymmetric.

Abies sp. — *Pityosporites absolutus* (Thierg.) Th. & Pf. (Pl. V, Figs. 4—6), breadth of the pollen grains 90—120 μ, of the body 80—105 μ, on the proximal face well developed cap 1·5—6 μ broad. Sacci not set with their broadest base on the body, surface reticulate. Sporadic, maximum (2·15%) in the upper part of the profile at Chyżne.

Picea sp. — *Pityosporites alatus* (R. Pot.) Th. & Pf. (Pl. VI, Figs. 2—3), breadth of the pollen grain 50—130 μ, sacs set with the broadest base on the body. Exine on the proximal face of the body thickened up to 3 μ, baculate, on the sacs exine 0·5 μ thick, reticulate. Common in Tertiary sediments (Rudolph 1935; Thomson and Pflug 1953; Stuchlik 1964); in our profiles in low quantities.

Cedrus sp. — *Pityosporites cedroides* Th. & Pf. (Pl. VI, Fig. 5) breadth of the pollen grains 70—120 μ, sacs semicircular with their proximal roots merged with the corpus. Surface of the sacs somewhat reticulate. Exine of the corpus forms a cap 7—9 μ broad on the proximal face. Surface of the body baculate. Bacula densely spaced, arranged in reticulum-like order. Rare.

Pinus t. *diploxylon* Rudolph — *Pityosporites labdacus* (R. Pot.) Th. & Pf. (Pl. VII, Figs. 3—7), breadth of the pollen grains 25—50 μ, body spheroidal or oval. Exine on the proximal face forms a very poorly developed cap 2—3 μ broad, surface granulate. Sacs spheroidal, not attached to the body by their broadest side, exine thin, reticulate. Frequent in all samples of the three profiles.

Pinus t. *haploxylon* Rudolph — *Pityosporites microalatus* (R. Pot.) Th. & Pf. (Pl. VII. Figs. 8—9), pollen grains elipsoidal or elongated elipsoidal (longer axis 60—130 μ). Sacs semicircular with the broad base attached to the body. Exine as in *Pinus* t. *diploxylon*. Regular, but in small quantities in all three profiles.

Pollen grains belonging to the second group are radiosymmetric, atreme (NPC-000):

Tsuga t. *diversifolia* (Maxim) Mast. — *Zonalapollenites igniculus* (R. Pot.) Th. & Pf. (Pl. V, Fig. 7), diameter 54—72 μ, exine baculate, forming a 18—20 μ wide fringe on the margin. On the surface small granuloid processus. Sporadic.

Tsuga t. *canadensis* Carr. — *Zonalapollenites* (*Tsuga*) *virifluminites* (Woodh) Th. & Pf. (Pl. V, Fig. 8), diameter 60—100 μ, exine on the surface undulating, forming a verruca-like sculpture. Sporadic.

Tsuga t. *pattoniana* Engelm. (Pl. VI, Fig. 1), differs from other types in bilateral symmetry of the pollen grains, which are 2-saccate. Corpus about 85 μ broad, sacs semicircular about 60 μ wide. Exine on the proximal face thicker than on the distal one, forms a well developed cap with small verrucae on its surface. Only sporadic in the profile at Lipnica Mała.

Tsuga t. *sieboldii* Carr. (Pl. VII, Figs 1—2), diameter about 50 μ, fringe 0·5—2·1 μ broad, surface of exine with small, 1·5 μ long spinules. Very rare.

Larix sp. — *Inaperturopollenites magnus* (R. Pot.) Th. & Pf. (Pl. VI, Fig. 4), pollen grains spheroidal, diameter 55—90 μ. Exine 2—4 μ thick, psilate or very finelly granulate. Sporadic.

Taxodiaceae

Pollen grains inaperturate, analept (NPC-131), with a leptoma developed in the form of a papilla on the distal face.

Sequoia sp. — *Sequoiapollenites polyformosus* Thierg. (Pl. VII, Fig. 10), spheroidal, diameter about 28 μ, papilla curved. Exine about 0·5 μ (on the distal face) to 1·5 μ thick (on the proximal face), surface granulate. Regular in all three profiles, maximum (2·19%) in the middle part of the profile at Chyżne.

Taxodium sp. — *Inaperturopollenites hiatus* (R. Pot.) Th. & Pf. (Pl.

VII, Figs. 11—12), spheroidal, diameter 25—30 μ, fossil always ruptured in characteristic way with a small papilla at the base of the rupture. Exine about 1 μ thick, surface granulate. Frequent in all investigated samples.

Glyptostrobus cf. *europaeus* — *Pollenites magnus dubius* R. Pot. & Ven. (Pl. VII, Fig. 13), elipsoidal, size 40—50 × 20—25 μ, ruptured along the polar axis. Exine about 1 μ thick with 3—4 folds along the rupture, surface granulate, often undulated. Frequent in all three profiles. Macrofossils of this species are also very frequent in the investigated profiles (Raciborski 1892; Łańcucka-Środoniowa 1963).

Cryptomeria sp. — *Sequoia pollenites largus* (Kremp) Manum (Pl. VII, Figs. 14—16) spheroidal, diameter about 35 μ, with a straight papilla (about 5 μ long), on the distal face. Exine granulate to finely verrucate. In small quantities in various samples of the three profiles.

Cupressaceae

Cupressus sp. — *Cupressacites* fsp. (Pl. VII, Fig. 17), spheroidal, diameter up to 30 μ, usually with an indistinct leptoma. Exine very thin (about 0·5 μ), finely granulate. Sporadic.

Taxodiaceae-Cupressaceae — *Inaperturopollenites dubius* (R. Pot.) Th. & Pf. (Pl. VII, Figs. 18—19), spheroidal, diameter 20—50 μ with an indistinct papilla. Exine up to 1 μ thick, finely granulate, often with undulated surface. Abundant in all samples of the investigated profiles. All pollen grains of the families *Taxodiaceae* and *Cupressaceae* which could not be more exactly determined were included in this group.

Gnetinae

Gnetaceae

cf. *Gnetaceaepollenites ellipticus* Thierg. (Pl. VIII, Figs. 1—2), pollen grains anomo-3-porate (NPC-800), ellipsoidal elongated, size 42 × 14 μ. Pores irregularly distributed with annulus 2 μ broad, pore diameter about 2 μ. Exine about 0·8 μ thick, with 3—4 folds running along the polar axis. Sporadic.

Angiospermae

Dicotyledones

Betulaceae

Betula sp. — *Trivestibulopollenites betuloides* Th. & Pf. (Pl. VIII, Fig. 3), pollen grains triporate (NPC-344), amb rounded triangular, diameter 25—35 μ. Exine 2—2·5 μ thick, in the apex area thickened up to

3·5 μ, sexine thicker than nexine. Surface of the exine psilate or finely granulate. Regular in all samples.

Alnus sp. — *Polyvestibulopollenites* (*Alnipollenites*) *verus* (R. Pot.) Th. & Pf. (Pl. VIII, Figs. 4—6), pollen grains 4—5 -pororate (NPC-444, 544), diameter 30—35 μ, pores circular, between them more or less distinct arci formed by thickened sexine. Exine about 1·5 μ thick, surface psilate or finely granulate. Frequent in all samples, reaching its maximum in the upper part of the profile at Chyżne (up to 41·19%).

Alnus cf. *glutinosa?* (L.) Gaertn. (Pl. VIII, Fig. 7) pollen grains 5-6-pororate (NPC-544,644), diameter about 37 μ. Pores circular, between them distinct arci formed by thickened sexine. Exine 1·5—2 μ thick, granulate or finely verrucate. Sporadic.

Ostrya sp. — *Triporopollenites rhenanus* (Th.) Th. & Pf., pollen grains 3-porate (NPC-344), amb rounded triangular with strongly convex sides, diameter 25—30 μ. Pores circular very small. Exine about 1 μ thick, surface finely granulate. Known from various Tertiary sediments (Oszast 1960; Stuchlik 1964), in our profiles sporadic.

Carpinus sp. — *Polyporopollenites carpinioides* (Pf.) Th. & Pf. pollen grains 3-5-porate (NPC-344-544), amb circular, diameter 30—40 μ. Pores small, circular. Exine about 1 μ thick, surface psilate or finely granulate. In small quantities.

Corylus t. *avellana* — *Triporopollenites coryloides* Th. & Pf. (Pl. VIII, Fig. 8), pollen grains 3-porate (NPC-344), amb rounded triangular with markedly convex sides, diameter 25—30 μ. Pores circular, up to 5 μ in diameter. Exine 1·5—2 μ thick, sexine thicker than nexine, psilate or finely granulate. Known from various Neogene sediments; in our material in small quantities (maximum 1·61%).

Fagaceae

Castanea sp. — *Tricolporopollenites megaexactus exactus* (R. Pot.) Th. & Pf., pollen grains tricolporate (NPC-345), oblate-spheroidal, size 17 × 10 μ, colpi narrow, ora circular. Exine very thin less than 0·7 μ, psilate. In small quantities.

Castanopsis sp. — *Pollenites cingulum* R. Pot. (Pl. VIII, Fig. 9), pollen grains tricolporate (NPC-345), oblate-spheroidal, polar axis 20—25 μ long. Colpi narrow, ora small circular. Exine about 1 μ thick, psilate ore finely granulate. Known from various Tertiary sediments; in our materials in small quantities, maximum (1·77%) in the lower part of the profile at Lipnica Mała.

Fagus sp. — *Tricolporopollenites fagoides* W. Kr. (Pl. VIII, Figs. 10—12), pollen grains tricolporate (NPC-345), spheroidal, diameter 30—40 μ. Colpi narrow, ora circular, diameter of the ora bigger than the breadth of the colpi. Exine about 1·5 μ thick, sexine thicker than nexine, baculate.

Regular in all three profiles in low percentage, maximum (2·8%) in the middle part of the profile at Chyżne.

Quercus sp. — *Tricolpopollenites asper* Th. & Pf. (Pl. VIII, Fig. 13), pollen grains tricolpate (NPC-343), oblate-spheroidal, diameter 20—40 μ. Exine finely verrucate, verrucae small, densely spaced. Common in Tertiary deposits; in our material regular, maximum (4·94%) in the upper part of the profile at Lipnica Mała.

Juglandaceae

Juglans sp. — *Multiporopollenites maculosus* (R. Pot.) Th. & Pf. (Pl. VIII, Fig. 14), pollen grains polypantopororate (NPC-766), polygonal or spheroidal diameter 38—45 μ. Number of spores 6—16, circular, diameter about 4 μ, with annulus. Sexine thicker than nexine, finely scrabate with small spinuloid processus. Known from various Tertiary sediments, in our material regularly in low percentage.

Carya sp. — *Subtriporopollenites simplex* (R. Pot. & Ven.) Th. & Pf. (Pl. VIII, Fig. 15), pollen grains tripororate (NPC-346), amb rounded triangular, diameter about 30 μ. Exine psilate. Common in Tertiary deposits; in our material regular, maximum (5·8%) in the upper part of the profile at Chyżne.

Pterocarya sp. — *Polyporopollenites stellatus* (R. Pot. & Ven) Th. & Pf. (Pl. VIII, Fig. 16), pollen grains (3) 5—7 colporate (NPC-(345) 545--745), diameter 30—38 μ, colpi short and rounded at their ends, ora lalongate, with small annuli. Exine psilate or finely granulate. Known from younger Tertiary and older Pleistocene deposits, in our material regular, maximum (3·81%) in the middle part of the profile at Chyżne.

Platycarya sp. — *Platycaryapollenites* cf. *miocaenicus* Nagy (Pl. VIII, Figs. 17—18), pollen grains tricolporate (NPC-345), amb rounded triangular, diameter about 18 μ. Exine about 1 μ thick, thickened in a form of arcoid streaks. Sporadic in Tertiary deposits, known from USSR (Pokrovskaya 1956a, 1956b), Hungary (Nagy 1969). Very rare in our profiles.

Engelhardtia sp. — *Triatriopollenites coryphaeus punctatus* (R. Pot.) Th. & Pf. (Pl. VIII, Figs. 19—20), pollen grains triporate (NPC-346), amb rounded triangular, pores on the apices, ora indistinct. Sexine thicker than nexine, psilate or finely granulate. Sporadic.

Salicaceae

Salix sp. — *Salicioidites* fsp. Th. (Pl. VIII, Figs. 21—22), pollen grains tricolporate (tricolporoidate) (NPC-345), oblate-spheroidal, size 20—32 × × 9—13 μ, colpi narrow, ora small, indistinct. Exine 1—1·5 μ thick, sexine thicker than nexine, reticulate. Lumina diameter up to 1 μ. Known from Oligocene-Pliocene deposits (Thomson and Pflug 1953); in our material frequent up to 8·69% in the middle part of the profile at Chyżne.

Ulmaceae

Ulmus sp. — *Polyporopollenites undulosus* (Wolf) Th. & Pf. (Pl. IX, Figs. 1—3), pollen grains 4—5-porate (NPC-444,544), amb circular or polygonal, diameter 24—45 μ, pores circular or ellipsoidal. Exine about 3 μ thick, irregularly verrucate. Verrucae forming an undulated surface. Regularly in Tertiary deposits, in our material in all samples, maximum (5·69%) in the upper part of the profile at Chyżne.

Zelkova sp. (Pl. IX, Fig. 4), pollen grains 4—5-porate (NPC-444,544), amb circular or polygonal, diameter about 38 μ. Pores ellipsoidal with annulus. Exine about 1·7 μ thick, thickened up to 2·5 μ, in the area of pores surface with elongated verrucae forming an undulated sculpture. Sporadic.

Celtis sp. (Pl. IX, Figs. 5—6), pollen grains 3—6-porate (NPC-344--644), amb circular, diameter 30—42 μ. Pores circular, diameter 3—8 μ, occasionally operculate. Exine 1—2 μ thick, finely verrucate, diameter of the verrucae up to 1·5 μ. Known from Tertiary sediments (Pokrovskaya 1956b; Nagy 1958; Oszast 1960, and others); in our material sporadic, maximum (4·04%) in the upper part of the profile at Chyżne.

Eucommiaceae

Eucommia cf. *ulmoides* Oliv. (Pl. IX, Fig. 9), pollen grains tricolporate (NPC-345) oblate-spheroidal, size 28—38 × 25—35 μ, colpi straight with distinct circular ora. Exine 1—2·5 μ thick, psilate, Sporadic.

Loranthaceae

cf. *Loranthus* sp. (Pl. IX, Fig. 10), pollen grains tricolpate (NPC-343), amb triangular with rounded apices and concave sides, diameter 18—22 μ. Colpi on the distal face forming a trisulcate pattern. Exine very thin, surface granulate. Sporadic.

Polygonaceae

Polygonum sp. (Pl. IX, Fig. 11), pollen grains tricolporate (NPC-345), oblate-spheroidal, polar axis 28—35 μ long. Exine about 2 μ thick, reticulate, lumina small, muri thin. Very rare.

Chenopodiaceae

Periporopollenites multiplex Weyl. & Pf., pollen grains polypantoporate (NPC-764), spheroidal, diameter 20—22 μ, pores circular, diameter 2—3 μ. Exine about 2 μ thick, finely foveolate. Sporadic.

Caryophyllaceae

Periporopollenites multiporatus Th. & Pf., pollen grains polypantoporate (NPC-764), spheroidal, diameter 25—33 μ, pores circular, diameter 3—8 μ. Exine tectate, tectum supported by bacula, supra granulate. Sporadic.

Hamamelidaceae

Liquidambar sp. — *Periporopollenites stigmosus* (R. Pot.) Th. & Pf. (Pl. IX, Fig. 7), pollen grains polypantoporate (NPC-764), spheroidal — oblate-spheroidal, diameter 20—40 μ, pores circular or oval, diameter about 5 μ, with granulate operculum. Exine 1—1·5 μ thick, faveolate. Sporadic.

Corylopsis sp. — *Pollenites cribellus* Dokt.-Hreb. (Pl. IX, Fig. 8), pollen grains tricolpate (NPC-343), oblate-spheroidal, size about 28 × 24 μ, exine about 1·5 μ thick, reticulate. Sporadic.

Lauraceae

Pollen grains atreme (NPC-000), spheroidal, diameter about 37 μ, exine about 1 μ thick, surface spinulate (Pl. IX, Fig. 12). Spinulae up to 1·5 μ long, regularly and densely spaced. Only one pollen grain in the profile at Chyżne.

Nymphaeaceae

cf. *Nuphar sp.* (Pl. IX, Fig. 13), pollen grains monocolpate (NPC-133), spheroidal to oblate, size 62×40 μ, colpus broadly ellipsoidal on the distal face, with a granulate membrane. Exine about 1·5 μ thick, spinate. Spines 2—5 μ long. Sporadic.

Nymphaeaceae sp. div., pollen grains monocolpate (NPC-133) spheroidal, diameter about 50 μ. Colpus broadly ellipsoidal on the distal face. Exine about 1·5 μ thick, surface pilate. Pila 2—3 μ long. Rare.

Rosaceae

Pollen grains tricolporate (NPC-345), oblate-spheroidal, diameter 15—35 μ, colpi broad. Exine finely granulate. Sporadic.

Leguminosae

Pollen grains tricolporate (NPC-345), amb rounded triangular. Two forms have been distinguished:

cf. *Caragana* sp. (Pl. IX, Fig. 14), diameter 20—22 μ, exine 1—2 μ thick, psilate. Sporadic.

Leguminosae sp. div. (Pl. IX, Figs. 15—16), diameter 13—30 μ, exine thin, psilate or finely granulate. Sporadic.

Lythraceae

Pollen grains tricolporate (NPC-345).

Decodon cf. *globosus* (Reid) Nikit. (Pl. IX, Figs 17—19), amb rounded triangular, size 30×17 μ, ora circular. Exine finely granulate. Seeds of *Decodon globosus* have often been reported from Tertiary sediments (Szafer 1950; Raniecka-Bobrowska 1957; Łańcucka-Środoniowa 1957, 1963). Sporadic in our material, regular only in the upper part of the profile at Chyżne, (maximum 1·47%).

cf. *Lythrum* sp., prolate-spheroidal, diameter 20—30 μ with 3 pseudocolpi. Colpi reach the pole, ora small, circular, pseudocolpi shorter than colpi. Exine 1—2·5 μ thick, psilate or finely granulate. Sporadic.

Nyssaceae

Nyssa sp. — *Tricolporopollenites kruschi* (R. Pot.) Th. & Pf., pollen grains tricolporate (NPC-345), amb rounded triangular, diameter 23—28 μ (ssp. *analepticus* Th. & Pf., Pl. IX, Figs 20—21) or about 40 μ [ssp. *rodderensis* Th. & Pf. (Pl. IX, Fig. 22)]. Exine tectate, supragranulate. Common in Tertiary sediments; in our profiles regular in low percentage (maximum 3·7% in lower part of the profile at Chyżne).

Myrtaceae

cf. *Eucalyptus* sp. (Pl. X, Fig. 1), pollen grains tricolporate (NPC-345), oblate-spheroidal, size 17—30×12—16 μ. Amb triangular with straight sides, colpi very short on the apices, ora small lalongate. Exine about 1·5 μ thick, granulate. Sporadic.

Myrtaceae sp. div. similar to *Eucalyptus*, size 18—20 μ, exine psilate. Sporadic.

O e n o t h e r a c e a e

Pollenites oculi noctis Thierg. (Pl. X, Fig. 2), pollen grains tricolporate (NPC-345), diameter about 40 μ, amb triangular with rounded apices. Big round pore on the apices with broad margin. Exine about 3 μ thick, in area of the pores thickened, surface granulate. Only in the profile at Chyżne.

H a l o r r h a g i d a c e a e

cf. *Myriophyllum* sp. (Pl. X, Figs. 3—4), pollen grains 3—5-porate (NPC-344—544), spheroidal, diameter about 25 μ. Pores circular or ellipsoidal on well defined aspides. Exine about 1·5 μ thick on mesoporium, thickened in the area of the pores up to 3 μ. Sporadic.

T i l i a c e a e

Pollen grains tricolporate (NPC-345), amb rounded triangular apertures regularly distributed.

Intratriporopollenites cf. *insculptus* Mai (Pl. X, Fig 5), diameter 27—40 μ, colpi very short. Exine about 2 μ thick, sexine as thick as nexine, surface with funnel-like concavities forming a reticulum-like pattern with lumina 1·5 μ in diameter. Sporadic.

Intratriporopollenites instructus instructus W. Kr. (Pl. X, Figs. 6—7), diameter about 40 μ. Exine about 2 μ thick, in the area of the pores thickened and forming a vestibulum. Surface of sexine with funnel-like concavities forming a reticulum-like pattern with lumina diameter 1·2 μ. Sporadic.

cf. *Intratriporopollenites microreticulatus* Mai, diameter about 35 μ, exine forming in the area of pores vestibulum, surface reticulate. Lumina diameter about 0·5 μ. Very rare.

S t e r c u l i a c e a e

Reevesia sp. — *Porocolpopollenites rotundus* forma *reticulata* Stuchl. (Pl. X, Fig. 8), pollen grains 4-porate, spheroidal (NPC-444), diameter 17—27 μ, pores circular, diameter about 3 μ. Exine about 1 μ thick, reticulate, lumina 2 μ in diameter. Sporadic.

Rutaceae

cf. *Ptelea* — *Tricolporopollenites cingulum fusus* (R. Pot.) Th. & Pf. (Pl. X, Fig 9), pollen grains tricolporate (NPC-345), prolate-spheroidal, size 16 × 28 μ, colpi reach the pole, ora circular. Exine about 2 μ thick, sexine thicker than nexine, surface with a fine sculpture consisting of elongated, irregularly distributed elements. Sporadic.

Anacardiaceae

cf. *Pistacia* sp. (Pl. X, Figs. 10—11), pollen grains polypantoporate (NPC-764), spheroidal, diameter 31—33 μ, pores ellipsoidal. Exine 1—1·5 μ thick, fine reticulate. Sporadic.

Rhus sp. — *Tricolporopollenites pseudocingulum* (R. Pot.) Th. & Pf., pollen grains tricolporate (NPC-345), spheroidal, diameter 23—38 μ, colpi nearly reach the pole, ora lalongate. Exine surface reticulate to finely striate. Sporadic, maximum (1·98%) in the upper part of the profile at Chyżne.

Aceraceae

Acer sp. (Pl. X, Fig. 12), pollen grains tricolpate (NPC-343), ellipsoidal, diameter 28—30 μ. Colpi nearly reach the pole, apocolpium diameter about 5 μ. Exine about 2 μ thick, surface finely striate, lirae running parallel to the polar axis. Sporadic.

Aquifoliaceae

Ilex sp. — *Tricolporopollenites iliacus* (R. Pot.) Th. & Pf., pollen grains tricolporate (NPC-345), prolate-spheroidal, diameter 35—42 μ, colpi broad, ora indistinct. Exine about 3 μ thick, clavate. Clavae smaller in the area of the aperture. Regular in low percentage.

Staphylleaceae

Staphyllea sp. — *Pollenites perexpressus* Dokt.-Hrebn. (Pl. X, Figs. 13—14), pollen grains tricolporate (NPC-345), broadely ellipsoidal, size about 40 × 30 μ. Colpi reach the pole, ora lalongate. Exine 2—3 μ thick, reticulate, lumina smaller in the equator area. Sporadic.

Cyrillaceae

Pollen grains tricolporate (NPC-345), colpi broad and short.

Cyrilla sp. (Pl. X, Fig. 15), amb rounded triangular, diameter 23—35 μ, ora lalongate. Exine in the area of apertures divided in two layers forming well defined vestibulum, surface psilate or finely granulate. Regular in low percentage in the profile at Chyżne, very rare at Lipnica.

Tricolporopollenites cingulum brühlensis T. & Pf. (Pl. X, Figs. 16—17), prolate-spheroidal, diameter 25—30 μ, ora circular. Exine 1·5—2 μ thick, psilate. Sporadic.

Vitaceae

cf. *Parthenocissus* sp. — *Tricolporopollenites macrodurensis* Th. & Pf., (Pl. X, Fig. 18), pollen grains tricolporate (NPC-345), prolate-spheroidal, ora circular 4 μ in diameter. Exine about 3 μ thick, reticulate. Lumina small. Sporadic.

Cornaceae

Cornus sp. — *Cornoidites minor* Stuchl., pollen grains tricolporate (NPC-345), rounded triangular, diameter 23—28 μ, ora lolongate. Exine about 2 μ thick, surface finely verrucate or granulate. Sporadic.

Araliaceae

Pollen grains tricolporate (NPC-345).

cf. *Aralia* sp. — *Tricolporopollenites euphorii* (R. Pot.) Th. & Pf. (Pl. XI, Figs. 1—4), amb rounded triangular, diameter 27—40 μ, colpi short, ora circular. Exine verrucate. Verrucae regularly and densely spaced, 3 μ in diameter. Known from various Tertiary sediments; in our material regular in low procentage, maximum (5,44%) in the lower part of the profile at Lipnica Mała.

cf. *Schefflera* sp. (Pl. XI, Figs. 5—8), amb triangular with straight sides, size about 26 × 25 μ, colpi rather long, running parallel to the polar axis, ora big, lalongate. Exine about 2 μ thick, sexine as thick as nexine, surface finely reticulate. Lumina diameter up to 1·5 μ. Hitherto not reported from Tertiary sediments, in our material pollen and macrofossils (Łańcucka-Środoniowa, personal communication) sporadic.

Araliaceae sp. div. (Pl. XI, Figs 9—10), prolate-spheroidal, size 25—40 × 20—30 μ, colpi long, nearly reach the pole, ora romboidal-circular. Exine 2—3 μ thick, reticulate. Sporadic.

Umbelliferae

Pollen grains tricolporate (NPC-345), prolate-spheroidal, size about 20 × 10 μ, colpi narrow, ora circular (Pl. XI, Figs 11—12). Exine 1·5—2 μ thick, granulate. Rare.

Ericaceae

Tetradopollenites ericius (R. Pot.) Th. & Pf., (Pl. XI, Figs. 13—14), pollen grains in tetrads, tricolporate (NPC-345), apertures at the site of contact in tetrad. Exine thin, granulate. Sporadic.

Symplocaceae

Symplocos sp. — *Porocolpopollenites vestibulum* (R. Pot.) Th. & Pf., pollen grains tricolporate (NPC-345), amb triangular to rounded triangular, diameter 30—37 μ, ora circular bigger than the breadth of the colpi, always with vistibules. Exine granulate. Regular in Tertiary sediments, in our material sporadic.

Bignoniaceae

cf. *Markhamia* sp. (Pl. XI, Figs. 15—16), pollen grains tricolpate (tricolporoidate), (NPC-343, 345?), amb rounded triangular, diameter 40—42 μ, colpi short. Exine 1—2 μ thick, reticulate, lumina small. Very rare.

Labiatae

Pollen grains tricolpate, amb more or less circular (NPC-343), diameter 30—45 μ, colpi broad (Pl. XI, Fig. 17). Exine about 2 μ thick, reticulate, lumina of various shape and size. Rare.

Plantaginaceae

cf. *Plantago* sp. (Pl. XI, Figs. 18—19), pollen grains 4-pororate (NPC-466), amb spheroidal, diameter about 22 μ, pores circular, diameter 3—4 μ, ora of the same size. Exine about 2 μ thick, surface finely verrucate or granulate. Rare.

Oleaceae

Fraxinus sp., pollen grains tricolporate (NPC-345), amb rounded triangular, diameter 17—25 μ, colpi short, ora circular. Exine about 3 μ thick, reticulate. Lumina up to 2·5 μ in diameter, muri about 1·5 μ wide. Sporadic, maximum (2·3%) in the upper part of the profile at Chyżne.

Rubiaceae

cf. *Randia* sp. (Pl. XI, Figs. 20—21), pollen grains 3-porate (NPC-344), spheroidal, diameter about 22 μ, pores circular, diameter 2—3 μ. Exine about 2·2 μ thick, reticulate, lumina polygonal, diameter about 2 μ. Sporadic.

Caprifoliaceae

Pollen grains tricolporate (NPC-345).

Viburnum sp. (Pl. XI, Figs. 22—24), amb spheroidal to prolate-spheroidal, colpi short, ora circular, small (diameter up to 2 μ). Exine about 3 μ thick, reticulate, simplibaculate. Known from Tertiary sediments; sporadic in our material.

cf. *Dipelta* sp. (Pl. XI, Fig. 25), amb rounded triangular, diameter about 42 μ, colpi narrow and short, ora circular and big. In the area of apertures well defined vestibulum. Exine of mesocolpium 3—4 μ thick, in the area of apertures 1—1·5 μ, surface spinulate. Hitherto not reported from Tertiary sediments. Only sporadic.

Compositae

subfam. *Liguliflorae*, pollen grains tricolporate (NPC-345), spheroidal, diameter 30—40 μ, colpi short, ora lalongate, big, poral lacuna well developed. Exine 7—8 μ thick, reticulate with big lumina, muri beset with small spinules. Sporadic.

Monocotyledones

Butomaceae

Butomus sp. (Pl. XII, Figs. 1—2), pollen grains monocolpate (NPC-133), spheroidal-elongated, size 34 × 30 μ, colpus along the distal side of the pollen grain. Exine about 2 μ thick, reticulate lumina polygonal, diameter 1—3 μ, muri 1—1·5 μ broad. Sporadic, maximum (1·46%) in the profile at Lipnica Mała.

Potamogetonaceae

Potamogeton sp., pollen grains atreme (NPC-000), spheroidal, diameter about 28 μ. Exine about 1·5 μ thick, reticulate. Diameter of the lumina 0·5—1·5 μ, muri thin, not wider than 1 μ. Sporadic in the profile at Chyżne.

Liliaceae

cf. *Tulipa* sp. (Pl. XII, Figs 3—4), pollen grains monocolpate (NPC-133), ellipsoidal elongated, longer axis 30—90 μ, shorter axis 20—30 μ, colpus with operculum. Exine about 2 μ thick, granulate, diameter of the granules 0·8 μ. Sporadic.

Cyperaceae

Pollen grains (1-)4-porate (NPC-464), oval, diameter 25—45 μ, pores irregularly distributed of various shape and size (Pl. XII, Fig. 5). Exine very thin, finely granulate. Known from Tertiary sediments; regular in our material in all profiles, maximum (25·31%) in the middle part of the profile at Chyżne.

Gramineae

Monoporopollenites gramineus Weyl. & Pf. (Pl. XII, Figs 6—7), pollen grains monoporate (NPC-134), spheroidal, diameter 25—45 μ, pores small with well developed annulus, diameter of the pore 2·5—3 μ. Exine 1·5—2 μ thick, finely granulate. Regular in Tertiary sediments, also in our material, maximum 11·11%.

Palmae

cf. *Corypha* sp. — *Monocolpopollenites parareolatus* W. Kr. (Pl. XII, Figs. 8—9), pollen grains monocolpate (NPC-133), spheroidal elongated, size 35—42 × 20—28 μ, colpus running along the distal face of the grain. Exine 2—2·5 μ thick, reticulate, lumina 2—3·5 μ in diameter, muri about 1·5 μ broad. Regular, but in low percentage.

Sparganiaceae

Sparganium sp. — *Monoporopollenites solaris* Weyl. & Pf., pollen grains monoporate (NPC-134), spheroidal to prolate-spheroidal, diameter 30—38 μ, pores small, circular on the distal face. Exine about 1·5 μ thick, reticulate, heterobrochate, diameter of the lumina 3—4 μ, muri about 1 μ broad. Sporadic.

Typhaceae

Typha t. *angustifolia* L. (Pl. XII, Fig. 10), pollen grains monoporate (NPC-134), spheroidal, diameter 20—25 μ, pores circular. Exine about 1·5 μ thick, finely reticulate, diameter of the lumina up to 1·5 μ. Very rare.

Dinoflagellatae

Deflandreidae

Deflandrea sp. (Pl. XII, Fig. 11), organisms pentagonal with 3 elongate corners, periphragma psilate, rounded, diameter about 70 μ, thickness 2—3 μ. Endophragma 1—1·5 μ thick, composed of many small fragments. Three corners of the armature elongated forming one upper and two lower horns, surface of the armature finely granulate. Very rare.

Leiofusidae

cf. *Leiofusa* (Pl. XII, Figs. 12—13), organisms ellipsoidal, size 103 × 49 μ, thickness of the wall 2·5—4 μ, surface psilate. Very rare, probably rebedded.

Hystrichosphaeridae

Hystrichosphaera ramosa (Ehr.) var. *gracilis* Dav. & Will. (Pl. XIII, Fig. 1), organisms spheroidal, diameter about 50 μ, on the surface many processus 12—13 μ long, straight or slightly undulated, usually dichotomically bifurcate at the tops, surface psilate. Regular in various samples.

Hystrichosphaera ramosa (Ehr.) var. *reticulata* Dav. & Will., (Pl. XIII, Fig. 2), spheroidal, diameter about 57 μ, armature reticulate with furcate processus on its surface. Processus 7—15 μ long, lumina of the reticulum 2—3 μ in diameter. Probably rebedded.

Oligosphaeridium complex (White) Dav. & Will. (Pl. XIII, Fig. 3), plankton organisms spheroidal to spheroid-ellipsoidal, diameter 35—40 μ. The inner wall psilate, outer finely granulate. On the surface processus 25—30 μ long, dichotomically furcate at their tips. Sporadic, probably rebedded.

DIVISION OF DISTINGUISHED PLANTS INTO GROUPS ACCORDING TO HABITAT AND CLIMATIC REQUIREMENTS

According to habitat requirements, the distinguished taxons may be devided into the following groups:

1. Aquatic and marshy plants: *Butomus, Glyptostrobus, Myriophyllum, Nuphar, Nymphaeaceae, Nyssa, Potamogeton, Sparganium, Taxodiaceae-Cupressaceae, Taxodium, Typha,* and some *Cyperaceae* and *Gramineae.*
2. Gallery-shrub and peat-bog plants: this group comprises plants growing along slow-flowing rivers or in lowlying

habitats with a high horizon of ground-water: *Alnus, Betula, Cyperaceae, Cyrilla, Decodon* cf. *globosus, Lythrum, Myrica, Osmunda, Polygonaceae, Ptelea, Ranunculaceae, Salix, Selaginellaceae, Sphagnum, Staphyllea* and, perhaps, *Engelhardtia* and *Pterocarya.* At slightly drier habitats there might occur *Araliaceae, Carya, Cornus, Corylus, Fraxinus, Juglans,* and others.

3. Dry-habitat plants on the slopes of mountain ridges and hills: *Abies, Caragana, Carpinus, Castanea, Castanopsis, Cornus, Corylopsis, Cryptogramma, Cryptomeria, Cupressus, Cyathea, Eucalyptus, Fagus, Ginkgo, Gnetaceae, Ilex, Larix, Leguminosae, Liquidambar, Loranthus, Lycopodium, Lygodium, Oleaceae, Picea, Pinus, Pistacia, Polypodiaceae, Quercus, Rhus, Rosaceae, Sequoia, Symplocos, Tsuga, Ulmus, Zelkova.*

From the point of view of climatic requirements, the components of this flora may be grouped as follows:

1. Plants of tropical and sub-tropical climate: *Bignoniaceae, Castanopsis, Corypha, Cyathea, Cyrillaceae, Engelhardtia, Gleicheniaceae, Liquidambar, Lygodium, Lythraceae, Ptelea, Symplocos,* and others.
2. Plants of warm temperate climate: *Araliaceae, Cedrus, Cryptomeria, Eucommia, Glyptostrobus, Juglandaceae, Lauraceae, Loranthaceae, Nyssa, Osmunda, 'Ostrya, Podocarpus, Sequoia, Staphyllea, Taxodium, Tulipa.*
3. Plants of temperate and cold climate: *Abies, Alnus, Betula, Carpinus, Caryophyllaceae, Cornus, Fagus, Larix, Oenotheraceae, Picea, Pinus, Quercus, Salix, Sparganium, Tilia, Tsuga, Ulmus.*

PALYNOLOGICAL PICTURE OF THE PROFILES

Chyżne (Tab. 1, Fig. 2) *.

In the profile at Chyżne two stages in the development of the vegetation may be distinguished. In the lower part of the diagram the proportion of *Taxodiaceae-Cupressaceae* and *Taxodium* is large, while in the upper part (from the 1·00 m horizon upwards) it decreases rapidly giving way to *Alnus*. There is also a marked decrease of *Polypodiaceae* (from 50 to 25%). The marshy-forest communities with *Taxodiaceae-Cupressaceae* give way to gallery-like shrub and peat-bog communities.

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* Tables 1—3 and Figs. 2—5 are to be found under the cover.

L i p n i c a M a ł a (Tab. 2, Fig. 3).

A trait characteristic of the Lipnica Mała profile is the predominance of trees and shrubs over herbaceous plants, as well as considerable monotony in the composition of the vegetation. The major part belongs to *Taxodiaceae-Cupressaceae, Taxodium, Alnus, Osmunda, Polypodiaceae, Pinus*. Other forms such as *Glyptostrobus, Betula, Cyperaceae, Gramineae, Sparganium, Engelhardtia, Carya, Pterocarya, Ulmus, Celtis, Quercus, Symplocos, Larix, Tsuga*, and *Picea* regularly occur in small numbers. Here one finds forms which are either altogether absent in the Chyżne profile or which only occur there occasionally, such as *Symplocos, Liquidambar, Corypha*.

L i p n i c a W i e l k a (Tab. 3, Fig. 4).

This profile, 70 cm thick, comprises only 7 samples and is also distinguished by the predominant proportion of trees and shrubs as compared to herbaceous plants. *Taxodiaceae-Cypressaceae, Taxodium, Osmunda, Polypodiaceae, Ulmus, Quercus, Larix*, and *Tsuga* predominate. *Polypodiaceae* spores occur in very large numbers, as in the lower part of the Chyżne profile. Probably this is partly due to the sandy deposit which favours the selection of sporomorphs.

It is interesting to note how strikingly similar are the profiles at Lipnica Mała and Lipnica Wielka, both in the sequence of the deposits, and in the course of curves in pollen diagrams (Fig. 5). The profile at Lipnica Wielka, built up of grey clays and sandy brown clays, resembles the upper part of the profile at Lipnica Mała. In the pollen diagrams, too, the curves for the respective plants follow a similar course; this is especially so in the case of *Taxodium, Taxodiaceae-Cupressaceae, Pinus, Osmunda, Polypodiaceae* curves, as well as those of the percentage proportion of trees and shrubs as compared to that of herbaceous plants. All these similarities have led to the assumption that the whole profile at Lipnica Wielka should be traced back to the same period as the upper part of the Lipnica Mała profile (beginning with the 4·80 m horizon, Fig. 5).

The character of the deposit and the course followed by the curves in the pollen diagrams also reveals similarities between the bottom part of the Chyżne profile and the upper sectors of the Lipnica Mała and Lipnica Wielka profiles. Within these sectors occur brown sandy clays, while in the pollen diagrams the marshy-forest components predominate. The curves of *Taxodium, Glyptostrobus, Taxodiaceae-Cupressaceae, Alnus, Carya, Pterocarya, Betula, Salix, Engelhardtia, Osmunda, Pinus, Larix, Tsuga, Cupressus, Ulmus, Quercus, Fagus, Araliaceae, Cyatheaceae* in the above-mentioned sectors of the three profiles follow a very similar course. True, there are some differences, such a divergences in the course of *Alnus* curves and those of the other components of gallery-like and aquatic communities. These differences, however, are not considerable and they are probably affected and deformed by the low frequency in the top samples at Lipnica Mała and Lipnica Wielka. It might well be that these sediments had originated approximately at the same time, but under somewhat different habitat conditions. The curves of other sporomorphs, particularly the group of plants from the dry habitats, are similar in all profiles. Only the *Engelhardtia, Liquidambar, Corypha, Schizaceaceae* (*Lygodium*), *Cupressus,* and *Symplocos* which have been recognized as older forms, occur in the Chyżne profile in slightly smaller numbers. On the other hand, *Ulmus, Tsuga, Abies, Carpinus, Fraxinus* (?), and *Osmunda* occur in the Chyżne profile in somewhat larger numbers than those in the Lipnica Mała and Lipnica Wielka profiles.

The analysis of the results of palynological investigations and of the sediment sequence leads to the conclusion that the three investigated profiles originated during three consecutive stages of sedimentation. The first from the base upwards, is the stage of undisturbed sedimentation (grey clays with plant remains, lignite interbedded with grey clays in the Lipnica Mała profile; grey clays in the upper part of the Lipnica Mała and Lipnica Wielka profiles). The second sedimentation cycle, distinguished by the in-flow of thick-grained material, should probably be referred to the wetter period (layers of brown sandy clays in the three profiles). The final, third stage is again one of undisturbed sedimentation (grey clays and other measures overlying them in the Chyżne profile). Thus, the Chyżne profile may be considered somewhat younger than those at Lipnica Mała and Lipnica Wielka. To all appearance it seems to be their continuation or extension.

GENERAL CHARACTERISTICS OF VEGETATION

Two stages may be distinguished in the developmental process of the vegetation. The first comprises the Lipnica Mała & Wielka profiles and the lower part of the Chyżne profile, while the second only the upper part of the Chyżne profile (from the 1·00 m — deep horizon up to the top).

During the first stage the western part of the Nowy Targ-Orawa Basin was covered by extensive marshes with a prevalence of *Taxodium*-type forests, composed for the most part of *Taxodium, Glyptostrobus, Taxodiaceae-Cupressaceae* and *Nyssa.* These forests, which were extremely compact, did not afford adequate conditions for the development of communities of photophillous water and marshy plants. Peat-bog communities covered the bottom of the Basin, whereas water and marshy plant communities with *Nymphaeaceae, Nuphar, Butomus, Sparganium, Myriophyllum, Cyperaceae* and *Gramineae* occupied small water reservoirs in the woods. Along the slow-flowing rivers, shrubs of *Betulaceae-Myricaceae — Lythraceae* type evolved, including *Salix, Betula, Alnus, Engelhardtia, Cyrilla, Decodon* cf. *globosus, Polygonum, Myrica, Osmunda, Sphagnum* and *Selaginellaceae*. In a large part of this stage the proportion of sporomorphs of these plants does not exceed 5—10%. In the drier habitats in the Basin, forest communities developed, composed of *Juglans, Pterocarya, Carya, Fraxinus, Corylus, Corylopsis, Araliaceae* (*Aralia*, cf. *Schefflera*), *Cornus*, and *Ericaceae*.

In the lower mountain sites the forest was composed of deciduous trees and shrubs (*Castanea, Castanopsis, Celtis, Ilex, Leguminosae, Liquidambar, Myrtaceae, Oleaceae, Pistacia, Rhus*), with ferns in the undergrowth (*Gleicheniaceae, Lygodium*). On the higher situated slopes of the mountains surrounding the Basin, the forest included deciduous trees (*Carpinus, Fagus, Quercus* and *Ulmus*) with a large proportion of coniferous trees (*Larix, Picea, Pinus, Tsuga*). Ferns, chiefly *Polypodiaceae*, were richly represented in the undergrowth.

Towards the end of the first stage, as a result of accumulation of thick-grained alluvial deposits in the river valley, the small water reservoirs were filled up, and the bog slimed. At the same time, too, the area of wet habitats extended. These conditions during the second stage favoured the development of forests and gallery-like shrubs, which manifested itself in the pollen spectra by a marked increase in the proportion of plants of this group (up to 70% in the top-layer samples). Simultaneously, too, the area of marsh-bog *Taxodium*-type forests diminished. The *Taxodiaceae-Cupressaceae* group hardly reaches 10 per cent in the profile top at Chyżne. The plant communities in the drier habitats situated on the slopes of mountain ridges were not much changed at that time. Thus, the differences in the development of vegetation during the first and the second stage should be attributed to the local changes of habitats, not to climatic changes.

As regards climatic requirements, the examined flora is only slightly differentiated. Its components belong to three groups of climate and vegetation, whose simultaneous occurrence is a trait characteristic of Miocene flora (Gulisashvili 1967). During the period, which the flora under discussion represents, the climate in the Basin was in all probability subtropical and wet of mountain type, resembling a warm temperate climate. In our times its counterpart seems to be the climate of mountain areas in the subtropical coastal zone, richly differentiated in morphology. According to Klimaszewski (1958), the Nowy Targ—Orawa Basin during the Upper Miocene adjoined the shore of the Paratethys Sea.

AGE OF THE EXAMINED DEPOSITS

In the examined profiles the group of young Tertiary — old Pleistocene plants is most numerously represented (*Osmunda, Tsuga canadensis, T.* t. *diversifolia, T.* t. *pattoniana, Pinus* t. *haploxylon, Sequoia, Taxodium, Glyptostrobus, Cryptomeria, Taxodiaceae-Cupressaceae, Juglans, Ostrya, Castanea, Carya, Pterocarya, Celtis, Ilex, Engelhardtia, Liquidambar, Corylopsis, Nyssa, Oenotheraceae, Araliaceae*).

There is also an abundant occurrence of elements found both in Tertiary and in Quaternary (*Sphagnum, Polypodiaceae, Abies, Picea, Larix, Pinus* t. *silvestris, Betula, Alnus, Carpinus, Corylus* t. *avellana, Fagus, Quercus, Salix, Ulmus, Rosaceae, Ericaceae, Cyperaceae*).

On the other hand, the group of old Tertiary elements (Palaeocene-Oligocene) is represented in insignificant number of forms (*Castanopsis, Cyrillaceae, Lygodium, Cyathea, Hemitelia, Podocarpus, Cupressus, Toroisporis, Laevigatosporites* cf. *bisulcatus*).

The large occurrence of *Taxodiaceae-Cupressaceae* testifies that the sediment is older than the Pliocene. The infrequent occurrence of the old Tertiary element and forms characteristic of Lower Miocene and Oligocene (of *Leguminosae* and *Rhus* in particular) excludes an age previous to the Lower Miocene. A comparison of the Orawa profiles with the pollen diagram of the Middle Miocene from Gosławice (M a m c z a r 1960) allows the exclusion of this part of the Miocene because of the very infrequent occurrence in the examined profiles of such elements as *Ptelea, Castaneoideae, Ilex, Cyrillaceae,* which are characteristic of the profile at Gosławice and Górne Mirosławice (D o k t o r o w i c z - H r e b n i c k a 1956b). Although the Orawa profiles include a marked number of younger forms (*Abies, Picea, Ulmus, Cyperaceae,* and above all *Alnus*) the deposits under discussion cannot be traced to the Pliocene, for large quantities of the sporomorphs of *Taxodiaceae-Cupressaceae* and *Taxodium* type occur simultaneously with them there.

In the Orawa profiles under examination one occasionally finds various forms of the *Hystrichosphaeridae group,* cf. *Deflandrea,* cf. *Leiofusa, Hystrichosphaera* and *Oligosphaeridium.* Their occurrence might lead to the conclusion that for a time there was some communication with the sea. It is a known fact, however, that these organisms are frequent in the Carpathian Flysch, and so in our material they probably occur on a secondary bed.

From the above comparison it may be inferred that the discussed floras from Orawa most likely represent a fragment of the Upper Miocene.

In the foreland of West Carpathians two Upper Miocene floras have been recorded, viz., at Piaseczno and Stare Gliwice. The Tortonian flora of the sulphur-bearing deposit from Piaseczno (O s z a s t 1967) is represented by 135 taxons, of which 109 belong to *Angiospermae*. Most of the genera and families described for Orawa are common in the Piaseczno flora, which differs however in a higher proportion of *Angiospermae*, chiefly shrubs, and by the insignificant part played by the marsh-bog plants. At Piaseczno the predominant communities are those of foliaceous trees and shrubs typical of dry habitats. These differences point to divergencies in ecological conditions, which are connected with the differences in the geographical position in relation to the Paratethys Sea. The Piaseczno flora comes from the northern shore of the Sea, from an area beyond the Carpathians, while the Orawa flora occurs in the Carpathians beyond the southern shore of that Sea.

In the pollen diagram of Upper Miocene flora from Stare Gliwice (Oszast 1960; Szafer 1961) three phases have been distinguished, two drier ones divided by a wetter one. The Orawa flora is uniform and gives no grounds for distinguishing any climatic changes. In the Stare Gliwice flora three groups of plant communities: marsh-bog forests, leafy forests and mixed forests of the dry, higher situated habitats are more or less equally represented, which indicates the more regional character of this flora. The Orawa flora is of a more local character. In the Stare Gliwice flora a rather striking fact is the comparatively marked occurrence of the *Fagus* pollen grains. Setting aside the local elements, the Orawa flora to some extent recalls the second climatic phase of Stare Gliwice flora.

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STRESZCZENIE

ANALIZA PALINOLOGICZNA OSADÓW NEOGEŃSKICH Z KOTLINY NOWOTARSKO-ORAWSKIEJ (KARPATY ZACHODNIE, POLSKA)

Metodą analizy palinologicznej opracowano osady pochodzące z trzech profili neogenu z Chyżnego, Lipnicy Małej i Lipnicy Wielkiej, stanowisk położonych w Kotlinie Nowotarsko-Orawskiej. Wyróżniono 152 formy należące do 66 rodzin, wśród których przeważają *Angiospermae* (76 form), mniej liczne są paprotniki (40 formy), nagonasienne (20 form) i mszaki (11 form). Stwierdzono 5 form nowych dla trzeciorzędu Polski, a mianowicie *Gnetaceaepollenites ellipticus, Aspleniopsis* sp., *Cryptogramma* sp., cf. *Schefflera* (*Araliaceae*) i cf. *Dipelta* (*Caprifoliaceae*). Opisano także 5 form planktonowych, w tym 3 *Hystrichosphaeridae,* 1 *Leiofusidae* i 1 *Deflandridae.*

W diagramach pyłkowych wyróżniono dwie fazy rozwoju roślinności. W fazie pierwszej, obejmującej profile z Lipnicy Małej i Lipnicy Wielkiej oraz dolną część profilu z Chyżnego, panowały lasy bagienne, złożone głównie z *Taxodium, Glyptostrobus* i *Taxodiaceae-Cupressaceae.* Druga faza, reprezentowana tylko przez górną część profilu z Chyżnego, odznacza się gwałtownym obniżeniem udziału składników lasu bagiennego, z równoczesnym wzrostem udziału zarośli galeriowych i zbioro-

wisk torfowiskowych. Zbiorowiska suchszych siedlisk nie uległy większym zmianom w okresie tworzenia się osadów.

Na podstawie wymagań klimatycznych składniki flory podzielono na 3 grupy: klimatu tropikalnego i subtropikalnego, klimatu umiarkowanego ciepłego i klimatu umiarkowanego z przejściem do klimatu chłodnego. Grupy te występują bardzo regularnie i brak jest wyraźnej zmiany, która mogłaby wskazywać na oscylację klimatu. Przyjęto, że w zachodniej części Kotliny panował w górnym miocenie wilgotny klimat subtropikalny o charakterze górskim, zbliżony do klimatu umiarkowanie ciepłego.

Profil z Lipnicy Wielkiej uznano za równowiekowy z górną częścią profilu z Lipnicy Małej, natomiast profil z Chyżnego za nieco młodszy od obu wyżej wymienionych profili. Przez porównanie z florami neogeńskimi z sąsiednich regionów przyjęto dla zbadanej flory z Orawy wiek górnego miocenu.

Instytut Botaniki Uniwersytetu Jagiellońskiego w Krakowie

Plate I

× 1000

1— 2. *Sphagnum* sp. — *Stereisporites (Stereisporites) minor* (Raatz) W. Kr.
3. *Sphagnum* sp. — *Stereisporites (Stereisporites) stereoides* (R. Pot. & Ven.) Th. & Pf.
4— 5. *Sphagnum* sp. — *Stereisporites (Stereisporites) megastereis* W. Kr.
6— 7. *Sphagnum* sp. — *Stereisporites (Stereigranisporites) granulus* W. Kr & Sontag
8— 9. *Sphagnum sp.* — *Stereisporites (Structisporis)* cf. *intrastructuris* W. Kr.
10—12. *Lycopodium* t. *annotinum* L.
13—16. *Lycopodium* t. *selago* L. — *Selagosporis selagoides* W. Kr.
17—19. *Lycopodium* t. *selago* L. — *Selagosporis* fsp. B. W. Kr.
20. *Selaginella sp.* — *Echinatisporites cycloides* W. Kr.

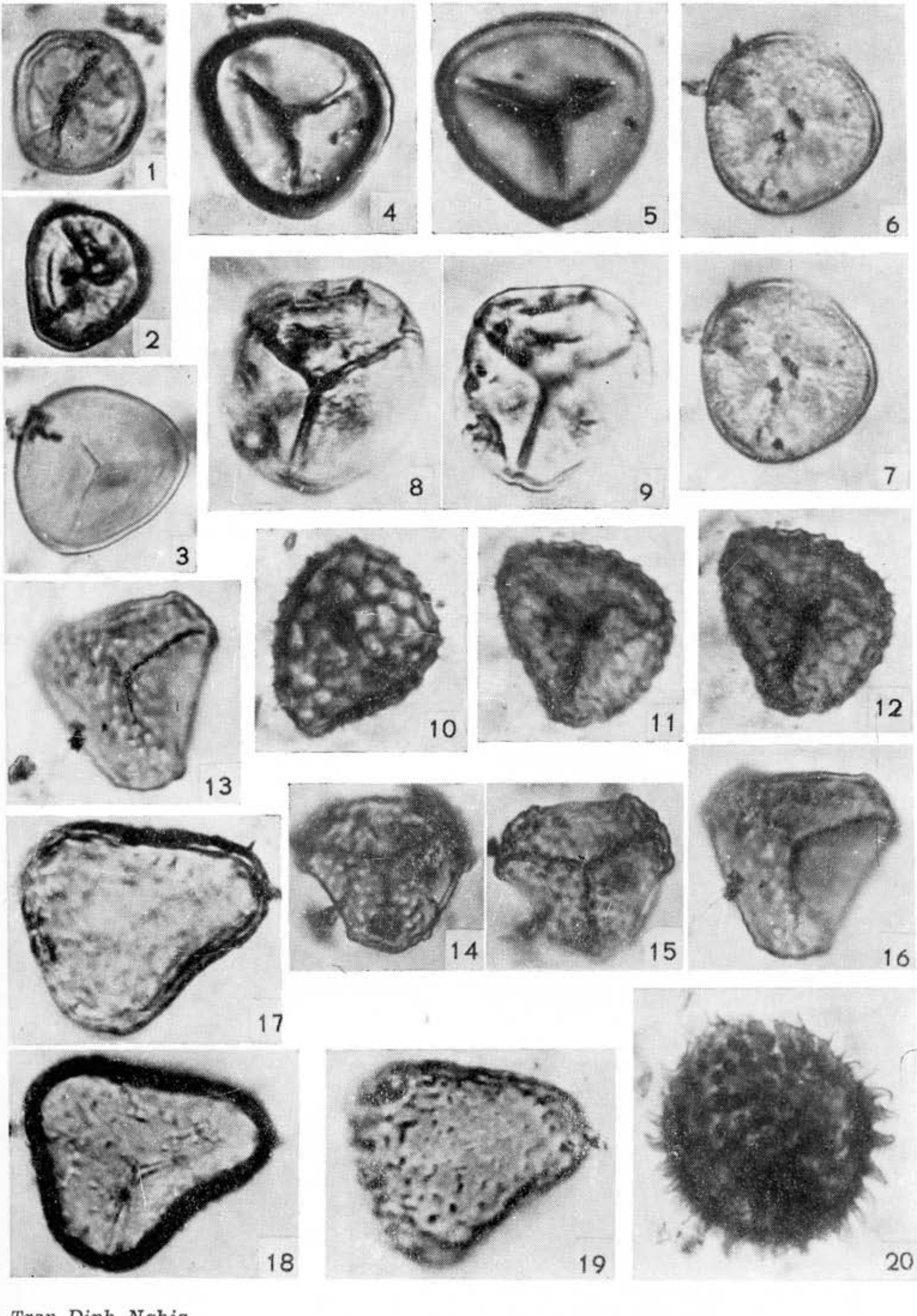
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Plate II

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1—3. *Selaginella* sp. — *Echinatisporites miocenicus* W. Kr. & Sontag
4. *Osmunda* cf. *claytoniana* L. — *Baculatisporites primarius primarius* W. Kr.
5—7. *Osmunda* t. *regalis* L. — *Baculatisporites quintus regulatoides* W. Kr.
8. *Schizeaceae* — *Triletes microvallatus* W. Kr.
9—10. *Cyathea* cf. *propinqua* Molt.
11. *Gleicheniaceae* — *Concavisporites* fsp.
12—13. *Gleicheniaceae* — cf. *Concavisporites obtusangulus* (R. Pot. & Ven) f. *minor* Pf.
14—16. *Cyathea* cf. *vestita* Mart.
17. *Microlepia* sp. 1
18. *Microlepia* sp. 2

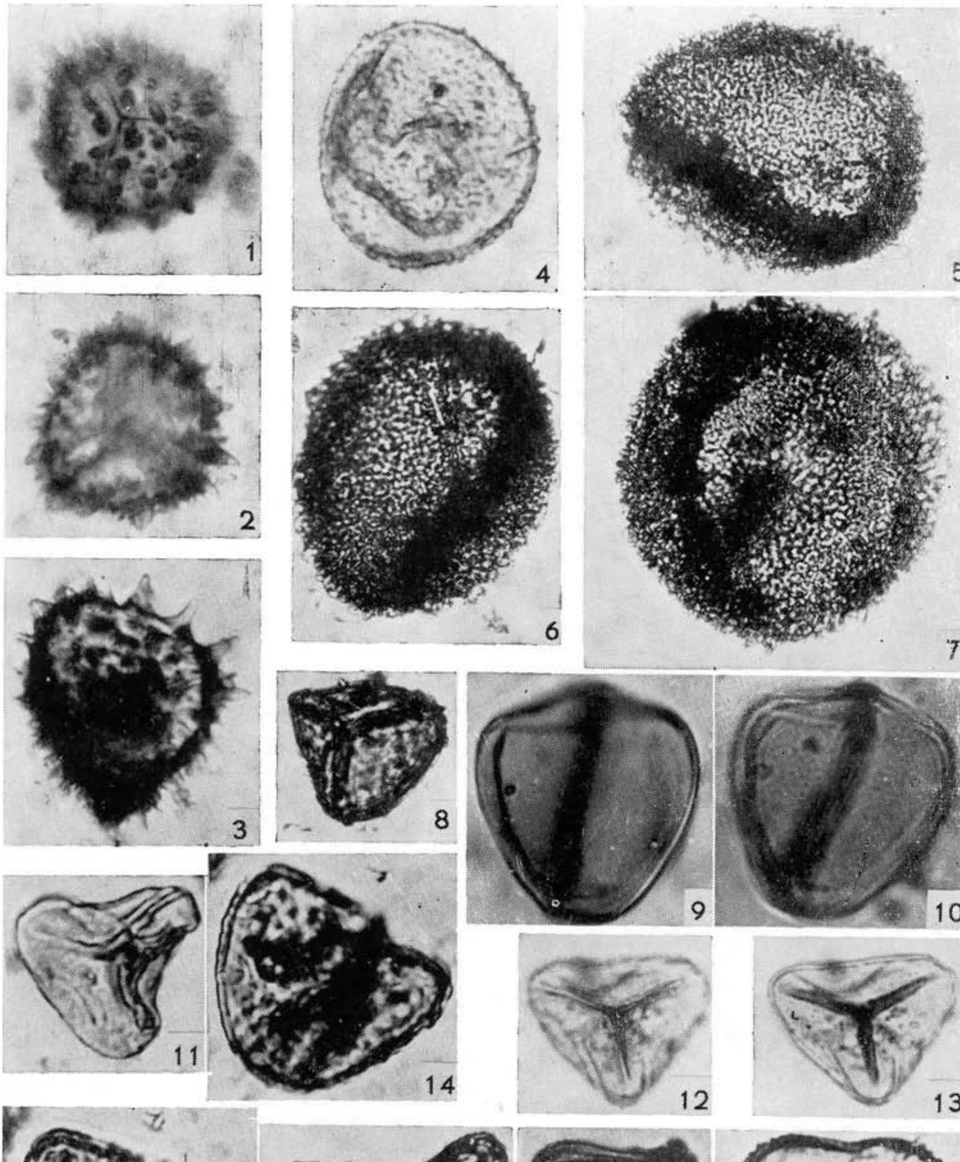

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Plate III

× 1000

1—2. *Cyatheaceae—Schizeaceae — Leiotriletes wolffi* W. Kr. subsp. *brevis* W. Kr.
3. cf. *Hemitelia* sp. 1
4—5. cf. *Hemitelia* sp. 2
6—7. *Cyatheaceae—Schizeaceae — Leiotriletes neddenioides* W. Kr.
8—9. *Cryptogramma* sp.
10—13. *Polypodiaceae — Laevigatosporites gracilis* Wilson & Webster
14. *Polypodiaceae — Laevigatosporites haardti crassicus* W. Kr.
15. *Polypodiaceae — Laevigatosporites nutidus nutidus* W. Kr.
16. *Polypodiaceae* forma 2
17—18. *Polypodiaceae* — Extrapunctatosporis fsp.
19—20. *Polypodiaceae — Laevigatosporites haardti haardti* W. Kr.
21. *Punctatisporites? punctatus* (Pf.) Th. & Pf.

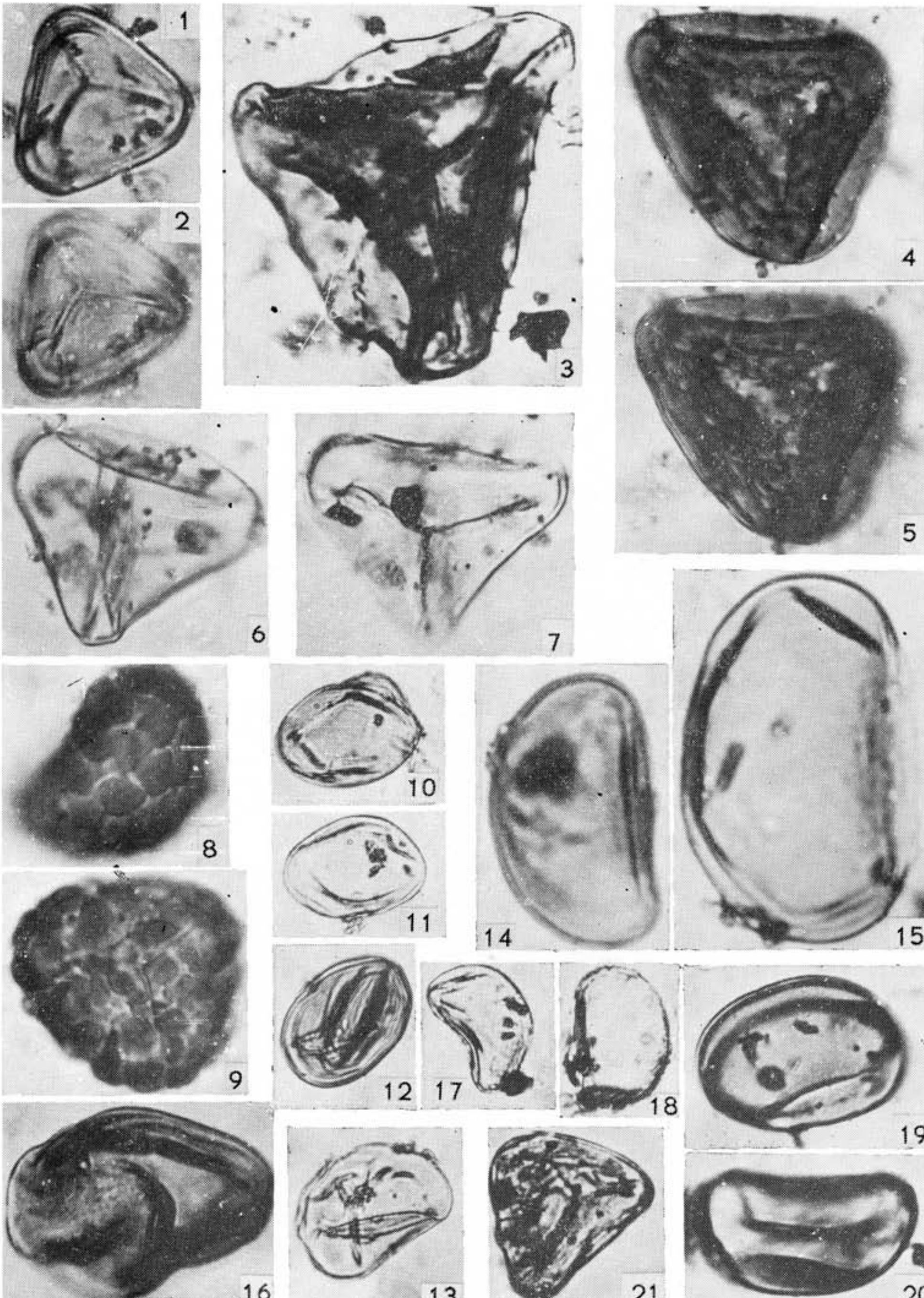

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Plate IV

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1. *Polypodiaceae* — *Laevigatosporites? bisulcatus* W. Kr.
2—3. *Polypodiaceae* — *Verrucatosporites alienus* (R. Pot.) Th. & Pf.
4. *Polypodiaceae* — *Verrucatosporites* cf. *bockwitzensis* W. Kr.
5. *Polypodiaceae* — *Verrucatosporites rugufavus* W. Kr.
6. *Polypodiaceae* — *Verrucatosporites tenellis* W. Kr.
7—10. *Laevigatisporites neddeni regularis* R. Pot. & Ven. Th. & Pf.
11—12. *Punctatisporites? punctatoides* W. Kr.
13—14. *Microfoveolatisporites* fsp.
15. *Polypodiaceae* — *Laevigatosporites haardti haardtioides* W. Kr.
16. *Ginkgo* sp. × 2000
17. *Ginkgo* sp.

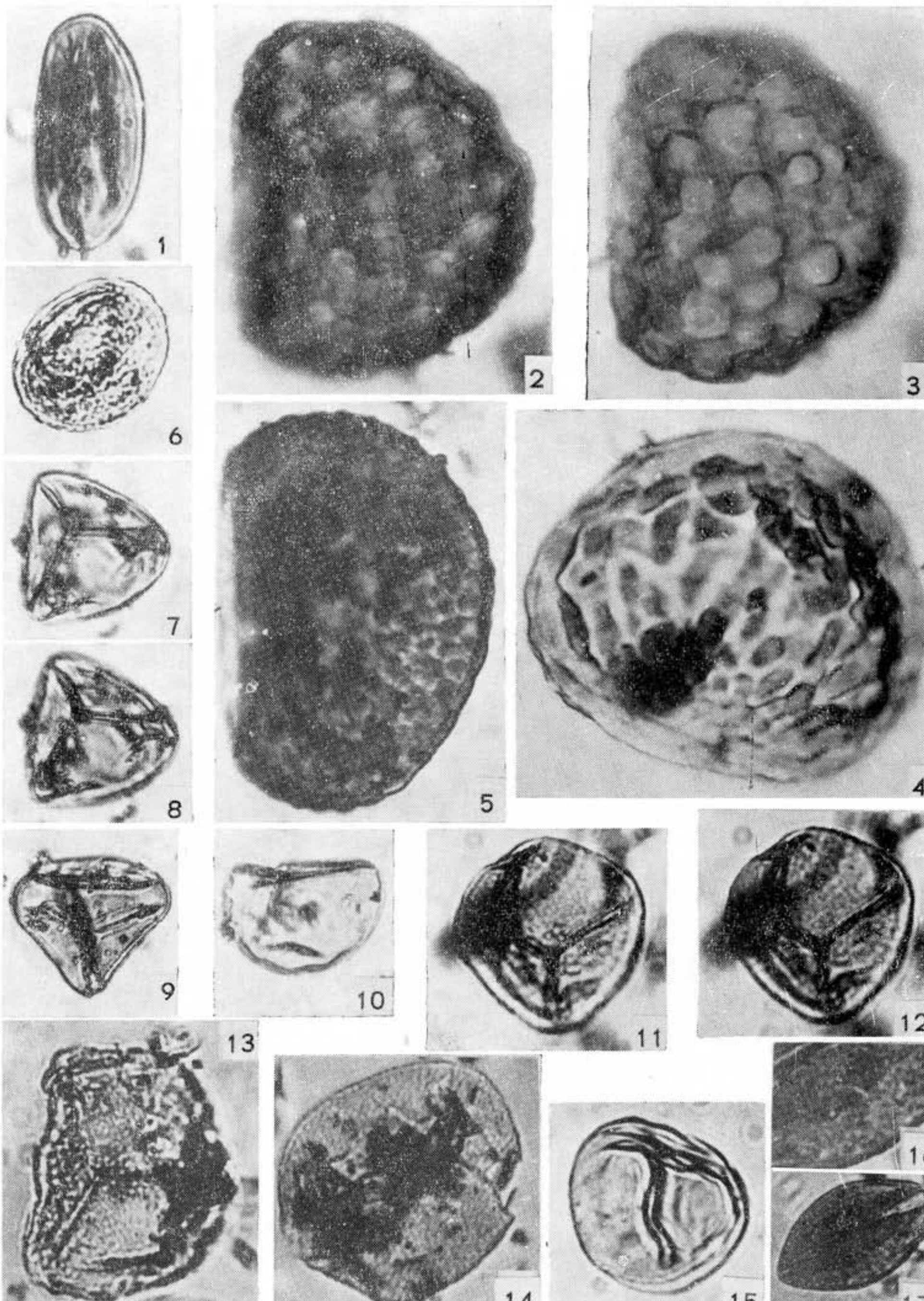

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Plate V

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1—2. *Toroisporis (Toroisporis)* cf. *pessinensis* W. Kr.
3. *Podocarpus* sp. 1
4—6. *Abies* sp. — *Pityosporites absolutus* (Thierg.) Th. & Pf. × 500
7. *Tsuga* t. *diversifolia* (Maxim.) Mast. — *Zonalapollenites igniculus* (R. Pot.) Th. & Pf.
8. *Tsuga* t. *canadensis* Carr. — *Zonalapollenites (Tsuga) virifluminites* (Woodh.) Th. & Pf.
9. *Podocarpus* sp. 2.

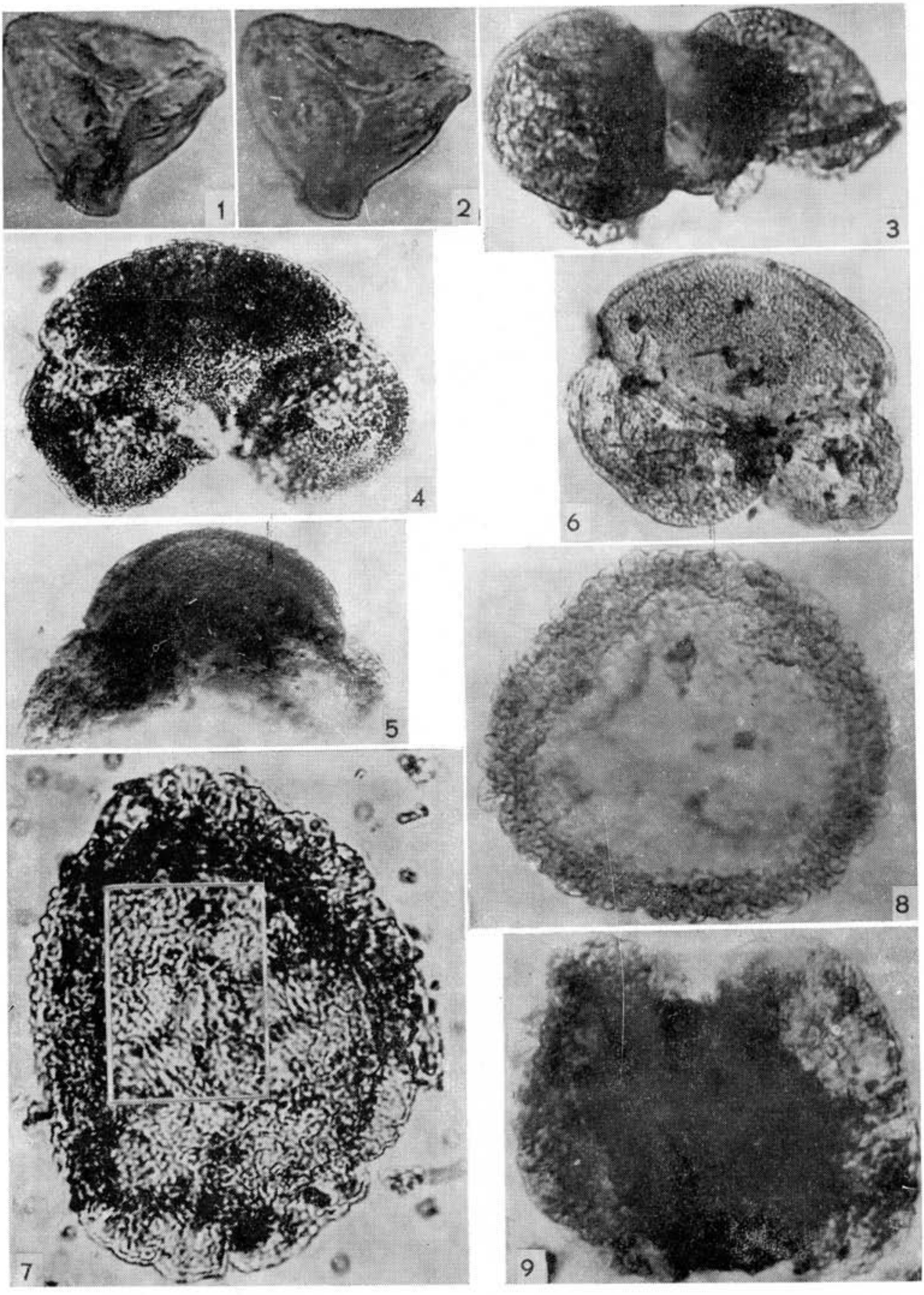
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Plate VI

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1. *Tsuga* t. *pattoniana* Engelm.
2—3. *Picea* sp. — *Pityosporites alatus* (R. Pot.) Th. & Pf.
4. *Larix* sp. — *Inaperturopollenites magnus* (R. Pot.) Th. Pf.
5. *Cedrus* sp.— *Pityosporites cedroides* Th. Pf.

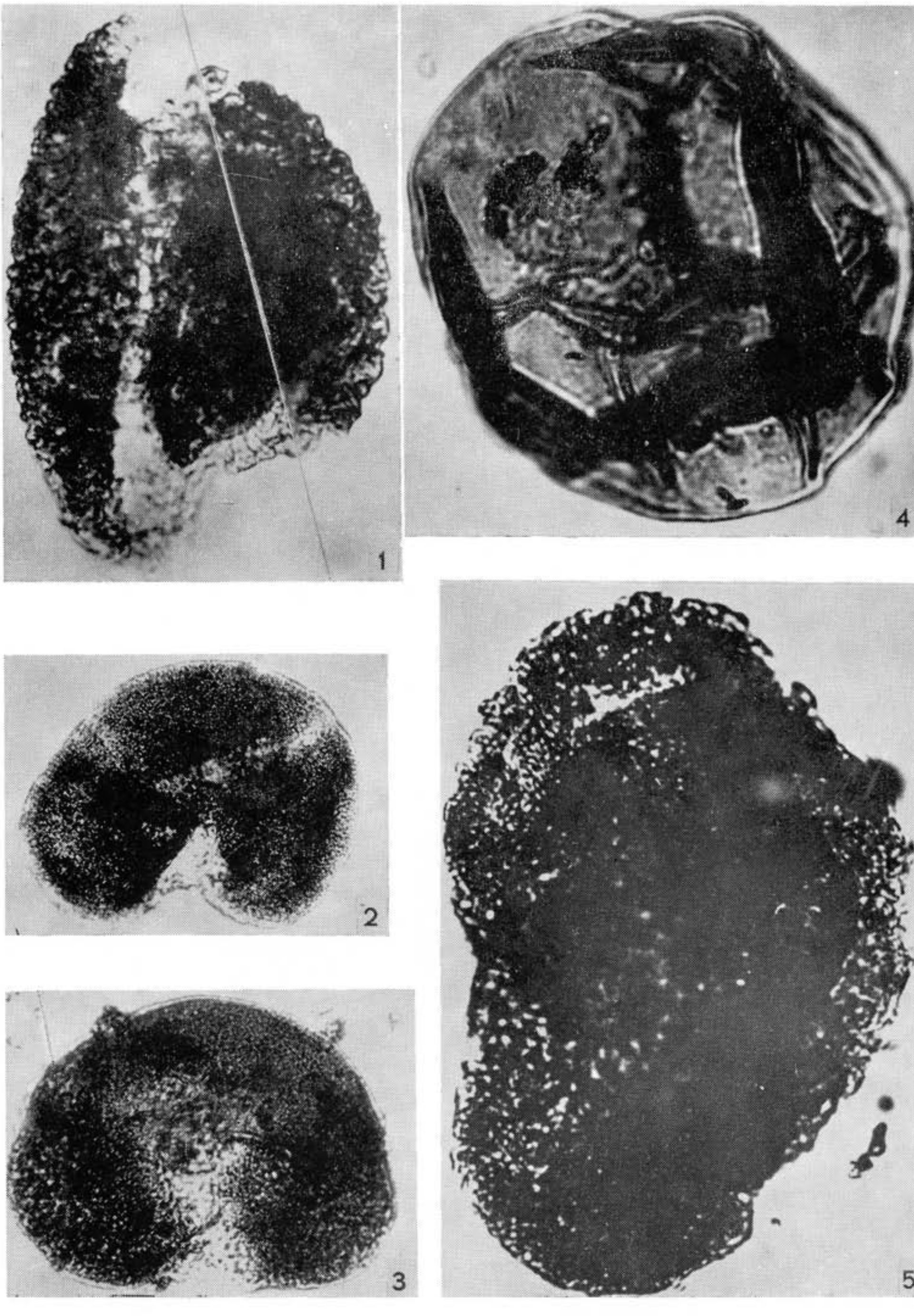
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Plate VII

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1—2. *Tsuga* t. *sieboldii* Carr.
3—7. *Pinus* t. *diploxylon* Rudolph — *Pityosporites labdacus* (R. Pot.) Th. & Pf.
8—9. *Pinus* t. *haploxylon* Rudolph — *Pityosporites microalatus* (R. Pot.) Th. Pf., × 500
10. *Sequoia* sp. *Sequoiapollenites polyformosus* Thierg.
11—12. *Taxodium* sp. — *Inaperturopollenites hiatus* (R. Pot.) Th. & Pf.
13. *Glyptostrobus* cf. *europaeus* (Brongn.) Heer — *Pollenites magnus dubius* R. Pot. & Ven.
14—16. *Cryptomeria* sp. — *Sequoia pollenites largus* (Kremp) Manum
17. *Cupressus* sp. — *Cupressacites* fsp.
18—19. *Taxodiaceae—Cupressaceae* — *Inaperturopollenites dubius* (R. Pot.) Th. & Pf.

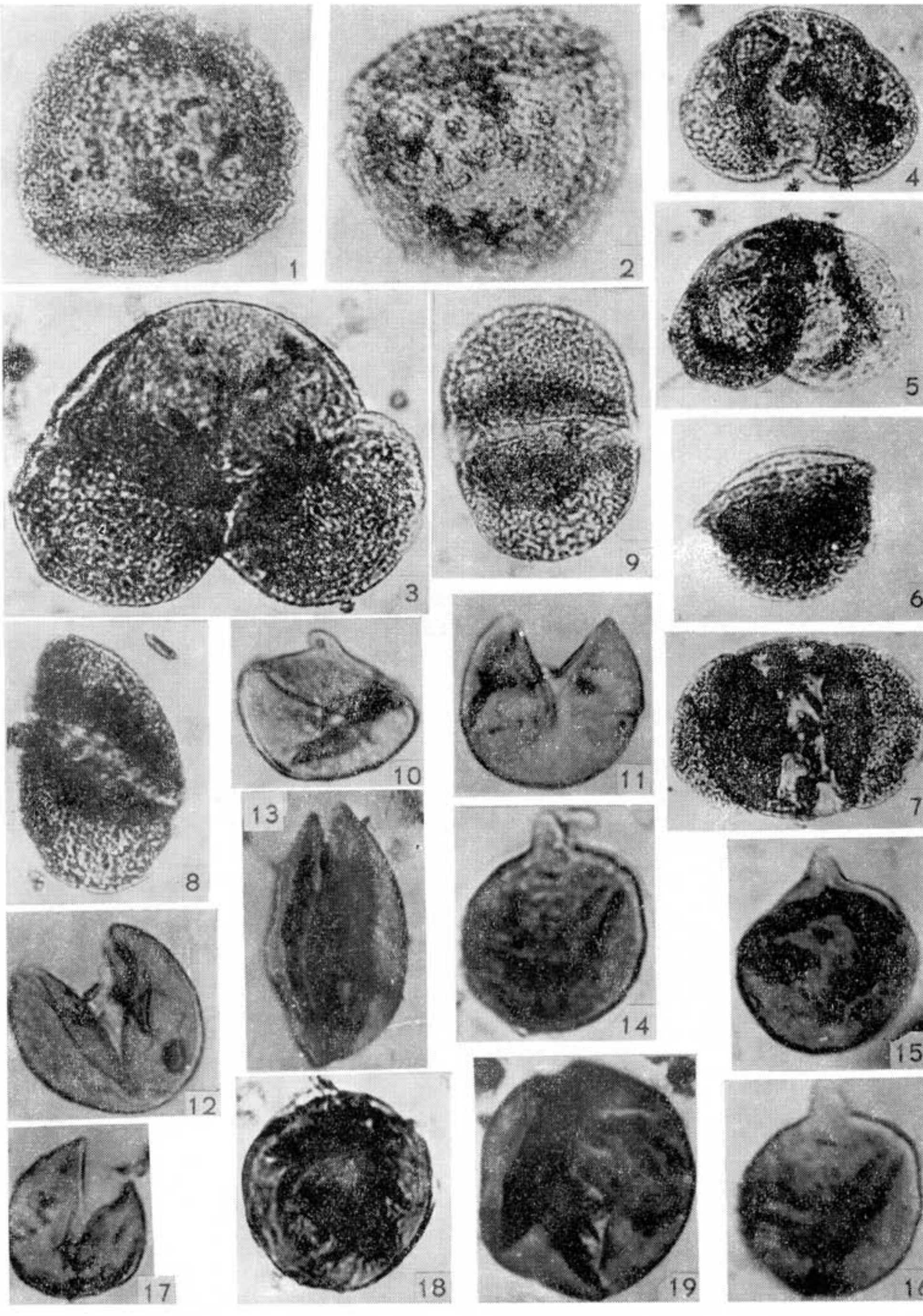

Plate VIII

× 1000

1—2. *Gnetaceaepollenites ellipticus* Thierg.
3. *Betula* sp. — *Trivestibulopollenites betuloides* Th. & Pf.
4—6. *Alnus* sp. — *Polyvestibulopollenites* (*Alnipollenites*) *verus* (R. Pot.) Th. & Pf.
7. *Alnus* cf. *glutinosa* (L.) Gaertn.
8. *Corylus* t. *avellana* L. — *Triporopollenites coryloides* Th. & Pf.
9. *Castanopsis* sp. — *Pollenites cingulum* R. Pot.
10—12. *Fagus* sp. — *Tricolporopollenites fagoides* W. Kr.
13. *Quercus* sp. — *Tricolpopollenites asper* Th. & Pf.
14. *Juglans* sp. — *Multiporopollenites maculosus* (R. Pot.) Th. & Pf.
15. *Carya* sp. — *Subtriporopollenites simplex* (R. Pot. et Ven.) Th. & Pf.
16. *Pterocarya* sp. — *Polyporopollenites stellatus* (R. Pot. & Ven.) Th. & Pf.
17—18. *Platycarya* sp. — *Platycaryapollenites* cf. *miocaenicus* Nagy
19—20. *Engelhardtia* sp. — *Triatriopollenites coryphaeus punctatus* (R. Pot.) Th. & Pf.
21—22. *Salix sp.* — *Salicioidites* fsp.

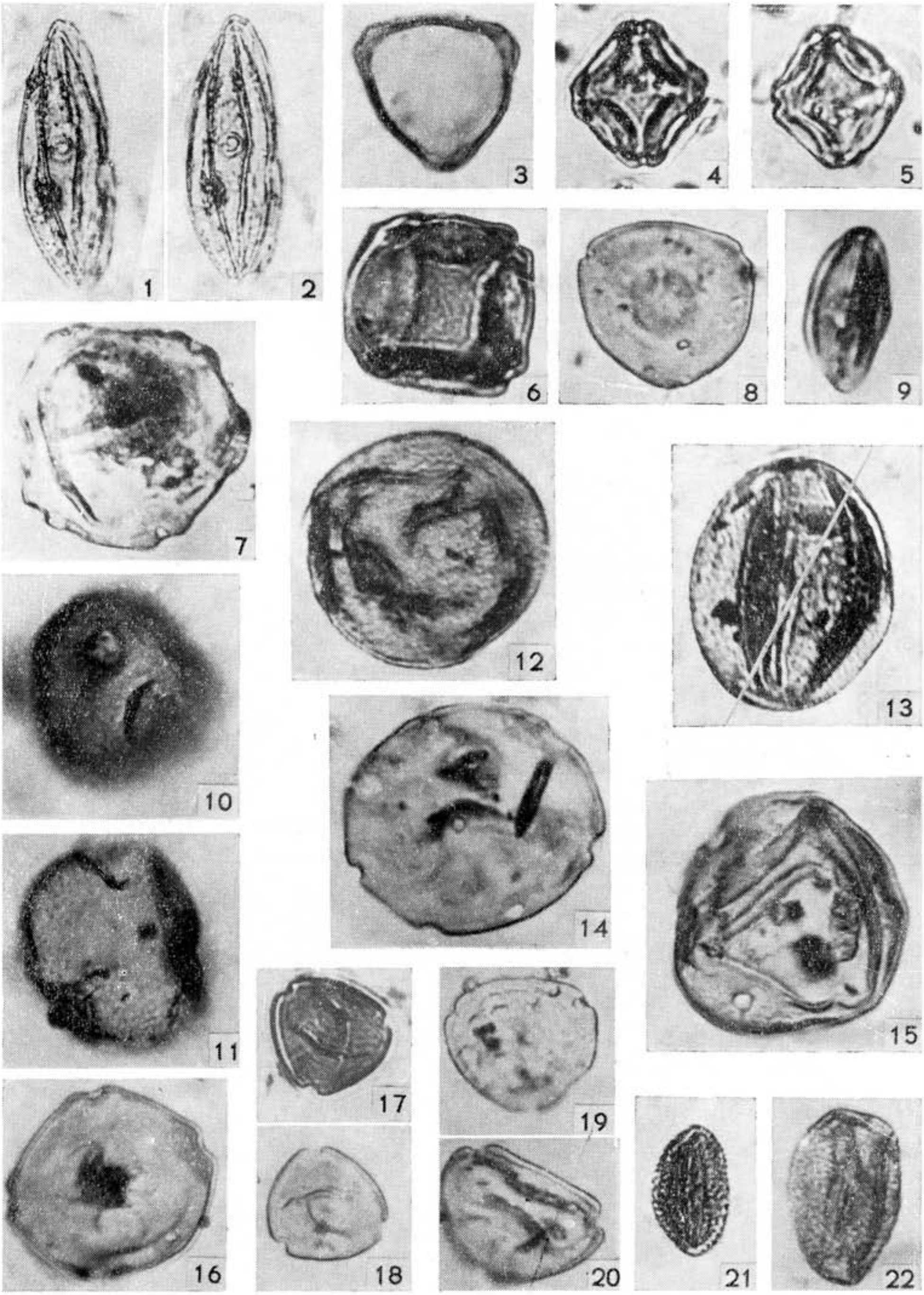

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Plate IX

× 1000

1—3. *Ulmus* sp. — *Polyporopollenites undulosus* (Wolf) Th. & Pf.
4. *Zelkova* sp.
5—6. *Celtis* sp.
7. *Liquidambar* sp. — *Periporopollenites stigmosus* (R. Pot.) Th. & Pf.
8. *Corylopsis* sp. — *Pollenites cribellus* Dokt.—Hreb.
9. *Eucommia* cf. *ulmoides* Oliv.
10. cf. *Loranthus* sp.
11. *Polygonum* sp.
12. *Lauraceae*
13. cf. *Nuphar* sp.
14. cf. *Caragana* sp.
15—16. *Leguminosae*
17—19. *Decodon* cf. *globosus* (Reid) Nikit.
20—21. *Nyssa* sp. — *Tricolporopollenites kruschi analepticus* (R. Pot.) Th. & Pf.
22. *Nyssa* sp. — *Tricolporopollenites kruschi rodderensis* (R. Pot.) Th. & Pf.

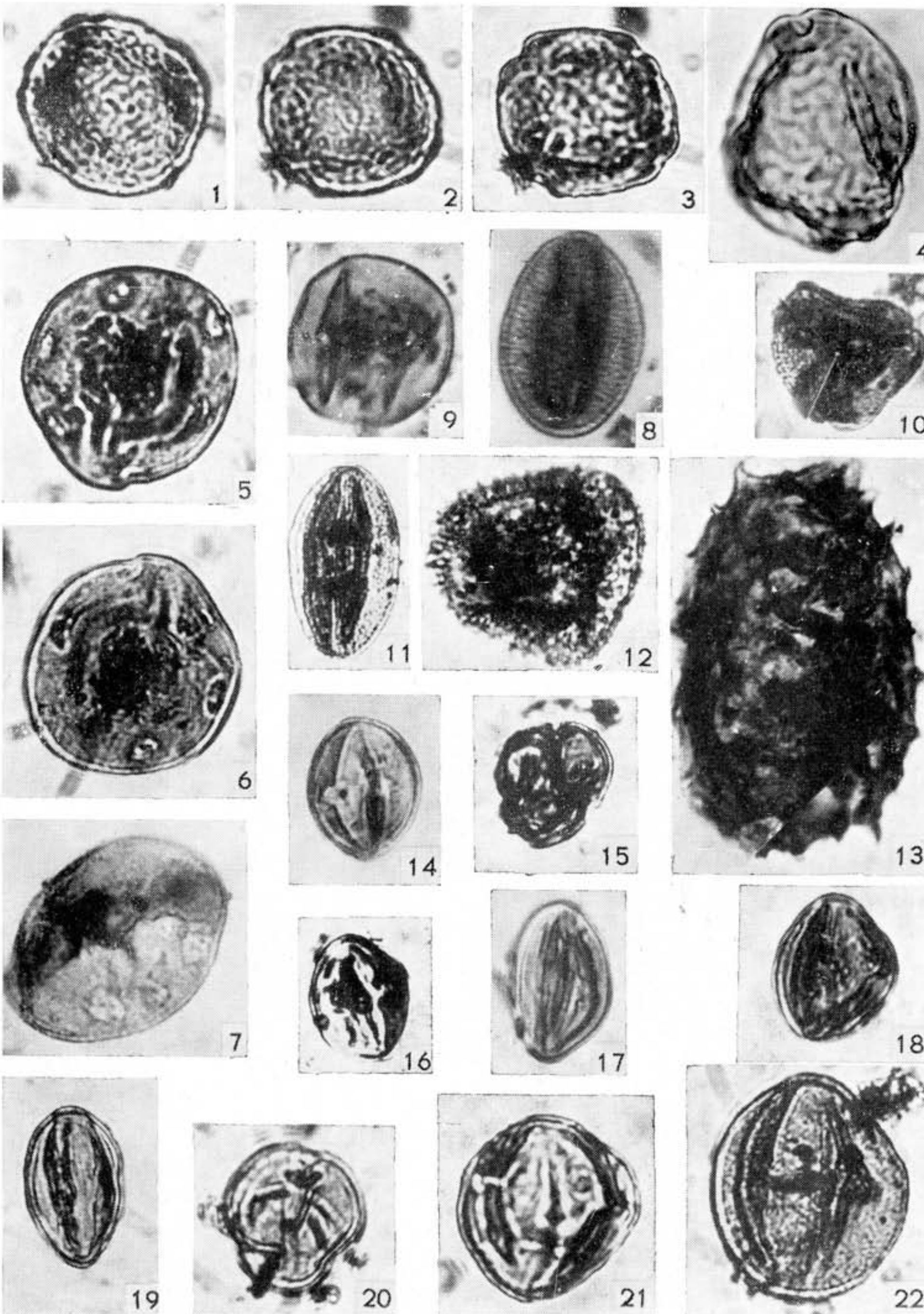
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Plate X

× 1000

1. cf. *Eucalyptus* sp.
2. *Oenotheraceae* — *Pollenites oculi noctis* Thierg.
3—4. cf. *Myriophyllum* sp.
5. *Tilia* sp. — *Intratriporopollenites* cf. *insculptus* Mai
6—7. *Tilia* sp. — *Intratriporopollenites instructus instructus* W. Kr.
8. *Reevesia* sp. — *Porocolpopollenites rotundus* f. *reticulata* (R. Pot.) Stuchl.
9. cf. *Ptelea* sp. — *Tricolporopollenites cingulum fusus* (R. Pot.) Th. & Pf.
10—11. cf. *Pistacia* sp.
12. *Acer* sp.
13—14. *Staphylea* sp. — *Pollenites perexpressus* Dokt.—Hreb.
15. *Cyrilla* sp.
16—17. *Cyrillaceae* — *Tricolporopollenites cingulum brühlensis* Th. & Pf.
18. cf. *Parthenocissus* sp. — *Tricolporopollenites macrodurensis* Th. & Pf.

Plate X

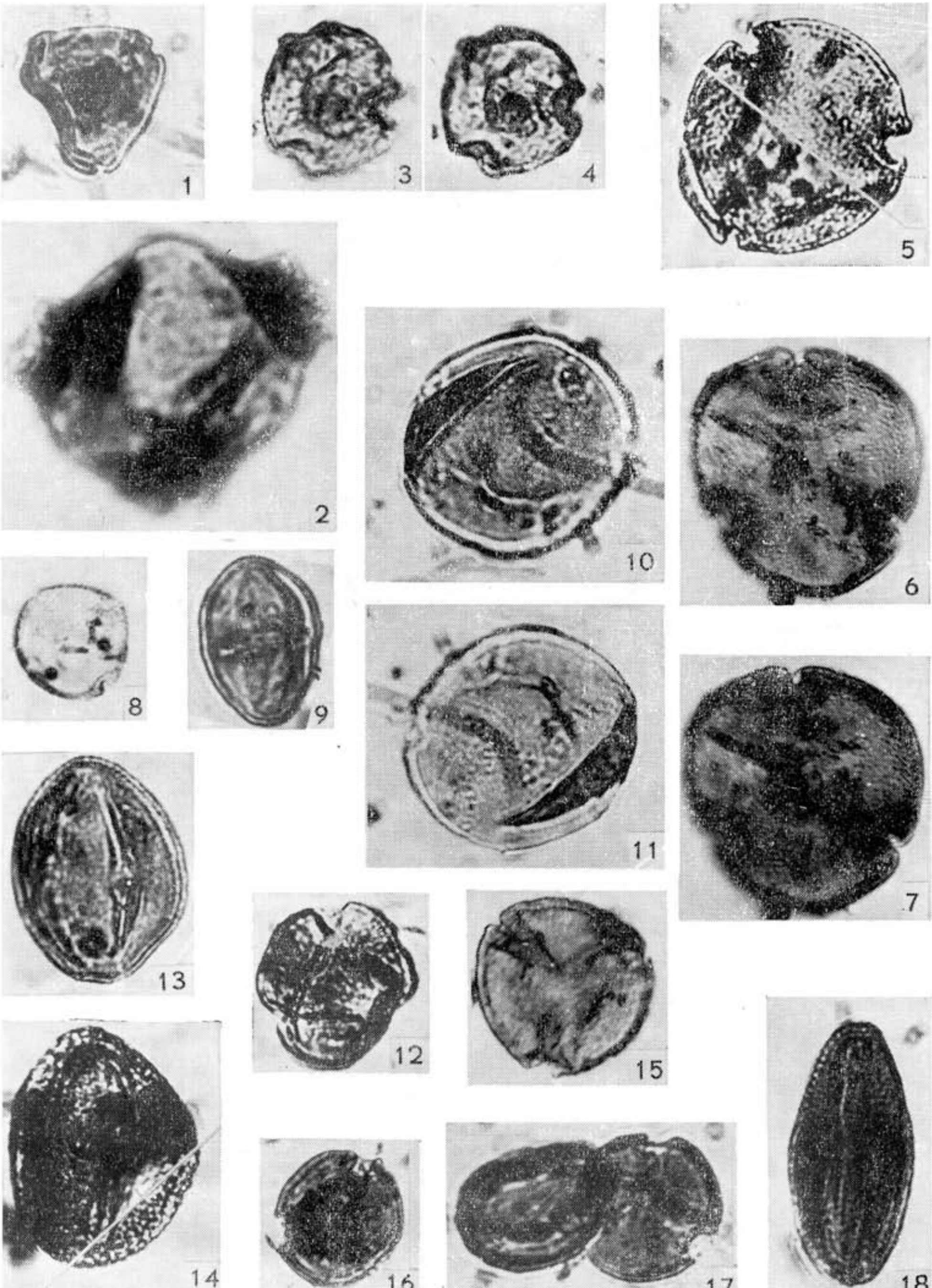

Plate XI

× 1000

1—4. cf. *Aralia* sp. — *Tricolporopollenites euphorii* (R. Pot.) Th. & Pf.
5—8. cf. *Schefflera* sp.
9—10. *Araliaceae* sp.
11—12. *Umbelliferae*
13—14. *Ericaceae* — *Tetradopollenites ericius* (R. Pot.) Th. & Pf.
15—16. cf. *Markhamia* sp.
17. *Labiatae*
18—19. cf. *Plantago* sp.
20—21. cf. *Randia* sp.
22—24. *Viburnum* sp.
25. cf. *Dipelta* sp.

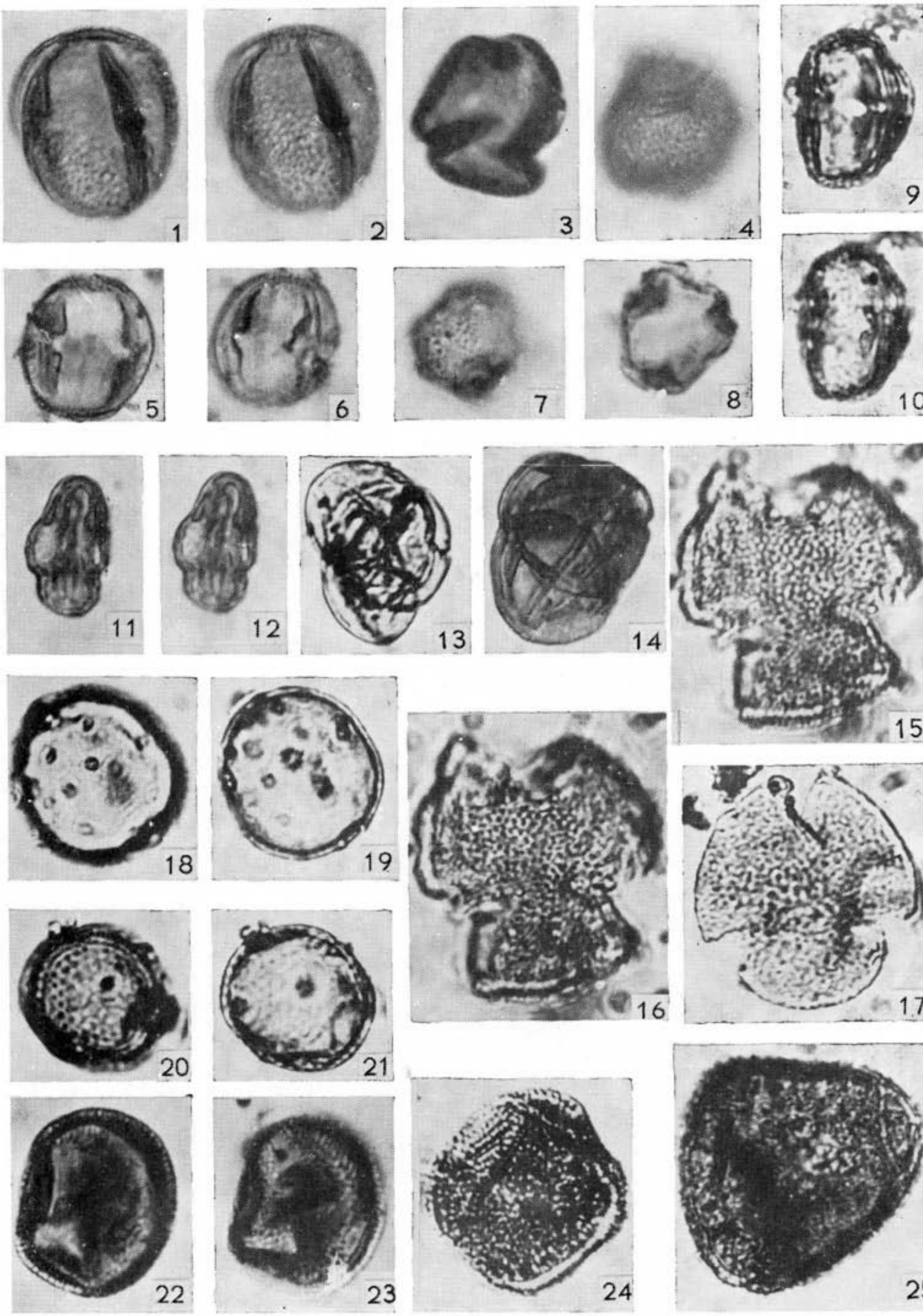
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Plate XII

× 1000

1—2. *Butomus* sp.
3—4. cf. *Tulipa* sp.
5. *Cyperaceae*
6—7. *Gramineae* — *Monoporopollenites gramineus* Weyland & Pf.
8—9. cf. *Corypha* sp. — *Monocolpopollenites parareolatus* W. Kr.
10. *Typha* t. *angustifolia* L.
11. *Deflandrea* sp. × 500
12—13. cf. *Leiofusa* sp.

Plate XII

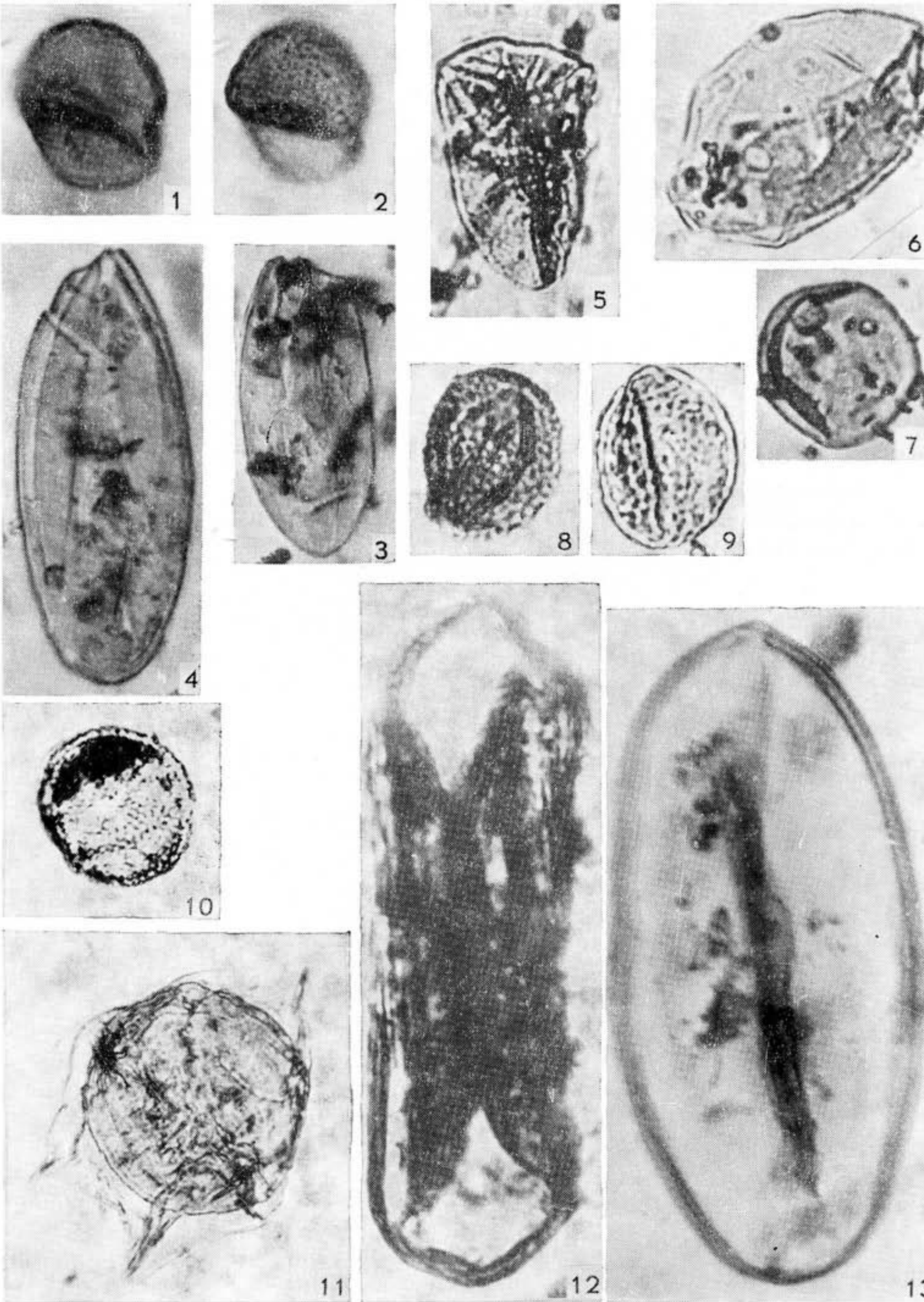

Plate XIII

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1. *Hystrichosphaera ramosa* (Ehrh.) var. *gracilis* Dav. & Will.
2. *Hystrichosphaera ramosa* (Ehrh.) var. *reticulata* Dav. & Will.
3. *Oligosphaeridium complex* (White) Dav. & Will.

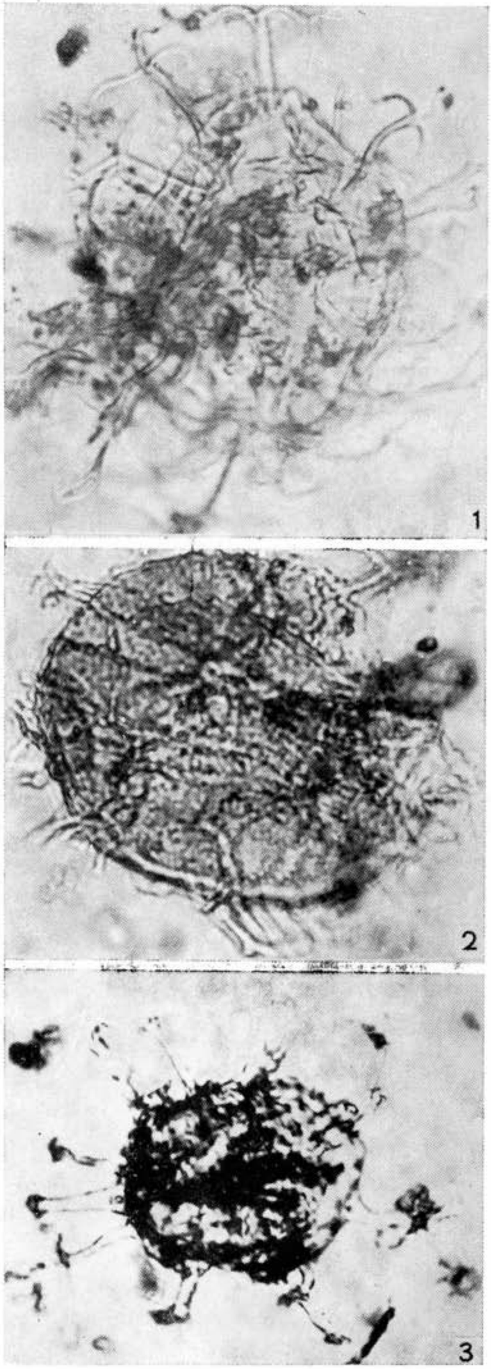


Plate XIV

Photo 1. Chyżne. General situation of the outcrop

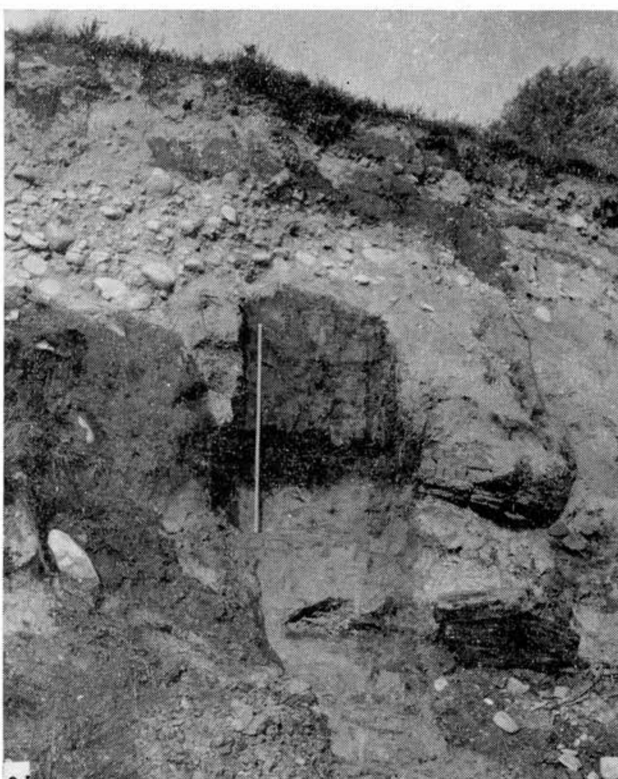
Fot. 1. Chyżne. Położenie ogólne odkrywki

Photo 2. Chyżne. Outcrop of the geological profile. Below quaternary gravels, clay and lignite layers, from which the pollen analysis has been made

Fot. 2. Chyżne. Odkrywka geologiczna profilu. Pod czwartorzędowymi żwirami warstwa gliny i lignitów, z której wykonano analizę pyłkową

Photo L. Stuchlik

Fot. L. Stuchlik



Tran Dinh Nghia

Plate XV

Lipnica Mała. Outcrop of the geological profile
Lipnica Mała. Odkrywka geologiczna profilu

Photo L. Stuchlik
Fot. L. Stuchlik

CHYŻNE

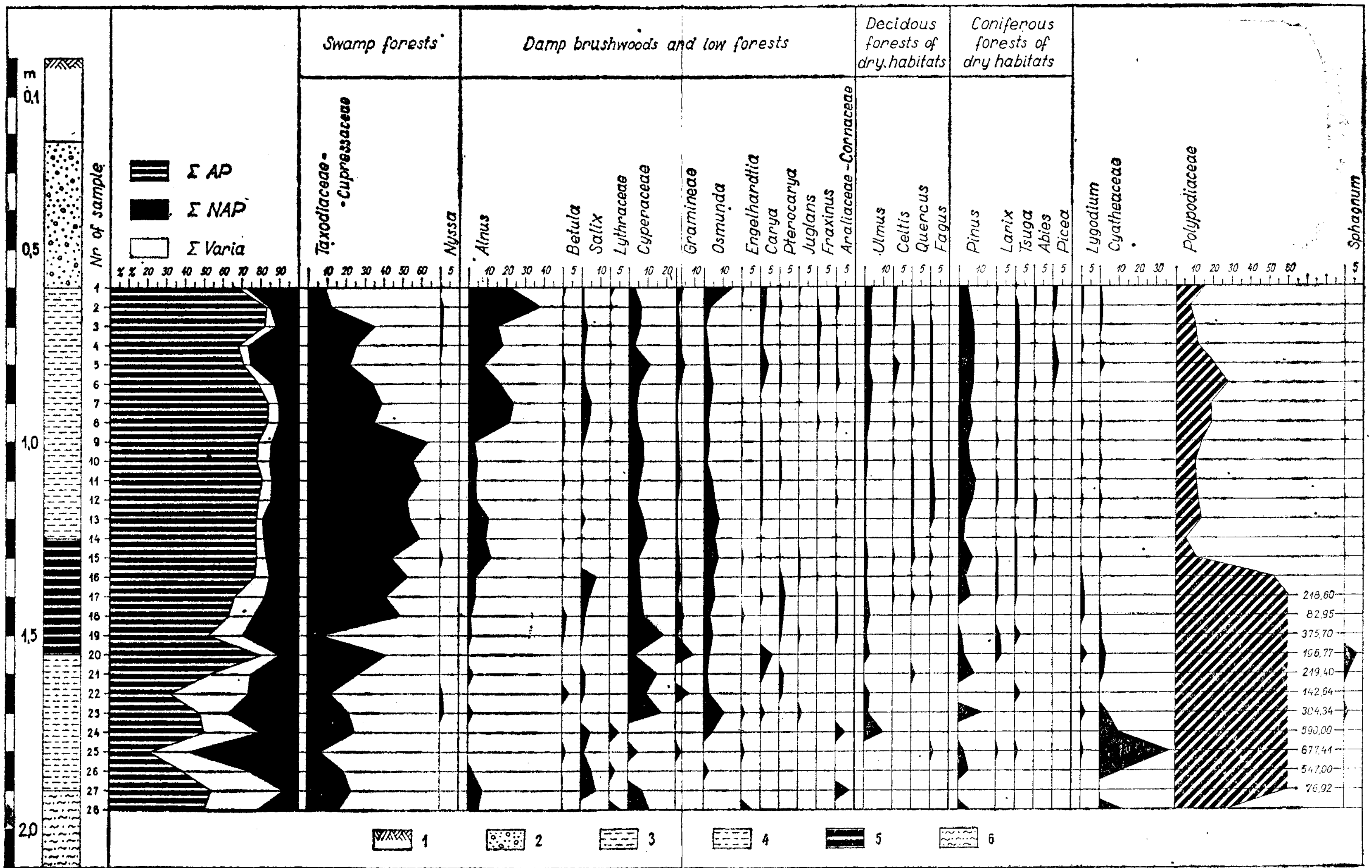


Fig. 2. Chyżne: pollen diagram and geological profile. 1 — soil; 2 — thick-grained sands with gravels; 3 — brown clays; 4 — dusty and blue clays; 5 — lignites; 6 — strongly sandy yellow loam

Ryc. 2. Chyżne: diagram pyłkowy i profil geologiczny. 1 — gleba; 2 — piaski gruboziarniste ze żwirami; 3 — iły brązowe; 4 — iły pylaste z iłami niebieskimi; 5 — lignity; 6 — glina żółta silnie zapiaszczona

LIPNICA MAŁA

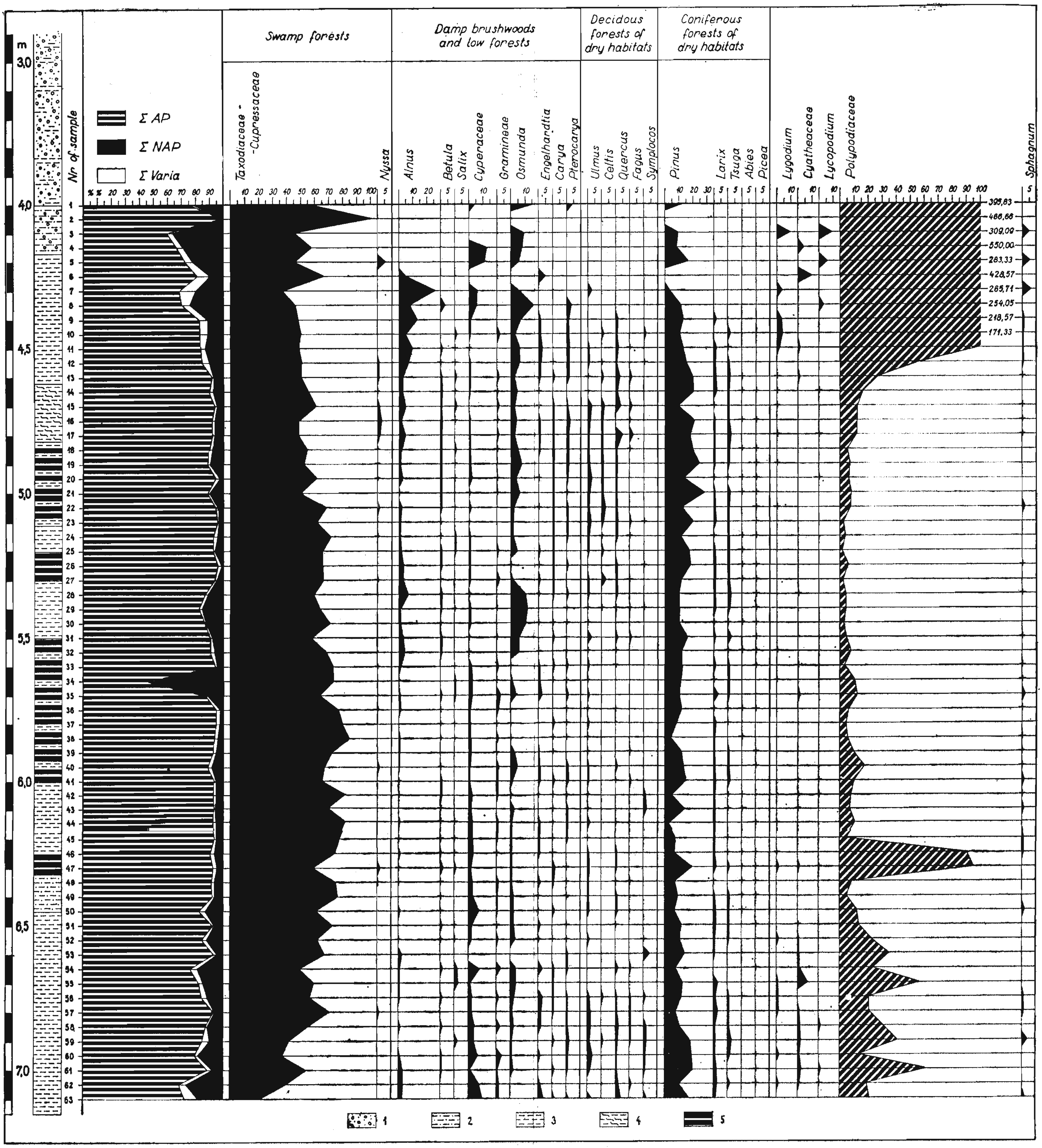


Fig. 3. Lipnica Mała: pollen diagram and geological profile. 1 — yellow, thick grained sands with gravels; 2 — grey-brown clays with sand; 3 — grey and brown clays; 4 — grey-brown clays with plant remains; 5 — lignites

Ryc. 3. Lipnica Mała: diagram pyłkowy i profil geologiczny. 1 — żółte piaski gruboziarniste ze żwirami; 2 — iły popielatobrązowe z piaskiem; 3 — iły popielate i brązowe; 4 — iły popielatobrązowe z detrytusem roślinnym; 5 — lignity

LIPNICA WIELKA

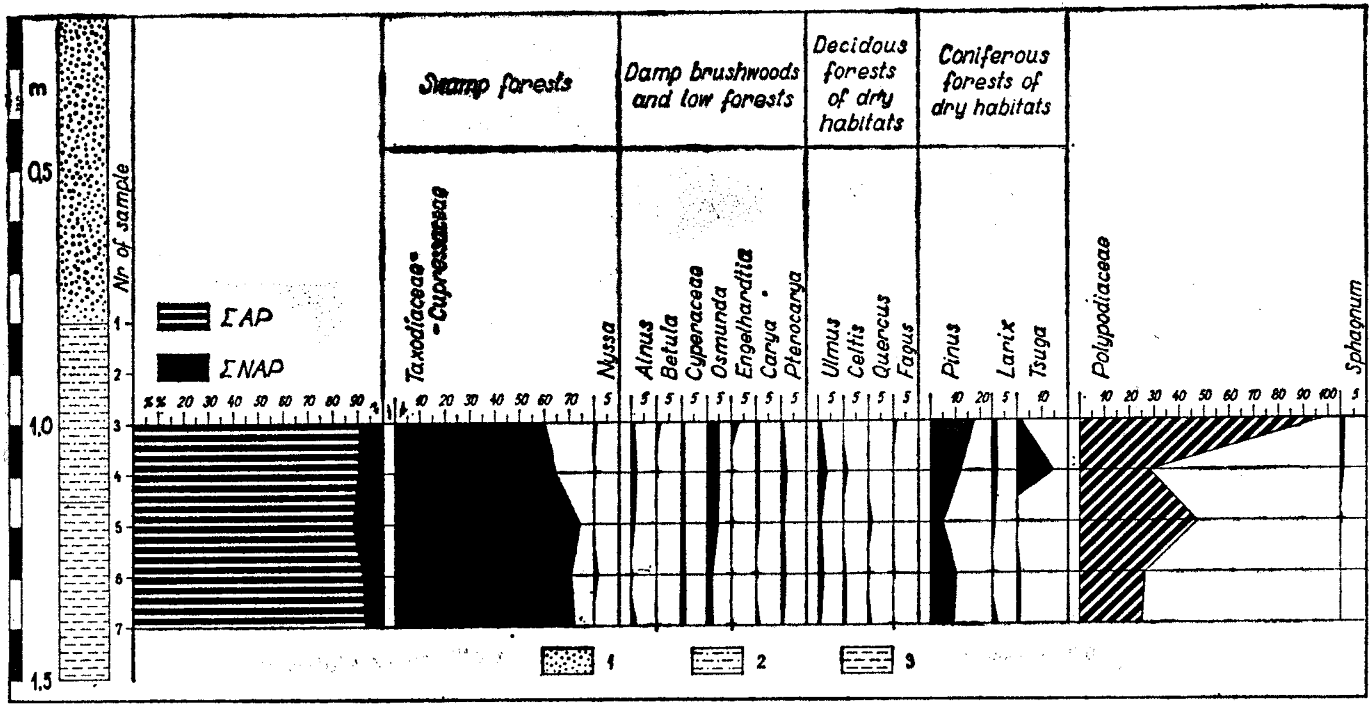


Fig. 4. Lipnica Wielka: pollen diagram and geological profile. 1 — brown sands, 2 — grey and sandy brown clays; 3 — grey clays

Ryc. 4. Lipnica Wielka: diagram pyłkowy i profil geologiczny. 1 — piaski brązowe; 2 — iły popielate z piaszczystymi iłami brązowymi; 3 — iły popielate

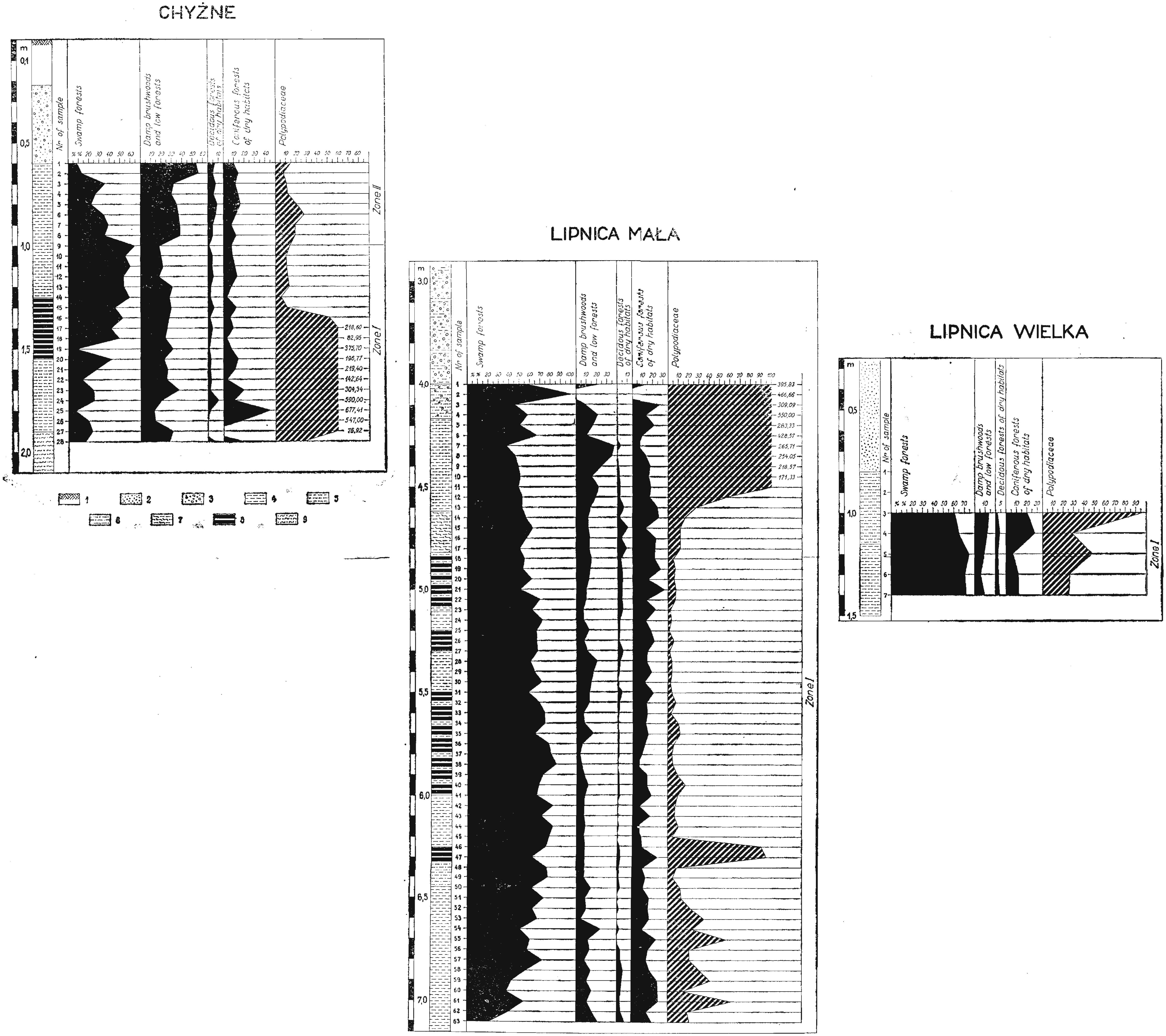


Fig. 5. Comparison of simplified pollen diagrams of the profiles at Chyżne, Lipnica Mała and Lipnica Wielka. 1 — soil; 2 — brown sands; 3 — thick grained sands with gravels; 4 — grey and brown clays; 5 — dusty and blue clays; 6 — grey clays with sandy brown clays; 7 — grey-brown clays with plant remains; 8 — lignites; 9 — strongly sanded yellow loam

Ryc. 5. Porównanie uproszczonych diagramów pyłkowych profili z Chyżnego, Lipnicy Małej i Lipnicy Wielkiej. 1 — gleba; 2 — piaski brązowe; 3 — piaski gruboziarniste ze żwirami; 4 — iły brązowe i popielate; 5 — iły pylaste z iłami niebieskimi; 6 — iły popielate z piaszczystymi iłami brązowymi; 7 — iły popielatobrązowe z detrytusem roślinnym; 8 — lignity; 9 — glina żółta silnie zapiaszczona

Table 1. Chyżne. Absolute numbers of sporomorphs

Tabela 1. Chyżne. Bezwzględne liczby oznaczonych sporomorf

No sample (próbki)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Depth (głębokość) m	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1,00	1,05	1,10	1,15	1,20	1,25	1,30	1,35	1,40	1,45	1,50	1,55	1,60	1,65	1,70	1,75	1,80	1,85	1,90	1,95
Σ of distinguished sporomorphs (suma oznaczonych sporomorf)	591	707	677	772	661	745	732	467	660	357	599	607	574	604	645	571	548	322	509	95	151	165	187	138	482	233	23	23
Σ of AP + NAP (suma ziarn pyłku drzew, krzewów i roślin zielnych) (AP + NAP)	404	602	564	525	494	508	551	350	508	288	485	464	441	510	501	322	131	141	79	27	33	35	30	10	19	15	8	10
Σ of AP (suma ziarn pyłku drzew i krzewów) (AP)	349	542	503	480	388	460	517	326	453	251	433	427	391	444	455	287	114	111	56	25	25	22	22	10	13	14	7	9
Σ of NAP (suma ziarn pyłku roślin zielnych) (NAP)	55	60	61	45	106	48	34	24	55	37	52	37	50	66	46	35	17	30	23	4	8	13	8	-	6	1	1	1
Σ of spores (suma zarodników)	169	91	78	111	147	194	148	91	109	47	89	108	119	67	117	218	389	158	410	65	108	102	150	122	450	205	10	8
Sphagnum	-	1	-	3	1	-	-	1	2	-	-	1	-	-	1	-	-	-	-	2	1	-	1	-	-	-	-	-
Lycopodium	-	2	-	2	1	-	-	-	-	-	1	1	1	-	-	-	-	-	2	-	3	1	1	-	1	3	-	1
Osmunda	79	19	4	16	17	30	23	9	21	6	25	31	42	35	45	20	10	6	5	1	1	2	5	1	-	1	-	-
Lygodium	6	4	-	5	2	-	3	3	1	3	1	6	2	-	2	2	3	4	-	1	-	-	1	-	1	-	-	-
Gleicheniaceae	-	4	3	-	-	-	4	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
Cyatheaceae	4	10	4	3	14	-	-	2	2	3	1	4	2	-	5	-	-	2	1	1	1	-	2	2	23	4	-	2
Polypodiaceae	80	51	67	82	112	164	118	76	82	34	60	65	72	32	63	196	376	146	402	62	103	97	140	118	420	197	10	5
Abies	3	13	1	6	-	7	2	2	2	2	4	8	5	1	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Tsuga	1	11	11	17	12	11	5	6	3	2	4	6	2	3	8	2	1	-	3	-	-	2	-	-	1	-	-	-
Picea	12	13	4	8	16	6	2	3	2	-	-	1	2	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Larix	4	1	1	1	3	2	-	1	5	1	3	3	2	2	5	4	1	-	2	1	-	-	-	-	1	-	-	-
Pinus	27	43	50	57	44	46	35	29	28	19	47	41	19	16	43	16	11	-	2	1	4	-	6	-	2	2	-	1
Sequoia	4	1	9	6	1	3	-	2	2	-	8	5	-	3	11	-	-	-	-	-	-	-	-	-	-	-	-	-
Taxodium	26	46	131	76	72	126	121	73	151	90	74	95	63	86	71	69	25	19	7	4	3	1	5	-	1	-	-	-
Glyptostrobus cf. europaeus	7	2	7	5	11	2	1	2	2	2	3	3	3	5	7	6	2	1	-	-	-	-	-	-	-	-	-	-
Cryptomeria	-	4	12	17	9	-	-	1	1	6	4	1	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Cupressus	-	3	3	-	4	1	-	1	1	1	-	2	-	-	5	-	-	1	-	-	-	-	-	-	-	-	-	-
Taxodiaceae-Cupressaceae	6	22	55	71	23	68	117	59	211	80	252	179	205	245	154	125	44	65	34	13	10	7	5	5	3	7	3	3
Betula	3	1	2	2	5	3	3	2	4	1	5	1	1	3	2	1	-	3	1	-	-	2	-	-	1	-	-	-
Alnus	113	248	94	122	44	99	147	86	17	16	21	23	57	53	70	14	6	2	2	-	1	-	1	-	-	1	1	1
Carpinus	13	2	1	3	4	-	3	-	1	-	-	4	-	1	2	-	-	1	-	-	-	-	-	-	-	1	-	-
Corylus cf. avellana	-	-	1	1	1	1	4	1	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-
Castanea	-	1	-	-	1	-	1	-	-	-	-	1	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Fagus	-	3	8	7	5	7	4	2	3	3	10	13	9	1	9	1	1	-	-	-	-	-	-	-	1	-	-	-
Quercus	-	-	8	6	9	6	2	2	2	3	6	8	4	8	10	1	3	-	-	-	1	-	-	-	-	-	-	1
Juglans	6	2	-	-	1	-	1	-	-	-	-	-	-	-	3	3	-	-	1	-	-	-	1	-	-	-	-	-
Carya	14	17	8	8	23	7	1	3	6	3	7	5	3	1	1	-	2	-	-	2	1	-	1	-	-	-	-	-
Pterocarya	2	4	1	1	6	3	1	3	2	2	4	-	-	-	2	6	5	4	1	-	1	1	-	-	-	-	-	-
Engelhardtia	3	1	-	-	-	-	2	1	-	-	-	-	-	-	4	-	-	2	-	-	-	-	1	-	1	-	-	1
Salix	6	5	19	12	5	10	29	15	3	1	3	1	8	1	2	28	8	3	1	-	1	1	-	1	1	2	1	-
Ulmus	23	21	24	22	14	26	22	12	3	6	6	6	4	6	12	5	3	6	1	1	-	2	1	2	-	-	-	-
Celtis	12	10	6	3	20	5	2	5	1	3	-	1	-	-	4	1	1	-	-	-	-	-	-	-	-	-	-	-
Leguminosae	-	2	4	2	1	-	4	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Decodon cf. globosus	7	1	3	-	1	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lythrum	1	2	-	1	-	1	-	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	1
Nyssa	2	10	5	6	-	1	-	-	-	-	-	-	1	-	6	-	-	-	-	-	-	1	1	-	-	-	-	-
Rhus	8	5	1	1	1	-	-	1	-	2	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Acer	1	-	-	1	3	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyrillaceae	-	1	1	1	1	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornus	5	7	2	1	2	6	-	1	-	1	-	2	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Araliaceae	2	2	1	5	2	5	-	2	-	1	2	4	-	1	-	1	-	1	1	-	-	-	-	1	-	-	1	-
Umbelliferae	-	1	2	-	3	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-
Symplocos	2	-	-	2	1	-	-	-	-	-	1	-	-	-	2	1	-	-	-	-	-	-	1	-	-	-	1	-
Labiatae	-	3	5	1	-	2	1	1	-	-	1	4	1	1	-	-	1	1	1	-	-	1	-	-	-	-	-	1
Fraxinus	-	8	13	5	3	4	-	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton	-	2	1	-	-	-	-	1	3	-	-	-	2	1	2	2	1	3	-	-	-	-	-	-	-	-	-	-
Liliaceae (cf. Tulipa)	5	1	1	1	3	-	1	-	-	4	2	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Cyperaceae	17	43	35	23	59	35	26	18	43	25	34	25	40	58	32	22	12	14	20	1	7	6	8	-	3	-	1	2
Gramineae	19	7	12	13	27	11	4	4	9	7	12	5	5	6	10	9	1	8	1	3	-	5	-	-	2	-	-	-
Palmae (cf. Corypha)	10	8	6	5	13	1	-	1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Sparganium	7	2	1	4	8	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Varia	18	14	35	36	20	43	33	26	43	22	25	35	14	27	27	31	28	23	20	3	10	28	7	6	13	13	5	5

Table 1 a. Chyżne. Sporomorphs found sporadically (in less than 6 samples)
Tabela 1 a. Sporomorfy sporadyczne (znalezione w mniej niż 6 próbach)

Selaginellaceae	10 (1), 15 (1), 23 (1).	Rosaceae	1 (1), 2 (3), 7 (1), 14 (1), 15 (1).
Podocarpus	1 (2), 10 (1), 11 (1).	Cf. Eucalyptus	2 (2), 5 (1), 11 (1), 16 (1).
Cedrus	2 (1), 6 (1), 12 (3).	Tilia	5 (4), 7 (1), 11 (1). 22 (1).
Gnetaceae	3 (1), 11 (1).	Ptelea	1 (1), 4 (1).
Ostrya	1 (4), 5 (2), 6 (1), 12 (1).	Pistacia	2 (1), 10 (1), 14 (1).
Castanopsis	4 (1), 10 (1), 15 (1), 18 (1).	Ilex	1 (4), 2 (1), 10 (1), 12 (1), 22 (1).
Myrica	1 (2), 2 (1), 7 (1), 12 (1).	Staphylea	1 (1), 5 (2).
Eucommia cf. ulmoides	1 (3), 5 (1).	Ericaceae	11 (1), 12 (1).
Loranthaceae	1 (1), 2 (1), 3 (1).	Sapotaceae	4 (1), 8 (1), 10 (1), 12 (1), 15 (1), 22 (1).
Polygonaceae	1 (1), 2 (4), 4 (1).	Solanaceae	3 (1).
Chenopodiaceae	7 (1).	Markhamia	1 (1), 3 (3), 12 (1).
Caryophyllaceae	11 (1), 12 (1), 17 (1).	Plantago	5 (1).
Liquidambar	1 (1), 5 (2), 14 (2).	Apocynaceae	5 (2).
Corylopsis	3 (2), 25 (1).	Caprifoliaceae	4 (1), 5 (2), 11 (1), 18 (1).
Magnoliaceae	2 (1), 3 (1), 6 (1).	Compositae	6 (1), 7 (1), 11 (1), 12 (1), 13 (1), 18 (2).
Lauraceae	7 (1), 12 (1).	Butomus	1 (2), 3 (2), 6 (1), 13 (1), 18 (2).
Ranunculaceae	4 (1), 28 (1).	Typha angustifolia	4 (1).
Nymphaeaceae	1 (4), 5 (3), 12 (1).		

Table 2. Lipnica Mała. Absolute numbers of sporomorphs
Tabela 2. Lipnica Mała. Bezwzględne liczby oznaczonych sporomorf

No sample (próbki)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Depth (głębokość) m	4,00	4,05	4,10	4,15	4,20	4,25	4,30	4,35	4,40	4,45	4,50	4,55	4,60	4,65	4,70	4,75	4,80	4,85	4,90	4,95	5,00
Σ of distinguished sporomorphs (suma oznaczonych sporomorf)	119	17	91	156	70	111	130	131	224	408	552	553	629	587	542	586	523	560	385	395	283
Σ of AP + NAP (suma ziarn pyłku drzew, krzewów i roślin zielnych) (AP + NAP)	19	3	14	20	15	17	28	28	59	131	237	311	470	474	459	486	443	492	326	344	242
Σ of AP (suma ziarn pyłku drzew i krzewów)(AP)	18	3	13	16	13	17	24	26	58	125	230	302	453	457	452	478	431	481	320	335	234
Σ of NAP (suma ziarn pyłku roślin zielnych)(NAP)	1	-	1	4	2	-	4	2	1	6	7	9	17	17	7	8	12	11	6	9	8
Σ of spores (suma zarodników)	99	14	76	135	54	92	98	101	161	269	306	225	153	100	76	88	72	56	53	41	38
Sphagnum	-	-	1	-	1	-	2	-	1	1	3	2	2	-	1	1	1	-	-	-	-
Lycopodium	-	-	2	-	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-	1	-
Osmunda	4	-	2	2	1	-	2	6	5	5	18	23	14	27	13	23	13	29	28	18	17
Lygodium	-	-	2	-	-	-	1	-	2	6	6	-	1	1	2	-	1	-	1	-	-
Cyatheaceae	-	-	-	1	-	2	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-
Polypodiaceae	94	14	68	132	51	90	93	94	153	257	275	197	133	81	60	64	56	27	25	22	20
Abies	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	1	-	2	-	2	1
Tsuga	-	-	-	-	-	-	-	-	-	2	1	3	8	5	4	3	9	6	3	1	5
Picea	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	2	3	2	1
Larix	-	-	-	-	-	-	-	-	1	-	5	3	8	11	2	3	5	3	3	1	3
Pinus	3	-	2	2	3	-	1	4	9	16	35	53	100	107	50	111	87	106	89	50	74
Taxodium	3	2	3	2	2	4	4	5	11	21	57	72	73	84	121	84	87	99	82	82	62
Glyptostrobus cf. europaeus	1	-	-	2	-	1	-	-	-	1	1	2	5	1	7	4	4	19	8	6	4
Cupressus sp.	-	-	-	-	-	-	-	-	1	4	5	8	2	4	3	7	2	3	2	1	-
Taxodiaceae-Cupressaceae	10	1	7	10	6	9	9	12	22	50	71	100	172	195	165	162	134	172	97	142	65
Betula	-	-	-	-	-	-	-	1	-	-	2	1	3	7	3	7	4	6	2	2	2
Alnus	-	-	-	-	-	1	9	3	9	8	26	25	17	16	23	11	21	9	4	9	1
Corylus cf. avellana	-	-	-	-	-	-	-	-	-	-	2	-	3	1	1	-	1	2	-	-	2
Castanopsis	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Fagus	-	-	-	-	-	-	-	-	-	-	1	-	7	-	8	2	11	1	-	-	-
Quercus	-	-	-	-	-	-	-	-	1	1	5	2	15	8	16	-	22	3	3	2	3
Juglans	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2	-	-	-	-
Carya	-	-	-	-	-	-	-	-	-	-	-	1	3	-	3	3	3	7	3	5	2
Pterocarya	1	-	-	-	-	-	-	1	1	2	6	8	9	-	5	14	7	11	6	3	1
Engelhardtia	-	-	-	-	-	1	-	-	1	2	7	5	6	2	1	4	3	5	-	1	-
Salix	-	-	-	-	-	-	-	-	-	2	1	1	4	1	4	1	-	4	1	1	-
Ulmus	-	-	-	-	-	-	1	-	-	-	2	3	2	1	12	11	6	7	6	12	4
Celtis	-	-	-	-	-	-	-	-	-	2	-	1	5	-	10	6	4	3	6	4	3
Nyssa	-	-	-	-	1	-	-	-	-	-	-	4	5	1	8	15	6	1	1	1	-
Tilia	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-
Araliaceae	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	1	-	-	-
Symplocos	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-
Labiatae	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Fraxinus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Caprifoliaceae	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	1	-	1	-
Butomus	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-	-	-	-
Cyperaceae	1	-	-	3	2	-	2	2	1	1	1	3	8	3	-	5	4	5	2	8	1
Gramineae	-	-	-	-	-	-	-	-	-	3	-	-	3	2	4	2	3	2	-	1	1
Palmae (cf. Corypha)	-	-	1	-	1	-	-	-	-	1	1	3	1	-	-	2	1	1	-	1	-
Sparganium sp.	-	-	-	-	-	-	-	-	-	-	-	3	4	1	3	-	1	4	2	-	3
Varia	1	-	1	1	1	2	4	2	4	8	9	17	6	13	7	12	8	12	6	10	3

No sample (próbki)	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Depth (głębokość) m	5,05	5,10	5,15	5,20	5,25	5,30	5,35	5,40	5,45	5,50	5,55	5,60	5,65	5,70	5,75	5,80	5,85	5,90	5,95	6,00	6,05
Σ of distinguished sporomorphs (suma oznaczonych sporomorf)	609	582	555	342	335	296	561	353	520	572	564	492	279	173	441	274	551	515	615	396	507
Σ of AP + NAP (suma ziarn pyłku drzew, krzewów i roślin zielnych) (AP + NAP)	536	551	509	317	305	284	469	292	449	506	479	465	241	142	404	256	508	447	481	345	457
Σ of AP (suma ziarn pyłku drzew i krzewów)(AP)	529	545	500	314	303	274	469	283	440	499	477	450	234	132	395	250	493	436	467	336	437
Σ of NAP (suma ziarn pyłku roślin zielnych)(NAP)	7	6	9	3	2	10	1	9	9	7	2	15	7	10	9	6	15	11	14	9	20
Σ of spores (suma zarodników)	66	26	31	23	20	8	79	54	67	58	72	19	31	28	25	11	30	58	116	47	41
Sphagnum	12	-	-	-	1	-	1	-	-	1	-	1	1	3	1	-	1	1	1	2	1
Lycopodium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Osmunda	13	12	11	17	1	3	57	41	53	34	31	2	3	6	-	1	2	13	27	5	2
Lygodium	2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
Cyatheaceae	-	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	-	-	-	1	1
Polypodiaceae	39	14	19	5	18	5	20	13	13	23	40	15	26	18	24	10	27	44	88	36	36
Abies	-	-	1	1	1	1	-	-	4	-	1	-	-	-	1	-	1	-	-	-	1
Tsuga	3	4	4	2	3	2	12	4	1	13	2	4	3	2	1	1	-	6	3	6	1
Picea	2	3	2	-	1	1	3	1	3	5	5	1	-	-	2	-	-	3	2	-	-
Larix	3	9	2	4	4	2	7	5	2	5	-	4	1	5	1	4	3	5	3	6	6
Pinus	65	113	62	57	58	36	56	36	51	89	65	60	29	16	50	22	24	57	70	54	23
Taxodium	111	143	148	107	51	80	125	102	133	133	122	159	86	37	130	88	188	126	142	93	151
Glyptostrobus cf. europaeus	2	4	9	5	3	1	4	4	9	8	3	8	4	2	4	6	4	1	2	5	2
Cupressus sp.	2	-	-	-	2	-	2	1	1	1	-	2	-	3	3	1	2	3	5	1	-
Taxodiaceae-Cupressaceae	267	205	229	111	154	113	194	111	218	175	236	181	97	55	186	116	252	212	204	136	231
Betula	7	2	2	4	3	1	3	3	1	6	5	-	-	1	1	1	1	-	2	2	5
Alnus	9	8	4	7	11	10	36	3	5	17	21	3	1	1	5	-	3	3	3	1	1
Corylus cf. avellana	-	-	-	-	-	-	2	-	2	1	1	-	1	-	-	-	1	1	-	-	-
Castanopsis	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	2	2	1	2
Fagus	-	4	1	-	-	1	-	1	-	3	-	-	-	-	-	-	-	1	-	4	-
Quercus	7	8	7	-	2	2	6	1	-	6	2	1	-	-	1	-	-	-	4	1	-
Juglans	-	1	-	-	1	-	-	1	-	2	-	-	-	-	-	-	-	1	-	2	1
Carya	8	6	4	2	3	2	3	-	2	6	-	4	1	-	-	4	1	1	-	2	2
Pterocarya	6	5	5	-	2	-	4	1	2	2	2	4	1	2	2	1	1	-	5	6	2
Engelhardtia	2	-	-	3	1	3	2	-	1	-	1	3	2	4	-	-	-	4	6	5	2
Salix	2	-	5	2	-	-	-	1	-	-	-	1	2	1	-	1	2	-	-	-	-
Ulmus	5	13	4	4	-	4	5	1	2	14	2	3	1	1	2	3	2	2	4	3	1
Celtis	14	4	1	2	-	8	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Nyssa	6	-	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	3	-	-
Tilia	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	-	-	1	1	1
Araliaceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Symplocos	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3
Labiatae	1	-	-	1	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	2
Fraxinus	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2	-	2	-
Caprifoliaceae	3	-	5	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-
Butomus	-	-	-	-	-	-	-	1	-	2	-	1	1	-	-	-	-	-	-	1	-
Cyperaceae	5	2	6	2	2	3	1	5	8	2	2	9	6	5	6	4	9	10	7	5	14
Gramineae	-	-	-	2	-	6	-	1	-	1	-	3	1	4	2	1	5	1	8	3	4
Palmae (cf. Corypha)	-	-	-	1	2	-	-	-	2	2	-	3	-	-	3	-	2	-	2	2	-
Sparganium sp.	-	3	1	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Varia	7	6	15	2	10	4	12	7	4	8	13	8	7	3	12	7	9	10	18	4	9

No sample (próbki)	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Depth (głębokość) m	6,10	6,15	6,20	6,25	6,30	6,35	6,40	6,45	6,50	6,55	6,60	6,65	6,70	6,75	6,80	6,85	6,90	6,95	7,00	7,05	7,10
Σ of distinguished sporomorphs (suma oznaczonych sporomorf)	250	527	577	549	572	231	399	273	224	283	107	174	113	224	189	201	184	225	220	268	147
Σ of AP + NAP (suma ziarn pyłku drzew, krzewów i roślin zielnych) (AP + NAP)	221	461	535	272	276	208	366	223	208	211	74	125	61	169	150	154	116	184	123	205	110
Σ of AP (suma ziarn pyłku drzew i krzewów)(AP)	217	442	515	260	272	196	352	199	200	197	74	108	60	157	145	134	108	157	121	175	88
Σ of NAP (suma ziarn pyłku roślin zielnych)(NAP)	4	19	20	12	4	12	14	24	8	14	-	17	1	12	5	20	8	27	2	30	22
Σ of spores (suma zarodników)	26	54	33	266	287	20	28	39	35	65	30	41	50	46	38	55	61	35	92	51	26
Sphagnum	2	-	3	3	-	-	-	3	-	-	-	-	-	1	1	-	5	-	-	-	2
Lycopodium	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-
Osmunda	7	3	5	3	3	2	9	6	5	8	-	6	3	5	2	4	1	2	3	1	-
Lygodium	-	1	-	1	2	-	-	-	-	2	-	-	1	2	1	-	-	3	-	3	-
Cyatheaceae	1	-	-	-	2	-	-	-	1	3	1	1	5	-	1	2	3	2	3	2	-
Polypodiaceae	16	50	25	259	279	18	19	30	29	52	28	33	41	38	33	48	52	28	84	43	25
Abies	1	-	-	1	1	1	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Tsuga	1	-	2	1	2	-	2	2	2	2	-	-	-	1	2	1	3	4	-	4	-
Picea	-	1	-	2	1	1	1	-	2	-	-	1	-	-	-	-	-	1	1	1	-
Larix	3	3	5	3	5	1	4	4	4	2	1	-	2	3	5	1	2	1	3	6	2
Pinus	33	15	41	19	57	16	36	17	26	26	11	11	9	22	12	17	23	38	27	25	21
Taxodium	60	183	169	108	84	98	138	92	53	88	17	41	14	65	35	56	22	43	26	50	23
Glyptostrobus cf. europaeus	3	8	9	5	1	7	9	6	5	4	-	4	-	2	3	2	-	2	1	1	-
Cupressus sp.	-	5	4	2	1	4	-	-	1	-	-	-	1	-	2	-	1	-	1	-	-
Taxodiaceae-Cupressaceae	100	194	247	101	87	52	145	49	98	52	36	25	28	38	70	28	30	29	46	39	2
Betula	1	1	2	1	5	1	1	1	2	1	-	1	-	1	-	1	-	2	2	-	-
Alnus	-	3	1	3	1	1	-	2	-	1	2	1	1	2	-	1	-	2	4	8	3
Corylus cf. avellana	-	-	1	-	1	-	-	-	-	1	-	2	-	-	-	-	-	-	-	1	-
Castanopsis	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	3	1	-	1
Fagus	-	-	-	-	-	1	-	-	-	-	-	1	-	1	1	1	1	-	-	2	-
Quercus	-	2	-	2	3	1	3	4	1	-	-	2	-	2	1	4	2	1	1	5	5
Juglans	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
Carya	1	1	2	1	6	2	-	3	-	1	-	2	1	1	2	-	1	-	1	-	2
Pterocarya	2	6	5	-	1	1	1	-	1	1	1	2	-	1	2	2	3	2	1	-	1
Engelhardtia	-	5	6	4	-	2	1	1	2	1	-	4	-	6	3	3	-	2	-	2	5
Salix	-	1	1	1	3	-	-	-	1	1	-	2	2	-	-	-	3	-	-	-	-
Ulmus	1	3	1	3	5	3	2	3	-	3	-	-	-	1	3	4	2	7	3	1	4
Celtis	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Nyssa	-	-	-	-	5	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Tilia	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1	1	-	2
Araliaceae	-	-	1	-	-	-	1	1	-	1	1	-	-	1	-	-	-	3	-	6	5
Symplocos	4	-	-	-	-	-	-	-	-	1	3	-	-	1	-	3	3	3	1	-	3
Labiatae	-	-	-	3	-	-	-	-	1	3	-	1	-	1	-	2	-	1	-	1	-
Fraxinus	2	-	5	-	-	-	1	1	-	-	1	-	-	-	-	1	-	-	-	1	-
Caprifoliaceae	-	2	2	-	-	-	2	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Butomus	-	-	-	2	-	-	-	2	-	1	-	-	-	2	-	2	-	-	-	-	-
Cyperaceae	4	15	15	10	5	6	12	18	5	6	-	11	1	5	4	7	5	13	2	17	12
Gramineae	-	4	3	1	-	3	2	3	1	2	-	4	-	3	-	4	-	8	1	5	2
Palmae (cf. Corypha)	-	2	3	-	-	-	1	-	-	-	-	1	-	2	-	-	-	1	-	-	2
Sparganium sp.	1	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-	-	-	1	-
Varia	3	12	9	11	9	3	5	11	1	7	2	7	2	8	1	2	7	5	5	12	11

Table 2 a. Lipnica Mała. Sporomorphs found sporadically (in less than 12 samples)
Tabela 2 a. Lipnica Mała. Sporomorfy sporadyczne (znalezione w mniej niż 12 próbach)

Selaginellaceae	23 (1), 30 (1), 54 (1), 63 (1).	Leguminosae	14 (1), 23 (1).
Gleicheniaceae	11 (2), 12 (3), 21 (1).	Decodon cf. globosus	20 (1), 28 (1), 34 (2), 45 (1), 49 (1), 50 (3).
Hymenophyllaceae	62 (1).	Lythrum	50 (2), 52 (1), 54 (4), 55 (1), 56 (2), 57 (2), 58 (1), 59 (3), 60 (4), 62 (4), 63 (2).
Podocarpus	14 (1), 24 (1), 25 (1), 28 (1), 29 (1), 32 (1), 41 (2), 43 (1), 45 (1), 47 (1).	Myrtaceae	50 (1), 62 (1).
Cedrus	32 (1).	Myriophyllum	16 (1).
Sequoia	50 (1), 54 (1), 60 (1).	Ptelea	33 (1), 44 (1), 45 (1), 51 (1), 59 (1), 62 (1).
Cryptomeria	18 (1), 23 (1), 44 (1), 52 (1), 55 (1), 59 (1), 62 (1).	Pistacia	13 (1), 15 (2), 27 (2), 29 (3), 31 (8).
Ostrya	24 (2), 44 (1).	Rhus	17 (1), 22 (1), 24 (1), 40 (2), 50 (1), 61 (1).
Carpinus	31 (1), 34 (1), 38 (2), 40 (1), 42 (1), 44 (2), 54 (1), 58 (1), 60 (3), 62 (1).	Acer	12 (1), 15 (1), 18 (1), 20 (1), 22 (3), 39 (1), 42 (1), 43 (1).
Castanea	27 (1), 36 (1), 41 (1), 58 (1), 59 (1).	Staphyllea	18 (1), 20 (1), 52 (1), 62 (1).
Myrica	12 (1), 16 (1), 22 (1).	Ilex	52 (1), 63 (1).
Platycarya	50 (1).	Cyrilla	62 (1).
Eucommia cf. ulmoides	15 (2), 17 (1), 53 (1).	Cornus	36 (1), 43 (1), 45 (1), 52 (1), 60 (1).
Chenopodiaceae	7 (1).	Umbelliferae	52 (1).
Caryophyllaceae	11 (1), 17 (1), 59 (1), 60 (1), 62 (2).	Ericaceae	32 (1).
Liquidambar	12 (1), 13 (2), 15 (2), 17 (2), 20 (1), 28 (1), 32 (4), 40 (1), 48 (1).	Markhamia	45 (1), 46 (1), 48 (1), 49 (1).
		Plantago	48 (2).
Corylopsis	19 (1), 21 (1), 29 (1), 33 (1), 43 (1), 62 (1).	Compositae	4 (1), 56 (1).
Lauraceae	27 (1).	Potamogeton	7 (1), 11 (1), 21 (3), 22 (1), 27 (1), 36 (1), 45 (1), 51 (1), 56 (1).
Nuphar	38 (1).		
Nymphaeaceae	12 (1).	Tulipa	37 (1), 45 (1), 47 (2), 58 (2), 59 (1).
Rosaceae	23 (1), 31 (1).		

Table 3. Lipnica Wielka. Absolute numbers of sporomorphs
Tabela 3. Bezwzględne liczby oznaczonych sporomorf

No sample (próbki)	1	2	3	4	5	6	7
Depth (głębokość) m	0,80	0,90	1,00	1,10	1,20	1,30	1,40
Σ of distinguished sporomorphs (suma oznaczonych sporomorf)	80	74	250	566	346	582	580
Σ of AP + NAP (suma ziarn pyłku drzew, krzewów i roślin zielnych) (AP + NAP)	16	6	116	405	218	446	446
Σ of AP (suma ziarn pyłku drzew i krzewów) (AP)	14	5	115	397	206	427	434
Σ of NAP (suma ziarn pyłku roślin zielnych) (NAP)	2	1	1	8	12	19	12
Σ of spores (suma zarodników)	62	68	133	155	123	131	127
Sphagnum	1	-	2	3	1	-	-
Lycopodium	-	-	2	-	-	1	-
Osmunda	2	7	6	23	11	10	12
Hymenophyllaceae	-	-	1	1	-	-	-
Cyatheaceae	1	1	-	-	-	-	-
Polypodiaceae	58	60	122	125	111	120	115
Tsuga	-	-	2	5	1	6	6
Larix	-	-	2	9	3	1	8
Pinus	2	-	22	52	11	47	40
Taxodium	5	1	12	67	31	91	100
Glyptostrobus cf. europaeus	-	-	1	6	-	2	3
Cupressus	-	-	2	10	3	8	3
Taxodiaceae-Cupressaceae	5	4	61	200	140	225	227
Betula	1	-	2	2	-	-	2
Alnus	-	-	2	9	3	1	8
Fagus	-	-	1	-	-	1	2
Quercus	1	-	-	-	3	1	5
Juglans	-	-	-	1	-	1	-
Carya	-	-	2	5	2	1	6
Pterocarya	-	-	1	9	3	7	4
Engelhardtia	-	-	3	1	1	1	2
Ulmus	-	-	1	12	2	8	3
Celtis	-	-	-	4	-	4	5
Nyssa	-	-	1	2	-	3	-
Tilia	-	-	-	-	1	1	1
Araliaceae	-	-	-	-	-	1	1
Oleaceae	-	-	-	1	1	-	1
Butomus	-	-	-	1	-	1	-
Cyperaceae	-	-	1	5	2	6	9
Gramineae	-	-	-	-	-	2	2
Sparganium	1	-	-	2	-	2	-
Varia	2	-	1	6	5	5	7

Sporomorphs found sporadically (sporomorfy sporadyczne)

Selaginellaceae	1 (1).	Corylus cf. avellana	7 (1).
Lygodium	4 (3).	Castanopsis	6 (1).
Ginkgo cf. biloba	4 (1).	Platycarya	7 (1).
Abies	6 (1).	Salix	5 (1).
Picea	4 (1).	Staphyllea	7 (1).
Sequoia	6 (1).	Potamogeton	6 (1).
Cryptomeria	3 (1).	Corypha	6 (5).
Carpinus	6 (1).		