A C T A P A L A E O N T O L O G I C A P O L O N I C A

Vol. XIX 1974 No. 3

MARIA ZIEMBIŃSKA—TWORZYDŁO

PALYNOLOGICAL CHARACTERISTICS OF THE NEOGENE OF WESTERN POLAND

Abstract. — Palynological analysis of deposits ranging from the Middle Oligocene through the Upper Miocene from borings in the Great Poland Lowlands is presented. Mai's climatic-floristic phases on the territory under study have been characterized on the basis of the results of palynological analyses. A permanent tendency has been found to eliminate succesive warmlike components of flora in younger warm phases of the Neogene.

Descriptions of 174 species of sporomorph are given. A new genus, *Iteapollis* a new species *Microfoveolatisporis minutus* and several new combinations have been erected by the present writer.

INTRODUCTION

The present paper is based on the materials coming from the Geological Institute's borings on the territory of the Great Poland Lowland (Text-fig. 1). The deposits from the Middle Oligocene through the Upper Miocene (Text-fig. 2) have been included in the studies.

The coal-bearing Tertiary deposits in the Great Poland Lowland are tripartite. The lowermost, Middle Oligocene deposits of brown coal or coaly clays are situated among glauconitic sands. Their thickness varies in different profiles from a few centimeters to five meters. The best developed and the thickest (30 to 40 m) is the middle part of the coal-bearing series, formed in the Lower and Middle Miocene. It is composed of a few to a dozen or so layers of lignite, with intercalations of barren sandy and clayey deposits varying in thickness. The uppermost, Upper Miocene complex of coal-bearing formation is separated from the preceding one by an assemblage of 20 to 40 m thick sandy deposits and directly overlaid by clayey-muddy deposits of Poznań Beds (Ciuk, 1970).

The southern profiles (Oczkowice, Nowa Wieś) resemble the lithological conditions observed in the Tertiary of the Sudeten Foreland and the region of Ściniawa (Ziembińska & Niklewski, 1966).

In the boreholes: Ustronie, Oczkowice, Nowa Wieś, Gierlachowo, Gołębin Stary, Krosinko, Mosina and Ślepuchowo, samples were taken from the entire profile at intervals of 0.5 to 1.0 m, while five others: Pecno, Bieczyny, Krosno, Borowo and Tarnówka, were sampled at random to supplement the studies. Pollen spectra were obtained from about 500 samples. Deposit samples were first subjected to flotation to separate organic parts and then, the same as samples of coaly deposits, prepared for a palynological analysis according to the method of Thiergart (1940) and Erdtman (1949), modified after Faegri & Iversen (1964). These methods are, generally, used for the maceration of the Tertiary deposits.

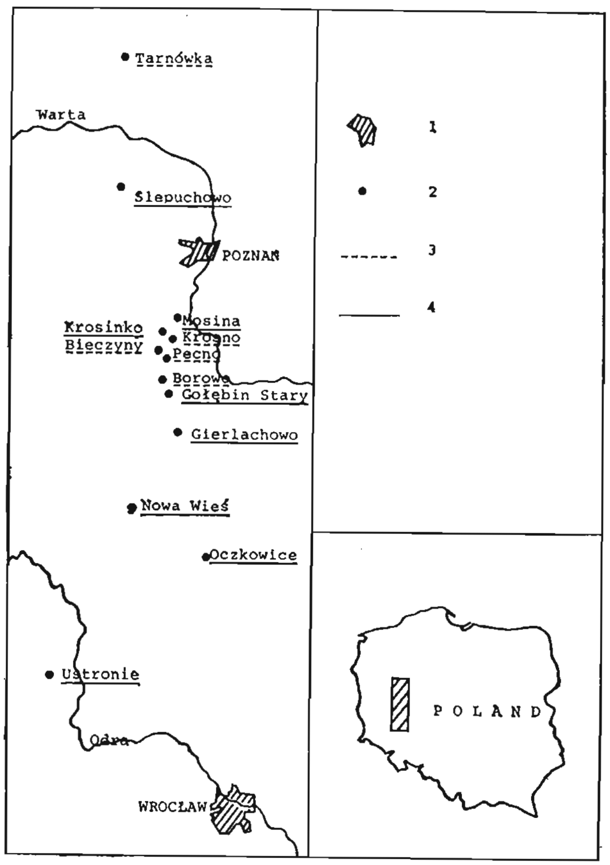


Fig. 1 — Distribution of the borings, sampled for palynological analyses. 1 towns, 2 localities, 3 samples random, 4 samples from the entire profile.

The present paper is based on the calculation of a percentage of particular types of sporomorphs in each sample, the basis adopted being about 500 pollen grains. The Gierlachowo and Ustronie profiles are presented in outline diagrams, the rest of them in abbreviated diagrams. The following intervals have been adopted: very rare forms — less than 0.2 per cent; rare

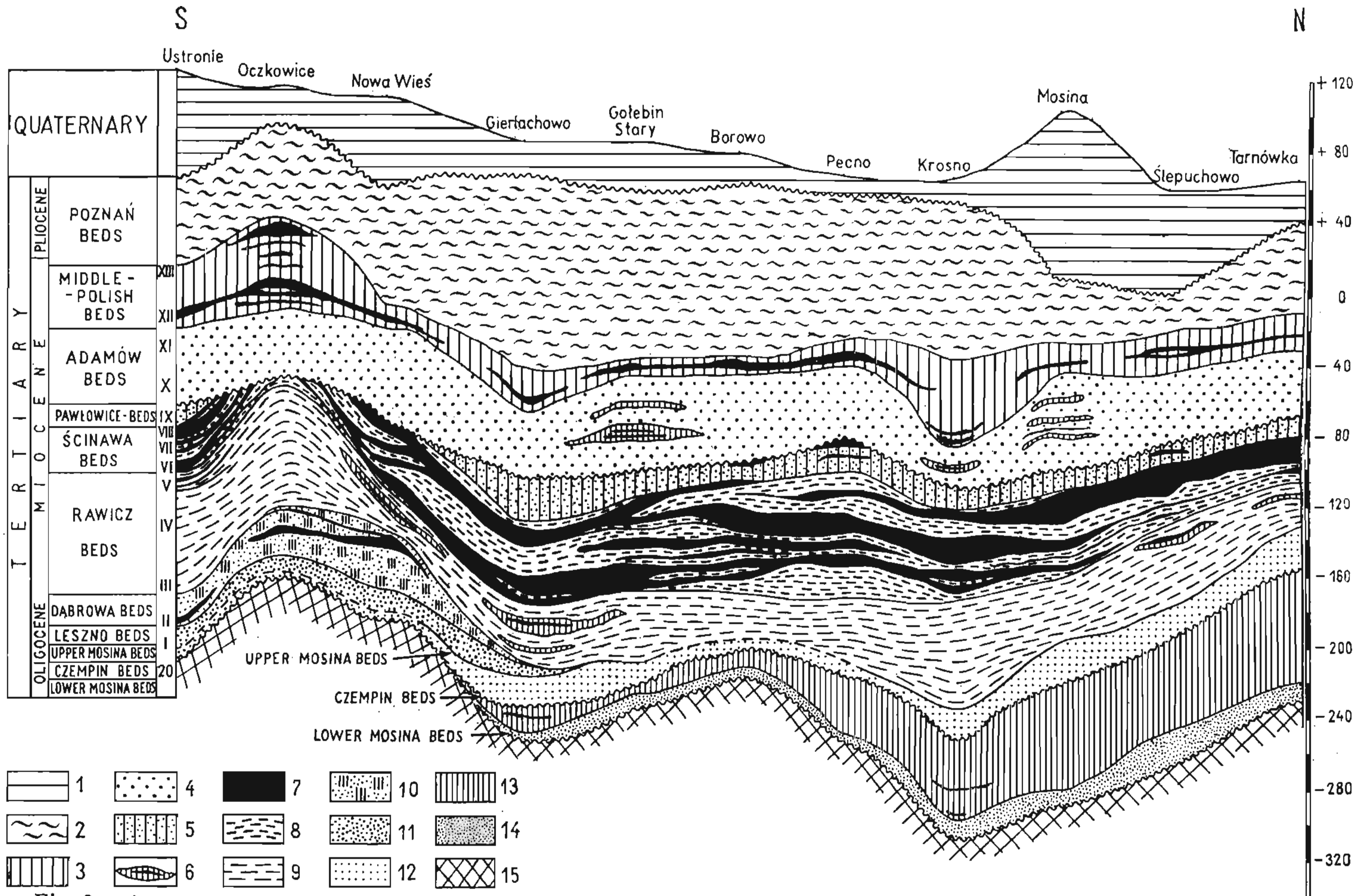


Fig. 2 — **A schematic geological cross section of the Tertiary deposits in the middle part of the Great Poland Lowland.** *1* Quaternary deposits, *2* gray clays (Poznań Beds), *3* gray-green clays (Middle Polish Beds), *4* sands and silts (Adamów Beds), *5* silts and dusty sands with muscovite (Pawłowice Beds), *6* coaly silt with brown coal intercalations, *7* brown coal, *8* clays and sands (Ścinawa beds), *9* coaly clays and clays (Rawicz Beds), *10* silts (Dąbrowa Beds), *11* quarz-sands (Leszno Beds), *12* quarz-sands with glauconite (Upper Mosina Beds), *13* silts (Czempin Beds), *14* quarz-glauconite sands (Lower Mosina Beds), *15* underground.

forms — 0.2 to 1.0 per cent; regularly occurring — 1.0 to 5.0 per cent; frequent — 5.1 to 20 per cent; abundant — more than 20 per cent. An artificial taxonomu of sporomorphs, based on priority names, has been adopted in the present paper.

The collection of the materials described is housed at the Palaeontological Laboratory of the Institute of Geology, Warsaw University.

The present writer feels indebted to Professor Edward Ciuk from the Geological Institute in Warsaw for making available the materials here described. She is also grateful to Professor Jadwiga Bobrowska from the Geological Institute and Professor Mikołaj Kostyniuk from the Warsaw University for their critical evaluation of the manuscript. Thanks are also due to Docent Wilfried Krutzsch from the Central Geological Institute in Berlin, German Democratic Republic, for his advice, as well as to Dr. Marcin Piwocki and Mrs. Irena Grabowska, B.S., from the Geological Institute in Warsaw, for their friendly aid.

THE HISTORY OF STUDIES AND THE METHODOLOGICAL REMARKS

On the territory of Poland, the first stratigraphic scheme of the Neogene continental deposits was presented by Raniecka-Bobrowska (1970), who based it on so far conducted palynological analyses of the younger Tertiary and on a consecutive abundant occurrence of sporomorphs, much the same as it has been done by Brelie (Berlie, 1969) in the case of the area of Rhineland.

The present writer seeks to apply, to the territory of Poland, another method of determining the age of the Tertiary continental deposits, that is, that based on cyclic changes in climate. This method was suggested for the territory of Lusatia by a team of German paleobotanists, Mai (1967), Krutzsch & Majewski (1967). According to Krutzsch (1959 c), cyclical changes in climate, reflected in, among other things, changes in vegetation, should be adopted as a main basis for the stratigraphy of the Tertiary.

The finding that a slow cooling-down of the climate occurred in the Oligocene, Miocene and Pliocene and was a preparation to the Pleistocene glaciation is accepted in most paleobotanical papers and textbooks. Some investigators (v. d. Hammen, 1957; Krutzsch, 1959 c; Szafer, 1961) believed however, that these changes did not occur steadily. It has been shown by Mai's papers, based on an analysis of aboundant carpological remains from the Neogene deposits collected in numerous outcrops in Lusatia, that it was possible to observe several climatic phases in the Neogene. These phases were reflected in the vegetation in an alternate occurrence of the paleotropical and the Arctic-Tertiary element, with a clear trend to diminishing the paleotropical element in warmer phases of the Upper Miocene and

Pliocene (Mai, Majewski & Unger, 1963; Mai, 1965, 1967). On the basis of this finding, thirteen climatic phases were distinguished by Mai (1967) in the period between the Upper Oligocene and the Upper Miocene. The periodicity of floristic changes is also confirmed by the results of palynological studies on the deposits from the same Lusatian outcrops, conducted simultaneously with the carpological studies (Krutzsch's oral communication, 1969). In Central and Northern Poland, the Tertiary deposits are known primarily from borings and, therefore, in Poland we have not such extensive possibilities of applying a carpological analysis as those in the German Democratic Republic. Under Polish conditions, the palynological analysis is thus a fundamental paleobotanical method of establishing the stratigraphy of both continental and brackish Tertiary deposits devoid of fauna.

According to Krutzsch & Majewski (1967), plant species and genera, which represent climatic indices, are on the whole entomophilous and the picture of the share of their pollen grains in samples is distorted by the abundantly concurring pollen of the anemophilous plants whose presence primarily depends on facial conditions. Percentage diagrams, which illustrate the occurrence of pollen of particular types do not, therefore, offer a clear picture of climatic changes. Thus, they should be modified so that the presence of pollen of the entomophilous plants might not be obliterated by the abundantly occurring pollen of the anemophilous ones. For this purpose, Krutzsch & Majewski (1967) suggest the use of an analytical method which consists in estimating the number of pollen grains of forms which occur abundantly or very frequently in exposing in the profiles the part of pollen grains of the entomophilous plants, occurring rarely or very rarely.

PALYNOLOGICAL CHARACTERISTICS AND PALEOCLIMATIC INTERPRETATION

The Middle Oligocene

The first Polish palynological descriptions of the Middle Oligocene deposits, dated faunally (Wolańska, 1962; Woźny, 1962) come from Great Poland (Grabowska, 1965). Typically Middle Oligocene spectra from the territories situated to the east (Stuchlik, 1964) were interpreted as Upper Oligocene ones. Deposits with a very similar composition of sporomorphs are known from the territory of the German Democratic Republic, where they are called Lusatian Bed 5 (Krutzsch, 1961). Their characteristic palynological picture, known as "Calau-Bild," corresponds to zone 20 in the stratigraphic divisions of the Paleogene (Krutzsch, 1967).

Here described borings of Gierlachowo, Gołębin Stary, Krosinko, Mosina, Ślepuchowo and Tarnówka contain, in the lower parts of their profiles, the deposits of mudstones, siltstones and dark, dusty sands with a considerable admixture of muscovite and single, small intercalations of lignite. According to Ciuk's (1967, 1970) lithostratigraphic division, these are Czempin Beds, known from earlier literature as Toruń clays. In pollen spectra of lignite and clays from Czempin Beds, the most numerous are pollen grains of the angiosperms. The nature of deposit and the abundant occurrence of marine plankton are indicative of the origin of pollen grains and spores which come from a vegetation growing outside the sedimentation basin. These profiles contain abundantly occurring pollen grains of conifers of the family Pinaceae and of the families Taxaceae, Taxodiaceae and Cupressaceae. Tricolporate forms of a varying botanical assignment are a morphological group of pollen, second in the degree of abundance. Also numerous is the group of triporate pollen grains, representing the families Betulaceae, Myricaceae and Juglandaceae.

Of forms important stratigraphically, most frequent, sometimes exceeding 20 per cent, is *Tricolporopollenites cingulum fusus*, related by Stuchlik (1964) with the family Rutaceae (cf. *Ptelea*). The part of this form in samples is characteristic of the Paleogene deposits, much less frequent in the Upper Oligocene and practically non-existent in the Miocene. The morphological species, *Quercoidites microhenrici*, which should probably be assigned to the genus *Quercus*, is another form occuring abundantly and important stratigraphically. It also occurs, in some profiles even abundantly, still in the entire Miocene, along with a morphologically related but somewhat larger form of *Quercoidites henrici*.

Of forms occurring rarely or even very rarely, but being of particular stratigraphic importance, the genus *Milfordia* is here recorded with the species *M. incerta* and *M. minima*. It is a morphological genus related with the family Restionaceae. This family occurs at present only in the subtropical zone (Engler, 1964) and the presence of the genus *Milfordia* in the Eocene and Oligocene deposits of Central Europe is indicative of a former wide distribution of this family over the northern hemisphere. The genus *Milfordia* is also, if very rarely, met with in warmer periods of the Lower and Middle Miocene (Krutzsch, 1970b). Of species, whose occurrence terminates in the Middle Oligocene, the following were recorded: *Aglaoreidia cyclops, Cicatricosisporites dorogensis, Cupanieidites eucalyptoides* and *Boehlensipollis hohli*. The last-named form is assigned by Krutzsch (1970b) to the most important index plants of the Middle Oligocene deposits. Despite the fact of its rare appearance in analyses, it is widely distributed and recorded in the Middle Oligocene of Southern England, Belgium, the German Democratic Republic, Poland, Byelorussia up to Central Asia (Erdtman, 1960; Krutzsch, 1962 *a*; Stuchlik, 1964; Manykin, 1958; Pokrowska *et al.* 1966; Krutzsch & Wanhornee, in press).

Of forms important ecologically, recorded were: the pollen of *Ephedra*, the spores of a fern of the families Osmundaceae, Gleicheniaceae and Schizaeaceae, the spores of the club moss, the pollen of herbaceous plants, Gramianeae and Chenopodiaceae and the pollen of the families Fagaceae, Nyssaceae, Ulmaceae, Tiliaceae, Juglandaceae, Symplocaceae, Araliaceae and Palmae. On the basis of such a palynological picture, on may attempt to reconstruct the plant community, which in those times predominated on a not very wet coast of the Middle Oligocene sea.

Percentage differences in the occurrence of particular groups of pollen of the Angiospermae and Gymnospermae in the sectors of profiles under study are indicative of the existence of plant communities of various types. Most broadly understood, the floristic picture was probably as follows: mixed forests were predominant in dry areas, leafy forests, including oaks and elms, in wetter areas and plant communities with some part of the *Nyssa* and an admixture of conifers of the genera of *Glyptostrobus* and *Taxodium* — on the swampy territories. The lower layer of forests was formed by shrubbery of the families Myricaceae, Cyrilliceae, Araliaceae and Ericaceae and the lowermost by ferns, mosses, club mosses and grass. The presence of the pollen of the Chenopodiaceae in the deposits of that age may be related to the salinity of substrate. Averdick (1958) believes that its presence in lignite deposits may indicate the effects of the sea. Similar is the opinion of Zagwijn (1960) who maintains that the Chenopodiaceae are a pioneer element, entering the areas left by the sea. The dry, sandy parts of the coast were probably overgrown with palm-trees, whose pollen, abundant in the Middle Oligocene deposits and variable morphologically, presumably represents various species of palms.

The vegetation of this type was an exponent of that period's climatic conditions. It includes the equivalents of the Turgay flora of the temperate type and the Poltava flora subtropical in character, which were separated by Krishtofovich (1955). The representatives of Krishtofovich's Turgay vegetation and Mai's (1967) Arctic-Tertiary element are abundant, both qualitatively and quantitatively, in pollen profiles of the Middle Oligocene. On the other hand, the subtropical vegetation or the element of the Poltava flora is relatively not very numerous, which indicates the predominance of the warm-moderate climate. This conclusion is in conformity with Krutzsch's (1967) chart, in which the climatic curve violently deflects in Paleogene zone 20. This depicts a distinct deterioration of climate in the Middle Oligocene as compared with that in the Eocene.

The Upper Oligocene

In the southern part of the area under study (Nowa Wieś and Oczkowice borings), the oldest deposits containing sporomorphs overlay Upper Oligocene quartz sands with glauconite (Ciuk, 1970; Piwocki, 1971). These are lignites and strongly coaly sands with vegetal detritus, whose spore-pollen composition resembles that of coal series IV, distinguished in the Ustronie borehole (Ziembińska & Niklewski, 1966). The deposits of lignite coaly shales and strongly coaly sands, corresponding in stratigraphic position to Lusatian Bed 4, are known from Lusatia and Saxony, among other places, from the region of Bitterfeld. In Western Poland, they were determined by Ciuk (1967, 1970) as Dąbrowa Beds, together with the Dąbrowa group of deposits. According to Ciuk (1970), they were formed on the swamps, left after the withdrawal of the Upper Oligocene sea. Their brackich character is indicated by few specimens of the marine planktonic forms of the class Dinophyceae, found in the Ustronie and Oczkowice profiles.

In the palynological pictures of this lowermost coal layer, accompanied by strongly coaly clays and sands in the Ustronie, Oczkowice and Nowa Wieś profiles, distinctly predominant are the pollen grains of angiosperms, which on the average make up 80 per cent of spectra, while the rest consists of the pollen grains of conifers, with the family Pinaceae (mostly *Pinus*, less frequently *Picea* and *Tsuga*) abundantly represented among them. On the other hand, the spores of ferns and club moss are very few in this part of profiles.

The pollen, representing leafy plants, displays a wide variety of types. Triporate pollen grains coming from the families Myricaceae, Betulaceae and Juglandaceae, the last-named represented by *Momipites punctatus*, are the most numerous components of the spectra. In addition to these, abundantly occurring types, also numerous is the group of tricolporate forms, with the species: *Quercoidites henrici*, *Q. microhenrici*, *Cupuliferoidaepollenites liblarensis* and *Tricolporopollenites cingulum*, the last-named with two subspecies, *T. cingulum fusus* and *T. cingulum pusillus*. Relatively numerous are morphological types corresponding to the pollen of the *Nyssa*, *Ilex* and Cyrillaceae (*Cyrillaceaepollenites megaexactus*). Of forms rarely appearing, but considerably important stratigraphically, is *Dicolporopollis middendorfi*, recorded in these deposits and whose occurrence terminates in the Upper Oligocene.

The forms *Leiotriletes maxoides maximus* and *L. maxoides maxoides*, representing the family Schizaeaceae (genus *Lygodium*), were found with the spores of other ferns.

The vegetation, whose pollen occurs in the spectra of this series, is typically Late Tertiary in character and earlier elements, except for *Tricolporopollenites cingulum fusus* and *Dicolporopollis middendorfi* already do not occur any more. The superiority of the pollen of plants living in a wet habitat indicates fairly specific ecological conditions which predominated after the withdrawal of the Upper Oligocene marine transgretion. The presence of various species of the pollen of palms, their relatively frequent occurrence and the presence of very typical and rare warmlike form *Olaxipollis matthesi*, related with the family Olacaceae, as well as the occurrence of the pollen of the family Sapotaceae indicate that in the later Oligocene the climate was warmer than in the Middle Oligocene. Despite the predominance of the pollen coming from the vegetation of swampy and wet habitats, the pollen of warmlike plants of a dryer substrate, constantly persists making up a considerable percentage.

The pollen composition of this series is similar to the spectre of Lusatian Bed 4, which in regard to age corresponds to the deposit from Bitterfeld (Thiergart *in*: Gothan *et al.*, 1940).

The macroflora of this horizon is determined by Mai (1967) as an Upper Oligocene one and assigned to climatic phase II of the later Tertiary. Mai believes precisely this phase, marked in palynological analysis by the abundance of angiosperm pollen, to be the most important in drawing the boundary between the Oligocene and Miocene. A transitory improvement of climate is observed by Mai in the process of this phase. Unfortunately, in pollen spectra of borings under study this improvement, as compared with phase I, is invisible, since there are no deposits of equal age with those of climatic phase I and which would be suitable for palynological studies. Maybe, phase I corresponds to sands with vegetal remains, known from brackish Leszno Beds of the environs of Chobienia (Piwocki, 1971) and Leszno (Ciuk, 1967).

The Lower Miocene

The lower part of the Miocene is developed in the southern area of Great Poland as fine-bedded layers of coal and coaly clays and clayely deposits. These deposits correspond to Spremberg Beds, which in Lusatia are developed on the whole in the form of numerous layers of coal interspersed by clays and sands. In the territory of Western Poland they are termed by Ciuk (1967, 1970) as Rawicz Beds, along with the Rawicz group of deposits. As follows from the profiles analysed, these beds include, in regard to age, three climatic phases, with which characteristic changes in vegetation are connected. These are phases III, IV and V.

Phase III

According to Mai (1967), the lowermost Miocene phase is marked in its macroflora by the predominance of a vegetation of the Arctic-Tertiary type, with Paleotropical elements occurring only sporadically. In the profiles here analysed, the deposits corresponding in pollen composition to climatic phase III were found in the Gierlachowo (Text-fig. 6) and Ustronie (Text-fig. 3) borings. This period's pollen spectra are typical Miocene and cool in character. There predominate facial forms, that is, the pollen of the Taxodiaceae and Taxaceae and the spores of the Polypodiaceae (*Laevigatisporites haardti*). Abundant is also the pollen of the triporates of the family Myricaceae (*Triatriopollenites rurensis*) and Juglandaceae (*Momipites punctatus*). The part of the pollen of the *Tsuga, Sciadopitys* and *Picea* is also considerable in the spectra. Pollen forms are few and of the elements characteristic of warmer climatic phases only the pollen of the Sapotaceae, Symplocaceae and Oleaceae is recorded sporadically. On the other hand, the forms whose presence is related by Krutzsch & Majewski (1967) with cooler climatic phases, are considerably more variable. More frequent is the pollen of the *Liquidambar* and Ulmaceae, the spore of the *Verrucatosporites arctotertiarius* is observed sporadically. In profile sectors of this climatic phase, completely lacking is the pollen of *Tricolporopollenites cingulum fusus* and *T. cingulum pusillus*, two subspecies which played a very important role in lower sectors of profiles.

Upwards, the picture of vegetation gradually becomes somewhat richer. An increase is observed in the number of pollen types, in particular in the group of forms characteristic of transitional climatic phases. This is the pollen of the *Carya, Pterocarya, Carpinus*, and forms which correspond morphologically to the genus *Parthenocissus*. Also numerous are the Osmundaceae. During this period, a very characteristic maximum of the part of older pollen in spectra appears in the Ustronie and Gierlachowo profiles. The pollen spectrum with a considerable part of alder was recorded in various profiles on the territory of Poland and on the basis of this fact Raniecka-Bobrowska (1970) suggests to consider it as an index and limiting spectrum between the Oligocene and Miocene deposits in the continental facies. In the profiles outside Poland, increased values of alder pollen were given by Pacltová (1966) for faunally defined Chattian-Aquitanian deposits from southern Slovakia. In Pacltová's profile, the part of alder, increased to 11 per cent, was accompanied in spectra by an abundantly occurring pollen of *Tricolporopollenites cingulum fusus* and *T. cingulum pusillus*. If we assume after Krutzsch (1971) that above the Oligocene the species *Tricolporopollenites cingulum fusus* only sporadically occurs in the Central European deposits, the period of "alder invasion" (Raniecka-Bobrowska, 1970) was earlier in Slovakia than in South-western and Central Poland. Under stratigraphic conditions similar to those in Polish deposits, an increased part of alder pollen in spectra (to 20 per cent) was recorded by Hunger (1955) in the lower part of the Berzdorf profile in the Żytawa coalfield. This horizon corresponds to a pollen spectrum from the lower part of the Turów coal deposit (Raniecka-Bobrowska, 1970).

Phase IV

Deposits, whose pollen spectra allow one to synchronize with climatic phase IV, were found in the following boreholes: Ustronie (Text-fig. 3), Oczkowice (Text-fig. 4), Nowa Wieś (Text-fig. 5), Gierlachowo (Text-fig. 6) and Ślepuchowo (Text-fig. 10). In all the profiles, these are mostly brown coal deposits, with small intercalations of brown clays. The content of the pollen characteristic of cooler phases decreases in the profile very distinctly, both concerning the number of types occurring in samples and their percentage in spectra. Thus, more and more pollen forms appear which represent the vegetation of the paleotropical element. These are various types of the pollen of palms, such as *Spinulaepollis spinosus*, Sapotaceae, *Araliaceaepollenites edmundi* and *A. euphorii*. At the same time, a considerable increase is observed in this sector of profiles in the percentage of *Cyrillaceaepollenites exactus* and *Querciodites henrici* occurring in spectra. The same as found by Mai (1967), no distinct boundary occurs between phasee III and IV in the palynological profiles from Great Poland. The consecutive, climatic phase IV is a period of the return of the warmlike flora with the predominance of an element of the subtropical type, as confirmed by Mai's (1967) observations of the Lusatian macroflora. In the optimum of phase IV, he determines the character of flora as conspicuously paleotropical and believes that during this optimum period several beds of lignite were formed, including the Berzdorf deposit, whose pollen profile was described by Hunger (1955).

Phase V

The presence of climatic phase V in the profiles of the Great Poland Lowland and South-western Poland is hardly distinguishable. Mai (1967) mainatins that the strongest deterioration of climate in the Lower Miocene occurred in climatic phase V, in which the greatest predominance of the Arctic-Tertiary element is observed, along with a general impoverishment of vegetation. The macroscopic remains begin to display abundant *Picea*, *Pseudotsuga*, *Fagus*, *Carpinus*, *Pterocarya* and *Liriodendron*. The climate of this phase is characterized by Mai (1967) as a wet, moderate, with abundant precipitation and considerable differences in the frequency of its occurrence over a year.

Pollen spectra which may be considered as representative of the deposits of entire phase V, were found only in the Ustronie profile, situated outside the territory under study. In this profile, the deposits of the lower part of the Miocene could be analyzed most completely. Phase V is represented in it by coaly shales with a considerable admixture of muscovite, occurring at depths ranging between 223.4 and 229 m. Single specimens of marine plankton with the species *Cordosphaeridium inodens* and *Baltisphaeridium* sp. were found in these shales. Pollen spectra represent a moderate warmlike flora rich in pollen types. The typically warmlike element is represented only by the pollen of the Oleaceae and sporadically occurring pollen grains of *Araliaceaepollenites edmundi*, *Intratriporopollenites instructus* and *Podocarpaceae*. The most abundantly represented, both in the number of types and the quantitative content of spectra, is the pollen of plants, which are transitional in their climatic character, that is, *Junglanspolennites verus*, *Carya*, *Pterocarya*, *Quercus*, Betulaceae and Osmundaceae. Of the forms which represent the vegetation of the temperate type, relatively abundant is the pollen of *Tsuga*, *Fagus*, *Sciadopitys*, *Carpinus*, *Corylus*, and Ulmaceae. The botanical composition of these spectra resembles to a considerable extent the bulk of the macroflora described by Mai (1967) from climatic phase V. However, on the basis of the materials analysed so far, it seems that the cooling-down of the climate and, consequently, the impoverishment of vegetation in climatic phase V are less distinctly visible in palynological spectra than those in phase III.

In other profiles from South-western Poland, Raniecka-Bobrowska (1970) also does not record such a distinct deterioration of climate in the upper part of the Lower Miocene as that suggested by Mai (1967). According to hitherto available data, climatic phase V falls during the period when clays and sands, which now separate from each other the two brown — coal beds at Turów, were deposited in this profile. Unfortunately, no palynological spectra from these deposits have hitherto been available. According to Raniecka-Bobrowska (1965), sandstones from Osieczów, whose leafy flora, described by her (Raniecka-Bobrowska, 1962), mostly includes elements indicative of a subtropical climate, are of equal age with the just mentioned, separating deposits from Turów. Small deposits of brown coal occur in the top of a sandstone series in the gorge of the Kwisa River near Osieczów. Palynological spectra, prepared by Raniecka-Bobrowska (1965), indicate a distinct climatic optimum, which undoubtedly corresponds to Mai's climatic phase VI. The warmlike flora from Osieczów is also considered by Mai (1967) as typical of climatic phase VI and, therefore, it is necessary to elucidate the presence of the deposits of cooler phase V in this part of Poland.

The Middle Miocene

Palynological spectra of all the profiles analysed have been obtained from the Middle Miocene. They allow one to refer the considerably thick (to 45 m) complex of clay-coal-sand layers to phases VI, VII and VIII of Mai's climatic-floral diagram. According to Ciuk's (1970) division, these deposits were determined as the Ścinawa Beds. They are formed by a complex of two deposits of lignite, separated by a muddy-clayey series, intercaled by coal. The lower deposit is more strongly developed in the northern part of the area under study and the upper in the southern part. By the use of palynological methods, they may be correlated with series IIa and II from the region of Ścinawa (Ziembińska & Niklewski, 1966).

Phase VI

A strong enrichment in pollen grains of angiosperms is, as in phase IV, observed once again in pollen spectra of the lower deposit of coal and corresponding clays. A horizon, particularly distinct in the southern part of the area, with a high or strongly increased content of the pollen of *Quercoidites henrici* and *Q. microhenrici*, as well as other types of the tricolporate pollen, is observed in all the profiles. The horizon with the increased percentage of the pollen of *Quercoidites* occurring in spectra and accompanying higher percentage of the pollen of *Rhoipites pseudocingulum* is always connected with the warmlike character of flora. In the northern part, the general character of the pollen flora, with a moderate increase in the content of the pollen of *Quercoidites henrici* and *Q. microhenrici*, as well as *Rhooidities pseudocingulum*, is an expression of warming-up of the climate, although not to such an extent as in the areas situated more to the south. Other warmlike elements also appear in spectra, such as the pollen of *Araliaceaepollenites edmundi* and *Olaxipollis matthesi*, a species related with the family Olacaceae and considered by Krutzsch (1962*a*) as an index element of warmer phases of the Miocene. In phase VI, the presence of this species was recorded in the Ustronie (Text-fig. 3), Nowa Wieś (Text-fig. 5) and Gierlachowo (Text-fig. 6) profiles. Pollen spectra of climatic phase VI from the Ustronie profile, resembles spectra from the profile of the "Glückauf" mine (Hunger, 1955). The profile from the main Upper Lusatian bed, corresponding to the upper bed from Turów, is marked in pollen spectra by a high percentage of warmlike forms, in particular of the pollen of *Quercoidites henrici*, which is accompanied by an abundance of the pollen *Rhoipites pseudocingulum*. Hunger (1955) found considerable palynological analogies between the picture from the Żytawa Coalfield and the deposits of lignite in Rhineland, where a maximum percentage of the pollen of *Q. henrici* is also observed in the main bed. It seems, however, that comparing profiles so distant from each other and in which deposits were formed under quite different geological-facial conditions may result in many misleading stratigraphic conclusions. We may only compare general changes in climate, which occurred in extensive areas nearly at the same time, as pointed out by Brelie (1968).

A general occurrence of an increased percentage of the pollen of *Q. henrici* in palynological spectra accompanied by the enrichment of fauna in warmlike forms and in particular the presence of *Olaxipollis* and *Reevesiapollis*, a relatively high percentage of the pollen of *Araliaceaepollenites emundi* and the appearance of the pollen of *Tricolporopollenites doliiformis* and *Symplocospollenites anulus* are the exponent of a general warming-up of this type in Mai's phase VI.

According to Mai (1967), the vegetation of climatic phase VI is marked, in macroflora, by the predominance of paleotropical and evergreen elements and by a considerably decreased percentage of Arctic-Tertiary forms. In this phase, there occur many representatives of the families

Mastixiaceae, Symplocaceae, Lauraceae, Theaceae and others. The rich mastixial florae of this phase are similar to earlier florae to such an extent that Kirchheimer (1940) considers them as Upper Oligocene ones. On the territory of Poland, the macroflora of this type is known only from the upper bed of Turów (Czeczott, 1959, 1961).

Phase VII

The picture of pollen gradually changes in all profiles of the muddy-clayey series with intercalations of brown-coal. A decrease is observed in the percentage of warmlike elements, followed by a gradual enrichment of spectra in the pollen of plants transitional and temperate in character. The pollen of plants, whose presence is determined by facial conditions, such as the families Taxaceae, Taxodiaceae, Cupressaceae and the genera *Nyssa*, *Ilex*, etc. occurs in various profiles in a varying percentage. The part of the pollen of plants which represent a intermediate element, that is, *Pterocarya*, *Juglans*, *Carya*, *Juglanspollenites verus* (related with the genus *Celtis*) and of the pollen, representing temperate elements, keeps in all profiles at a relatively high level. This particularly concerns the pollen of *Tsuga*, almost absent at all from the deposits of the preceding phase and the pollen of *Sciadopitys* and *Fagus*. The enrichment of spectra in the elements of a cooler vegetation is indicative of a consecutive cooling-down, related with Mai's phase VII. As indicated by both macroflora and pollen profiles, this cooling-down is not so intense as that recorded in phases III and V, and the warmlike forms in the profiles of the southern part of the area under study do not disappear completely, but only become less frequent, both in particular samples and in regard to the number of samples in a profile. The transitional period of cooling-down of phase VII is visible in all the profiles elaborated.

Phase VIII

Deposits of the second horizon of the Middle Miocene lignite, observed in the area under study, a lithostratigraphic counterpart of which is Lusatian Bed 2, more or less correspond to phase VIII. According to Mai, the almost subtropical climate of this phase is related with a consecutive return of the warmlike mastixioidal flora, with such characteristic species as *Tectocarya lusatica*, *Magnoliaespermum geinitzii* and *Symplocos areaceaeformis*. Many palynological profiles were prepared of the deposits of Lusatian Bed 2, but the most complete one and suitable for comparisons is that prepared by Thiergart (1938) from the Marga mine. A horizon with a considerable content of the pollen of *Quercoidites henrici* (reaching 43 per cent) and an increased percentage of the pollen of *Rhoipites pseudocingulum* appears in the lower part of this profile. This is the second, so distinct maximum of the percentage of these pollen types in the Middle Miocene deposits. In the profiles from the Great Poland Lowland, this horizon may also be observed, although an increase in the content of *Q. henrici* is not so great, making up about 15 to 25 per cent in spectra, in which it is accompanied by an increased percentage of warmlike elements. Once more such pollen types as *Olaxipollis matthesi, Symplocospollenites anulus, Eucomia, Reevesiapolis* etc. appear in samples, along with other types representing warmlike elements. In this phase, much the same as in all other Miocene warm phases, pollen flora from the profiles, coming from the southern part of the area under study, are much more of the character of warm climate than those from the profiles of the northern part. The part of warmlike forms is considerably larger, both concerning their percentage and frequency of recurrence in the profile. In the profile from the Ślepuchowo boring (Text-fig. 10), warmlike elements are the rarest, but relatively large is the percentage of the pollen of *Q. henrici*, which reaches 22.5 per cent.

Phase IX

In most of the profiles under study, after the deposition of the layers of lignite, which corresponded to climatic phase VIII, there occurred an interval in the phytogenetic sedimentation. The deposit, overlaying the brown-coals of phase VIII and mostly consisting of muddy and dusty sands with an admixture of muscovite, is termed by Ciuk (1970) as the Pawłowice Beds.

Due to very scant macroscopic florae, occurring in it, phase IX is characterized by Mai (1967) not very precisely. According to Krutzsch's oral communication this sector of the profile on the territory of Lusatia is accurately documented palynologically. Unfortunately, no descriptions of this phase have hitherto been published, but, on the basis of comparative materials from the Meuro, Klettwitz and Meurostolln mines, the conclusions may be drawn on the character of this phase's climate. There occurred a repeated and far-reaching impoverishment of warmlike elements and an increase in the occurrence, in pollen spectra, of forms which represent an Arctic-Tertiary floral element.

The characteristics of phase IX are best visible in the Gierlachowo profile (Text-fig, 6), in which a horizon has been recorded with an increased percentage of the pollen of *Sciadopitys* and a conspicuous increase in the content of various types of the pollen of *Tsuga*. According to Krutzsch (1971), the numerous appearance of various types of the pollen of the genus *Tsuga* is a characteristic feature of this phase. In the Gierlachowo profile, above the horizon with an increased content of the pollen of *Sciadopitys* and *Tsuga*, abundant is also the pollen of *Liquidambar*, whose maximum reaches 28 per cent. The general spore-pollen composition of the deposits of phase IX resembles those observed in phases III and V. A larger percentage of the pollen of *Tsuga* and *Sciadopitys*, an increased content of that of the Ericaceae and a sporadical but consistent occurrence of that of *Carpinus* are fundamental factors in which the spectra of this phase differ from those of phases III and V. The horizon with an increased percentage of the pollen of *Sciadopitys* was observed in many European profiles. An increase in the content of the pollen of this type in the top part up to 22 per cent is observed by Thiergart (1938) in the profile of the Marga mine. An equally large percentage of the pollen of *Sciadopitys* was also recorded in the profiles of lignite deposits in Rhineland. On the basis of this fact, Thiergart (1949, 1953) considered the horizons with an increased content of the pollen of *Sciadopitys* as index horizons for paralleling coal deposits. This view was confirmed by the works of Thomson (1950), Thomson & Rein (1951) and Rein (1951). In a model palynological profile from Rhineland's lignites, Brelie (1968) distinguished three horizons with an increased percentage of the pollen of *Sciadopitys*, occurring in sector D, which was paralleled with deposits equal in age to the deposits occurring between Lusatian Beds 2 and 1. The next increase in the content of this pollen occurs, according to Brelie (1968) only in the Pliocene deposits. Raniecka-Bobrowska (1970) considers the horizon with an abundant occurrence of the pollen of *Sciadopitis* in spectra as characteristic precisely of the deposits of climatic phase IX.

In the Gierlachowo profile, in addition to many sporomorphs, there occur single specimens of marine plankton of the genus *Baltisphaeridium*. The remains of marine animals (sponge spicules) and grains of glauconite were found by Piwocki (1971) in the Pawłowice Beds near Rawicz. Marine connections of the deposits of the upper Brieske Beds in the German Democratic Republic, corresponding to the Pawłowice Beds (Ciuk, 1970) in Poland, were mentioned by Ahrens & Lotsch (1967) and Ahrens *et al.* (1968).

The Upper Miocene

Phase X

According to Ciuk's (1970) lithostratigraphic diagram, the Upper Miocene includes the Adamów and Middle Polish Beds. A not very thick layer of lignite, whose pollen flora is marked by an increased content of warmlike elements as compared with underlaying deposits, occurs in the top of clays and strongly coaly muds, belonging to the Adamów Beds in the Gierlachowo, Gołębin Stary, Krosinko and Mosina borings. On the territory of Lusatia, a rich mastixial flora with the same genera and species, which predominated in phases VI and VIII, was once again found by Mai in the clays concurring with the deposits of the "accompanying bed," which is equal in age to the coals from the Adamów Beds. Mai believes, however, that despite another increase in the content of the mastixioidal flora, the percentage of the elements which represent the Arctic-Tertiary component of vegetation in Phase X is higher than in all preceding warm phases.

This view is fully confirmed in the palynological profiles, here described, in particular in the Gierlachowo profile. The pollen of *Quercus* and also, to a considerable extent, of *Parthenocissus*, *Zelkova*, *Celtis*, as well as the spores of *Osmunda* abundantly occur among pollen forms representing the intermediate and temperate element, that is, that connected with the northern element of the Tertiary vegetation. The curve showing the percentage of the pollen of *Tsuga* and *Sciadopitys* in spectra has a continuous trace at the level of two or three per cent, while in earlier warmlike phases the pollen grains of two genera appear rarely or are lacking at all. Consequently, the pollen of *Fagus*, *Carpinus* and *Ulmus* occurs in the deposits of this phase. The percentage of warmlike forms is relatively low. *Quercoidites henrici* and *Cyrillaceaepollenites megaexactus*, which in warmer phases (VI and VIII) were abundant, in this phase hardly reach ten percent. The pollen of palms and *Araliaceaepollenites edmundi* occurs regularly, making up 1 to 1.5 per cent, while that of *Hedera*, Sapotaceae, *Tilia, Eucomia, Reevesia* and *Itea* appears only sporadically. The presence of pollen grains of the genera *Reevesia* (the family Sterculiaceae) and *Itea* (the family Saxifragaceae) undoubtedly indicates a very warm climate in Phase X. At present, the genera *Reevesia* and *Itea* are distributed in the tropical and subtropical areas of South-eastern Asia.

Phases XI and XII

The palynological pictures of the highermost layers of coal and accompanying clays, assigned to Middle Polish Beds (Ciuk, 1970), pose the greatest interpretative problems. In the southern part of the territory under study, the pollen spectra from the Ustronie profile are in conformity with the results of palynological analyses obtained by Thiergart (1937) from the deposits of Lusatian Bed 1 at the "Clara III" mine. Despite a considerable percentage of pollen forms, representing temperate and transitional elements, which occur in pollen spectra of the highermost coal layer of the Ustronie profile, the content of species representing warmlike elements, such as *Araliaceaepollenites edmundi* (14 per cent), *Rhooidites pseudocingulum* (22 per cent), Symplocaceae, *Eucomia*, etc. is also large.

The deposits of Lusatian Bed 1 in the climatic-stratigraphic diagram of the Neogene are identified by Mai (1967) with climatic phase XII, whose climate he determines, on the basis of macroflora, as nearly subtropical and compares with that of phase X. He emphasizes, however, that about 50 per cent of the species described from the deposits of this phase are among the Arctic-Tertiary elements, even despite the appearance of the mastixial flora. On the basis of the observations of macroflora, Mai finds that during the period of the Late Neogene younger climatic phases were gradually and consistently enriched in the representatives of the Arctic--Tertiary element.

Phase XIII

On the territory of Lusatia, this phase was characterized by Mai as a period of the formation of small layers of brown-coal and accompanying clays overlaying the deposits of Lusatian Bed 1. In the Polish diagram of Ciuk (1970), all of them are deposits of the Middle Polish Beds with a strongly developed layer of lignite or what is known as the Middle Polish layer.

In Lusatia, the flora from the deposits, which correspond to phase XIII, is marked by a far-reaching impoverishment of warmlike elements. Nearly 90 per cent of the species are representatives of the Arctic and intermediate elements. Since those times, a great majority of the representatives of the laurileafy flora has disappeared completely from the territory of Central Europe as a result of the deterioration in climate (Mai, 1967). The climate of this phase is characterized by Mai as temperate and wet, with a frosty winter.

In the profiles elaborated from the territory of Great Poland, palynological pictures from the highermost layers of coal and accompanying clays display a far-reaching decrease in the number of pollen species representing warmlike elements. The pollen of pine, alder and *Nyssa* is a predominant component, with that of *Sciadopitys*, *Betula* and *Ulmus* being also frequent. The pollen of the Taxaceae, Taxodiaceae and the spores of the Polypodiaceae occur abundantly in some samples. Micro- and macrospores of the *Azolla* have also been found in this part of the profiles. Such pollen conditions were also observed by Grabowska in the materials from the Lusowo boring in the environs of Poznań.

The palynological pictures of coal layers from the region of Great Poland considerably depart from those observed in the deposits of Lusatian Bed 1 and brown-coal series I from the Ustronie boring. It seems that these differences are so great that the time of the formation of these brown-coal layers must not be synchronized with the period during which Lusatian Bed 1 was formed. Likewise, the differences in the quantity of warmlike forms occurring in the profiles of the southern and northern parts of the area are so great that they cannot be ascribed only to a more northern situation of the profiles of Great Poland as compared with those of Lusatia. The lignite layers of the environs of Poznań seem to be formed later than those in Lusatia and the period of their formation may be synchronized with Mai's phase XIII.

DESCRIPTIONS

Class **Bryophyta**

Genus *Stereisporites* Pflug, 1953

Type species: Stereisporites stereoides (R. Potonié & Venitz, 1934) Thomson & Pflug, 1953

Stereisporites (Stereisporites) involutus (Doktorowicz-Hrebnicka, 1960) Krutzsch, 1963
(Pl. II, Fig. 5a, b)

1960. *Sporites stereoides* R. Pot. & Ven. forma *involuta* Dokt.-Hrebn.; J. Doktorowicz-Hrebnicka, p. 72, Pl. 15, Fig. 2.

Material. — Four well-preserved specimens.

Description. — In polar view, triangular-rounded in outline, size 25 to 30 μ. Exine two-layered, 15 to 2 μ thick, slightly thickened at corners. Outer layer with a fine, rugulate sculpture. Arms of the Y-mark, up to one-third of radius with bands of a smooth exine.

Botanical affinity. — Family Sphagnaceae.

Remarks. — Described by Doktorowicz-Hrebnicka as a form, *Stereisporites involutus* was raised by Krutzsch (1963) to the rank of species with several subspecies. Specimens under study differ from *S. (St.) involutus involutus* in a more distinct sculpture.

Occurrence (in the area described). — Upper Miocene (phase XIII), Oczkowice.

Stereisporites (Stereisporites) stereoides gracilioides Krutzsch & Sontag, 1963
(Pl. II, Fig. 2)

1963*a*. *Stereisporites (Stereisporites) gracilioides* W. Kr. & Sontag; W. Krutzsch, p. 44, Pl. 3, Figs 34—36.

Material. — Three specimens.

Description. — Triangular-rounded in polar view; size 25 to 28 μ. Exine two-layered, less than 1 μ thick; both layers equal in thickness, outer smooth or with an indistinct sculpture. Arms of Y-mark straight, narrow, reaching equator.

Botanical affinity. — Probably the family Sphagnaceae.

Remarks. — The characters of specimens under study are in complete conformity with Krutzsch's (1963*a*) description and illustrations.

Occurrence (in the area described). — Upper Miocene (phase XIII), Oczkowice.

Stereisporites (Stereisporites) megastereis Krutzsch, 1963
(Pl. II, Fig. 6)

1963*a*. *Stereisporites (Stereisporites) megastereis* W. Kr.; W. Krutzsch, p. 46, Pl. 5, Figs 19—22.

Material. — Eight specimens.

Description. — Acutely triangular in outline, size 26 to 30 μ. Exine two-layered, 2 μ thick. Outer layer one-third of the thikness of inner, surface smooth. A separated contact area with a fine structure of the inner exine layer is distinctly visible on proximal face. Y-mark distinct, its arms half the length of radius.

Botanical affinity. — Family Sphagnaceae.

Remarks. — The characters of specimens under study are in conformity with Krutzsch's (1963*a*) description and illustrations. A distinctly separated contact area is a particularly conspicuous character. A similar form is described by Stuchlik (1964) as *Sphagnum* sp. — *Stereisporites stereoides* (R. Pot. & Ven.).

Occurrence (in the area described). — Miocene (phases VII, IX and XIII), Oczkowice, Mosina, Krosinko.

Stereisporites (Stereigranisporis) cf. *granulus* Krutzsch & Sontag 1963
(Pl. II, Fig. 3)

1963. *Stereisporites (Stereigranisporis) granulus* W. Kr. & Sontag; W. Krutzsch, p. 86, Pl. 24, Figs 13—16.

Material. — One specimen.

Description. — In polar view triangular, rounded, size 22 μ. Exine two-layered, 2 μ thick, thickened at corners; outer layer equalling inner in thickness, except at corners where it is twice as thick. Sculpture verrucate, verrucae less than 0.5 μ high and about 0.5 μ wide at the base. Y-mark with straight arms up to three-quarters of radius.

Remarks. — The specimen from Ustronie is very similar to those of *Stereisporites (Stereigranisporis) granulus*, from which it differs only in a much thicker exine.

Botanical affinity. — Probably the family Sphagnaceae.

Occurrence (in the area described). — Upper Miocene (Phase XII), Ustronie.

Class **Pteridophyta**

Genus *Leiotriletes* (Naumowa, 1937) R. Potonié & Kremp, 1954

Type species: Leiotriletes sphaerotriangulus (Loose, 1932) R. Potonié & Kremp, 1954

Leiotriletes triangulatoides Krutzsch, 1962
(Pl. I, Fig. 4)

1962. *Leiotriletes triangulatoides* W. Kr.; W. Krutzsch, p. 24, Pl. 2, Figs 1—3.

Material. — Three specimens.

Description. — In polar view triangular, obtuse, concave, size 35 to 40 μ. Exine two-layered, about 1 μ thick in lateral and 1.5 μ in angular parts. Arms of Y-mark reaching nearly a half of radius.

Remarks. — A secondary structure, probably a result of organic corrosion (bacteria, viruses) occurs both in the specimens under study and those of this species described by Krutzsch (1962).

Botanical affinity. — Unknown.

Occurrence (in the area described). — Middle Oligocene, Tarnówka.

Leiotriletes maxoides maxoides Krutzsch, 1962
(Pl. I, Figs 1,7)

1962*b*. *Leiotriletes maxoides* W. Kr.; W. Krutzsch, p. 18, Pl. 2, Figs 1—3.

Material. — Twenty-five specimens.

Description. — In polar view triangular, obtuse-convex, with widely rounded corners; size 75 to 80 μ. Exine two-layered, to 3 μ thick, smooth. Outer layer three times as thick as inner, in angular parts more strongly thickened. Y-mark with short arms up to half radius. A labiate swelling of exine occurs parallel to the arms of Y-mark.

Remarks. — The swelling of exine, paralleling the arms of Y-marks, is a character of this subspecies. Several specimens described under various names, among them those from Poland (*Lygodium-Sporites adriennis* R. Pot. & Gell., Romanowicz, 1961), may be assigned here on the basis of this character.

Botanical affinity. — Family Schizaeaceae, genus *Lygodium.*

Occurrence (in the area described). — Middle and Upper Oligocene, Tarnówka, Gierlachowo.

Leiotriletes maxoides maximus (Pflug, 1953) Krutzsch, 1959
(Pl. I, Fig. 3)

1953. *Divisisporites maximus* Pf.; P. W. Thomson & H. Pflug, p. 52, Pl. 1, Fig. 57.

Material. — Two specimens.

Description. — In polar view triangular, obtuse-straight, with widely rounded corners; size more than 80 μ. Exine more than 3 μ thick, polylayered, smooth. Outer layer strongly thickened at corners. Arms of Y-mark straight, forking, equalling two-thirds of radius.

Remarks. — The swellings of exine parallel to the arms of Y-mark are lacking in this subspecies.

Botanical affinity. — Family Schizaeaceae, genus *Lygodium* (?).

Occurrence (in the area described). — Upper Oligocene, Lower Miocene, Gierlachowo.

Genus *Punctatisporites* Ibrahim, 1933

Type species: Punctatisporites punctatus (Ibrahim, 1932) 1933

Punctatisporites sp.
(Pl. I, Fig. 2)

Material. — One specimen.

Description — Spore oriented somewhat obliquely, strongly elongate polarly; size 48 μ. Exine poly-layered. The innermost layer very thin (about 0.5 μ), the middle one the thickest (about 1.5 μ) and the outer 0.5 μ thick, with a punctate sculpture. Arms of Y-mark wide, stragiht 15 μ long, with thickenings of exine running along them.

Occurrence (in the area described). — Lower Miocene, Ustronie.

Genus *Trilites* Cookson, 1947 *ex* Couper, 1953

Type species: *Trilites tuberculiformis* Cookson, 1947

Trilites microvallatus Krutzsch, 1967
(Pl. II, Figs 7, 8)

1967*b*. *Trilites microvallatus* W. Kr.; W. Krutzsch, p. 76, Pl. 20, Figs 8—11.

Material. — A dozen or so specimens.

Description. — Concave-triangular in polar view, with widely rounded corners; spore diameter 28 to 34 μ. Exine two-layered, about 2 μ thick, uniform in thickness. Outer layer with a verrucate sculpture, verrucae wide, low, fairly closely spaced. Y-mark situated on a distinct elevation, its arms straight, about two-thirds of radius.

Remarks. — Specimens of *T. microvallatus* are very similar to those of *T. multivallatus* (= *Corrugatisporites solidus* subsp. *multivallatus* Pf.) described by Potonié from the Eocene of Geiseltal, G.D.R., but differ from them primarily in size.

Botanical affinity. — Family Schizaeaceae, genus *Lygodium.*

Occurrence (in the are described.) — Middle Oligocene, Tarnówka, Gierlachowo, Krosno, Mosina.

Trilites multivallatus (Pflug, 1953) Krutzsch, 1959
(Pl. II, Figs 10a, b)

1953. *Corrugatisporites solidus multivallatus* Pf.; P. W. Thomson & H. Pflug, p. 55, Pl. 2, Figs 37, 38.

Material. — A dozen or so specimens.

Description. — Triangular or concave-triangular in outline; size 38 to 50 μ. Exine consisting of two layers about 3 μ thick. Surface covered with a coarse, verrucate sculpture of the corrugate type. Y-mark distinct, its arms up to two-thirds of radius.

Remarks. — This species, erected by Krutzsch on the basis of *Corrugatisporites solidus multivallatus*, is similar to *Trilites microvallatus*, except for its size and coarseness of sculpture. In Central Europe common from Middle Oligocene through the Upper Miocene.

Botanical affinity. — Family Schizaeaceae, probably the genus *Lygodium*.

Occurrence (in the area described). — Middle Oligocene through Middle Miocene, various localities.

Genus *Favosisporis* Krutzsch, 1959

Type species: *Favosisporis trifavus* Krutzsch, 1959

Favosisporis trifavus Krutzsch, 1959
(Pl. II, Fig. 9)

1959*a*. *Favosisporis trifavus* W. Kr.; W. Krutzsch, p. 127—128.

Material. — More than twenty specimens.

Description. — Convex-triangular to rounded-triangular in outline; size 32 to 40 μ. Exine consisting of two-layers, to 2 μ thick. Outer layer identical in thickness with inner, densely covered with flat, widely rounded verrucae 2 to 3 μ in diameter and 1.5 μ high. Y-mark slightly elevated, its arms straight, reaching to three-quarters of radius.

Remarks. — Various species of the genus *Favosisporites* were included in the illustration of the group *trifavus* (Krutzsch, 1958). In 1959*a*, Krutzsch presented diagrams of the genus *Favosisporis* and *F. trifavus* without illustrating them. An illustration and description of this species are given only in Parts IV/V of this atlas (Krutzsch, 1967*b*).

Botanical affinity. — Family Cyatheaceae, genus *Cyathea.*

Occurrence (in the area described). — Middle Oligocene to Miocene, Tarnówka, Mosina, Krosno.

Genus *Camarozonosporites* Pant, 1954 *ex* R. Potonié, 1956

Type species: Camarozonosporites creataceus (Weyland & Krieger, 1953) R. Potonié, 1956

Camarozonosporites heskemensis (Pflanzl, 1955) Krutzsch, 1959
(Pl. II, Figs 12a, b)

1955. *Cingulatisporites heskemensis* Pflanzl; F. Mürriger & G. Pflanzl, p. 83, Pl. 5, Figs 1—3.

Material. — Ten specimens.

Description. — Convex-triangular in outline; size 28 to 35 μ. Exine consisting of two layers, inner layer at corners as thick as outer, in the middle part three or four times as thick. The entire exine at corners about 1 μ thick, in the middle part about 4 μ thick. Y-mark distinct, its arms straight, reaching to two-thirds of radius. Sculpture, formed by labyrinthine arranged lists 1—1.5 μ wide, is developed on the distal face.

Remarks. — A form, very similar morphologically, is known from the Paleocene of Texas (Elsik, 1968) as *Sphagnum bimammatus* (Naumova & Bolhovit, 1963). In Stuchlik's (1964) work, this species is illustrated and described as *Lycopodium cernuum.*

Botanical affinity. — Family Lycopodiaceae, *Lycopodium cernuum* (Stuchlik, 1964).

Occurrence (in the area described). — Middle Oligocene, Mosina, Tarnówka.

Camarozonosporites (Hamulatisporis) rarus (Doktorowicz-Hrebnicka 1960) Krutzsch 1963
(Pl. II, Fig. 11)

1960. *Lycopodium* forma *rara* Dokt.-Hrebnicka; J. Doktorowicz-Hrebnicka, p. 74, Pl. 16, Fig. 16.

Material. — Three specimens.

Description. — Rounded-triangular in equatorial outline; size 48 to 53 μ. Exine to 3 μ thick, covered on distal face with narrow, listlike processes forming sculpture of the hamulata type. Y-mark distinct, its arms straight, up to two-thirds of radius. Inter-arm areas covered with coarse-verrucate sculpture which turns equatorially in a labyrinthine one.

Remarks. — The species was erected by Krutzsch on the basis of a from described by Doktorowicz-Hrebnicka from the Miocene. Later, it was found in the deposits of various ages (Pliocene, Miocene, Lusatian Bed 2; Upper Oligocene — Lusatian Bed 4).

Botanical affinity. — Probably the family Lycopodiaceae.

Occurrence (in the area described). — Middle Oligocene, Tarnówka.

Genus *Cicatricosisporites* R. Potonié & Gelletrich 1933

Type species: Cicatricosisporites dorogensis R. Potonié & Gelletrich 1933

Cicarticosisporites dorogensis R. Potonié & Gelletrich, 1933
(Pl. IV. Fig. 1a, b)

1933. *Cicatricosi-sporites dorogensis* R. Pot. & Gell.; R. Potonié & J. Gelletrich, p. 522, Pl. 1, Figs 1—3.

Material. — Three specimens.

Description. — Rounded-triangular in outline, size 48—57 μ. Exine consisting of two layer to 5 μ thick with a listlike sculpture. Lists and spaces between them about 2 μ wide. They do not reach the Y-mark. Along the arms lack of sculpture. On the distal face, lists rectilinear. Y-mark distinct, with straight arms reaching about two-thirds of radius.

Remarks. — Very common in the Early Tertiary deposits, this species terminates its occurrence in the Middle Oligocene.

Botanical affinity. — Family Schizaeaceae, the genera *Mohria* and *Aneimia.* Spores with a listlike sculpture are also met within the families Parkeniaceae and Diksoniaceae.

Occurrence (in the area described). — Middle Oligocene, Mosina boring.

Cicatricosisporites chattensis Krutzsch, 1961

(Pl. III, Fig. 1a, b, c; Pl. IV, Fig. 3a, b)

1961. *Cicatricosisporites chattensis* W. Kr.; W. Krutzsch, p. 334/5, Pl. 1, Figs 1—2.

Material. — Eight specimens.

Descriptions. — Triangular in outline; size 45 to 62 μ. Exine about 2 μ thick, covered with very high (to 4 μ) and wide (to 4 μ), listlike processes; lists with uneven margins, which are higher in the middle part of walls than in corners. Running parallel to equator they do not reach the arms of Y-mark. Y-mark slightly elevated, its arms nearly equal to radius.

Remarks. — This is a very characteristic species, easily identifiable, even in fragments, due to the structure of its lists.

Botanical affinity. — Unknown.

Occurrence (in the area described). — Middle Oligocene; Tarnówka.

Genus *Polypodiaceoisporites* R. Potonié, 1956

Type species: Polypodiaceoisporites speciosus (R. Potonié 1934) 1956

Polypodiaceoisporites marxheimensis (Mürriger & Pflug, 1952) Krutzsch 1959

(Pl. IV, Fig. 2a, b)

1952. *Triradiato-sporites marxheimen* Mürr. & Pf. F. Mürriger & H. Pflug, Pl. 11, Fig. 2.

Material. — Five specimens.

Description. — Triangular obtuse-convex in outline and with a distinct, high ring around the equator; size 68 to 83 μ. Cingulum 6 to 7 μ wide in the central part of walls, slightly narrower in corners. On the proximal face, sculpture coarse-verrucate, near Y-mark consisting of separate verrucae, near equator of fused verrucae. On the distal face, sculpture in the form of labirynthine arranged lists 5 to 7 μ wide. Y-mark distinct, with straight arms, nearly reaching the equator.

Remarks. — The species *Polypodiaceoisporites marxheimensis* was only illustrated by Mürriger & Pflug (1952). Its first description was given by Thomson & Pflug (1953), who changed the genus from *Triradiato-sporites* into *Cingulatosporites*. In 1959*a*, Krutzsch included the species *C. marxheimensis* in the genus *Polypodiaceoisporites*, redescribed by R. Potonié in 1956.

Botanical affinity. — Family Dicksoniaceae, the genus *Cibotium*.

Occurrence (in the area described). — Middle Oligocene, Tarnówka, Mosina.

Genus *Neogenisporis* Krutzsch, 1962

Type species: Neogenisporis neogenicus Krutzsch, 1962

Neogenisporis neogenicus Krutzsch, 1962
(Pl. III, Figs 2a, b, 3)

1962*a*. *Neogenisporis neogenicus* W. Kr.; W. Krutzsch, p. 267—8, Pl. 1, Figs 1—4.

Material. — A dozen or so fairly well preserved specimens.

Description. — Concave-triangular in outline; in corners walls at an angle of 120° to each other; size 38 to 47 μ; polar axis 25 to 30 μ long. Exine polylayered, the thickest (2 to 3 μ) in the central part of walls and considerably thinner (about 1.5 μ) in corners. The arms of Y-mark straight, not bifurcate, reaching equator. On the distal face the folds of exine run following the Y-mark.

Remarks. — This species is considered by Krutzsch (1962) as a typical representative of the Arctic-Tertiary element in the Later Tertiary and for this reason it has been assigned in the profiles under study to types characteristic of the temperate climate.

Botanical affinity. — Family Cyatheaceae, probably the genus *Cyathea*.

Occurrence (in the area described). — Few specimens occurring in the Middle and Upper Miocene of Ustronie, Gierlachowo, Mosina and Ślepuchowo.

Genus *Baculatisporites* Thomson & Pflug, 1953 emend. Krutzsch, 1967

Type species: Baculatisporites primarius (Wolff, 1934) Thomson & Pflug, 1953

Baculatisporites primarius primarius Krutzsch, 1967
(Pl. V, Fig. 1)

1967*b*. *Baculatisporites primarius primarius* W. Kr.; W. Krutzsch, p. 54, Pl. 9, Figs 1—12.

Material. — More than 30 well-preserved specimens.

Description. — Round in outline; size 40 to 48 μ.Y-mark fine, arms up to half of radius. Exine consisting of one layer, 0.5 to 1 μ thick, covered with widely and irregularly spaced processes to 1 μ high, about 0.5 to 1 μ in diameter at the base, and rounded or somewhat tapering at the apex.

Remarks. — Wolff's (1934) species *Sporites primarius* was later frequently cited in literature. In 1967 *b*, Krutzsch erected, within this species, five new subspecies, based on the differences in size and the character of sculpture. The characters of the species, described and illustrated by Wolff, are in conformity with those of the subspecies *Baculatisporites primarius primarius.*

Botanical affinity. — Family Osmundaceae.

Occurrence (in the area described). — Middle Oligocene of Tarnówka and Middle and Upper Miocene of Ustronie, Gierlachowo, Gołębin Stary and Pecno.

Baculatisporites primarius major (Raatz, 1937), Thomson & Pflug, 1953
(Pl. V, Figs 2a, b; 3)

1937. *Sporites primarius major* Raatz; G. V. Raatz, p. 12, Pl. 1, Fig. 14.

Material. — Eight specimens.

Description. — Round in outline; size 68 to 78 μ. Y-mark with short arms reaching at most a half of radius. Exine monolayered, about 1 to 1.5 μ thick, covered with widely and irregularly spaced verrucate processes 1 to 1.5 μ in height and diameter at the base.

Remarks. — This subspecies was erected by Raatz (1937). In 1953, Thomson and Pflug changed the generic name into *Baculatisporites.* In 1967*b*, Krutzsch revalorized the subspecies of Raatz.

Botanical affinity. — Family Osmundaceae. According to Krutzsch, spores most similar morphologically occur in the species *Osmunda rachelli* and *Osmunda presliana.*

Occurrence (in the area described.) — The deposits from the Middle and Upper Miocene of the Oczkowice, Gierlachowo, Tarnówka and Mosina borings.

Baculatisporites nanus nanus Krutzsch, 1967
(Pl. V, Figs 2a, b; 3a, b)

1934. *Sporites nanus* Wolff; H. Wolff, p. 66, Pl. 5, Fig. 9.

Material. — Fifteen specimens.

Description. — Round in outline; size 27 to 35 μ. Y-mark with narrow, relatively long arms, reaching three-quarters of radius. Exine consisting of one layer, thin (mostly less than 0.5 μ), covered with separate, wide, short baculae.

Remarks. — Specimens of *B. nanus nanus* are frequent in all horizons of the Later Tertiary. They are smaller than other species of *Baculatisporites.*

Botanical affinity. — Family Osmundaceae.

Occurrence (in the area described). — Lower, Middle and Upper Miocene in the Gierlachowo, Oczkowice and Ustronie borings.

Baculatisporites nanus baculatus (Krutzsch, 1959) 1967
(Pl. V, Fig 4a, b)

1959*a*. *Baculatisporites baculatus* W. Kr.; W. Krutzsch, p. 141.

Material. — Five specimens.

Description. — Round in outline; size 30 to 40 μ. Y-mark with straight, long arms sometimes reaching equator. Exine thin. Sculpture baculate; baculae spaced, about 0.5 μ in diameter and to 1.5 μ long.

Remarks. — It differs from the specimens of *B. nanus nanus* in somewhat larger dimensions and primarily in the elements of sculpture, which are narrower and longer.

Botanical affinity. — Family Osmundaceae.

Occurrence (in the area described). — Upper Miocene, sporadically, in Ustronie, Gierlachowo, Nowa Wieś borings.

Baculatisporites quintus quintus Krutzsch, 1967
(Pl. V, Figs 5a, b)

1953. *Rugulatisporites quintus* Th. & Pf.; P. W. Thomson & H. Pflug, p. 56, Pl. 2, Figs 44—47.

Material. — A dozen or so specimens.

Description. — Round in outline; size 36 to 60 μ. The arms of Y-mark narrow up to two-thirds of radius. Exine consisting of one layer about 1 μ thick, covered with closely spaced conical processes, sometimes fused in the base and forming a listlike sculpture, with its elements varying in height within limits of 1 to 2 μ.

Remarks. — Specimens of this species are frequently met in literature under various generic names. Due to an indubitable similarity to the family Osmundaceae, all forms of this type were assigned by Krutzsch (1967*b*) to the genus *Baculatisporites.*

Botanical affinity. — Family Osmundaceae.

Occurrence (in the area described). — Few specimens in various stratigraphic horizons from the Middle Oligocene through the Middle Miocene, the Ustronie, Oczkowice and Nowa Wieś borings.

Genus *Retitrilites* (van der Hammen *ex* Pierce, 1961) emend. Döring *et al.*, 1963

Type species: Retitrilites globosus Pierce, 1961

Retitrilites lusaticus Krutzsch, 1963
(Pl. VI, Figs 1a, b; 3a—c)

1963*a*. *Retitrilites lusaticus* W. Kr.; W. Krutzsch, p. 96, Pl. 29, Figs 1—6.

Material. — Five specimens.

Description. — Subround in outline; size 33 to 38 μ. Exine consisting of two layers, both layers equal in thickness. The surface covered with listlike processes about 1.5 to 2 μ high, forming a reticulum with relatively large, subround meshes about 6 to 8 μ in diameter. On distal face, reticulum strongly developed. On proximal face, polar area almost completely devoid of sculpture. Y-mark distinct, its arms straight, equalling three-quarters of radius.

Remarks. — Specimens in the material under study are larger than those described by Krutzsch (1963*a*).

Botanical affinity. — *Lycopodium*.

Occurrence (in the area described). — Middle Oligocene, Tarnówka.

Retitrilites oligocenicus Krutzsch, 1963
(Pl. VI, Fig. 2)

1963. *Retitrilites oligocenicus* W. Kr.; W. Krutzsch, p. 92, Pl. 27, Figs 9—13.

Material. — Two specimens.

Description. — Rounded-triangular in outline; size 31 to 35 μ. Exine consisting of two layers about 1 μ thick. Outer layer covered on distal face with baculate processes to 2.5 μ high. A thin film between them forms a polygonally meshed reticulum, with particular meshes to 5 μ in diameter. Proximal face without sculpture. Y-mark well developed, its armes equalling two-thirds of radius.

Remarks. — Specimens of this species are similar to those of *Retitriletes verrucatus* (Krutzsch, 1963*a*), from which they differ, however, in the lack of elevation near Y-mark, in a slightly different shape and the length of the arms of Y-mark.

Botanical affinity. — *Lycopodium*.

Occurrence (in the area described). — Middle Oligocene, single specimens from the Mosina boring.

Genus *Reticulosporis* Krutzsch, 1963

Type species: Reticulosporis miocenicus (Selling, 1944) Krutzsch, 1959

Reticulosporis miocenicus (Selling, 1944) Krutzsch, 1959
(Pl. VI, Fig. 4)

1944. *Schizaea miocenica* Selling; O. H. Selling, p. 68, Pl. 4, Fig. 46.

Material. — Three specimens.

Description. — Widely beanlike in equatorial view; 85 to 100 μ in size. Polar axis 65 to 75 μ long. Exine consisting of two layers, about 3 μ thick. Outer layer, twice as thick as inner. Sculpture in the form of conical processes about 1 μ high, fused together at the base and with blunt apices. The processes form a reticulum with its meshes about 2 μ in diameter. Monolete straight, relatively long.

Remarks. — Spores of this species are, according to Krutzsch (1963*a*), relatively small (about 70 μ), this being one of the characters differing them from *R. polonicus.* In the material under study, the size ratio of the specimens of these species is opposite. Specimens, in which the structure of the reticulum and processes of sculpture is characteristic of *R. miocenicus*, are larger.

Botanical affinity. — Family Schizaeaceae. According to Selling (1944) a probable affinity to *Schizaea pusilla*, a Recent South American species.

Occurrence (in the area described). — Middle Miocene, Gierlachowo.

Reticulosporis polonicus Krutzsch, 1959
(Pl. VI, Fig. 5)

1959*a*. *Reticulosporis polonicus* W. Kr.; W. Krutzsch, p. 229.

Material. — Two specimens.

Description. — Widely beanlike in equatorial view. Monolete short, equator diameter 63 to 65 μ long. Exine consisting of two layers, about 3.5 μ thick. Its inner layer smooth, many times thinner than outer. Outer thick, with an uneven, serrate margin, covered with baculate processes about 2 μ high, regularly and closely spaced, forming a network with hexagonal meshes. Meshes about 2.5 to 3 μ in diameter.

Remarks. — This species was first illustrated by J. Doktorowicz-Hrebnicka (1954) who assigned its species to the Recent *Schizaea scottsbergi.* In 1959*a*, Krutzsch described a new genus, *Reticulosporis* in which he included the species illustrated by Doktorowicz-Hrebnicka, and gave it a new name *R. polonicus.*

Botanical affinity. — Probably the family Schizaeaceae.

Occurrence (in the area described). — Middle Miocene, Gierlachowo.

Genus *Laevigatosporites* Ibrahim, 1933

Type species: Laevigatosporites vulgaris (Ibrahim, 1932), 1933

Laevigatosporites haardti haardti Krutzsch, 1967
(Pl. VII, Fig. 2)

1934. *Sporites haardti* R. Pot. & Ven.; R. Potonié & H. Venitz, p. 13, Pl. 1, Fig. 13.

Material. — Many well preserved specimens.

Description. — Beanlike in equatorial and oval in polar view. Diameter of species 32 to 40 μ; length of polar axis about 25 to 30 μ. Exine monolayered, about 1 to 2 μ thick. Monolete relatively long (20 to 25 μ), rectilinear, not bifurcate.

Remarks. — It was separated from *L. gracilis* and *L. nutidus* by Krutzsch (1967*b*), who did it on the basis of dimensions, assuming 30 and 45 μ as limiting values.

Botanical affinity. — Family Polypodiaceae.

Occurrence (in the area discribed). — Oligocene and Miocene, very numerous, sometimes even abundant in all profiles.

Laevigatosporites nutidus nutidus Krutzsch, 1967
(Pl. VII, Fig. 1)

1960. Polypodiaceae — *Sporites haardti* R. Pot. & Ven forma *nutidus* Mamczar; J. Mamczar, p. 23, Pl. 1, Fig. 9.

Material. — Ten well preserved specimens.

Description. — Oval in equatorial view. Equatorial diameter 45 μ, polar axis 30 to 35 μ. Monolete long, not bifurcate. Exine consisting of two layers, smooth.

Remarks. — On the basis of size, this species was separated by Krutzsch (1967*b*) from *L. haardti.* In the material under study, rare specimens of *L. nutidus* occur in the uppér sectors of profiles (Middlé Polish Beds).

Botanical affinity. — Family Polypodiaceae.

Occurrence (in the area described). — Upper Miocene of the Ustronie and Oczkowice profiles.

Laevigatosporites gracilis Wilson & Webster, 1946
(Pl. VII, Fig. 3)

1946. *Levigato-sporites gracilis* Wilson & Webster; L. R. Wilson & B. M. Webster, p. 273—274, Fig. 4.

Material. — More than 50 specimens.

Description. — Beanlike in outline in equatorial view. Diameter 23 to 27 μ, polar axis 16 to 19 μ. Exine consisting of one layer, smooth, less than 1 μ thick. Monolete, 16 to 20 μ long, rectilinear.

Remarks. — In conformity with Krutzsch's (1967*b*) division, all specimens with a smooth exine and less than 30 μ in diameter are assigned to this species.

Botanical affinity. — Family Polypodiaceae.

Occurrence (in the area described). — Miocene: Ustronie, Oczkowice, Gierlachowo, Krosno and Gołębin Stary borings.

Levigatosporites sp.

Material. — One specimen.

Description. — In equatorial view widely oval in outline, with a slight flattening near the contact margin. Diameter 44 μ, polar axis 33 μ. Exine consisting of two layers, thick. Inner layer less than 1 μ thick, outer twice as thick, covered with low and wide verrucae.

Remarks. — Up to now no species with similar features have been described.

Botanical affinity. — Probably the family Polypodiaceae.

Occurrence (in the area described). — Lower Miocene, Wirczyn.

Genus *Verrucatosporites* Thomson & Pflug, 1953

Type species: Verrucatosporites alienus (R. Potonié, 1931) Thomson & Pflug, 1953

Verrucatosporites histopteroides Krutzsch, 1962

(Pl. VII, Fig. 6a, b)

1962*a*. *Verrucatosporites histiopteroides* W. Kr.; W. Krutzsch, p. 269, Pl. 2, Figs 1—6.

Material. — A few well preserved specimens.

Description. — Oval in polar and widely beanlike in equatorial view. Equator diameter 45 to 65 μ. Monolete about two-thirds of diameter, rectilinear, not bifurcate. Exine polylayered, about 2 to 3 μ thick, covered with closely spaced, flat, polygonal verrucae varying from 5 to 8 μ in diameter and 3 to 5 μ in height.

Remarks. — In this species, two subspecies differing in size only, were distinguished by Krutzsch (1967*b*), who assumed the value of 50 μ as a boundary between them. In the material under study, both of them were found, but, due to a small number of specimens, they were treated as one. Krutzsch considers this species as a typical form of tropical flora.

Botanical affinity. — Family Polypodiaceae. According to Krutzsch (1962*a*) it is probably related to*Histiopteris* (*Pteris*) *incisa*, an only still living species of the genus *Histiopteris.*

Occurrence (*in the area described*). — Middle Miocene, phase VIII; Ustronie, Gierlachowo.

Verrucatosporites favus (R. Potonié, 1931c) Thomson & Pflug, 1953
(Pl. VII, Fig. 9)

1931c. *Polypodii* (?) — *sporites favus* R. Pot.; R. Potonié, p. 556, Fig. 3.

Material. — Eight well preserved specimens.

Description. — Convex-beanlike to oval in equatorial view. Diameter 42 to 64 μ. Monolete equalling in length two-thirds the diameter of spore. Exine polylayered, about 3 μ thick, covered with closely spaced, low verrucae 3 to 5 μ in diameter and 2 μ high.

Remarks. — Specimens in the material under study differ from those of *V. favus* in a less regular sculpture.

Botanical affinity. — Family Polypodiaceae. Krutzsch (1967) compares it with some species of the genus Polypodium.

Occurrence (in the material under study). — Neogene phases VI and VIII of the Ustronie, Nowa Wieś, Pecno and Tarnówka boreholes.

Verrucatosporites megabalticus Krutzsch, 1967
(Pl. VII, Fig. 5a, b)

1967b. *Verrucatosporites megabalticus* W. Kr.; W. Krutzsch, p. 180, Pl. 66, Figs 1—3.

Material. — Twelve well preserved specimens.

Description. — Concave-beanlike and elongate in equatorial view. Proximal face concave. Equatorial diameter 48 to 52 μ, polar axis 25 to 27 μ. Exine polylayered, to 3 μ thick, covered with closely spaced hemispherical or even spherical verrucae to 7 μ in diameter and height.

Remarks. — Krutzsch considers this species as a floristic component of cooler phases mostly of Lower Neogene and Upper Paleogene.

Botanical affinity. — Family Polypodiaceae.

Occurrence (in the area described). — Middle Oligocene only, Tarnówka borehole.

Verrucatosporites balticus balticus Krutzsch, 1967
(Pl. VII, Fig. 4a, b)

1967b. *Verrucatosporites balticus balticus* W. Kr. 1967; W. Krutzsch, p. 117, Pl. 65, Figs 6—8.

Material. — Ten well preserved specimens.

Description. — Beanlike, concave-convex in equatorial view. Diameter 30 to 36 μ, polar axis 19 to 23 μ. Exine, consisting of two layers, is 1.5 to 3 μ thick. Inner layer two times thinner than outer. Outer layer covered with closely spaced, polygonal verrucae about 2 μ high and about 3 to 4 μ in diameter at the base.

Remarks. — In their small size and a polygonal outline of their relatively not very high verrucae, the specimens of this subspecies differ distinctly from other species of the genus *Verrucatosporites.*

Botanical affinity. — Undoubtedly the family Polypodiaceae. According to Krutzsch (1967), similar spores occur in the Recent species *Nephrolepis cordifolia* and *Polypodium meyenianum.*

Occurrence (in the area described). — Lower Miocene (phase V), Ustronie boring; Middle Miocene (phase IX), Ustronie and Nowa Wieś borings.

Verrucatosporites irregularis Krutzsch, 1963
(Pl. VII, Fig. 9)

1963*a*. *Verrucatosporites irregularis* W. Kr.; W. Krutzsch, p. 192, Pl. 72, Figs 5—8.

Material. — One specimen with a poorly preserved sculpture occurring in the central part.

Description. — Oval in equatorial outline, with a concave proximal and strongly convex distal part. Diameter 47 μ; polar axis 32 μ long. A two-layer exine has its outer layer covered with verrucae 1 to 2 μ high and varying in diameter. Verrucae are higher in the distal part, very small near the monolete, which is short and straight.

Botanical affinity. — Family Polypodiaceae. According to Krutzsch (1963*a*), it may be compared with the species *Polypodium trisariale, Monogramma persicariaefolia* or *Campyloneurum phyllitides.*

Occurrence (in the area described). — Lower Miocene, Ustronie, phase III.

Verrucatosporites bockwitzensis Krutzsch, 1967
(Pl. VII, Fig. 11)

1967*b*. *Verrucatosporites bockwitzensis* W. Kr.; W. Krutzsch, p. 190, Pl. 71, Figs 1—2.

Material — A few specimens.

Description. — Oval in equatorial outline. Monolete short, 18 μ. Spore 52 μ in diameter. An one-layer wall is covered with very closely-spaced, flat, polygonal verrucae to 7 μ in maximum diameter and to 2.5 μ high.

Remarks. — The diameter of the specimens is smaller than limiting values given by Krutzsch (1967), but, because of its very flat and large elements of sculpture, is assigned by the present writer to *Verrucatosporites bockwitzensis.*

Botanical affinity. — Family Polypodiaceae.

Occurrence (in the area described). — Middle Oligocene, phase 20, Mosina.

Genus *Reticuloidosporites* Pflug, 1953

Type species: Reticuloidosporites dentatus Thomson & Pflug, 1953

Reticuloidosporites cf. *dentatus* Pflug, 1953
(Pl. VII, Fig. 8)

1953. *Reticuloidosporites dentatus* Pf.; P. W. Thomson & H. Pflug, p. 60, Pl. 4, Fig. 11.

Material. — One specimen.

Description. — Beanlike in equatorial view. Monolete straight, equalling in length a half of spore diameter. Diameter 50 μ, polar axis 32 μ. Exine about 1.5 μ thick, its outer layer thinner (0.5 μ). In proximal part, wall smooth; in distal part — covered with closely-spaced polygonal processes in form of blunt teeth.

Remarks. — The species is considered as Lower Tertiary one (Krutzsch, 1967*b*).

Botanical affinity. — Unknown.

Occurrence (in the area described). — Middle Oligocene, Tarnówka.

Incertae sedis
Genus *Monoleiotrilites* Krutzsch, 1959

Type species: Monoleiotrilites angustus Krutzsch, 1959

Monoleiotrilites minimus Krutzsch, 1962
(Pl. II, Fig. 1)

1962*b*. *Monoleiotrilites minimus* W. Kr.; W. Krutzsch, p. 44, Pl. 15, Figs 10—11.

Material. — Three specimens.

Description. — Convex-triangular in outline, 25 to 27 μ in size. Exine consisting of one layer, very thin (less than 0.5 μ). Y-mark distinct, with long, straight arms nearly reaching equator. Because of a very thin wall secondary folds occur frequently.

Remarks. — These rare specimens differ from other species of this genus in a delicate structure.

Botanical affinity. — Unknown so far.

Occurrence (in the area described). — Upper Miocene phase XIII, Oczkowice.

Genus *Microfoveolatisporis* Krutzsch, 1962

Type species: *Microfoveolatisporis teummlitzensis* Krutzsch, 1962

Microfoveolatisporis minutus sp. n.

(Pl. II, Fig. 4)

Holotype: Pl. II, Fig. 4

Type horizon and locality: Upper Miocene, phase XI, Ustronie, depth 140.0—140.7 m.

Derivation of the name. — After small size.

Material. — Eight specimens.

Diagnosis. — Subround in outline, size 25 to 30 μ. Exine 0.5 μ thick, consisting of two layers. Arms of Y-mark with paralleling lateral lists, equalling a half of radius.

Description. — Spores subround in outline, small (25 to 30 μ). Exine very thin (mostly less than 0.5 μ), consisting of two layers. Outer layer, identical in thickness with inner, displays a very distinct fine-faveolate sculpture. Arms of Y-mark long, straight, not bifurcate, nearly reaching equator and with lateral lists running along them.

Remarks. — This species is similar to *Microfoveolatisporis apheloides* Krutzsch, 1962*b*, from which is differs in smaller size, thinner walls and more distinctly developed lists accompanying the arms of Y-mark.

Botanical affinity. — Unknown. Spores of *Pteridium aquilinum* display a somewhat similar structure.

Occurrence (*in the area described*). — Upper Miocene, Oczkowice, and Ustronie.

Class **Gymnospermae**

Genus *Pityosporites* Seward, 1914

Type species: *Pityosporites antarcticus* Seward, 1914

Pitiosporites microalatus (R. Potonié, 1931) Thomson & Pflug, 1953

(Pl. VIII, Fig. 3)

1931*b*. *Piceae-pollenites microalatus* R. Pot.; R. Potonié, p. 5, Fig. 34.

Material. — More than 100 specimens.

Description. — Bisaccate pollen grains 48 to 60 μ long and 28 to 40 μ wide. Corpus rounded-rhomboid in outline. Sacci hemispherical, widely mounted on corpus. Sculpture of sacci reticulate, with reticular meshes arranged somewhat radially. Both proximal and distal face of wall fine-punctate.

Remarks. — Krutzsch (1971) separated *P. microalatus* from *P. alatus* only on the basis of difference in size (boundary size 60 μ). *P. microalatus* has been frequently cited in literature. In 1935, Rudolph termed this type of pollen structure as the *Pinus Haploxylon* type. This term was generally accepted and widely used afterwards. Doktorowicz-Hrebnicka (1960, 1961, 1964) distinguished 17 forms of this type and Mamczar (1960) three more. Eight of them were assigned by Krutzsch (1971) to *P. microalatus* as fully fitting with the diagnose of the species.

Botanical affinity. — Genus *Pinus.*

Occurrence (in the area described). — Oligocene and Miocene, abundant in all samples and only rarely less than 5 per cent.

Pityosporites alatus (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. VIII, Fig. 4)

1931*b*. *Piceae-pollenites alatus* R. Pot.; R. Potonié, p. 5, Fig. 31.

Material. — About hundred specimens.

Description. — Bisaccate pollen grains more than 60 μ long (including sacci) and 40 to 52 μ in corpus height. Corpus rounded, 38 to 45 by 38 to 52 μ. Exine thin, less than 0.5 μ. Sacci hemispherical, widely mounted on corpus, whose base equals corpus breadth and height is 28 to 35 μ. Sculpture on sacci distinctly reticulate, in central part mesh diameter reaching 3 to 4 μ. Distal face of corpus between sacci fine-punctate, mostly narrow. Bases of usually parallel to each other.

Remarks. — Potonié (1931*b*) considered this species as belonging to the genus *Picea*. Later, many authors described it as a large form of *P. haploxylon* (Thiergart, 1938; Kremp, 1949 and others). In 1951, changing his mind, Potonié included it in the genus *Abietinaepollenites.* Revising this species, Krutzsch (1971) included it (following Thomson & Pflug, 1953) in the genus *Pityosporites. P. alatus* was described by many authors under various specific names (the list of synonyms, cf. Krutzsch, 1971, p. 51).

Botanical affinity — Probably the genus *Pinus.*

Occurrence (in the area described). — Oligocene and Miocene, in many samples of all profiles, sometimes more than 5 per cent.

Pityosporites labdacus labdacus Krutzsch, 1971
(Pl. IX, Fig. 6)

1931*b*. *Pollenites labdacus* R. Pot.; R. Potonié, p. 5, Fig. 32.

Material. — Several hundred specimens.

Description. — Bisaccate pollen grains to 85 μ long and to 50 μ in corpus height. Sacci hemispherical, fused to corpus by a wide base having parallel margins. On distal face, the surface of exine smooth between sacci. On proximal, a slightly swollen exine forms an indistinct crest.

Remarks. — Krutzsch (1971) distinguished in *P. labdacus* three subspecies differing from each other in size and in the thickness of exine in the distal part of grain. He included in *P. labdacus labdacus* forms described by various authors mostly as the *P. silvestris* type.

Botanical affinity. — Genus *Pinus*. This type of the structure of pollen grains is observed in many Recent species of this genus.

Occurrence (in the area described). — Oligocene and Miocene, in all profiles, sometimes abundantly.

Pityosporites labdacus reticulatus (Doktorowicz-Hrebnicka, 1960) Krutzsch, 1971

(Pl. VIII, Fig. 7)

1960. *Pinus silvestris* Rudolph forma *reticulata* Dokt.-Hrebn.; J. Doktorowicz-Hrebnicka, p. 77, Pl. 19, Fig. 24.

Material. — A dozen or so specimens.

Description. — Including sacci, pollen grains are 56 to 90 μ long, corpus 35 to 47 μ high. Sacci semicircular in outline, sculpture reticulate. Reticular meshes large, reaching about 10 μ, polygonal. Corpus oblate in outline. On the proximal face exine granulate, thickened in form of a crest.

Remarks. — This subspecies was distinguished as a form in both Mamczar's (1960) and Doktorowicz-Hrebnicka's (1960) papers. Krutzsch (1971) acknowledged the authorship of the latter writer.

Botanical affinity. — Genus *Pinus*.

Occurrence (in the area described). — Middle Miocene in Gierlachowo and Middle Oligocene in Tarnówka.

Pityosporites labdacus pseudocristatus (Doktorowicz-Hrebnicka, 1960) Krutzsch, 1971

(Pl. VIII, Fig. 6; Pl. IX, Fig. 4)

1960. *Pinus silvestris* Rudolph forma *pseudocristata* Dokt.-Hrebn.; J. Doktorowicz-Hrebnicka, p. 77, Pl. 20, Fig. 26.

Material. — Twelve specimens.

Description. — Pollen grains 42 to 93 μ long (sacci included), corpus — 32 to 45 μ. Sacci hemispherical. Exine with a reticulate sculpture. Reticular meshes fine, not forming distinct polygons. Corpus subround or somewhat elongate in outline. The structure of exine between sacci fine, on proximal face coarse-punctate. In this part of corpus, the surface of exine uneven, undulate. A distinct, undulating crest occurs around the corpus.

Remarks — This species was erected by Krutzsch (1971) on the basis of two forms, *pseudocristata* and *pseudocristata similis*, described by Doktorowicz-Hrebnicka (1960). The latter, considerably larger form, has a somewhat different sculpture of sacs, marked by very large, polygonal meshes of reticulum.

Botanical affinity. — Genus *Pinus.*

Occurrence (in the area described). — In the deposits of Middle Polish Beds of Oczkowice and in the Middle Oligocene of Tarnówka.

Pityosporites scopulipites (Wodehouse, 1933) Krutzsch, 1971
(Pl. VIII, Fig. 1)

1933. *Pinus scopulipites* Wodh.; R. P. Wodehouse, p. 488, Fig. 8.

Material. — Four specimens.

Description. — Pollen grains 42 to 56 μ long and 37 to 42 μ high. Corpus oblate. Sacci hemispherical, widely mounted on corpus. The sculpture of exine on sacci reticulate, its meshes not forming acute-angled polygons, but have slightly rounded corners. Exine corpus scabrous, more distinct on the proximal than distal face. In the proximal part, exine slightly thickened and forming an indistinct crest.

Remarks. — Despite its being described long ago, this species is only rarely cited in literature. Described and illustrated recently by Krutzsch (1971), the species is rare and differs from *P. minimus* and *P. pristinipollis*, species related morphologically, primarily in dimensions.

Botanical affinity. — Genus *Pinus.* According to Wodehouse (1933), similar in morphological type are pollen grains of the Recent species *Pinus scopulorum.*

Occurrence (in the area described). — Only in Ustronie, Lower Miocene, phase V.

Pityosporites insignis (Naumova *ex* Bolchovitina, 1953) Krutzsch, 1971
(Pl. IX, Fig. 3).

1953. *Pinus insignis* Naumowa; N. A. Bolchovitina, Pl. 13, Fig. 1.

Material. — Four specimens.

Description. — Pollen grains 60 to 72 μ long and 38 to 40 μ heigh. Corpus 45 to 51 μ long, oblate in polar view. The exine relatively thick, on distal face between sacci smooth, on proximal face distinctly gemmate. Sacci relatively small, nearly spherical, narrowly fused. Exine sculpture reticulate, its meshes' diameters conspicuously increasing towards the centrum.

Remarks. — *P. insignis* is marked mostly by the lack of a distinct structure of exine on the distal face, between sacs. Very rarely found in the material under study.

Botanical affinity. — Genus *Pinus.*

Occurrence (in the area described). — Upper Miocene, Nowa Wieś and Lower Miocene, Gierlachowo.

Pityosporites peuceformis (Zaklinskaja, 1957) Krutzsch, 1971
(Pl. IX, Fig. 5)

1957. *Pinus peuceformis* Zaklinskaja; E. D. Zaklinskaja, p. 149, Pl. 12, Figs 9—12.

Material. — Three specimens.

Description. — Pollen grains 75 to 89 μ long, corpus 42 to 50 μ high. Corpus oval, sacci subspherical. Exine on sacci reticulate, reticulum meshes in the form of irregular polygons. Corpus exine between sacci smooth and thickened on proximal face, forming a crest to 6 μ high.

Remarks. — Described by Zaklinskaja from the Middle Eocene, this species was found in some cooler Miocene phases of Germany. It differs from others in its larger dimensions and distinct, undulate swelling of exine on proximal face.

Botanical affinity. — Genus *Pinus.* This species is compared by Zaklinskaja (1971) with *Pinus peuce.*

Occurrence (in the area described). — Middle Oligocene, Tarnówka.

Genus *Abiespollenites* Thiergart, 1937

Type species: *Abiespollenites absolutus* Thiergart, 1937

Abiespollenites latisaccatus (Trevisan, 1967), Krutzsch, 1971
(Pl. VIII, Fig. 2; Pl. X, Fig. 1)

1967. *Pityosporites latisaccatus* Trevisan; L. Trevisan, p. 21, Pl. 12, Fig. 4a—c.

Material. — Twelve specimens.

Description. — Pollen grains 95 to 120 μ long and 65 to 90 μ high. Corpus oblate, 80 to 103 μ long. Sacci semicircular in outline, narrowly mounted on corpus. The sculpture of exine on sacci distinctly reticulate. The structure of the corpus exine columellar, forming on the surface labyrinthine, fine rollers. Between sacii exine smooth. On the proximal face exine twice as thick as on equator. On the proximal part a distinct crest somewhat depressed at the pole.

Remarks. — According to Krutzsch (1971), this species is a typical representative of the Arctic-Tertiary element, which from the Eocene-Oligocene boundary occurs in cooler phases only.

Botanical affinity. — The nearest morphologically is the species *Abies firma.*

Occurrence (in the area described). — Miocene, Ustronie, phase V; Gierlachowo, phase VII and Nowa Wieś, phase XIII.

Abiespollenites maximus Krutzsch, 1971
(Pl. XI, Fig. 2)

1971. *Abiespollenites maximus* W. Kr.; W. Krutzsch, p. 92, Pl. 18, Figs 1—4.

Material. — One specimen.

Description. — Pollen grains 180 to 210 μ long. Corpus oblate 130 μ long and 105 μ wide. Sacci hemispherical, sculpture reticulate, its meshes irregularly polygonal. Corpus exine on the proximal face strongly thickened, forming a high (to 8 μ) crest, on the distal face considerably thinner.

Remarks. — This species differs in large dimensions from all others of this genus. In Krutzsch's opinion, this species may be compared only with *A. davidianaeformis.* It is a very rare element, occurring only in cooler Miocene phases.

Botanical affinity. — The genera *Pinus* or *Keteleeria.*

Occurrence (in the area described). — Upper Miocene, Ustronie.

Abiespollenites microsaccoides Krutzsch, 1971
(Pl. X, Fig. 3)

1971. *Abiespollenites microsaccoides* W. Kr.; W. Krutzsch, p. 94, Pl. 19, Figs 1—3.

Material. — Five specimens.

Description. — Corpus rounded, about 90 to 100 μ long. Sacci small, subspheroid, exine sculpture reticulate, its meshes small, irregularly polygonal. The exine of corpus on proximal face strongly thickened and forming a crest 6 to 8 μ high, on distal face delicate, fine-punctate.

Remarks. — In their relatively small size and very strongly developed crest, specimens of this species differ from those of all other species of the genus *Abiespollenites.*

Botanical affinity. — Species *Abies cephalonica* and *A. holophylla* are marked by a type of pollen similar morphologically.

Occurrence (in the area described). — Middle Miocene, Ustronie and Upper Miocene, Oczkowice.

Abiespollenites dubius (Chlonova, 1960) Krutzsch, 1971
(Pl. X, Fig. 2)

1960. *Keteleeria dubia* Chlonowa; A. V. Chlonova, p. 59, Pl. 9, Fig. 5.

Material. — Five specimens.

Description. — Pollen grains 120 to 140 μ long and 90 to 100 μ high. Corpus suboblate, sacci subspheroid, with a polygonal reticulum, its meshes 3 to 5 μ in diameter. Exine on corpus relatively thin (2 to 3 μ), distinctly columellar in structure, very slightly thickened in proximal part.

Remarks. — This species was first described by Thiergart (1937) from the Miocene of Germany, as a pollen of the *Keteleeria* type and afterwards was frequently cited as this type (Kirchheimer, 1938; Leschik, 1956, and, in Soviet literature, Chlonova, 1960; Pokrovskaya, 1956). Pollen grains similar in the type of structure were described or illustrated from the territory of Poland by Doktorowicz-Hrebnicka (1957), Oszast (1960), Romanowicz (1961), Mamczar (1961), Ziembińska & Niklewski (1966) and Stachurska *et al.* (1967, 1971).

Botanical affinity. — Genus *Keteleeria.*

Occurrence (in the area described). — Lower Miocene, Gierlachowo and Niedźwiedzice.

Genus *Piceapollis* Krutzsch, 1971

Type species: *Piceapollis praemarianus* Krutzsch, 1971

Piceapollis tobolicus (Panova, 1966) Krutzsch, 1971
(Pl. XI, Fig. 1).

1966. *Picea tobolica* Panova; L. A. Panova, p. 220, Pl. 105, Fig. 4.

Material. — Eight specimens.

Description. — Pollen grains 110 to 140 μ long and 75 to 90 μ high. Corpus suboblate with distal face somewhat concave. Sacci hemispherical, with a distinct fine-reticulate sculpture. On the distal face of corpus exine smooth, on proximal slightly thickened and forming a small crest.

Remarks. — This is an exceptionally large form of the genus *Piceapollis*, differing from the type species in larger dimensions only (Krutzsch, 1971). Relatively frequent in the deposits of Central Europe. In the deposits from the territory of Germany it is known from cooler Miocene phases. It was also described from the Middle and Upper Oligocene and the Miocene of Siberia. Nagy (1969) described it as *P. neogenicus* from the Miocene of Hungary. Such large forms of *Picea* were recorded in the deposits of Poland by Romanowicz (1961).

Botanical affinity. — Genus *Picea.*

Occurrence (in the area described). — Middle Oligocene, the Tarnówka, Mosina and Krosinko profiles.

Genus *Cedripites* Wodehouse, 1933

Type species: *Cedripites eocenicus* Wodehouse, 1933

Cedripites miocaenicus Krutzsch, 1971
(Pl. XI, Fig. 3)

1971. *Cedripites miocaenicus* W. Kr.; W. Krutzsch, p. 120, Pl. 29, Figs 1—4.

Material. — Two specimens.

Description. — Pollen grains 75 and 82 μ long. Corpus oblate. Sacci hemispherical, with arcuate bases. The sculpture of sacci in the form of a fine reticulum, its meshes radially elongate. On the distal face of corpus between sacci exine thin, smooth, on the proximal face thickened and forming a crest columellar in structure.

Remarks. — Specimens of the genus *Cedripites* occur in the material under study very rarely and are on the whole poorly preserved.

Botanical affinity. — Probably the genus *Cedrus.*

Occurrence (in the area described). — Middle Miocene (phase IX), Gierlachowo.

Genus *Podocarpidites* Cookson, 1947

Type species: *Podocarpidites ellipticus* Cookson, 1947

Podocarpidites podocarpoides (Thiergart, 1958) Krutzsch, 1971
(Pl. IX, Fig. 1)

1958. *Pityosporites podocarpoides* Thiergart; F. Thiergart, p. 449, Pl. 1, Fig. 15.

Material. — Eight specimens.

Description. — Pollen grains 50 to 85 μ long and 35 to 42 μ wide. Corpus rounded or rhomboid. Reticulum on sacci distinct, its fine, polygonal meshes 3.5 to 4 μ in diameter are arranged radially near distal pole. Exine of corpus relatively thick (to 2 μ) and having a verrucate sculpture.

Remarks. — Very similar specimens of *Podocarpus* were determined by Mamczar (1960) as forma *papiliona.* Specimens of *Podocarpus* similar in structure were, on the other hand, considered by Doktorowicz-Hrebnicka (1964) as forma *suprema.*

Botanical affinity. — Genus *Podocarpus.*

Occurrence (in the area described). — Middle Oligocene, Tarnówka; Lower and Middle Miocene, Ustronie, Nowa Wieś, Gierlachowo.

Podocarpidites libellus (R. Potonié, 1931) Krutzsch, 1971
(Pl. IX, Fig. 2)

1931*b*. *Pini* (?) *pollenites libellus* R. Pot.; R. Potonié, p. 5, Fig. 33.

Material. — Thirty specimens.

Description. — Pollen grains 35 to 50 μ long and 36 μ wide. Corpus suboblate. Sac bases on distal face parallel to and near each other. Reticulum on sacci distinct, radially arranged, mesh of 1.5 to 2.5 μ in diameter. Exine on corpus 1 to 2.5 μ thick, with a fine sculpture and distinct columellar structure, thickened in proximal and thinner in distal part.

Remarks. — Specimens of this species differ from those of *P. podocarpoidites* in smaller dimensions only. The limiting value between *P. poro-*

carpoidites and *P. libellus* amounts to about 50 μ. This species was described in literature under various generic names, including *Podocarpus* forma *libella* from Konin (Mamczar, 1960).

Botanical affinity. — Genus *Podocarpus.*

Occurrence (in the area described). — Middle Miocene (phases VI and VIII) at Gierlachowo and Middle and Upper Miocene at Ustronie.

Genus *Zonalapollenites* Pflug, 1953

Type species: Zonallapollenites igniculus (R. Potonié, 1931) Thomson & Pflug, 1953

Zonallapollenites igniculus (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. XIII, Fig. 1)

1931c. *Sporonites igniculus* R. Pot.; R. Potonié, p. 556, Fig. 2.

Material. — Four specimens.

Description. — Spheroid in polar view, 43 to 55 μ in size, with a strongly developed, large equatorial collar to 10 μ wide, On proximal face sculpture in the form of large, polygonal, flat verrucae, on distal consisting of fine, irregular, tubercular processes.

Remarks. — This species is included in a group of species of the genus *Zonalapollenites* devoid of spines on the surface of exine.

Botanical affinity. — Genus *Tsuga.*

Occurrence (in the area described). — Lower Miocene at Ślepuchowo and Wirczyn; Lower and Middle Miocene at Gierlachowo.

Zonalapollenites maximus (Raatz, 1937) Krutzsch, 1971
(Pl. XIII, Fig. 2).

1937. *Tsugapollenites igniculus* R. Pot. forma *maximus* Raatz; G. V. Raatz, p. 15, Pl. 1, Fig. 13.

Material. — Twelve specimens.

Description. — Grain circular in outline, 70 to 100 μ in diameter, with a large equatorial collar. Sculpture in the form of large, flat verrucae, which on the proximal face are of 2 to 4 μ in diameter and closely spaced and on the distal widely spaced, of 1.5 to 2 μ in diameter.

Remarks. — Several pollen forms of the genus *Tsuga* were described and illustrated by Doktorowicz-Hrebnicka (1964), who called attention to the presence of spines in most fossil pollen grains of this genus. On the basis of this character Krutzsch (1971) divided the fossil pollen of *Tsuga* into two groups, with and without spines. Doktorowicz-Hrebnicka's (1964) work was probably unknown to Krutzsch (1971) who did not take into account in his synonymy the forms distinguished by her. On the basis of illustrations and descriptions of Mamczar (1960) and Doktorowicz-Hrebnicka (1964, p. 34, Fig. 103) it seems, that *Tsuga diversifolia* forma *nudulata* is identical with *Zonalapollenites maximus* (Raatz) Krutzsch.

Botanical affinity. — Genus *Tsuga.*

Occurrence (in the area described). — Middle Oligocene through Upper Miocene in the Mosina, Ślepuchowo, Ustronie and Gierlachowo borings.

Zonalapollenites verrucatus Krutzsch, 1971
(Pl. XII, Fig. 4)

1971. *Zonalapollenites verrucatus* W. Kr.; W. Krutzsch, p. 144, Pl. 39, Figs 1—4.

Material. — Twelve specimens.

Description. — Specimens 50 to 75 μ in size, with a poorly developed equatorial collar. Exine verrucate. On proximal face verrucae large and thick-walled, on distal thin-walled and rounded.

Remarks. — Like most Tertiary species of *Tsuga,* this species is characteristic of cooler climatic phases.

Botanical affinity. — Genus *Tsuga.*

Occurrence (in the area described). — Middle Miocene (phase IX) at Gierlachowo, Upper Miocene (phase XIII) at Oczkowice and Middle Miocene (phase VII) at Ślepuchowo.

Zonalapollenites spinosus (Doktorowicz-Hrebnicka 1964) comb. n.
(Pl. XI, Fig. 1a, b)

1964. *Tsuga* forma *spinosa* Dokt.-Hrebn.; J. Doktorowicz-Hrebnicka, p. 38, Pl. 9, Fig. 39.

1971. *Zonalapollenites spinulosus* W. Kr.; W. Krutzsch, p. 148, Pl. 41, Figs 1—4.

Material. — Ten specimens.

Description. — Specimens 65 to 85 μ in size, with a fairly well developed equatorial collar. On proximal face the sculpture in the form of very large, irregularly polygonal verrucae; on distal face sculpture granulate. Both faces and collar are covered with irregularly scattered spines to 1 μ long.

Remarks. — *Zonalapollenites spinulosus* Krutzsch is conspecific with *Tsuga* forma *spinosa* of Doktorowicz-Hrebnicka (1964) — as follows from the photos and descriptions. The morphological structure of *Z. spinosus* is very similar to that of *Z. verrucatus,* but, due to the presence of distinct spines on its surface, the species has been assigned to a different group of species.

According to Krutzsch (1971) this species occurs not only in cooler, but also warmer climatic phases of the Miocene (phases II, VI and VIII), in the latter as a very rare and in the former as a relatively frequent element.

Botanical affinity. — Genus *Tsuga.*

Occurrence. — In Czechoslovakia, the German Democratic Republic, Turkey and the USSR. In Poland: in the Rogoźno deposit (Doktorowicz-Hrebnicka, 1964). In the material under study: specimens from the Gierlachowo, Oczkowice and Ustronie borings.

Zonalapollenites minimus Krutzsch, 1971
(Pl. XIII, Fig. 4)

1971. *Zonalapollenites minimus* W. Kr.; W. Krutsch, p. 150, Pl. 42, Figs 3—4.

Material. — Seven specimens.

Description. — Circular in equatorial outline, 35 to 52 μ in diameter, with a very distinctly developed equatorial collar. On proximal face polygonal, thick-walled verrucae. On distal face sculpture granulate. Both faces and collar covered with irregularly scattered spines less than 1 μ long.

Remarks. — A species common in the Miocene. In the presence of a strongly developed collar and spines, as well as in its small size, it considerably differs from other species of this genus.

Botanical affinity. — Genus *Tsuga.*

Occurrence (in the area described). — Miocene, cool phases (VII and IX) of the Ustronie, Gierlachowo and Oczkowice borings.

Zonalapollenites spectabilis (Doktorowicz-Hrebnicka, 1964) comb. n.
(Pl. XII, Fig. 3)

1964. *Tsuga* typus *diversifolia spectabilis* Dokt.-Hrebn.; Doktorowicz-Hrebnicka, p. 38, Pl. 6, Figs 17, 17a.

1971. *Zonalapollenites reuterbergensis* W. Kr.; W. Krutzsch, p. 156, Pl. 45, Figs 1—4.

Material. — Eight specimens.

Description. — Specimens 60 to 82 μ in size, with a relatively strongly developed equatorial collar and very distinct sculpture. Proximal face is covered with large, elongate, polygonal, thick-walled, closely spaced verrucae, distal — with smaller, thin-walled, rounded exine processes. Fairly numerous, thin spines occur on both faces.

Remarks. — It seems that *Z. reutenbergensis* Krutzsch, 1971, is conspecific with *Tsuga* type *diversifolia spectabilis* Dokt.-Hrebn., 1964.

Botanical affinity. — Genus *Tsuga.*

Occurrence. — The German Democratic Republic: many localities, including about twenty Pliocene ones. Cooler Miocene phases, primarily phase IX. Poland: Rogoźno deposits (Doktorowicz-Hrebnicka, 1964). In the material under study: Middle Miocene of Gierlachowo (phase IX?), Ustronie (phase IX) and Oczkowice (phase IX).

Zonalapollenites neogenicus Krutzsch, 1971
(Pl. XIII, Fig. 2; Pl. XIII, Fig. 4)

1971. *Zonalapollenites neogenicus* W. Kr.; W. Krutzsch, p. 160, Pl. 47, Figs 4—6.

Material. — A dozen or so specimens.

Description. — Specimens 60 to 90 μ in diameter, with a poorly developed equatorial collar and distinct differences in sculpture occurring between the distal and proximal face. On the proximal face verrucae varying in size and shape and irregularly scattered spines. On the distal face — fine granulae with very numerous spines.

Remarks. — On the basis of photographs and descriptions, *Tsuga* typus *canadensis* forma *crispa* Mamczar, described by Mamczar (1960) and later by Doktorowicz-Hrebnicka (1960 and 1961) seems to be conspecific with *Z. neogenicus* Krutzsch, 1971.

Botanical affinity. — Genus *Tsuga.*

Occurrence (in the area described). — Miocene, the Ustronie, Oczkowice and Krosinko profiles.

Genus *Sciadopityspollenites* Raatz, 1937

Type species: *Sciadopityspollenites serratus* (R. Potonié & Venitz, 1934) Raatz, 1937

Sciadopityspollenites serratus (R. Potonié & Venitz, 1934) Raatz, 1937
(Pl. XIII, Fig. 5)

1934. *Sporites serratus* R. Pot. & Ven.; R. Potonié & H. Venitz, p. 15, Pl. 1, Fig. 6.

Material. — Several dozen specimens.

Description. — Specimens 32 to 48 μ in size. The sculpture in the form of closely spaced, flattened verrucae, irregular in shape and 2 to 3 μ high. The outer layer of exine, which makes up the walls of verrucae, equalls in thickness about one-third the diameter of a verruca, is covered with very fine pilae less than 0.5 μ long; it has a columellar structure.

Remarks. — The species is very common in the Tertiary flora and is known from the Eocene through the Pliocene. According to some authors (Thiergart, 1949; Kirchheimer, 1950; Brelie, 1967; Bobrowska, 1970), its more abundant occurrence in the profiles is a stratigraphic index. Krutzsch (1971) believes that it is connected with cooler climatic phases of the Miocene.

Botanical affinity. — Genus *Sciadopitys.*

Occurrence (in the area described). — Miocene, abundant in some horizons (Oczkowice, Gierlachowo, Ustronie, Krosinko, mostly in phase IX).

Sciadopityspollenites varius Krutzsch, 1971
(Pl. XIII, Fig. 3)

1971. *Sciadopityspollenites varius* W. Kr.; W. Krutzsch, p. 188, Pl. 59, Figs 1—3.

Material. — Two specimens.

Description. — Specimens 48 to 52 μ in size. The sculpture verrucate. Verrucae varying in size, fairly closely spaced, baculate, with round heads covered with fine (less than 0.5 μ), sharp pilae.

Remarks. — This species differs from others primarily in larger dimensions and a baculate shape of verrucae.

Botanical affinity. — Genus *Sciadopitys.*

Occurrence (in the area described). — Middle Miocene, Oczkowice.

Sciadopityspollenites quintus Krutzsch, 1971
(Pl. XIII, Fig. 6)

1971. *Sciadopityspollenites quintus* W. Kr.; W. Krutzsch, p. 180, Pl. 15, Figs 1—6.

Material. — Five specimens.

Description. — Subrounded in outline, 40 to 45 μ in diameter. Sculpture in the form of small, widely spaced verrucae. Thickness of exine 1.8 μ. Outer layer of exine on verrucae and between them has a punctate structure.

Remarks. — According to Krutzsch (1971) this species is characteristic of warmer climatic sectors of the Miocene.

Botanical affinity. — Genus *Sciadopitys.*

Occurrence (in the area described). — Middle Miocene (phase VIII), Gierlachowo.

Sciadopityspollenites verticillatiformis (Zauer, 1960) Krutzsch, 1971
(Pl. XIII, Fig. 7)

1960. *Sciadopitys verticillatiformis* Zauer; J. M. Pokrowskaja & Stelmak, p. 41, Pl. V, Fig. 6a.

Material. — Three specimens.

Description. — Specimens 38 to 45 μ in size. Sculpture verrucate. Verrucae closely spaced, relatively high (2.5 μ), 1 to 1.5 μ in diameter, rounded on apex.

Remarks. — The same as *S. serratus*, this species is characteristic of cooler climatic phases of the Miocene (Krutzsch, 1971). It differs from other species of the genus *Sciadopitys* in its smaller dimensions and the height of verrucae.

Botanical affinity. — Genus *Sciadopitys.*

Occurrence (in the area described). — Very rare, Middle Oligocene, Tarnówka.

Sciadopityspollenites tuberculatus (Zaklinskaja, 1957) Krutzsch, 1971
(Pl. XIII, Fig. 8)

1957. *Sciadopitys tuberculata* Zakl.; E. D. Zaklinskaja, p. 173, Pl. 16, Fig. 3.

Material. — Two specimens.

Description. — Spheroid in outline, 45 to 48 μ in diameter. Sculpture verrucate. Verrucae about 3 μ high and 2.5 to 3 μ in diameter, flattened on apex. Walls of verrucae thick. Outer layer of exine between verrucae distinctly finely-punctate.

Remarks. — Very similar to *S. serratus*, from which it differs primarily in the structure of verrucae. Very rare in deposits.

Botanical affinity. — Genus *Sciadopitys.*

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Genus *Psophosphaera* (Naumova, 1937) *ex* Bolchovitina, 1953

Type species: Psophosphaera tenuis Naumova, 1937

Psophosphaera pseudotsugoides Krutzsch, 1971
(Pl. XIV, Fig. 8)

1971. *Psophospaera pseudotsugoides* W. Kr.; W. Krutzsch, p. 192, Pl. 61, Fig. 2.

Material. — Eleven specimens.

Description. — Large (59 to 75 μ), spherical pollen grains with exine psilate or finely-punctate, about 1 μ thick. Germinal apertures lacking.

Remarks. — Pollen grains of this type, common in the Tertiary deposits, frequently cited in literature as the *Larix*, *Pseudotsuga* type. Such grains were identified by Potonié, Thomson & Thiergart (1950) as *Pseudotsugoidites.* The synonymy of this species is very extensive (Krutzsch, 1971). These variously determined forms were given a new specific name by Krutzsch (1971), who definitely elucidated the difference between the pollen grains with a morphological structure of this type and the remains of plankton described by R. Potonié (1934) as *Sporonites magnus* and later acknowledged as *Pollenites magnus* R. Pot. & Ven., 1934.

Botanical affinity. — Perhaps the genera *Larix* and *Pseudotsuga.*

Occurrence (in the area under study). — Cooler phases (III, V, IX and XIII) of the Miocene in various profiles: Ustronie, Nowa Wieś, Krosinko, Mosina.

Genus *Inaperturopollenites* Thomson & Pflug, 1953

Type species: Inaperturopollenites dubius (R. Potonié & Venitz, 1934) Thomson & Pflug, 1953

Inaperturopollenites dubius (R. Potonié & Venitz, 1934) Thomson & Pflug, 1953

(Pl. XIV, Fig. 3)

1934. *Pollenites magnus dubius* R. Pot. & Ven.; R. Potonié & H. Venitz, p. 17, Pl. 2, Fig. 21.

Material. — More than 1000 in the entire material.

Description. — Spheroidal in primary equatorial outline, 26 to 35 μ in diameter, with a small ligula 3 to 4 μ high and 2 to 3 μ in diameter. Wall very thin (less than 0.5 μ), composed of two layers, with a punctate sculpture.

Remarks. — This species is very frequent in Oligocene and, primarily, Miocene deposits. It differs from. *I. concedipites*, a species described by Wodehouse (1933), primarily in the type of sculpture. Due to a very thin wall, it is frequently strongly compressed secondarily.

Botanical affinity. — According to Thomson & Pflug (1953), primarily the family Cupressaceae.

Occurrence (in the area under study). — Abundant in all profiles.

Inaperturopollenites radiatus Krutzsch, 1971

(Pl. XIV, Fig. 4a, b)

1971. *Inaperturopollenites radiatus* W. Kr.; W. Krutzsch, p. 199, Pl. 63, Figs 1—2.

Material. — Ten specimens.

Description. — Nonaperturate pollen grains 25 to 32 μ in diameter, with a slightly separated depression 4 to 6 μ in diameter situated in the middle of distal face. From this depression, radially arranged wrinkles run towards equator. Exine consisting of a single layer, less than 1 μ thick. Sculpture very fine, punctate or chagrenate.

Remarks. — This species was erected by Krutzsch on the basis of the presence of radially arranged wrinkles.

Botanical affinity. — Families Taxaceae, Taxodiaceae, Cupressaceae.

Occurrence (in the area under study). — Miocene, Oczkowice, Ustronie.

Inaperturopollenites concedipites (Wodehouse, 1933) Krutzsch, 1971
(Pl. XIV, Fig. 1)

1933. *Cunninghamia concedipites* Wdeh.; R. P. Wodehouse, p. 495, Fig. 19.

Material. — Abundant, more than 1000.

Description. — Spheroidal in equatorial view, 23 to 32 and mostly about 25 to 26 μ in diameter. A small ligula about 2 μ wide and high occurring in the middle of a grain. Exine very thin (less than 1 μ), composed of two layers, usually equal in thickness. Outer layer with a distinct sculpture in the form of fairly widely spaced small, verrucate processes. Sculpture reaching and sometimes even covering the base of ligula.

Remarks. — Many pollen forms described from Central Europe as *Inaperturopollenites magnus dubius* or *Inaperturopollenites dubius* belong to *Inaperturopollenites concedipites* (synonymy — cf. Krutzsch, 1971).

Botanical affinity. — Most likely the genus *Glyptostrobus*.

Occurrence (in the area under study). — In very many samples (varying from 1 to 20 per cent) from warm phases (VI, VIII, X) of the Miocene.

Inaperturopollenites verrupapillatus Trevisan, 1967
(Pl. XIV, Fig. 5)

1967. *Inaperturopollenites verrupapillatus* Trevisan; L. Trevisan, p. 15, Pl. 6, Fig. 9a—c.

Material. — Few specimens.

Description. — Spheroidal 35 to 43 μ in diameter, with a small ligula to 4 μ high and 2.5 to 3 μ wide. Exine consisting of two layers, equal in thickness, totalling about 1 μ. Outer one having a distinct sculpture in the form of closely spaced spiny and undulate processes.

Remarks. — Specimens of *I. verrupapillatus* preserved in a rifted state, are termed in literature as *I. hiatus*.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene deposits of the Tarnówka and Ślepuchowo profiles.

Genus *Sequoiapollenites* Thiergart, 1938

Type species: *Sequoiapollenites polyformosus* Thiergart, 1938

Sequoiapollenites polyformosus Thiergart, 1938
(Pl. XIV, Fig. 7a, b)

1938. *Sequoiapollenites polyformosus* Thierg.; F. Thiergart, p. 308, Pl. 24, Figs 14, 15.

Material. — Abundant; several hundred specimens.

Description. — Grains small, 25 to 35 μ in diameter, with a distinctly developed papilla having a wide area devoid of on outer, sculptured layer of exine. Papilla straight or slightly deflected at the end, 4 to 5 μ high and about 2.5 to 3 μ wide. Endopore situated at the apex of papilla. Exine, except for the area around papilla, composed of two layers equal in thickness and totalling about 1 μ. Outer layer finely punctate.

Remarks. — This is the most common species of the genus *Sequoiapollenites* occurring in some horizons, mostly (and abundantly) in the Middle Miocene.

Botanical affinity. — Apart of the genus *Sequoia*, a similar pollen type is known in the genera *Cryptomeria*, *Sequoiodendron* and *Metasequoia*.

Occurrence (in the area under study). — In all Miocene profiles, in some of them even abundant.

Sequoiapollenites rotundus Krutzsch, 1971

(Pl. XIV, Fig. 11a, b)

1971. *Sequoiapollenites rotundus* W. Kr.; W. Krutzsch, p. 222, Pl. 73, Figs 1—10.

Material. — A dozen or so specimens.

Description. — Grain spheroid, 22 to 28 μ in diameter. Exine composed of three layers 1.5 to 2 μ in total thickness. Outer layer punctate. Papilla with a one-layer exine and very small endopore on apex occur in the distal part of grain. It is surrounded by a not very wide, round area devoid of the outer layer of exine.

Remarks. — This relatively rare species, distinguished by its very regular, round shape and small dimensions, is known mostly from Lusatian Bed 2.

Botanical affinity. — Probably the family Taxodiaceae and the genus *Sequoia.*

Occurrence (in the area under study). — Middle Miocene (phases VIII—IX), Gierlachowo.

Sequoiapollenites sculpturius Krutzsch, 1971

(Pl. XIV, Fig. 2a, b)

1971. *Sequoiapollenites sculpturius* W. Kr.; W. Krutzsch, p. 216, Pl. 10, Figs 1—3.

Material. — A dozen or so specimens.

Description. — Grains spheroidal, 25 to 32 μ in diameter. Exine relatively thick (about 1.5 μ), composed of two layers equal in thickness. Outer layer covered with irregularly distributed, roller-like processes about 1 μ high. Papilla large, 3.5 to 4 μ wide and about 5 μ high, with a distinct endopore in its apical part, surrounded by a wide, psilate area devoid of the outer layer of exine and separated by an irregular line.

Remarks. — *S. sculpturius* differs from other species in the type of sculpture.

Botanical affinity. — Pollen grains with a similar structure are termed by Doktorowicz-Hrebnicka (1959, Pl. 1, Figs 16—18) as *Taxodium* (?).

Occurrence (in the area under study). — Middle Oligocene, Tarnówka and Upper Miocene, Oczkowice.

Sequoiapollenites gracilis Krutzsch, 1971
(Pl. XIV, Fig. 9a, b)

1971. *Sequoiapollenites gracilis* W. Kr.; W. Krutzsch, p. 214, Pl. 69, Figs 1—5.

Material. — Three specimens.

Description. — Grains spheroidal in outline, 27 to 34 μ in diameter, with a papilla 3 to 5 μ wide at the base and 5 to 6 μ high. Papilla surrounded by an extensive area devoid of the outer layer of exine. Exine less than 1 μ thick with outer layer thinner and granulate and inner psilate.

Remarks. — Pollen grains of *S. gracilis* are very rare in the material under study. They differ from other species, primarily in a very delicate exine having a granulate sculpture.

Botanical affinity. — Family Taxodiaceae?

Occurrence (in the area under study). — Upper Miocene (phase X), Oczkowice.

Genus *Ephedripites* Bolchovitina, 1953

Type species: *Ephedripites mediobaculatus* Bolchovitina, 1953

Ephedripites (Distachyapites) eocenipites (Wodehouse, 1933) Krutzsch, 1961
(Pl. XIII, Fig. 10)

1933. *Ephedra eocenipites* Wdh.; R. P. Wodehouse, p. 495, Fig. 20.

Material. — Three specimens.

Description. — Grains elongate-oval in outline (P/E = 1.9 to 2.1); polar axis 65 to 75 μ long, equator 32 to 35 μ in diameter. Six to seven ridges are visible, not reaching the poles, A distinct zigzag line runs in intercostal depressions. Ridges about 1 μ wide. Exine composed of two layers, about 2 μ thick.

Remarks. — According to Krutzsch (1971), this species is frequent from the Eocene through the Upper Miocene, but mostly it occurs in the Middle Oligocene.

Botanical affinity. — Family Gnetaceae, genus *Ephedra.*

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Ephedripites (Distachyapites) bernheidensis Krutzsch, 1961
(Pl. XIII, Fig. 19)

1961. *Ephedripites (Distachyapites) bernheidensis* W. Kr.; W. Krutzsch, p. 25, Pl. 2, Figs 22—26.

Material. — Five pollen grains.

Description. — Prolate in outline (P/E = 2.0 to 2.1); polar axis 45 to 50 μ long, equator 23 to 29 μ in diameter. Eight ridges, reaching the poles, are visible. No zigzag line is visible in intercostal depressions. Ridges about 2 μ wide, exine 1 to 2 μ thick.

Remarks. — According to Krutzsch (1961), this species differs from others in a lack of zigzag line and, due to this character, it makes up a form transitional between the Subgenera *Distachyapites* and *Ephedripites.*

Botanical affinity. — Family Gnetaceae, genus *Ephedra.*

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Phyllum **Angiospermae**
Class **Monocotyledonae**
Genus *Arecipites* Wodehouse, 1933

Type species: *Arecipites papillosus* (Mürriger & Pflug, 1951 in Thomson & Pflug, 1953) Krutzsch, 1970d

Arecipites papillosus (Mürriger & Pflug, 1951 *in* Thomson & Pflug, 1953) Krutzsch, 1970
(Pl. XV, Fig. 3a—c)

1953. *Monocolpopollenites papillosus* Mürr. & Pf.; P. W. Thomson, H. Pflug, p. 63, Pl. 4, Figs 38, 48—49.

Material. — A dozen or so specimens.

Description. — Grains subprolate, 32 to 42 μ in diameter. A poorly developed furrow does not reach the poles. Exine 1 to 1.5 μ thick, composed of two layers, the inner one thinner and with a visible columellar structure, the outer having a reticulate sculpture consisting of the murri-type processes more than 0.5 μ wide and regularly arranged. The meshes polygonal to 3 μ in diameter in the proximal part and gradually decreasing towards the furrow.

Remarks. — In its large dimensions and very distinct, polygonal reticulum, this species differs from all others, Mürriger & Pflug (1951) did not determine it, but described it as a strongly verrucate type of the Monocotyledonae pollen, probably the pollen of palms. Specimens similar in structure are termed by Stuchlik (1964) as cf. *Corypha* sp.

Botanical affinity. — Probably the family Palmae and genus *Corypha* (?).

Occurrence (in the area under study). — Middle Oligocene, Tarnówka, Mosina, Krosinko.

Arecipites pseudoconvexus Krutzsch, 1970
(Pl. XV, Fig 1a—e)

1970*d*. *Arecipites pseudoconvexus* W. Kr.; W. Krutzsch, p. 103, Pl. 21, Figs 1—5.

Material. — More than 20 specimens.

Description. — Grains subprolate, with polar axis 28 to 36 μ long and equator 22 to 26 μ in diameter. Exine about 1.5 μ thick, composed of two layers, nearly equalling each other in thickness.

Sculpture composed of the murri type processes to about 1 μ wide, forming a reticulum with regularly polygonal meshes 1.5 to 2 μ wide on proximal face and decreasing towards furrow to 0.5 μ

Remarks. — In the material under study, the grains of *Arecipites pseudoconvexus* are most frequent in the Middle and Upper Miocene.

Botanical affinity. — Family Palmae.

Occurrence (in the area under study). — Middle and Upper Miocene (phases VI, VIII and IX) in the Gołębin Stary, Oczkowice and Gierlachowo profiles.

Arecipites butomoides butomoides Krutzsch, 1970
(Pl. XV, Fig. 5)

1970*d*. *Arecipites butomoides butomoides* W. Kr.; W. Krutzsch, p. 112, Pl. 24, Figs 12—16.

Material. — Seven specimens.

Description. — Pollen grains with a strongly developed furrow reaching both poles, subprolate and with slightly tapering polar areas. Equator 27 to 33 μ in diameter. Exine about 1.5 μ thick composed of two layers subequal in thickness. The outer layer with a distinct reticulate sculpture, with subround meshes, formed by regularly arranged murri type processes. Mesh lumina on proximal face somewhat larger than on distal.

Remarks. — Specimens of this species were described in literature as cf. *Butomus* (B. Pacltová, 1963). In the material under study, they occur rarely and only in the uppermost parts of profiles in the clayey or muddy deposits.

Botanical affinity. — Probably the genus *Butomus*.

Occurrence (in the area under study). — In upper parts of the Upper Miocene; Ślepuchowo and Krosinko.

Arecipites sp.
(Pl. XV, Fig. 2a—c)

Material. — Three well preserved specimens.

Description. — Elongate-subprolate in outline, polar axis 40 to 43 μ long, equator diameter 27—30 μ. Furrow short, not reaching the poles.

Exine to 1.5 μ thick, composed of two layers, equal in thickness. Sculpture in the form of the murri type processes about 0.5 μ wide, arranged as a reticulum with large, polygonal meshes on proximal face. The sculpture becomes less distinct distally and the reticulum near furrow has mesh lumina less than 1 μ. in diameter. The columellar layer well developed, columellar arranged in single rows.

Remarks. — Specimens of this species are to the greatest extent similar to a specimen of *A.* sp. *6* described by Krutzsch (1970*d*), from which they differ primarily in larger dimensions.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Upper Oligocene (phase II), Oczkowice.

Genus *Magnolipollis* Krutzsch, 1970

Type species: Magnolipollis neogenicus Krutzsch, 1970*d*.

Magnolipollis neogenicus Krutzsch, 1970
(Pl. XV, Figs 6, 7)

1970*d*. *Magnolipollis neogenicus* W. Kr.; W. Krutzsch, p. 132, Pl. 32, Figs 1—16; Pl. 33, Figs 1—18.

Material. — Seven specimens.

Description. — Subprolate in outline; polar axis 38 to 63 μ long. Exine 1 to 1.5 μ thick with a compact structure and an irregularly punctate sculpture.

Remarks. — Krutzsch (1970*d*) divided this species into two subspecies, *M. neogenicus neogenicus* and *M. neogenicus minor*, assuming 50 μ as a limiting dimension.

Botanical affinity. — Most likely the family Magnoliaceae.

Occurrence (in the area under study). — Upper Miocene, Oczkowice.

Genus *Liriodendroipollis* Krutzsch, 1970

Type species: Liriodendroipollis verrucatus Krutzsch, 1970*d*.

Liriodendroipollis verrucatus Krutzsch, 1970
(Pl. XV, Fig. 4)

1970*d*. *Liriodendroipollis verrucatus* W. Kr.; W. Krutzsch, p. 142, Pl. 37, Figs 1—2.

Material. — Five well preserved specimens.

Description. — Elongate-subprorale in equatorial outline, with a pointed pole. Polar axis 53 to 65 μ long. Exine with a punctate sculpture and irregularly scattered large, round verrucae to about 3 μ high and wide. Polar area narrow, furrow long and deep.

Remarks. — This species was assigned by Ziembińska & Niklewski (1966) to the genus *Sciadopitys*. In the profles here described it occurs in a similar stratigraphic position as in the Lubin- Ścinawa area in a group of deposits which correspond to Lusatian Bed 3.

Botanical affinity. — Family Magnoliaceae, the genus *Liriodendron*.

Occurrence (in the area under study). — Lower Miocene, Gierlachowo, Oczkowice.

Genus *Graminidites* Cookson, 1947

Types species: Graminidites media Cookson, 1947

Graminidites soellichauensis Krutzsch, 1970

(Pl. XVI, Fig. 1a—c)

1970*d*. *Graminidites soellichauensis* W. Kr.; W. Krutzsch, p. 51, Pl. 1, Figs 3—5.

Material. — Two specimens.

Description. — Spheroidal in equatorial outline, 35 to 37 μ in diameter. Pore round, about 2 μ wide, with a very distinct annulus about 2.5 μ wide. Exine 1.5 μ thick, composed of two layers. Outer layer somewhat thinner, with a punctate sculpture.

Remarks. — Specimens found in the Mosina boring differ slightly from those described by Krutzsch in smaller dimensions of the pollen grain, pore and annulus.

Botanical affinity. — Family Gramineae.

Occurrence (in the area under study). — Middle Oligocene, Mosina.

Graminidites crassiglobosus (Trevisan, 1967) Krutzsch, 1970

(Pl. XVI, Fig. 3a, b)

1967. *Monoporopollenites crassiglobosus* Trevisan; L. Trevisan, p. 49, Pl. 33, Fig. 5a—e.

Material. — A dozen or so specimens.

Description. — Subprolate or spheroidal in outline, 23 to 28 μ in diameter, with a round pore about 1.5 μ wide and surrounded by an annulus about 1.5 μ wide. Exine less than 1 μ thick, composed of two layers. Outer with punctate sculpture.

Remarks. — According to Krutzsch (1970*d*), this species is connected with cooler or intermediate climatic phases.

Botanical affinity. — Family Gramineae.

Occurrence (in the area under study). — Upper Miocene; Oczkowice, Krosno, Gołębin Stary.

Graminidites laevigatus Krutzsch, 1970
(Pl. XVI, Fig. 2a, b)

1970*d*. *Graminidites laevigatus* W. Kr.; W. Krutzsch, p. 60, Pl. 5, Figs 1—6.

Material. — Nineteen specimens.

Description. — Spheroidal in outline, 28 to 32 μ in diameter. Pore round 2 to 3 μ in diameter, surrounded by a low annulus 1.5 to 2.5 μ wide. Exine thin (less than 1 μ), composed of two layers. Outer layer with a very fine, punctate sculpture.

Remarks. — Specimens of this species are common in the Tertiary deposits (for synonymy see Krutzsch, 1970*d*). In the material described they occur in various Miocene phases.

Botanical affinity. — Family Gramineae.

Occurrence (in the area under study). — Middle Oligocene, Tarnówka; Lower Miocene, Gierlachowo; Middle Miocene, Ustronie, Gierlachowo; Upper Miocene, Krosinko, Oczkowice, Gołębin Stary.

Genus *Sparganiaceaepollenites* Thiergart, 1937

Type species: Sparganiaceaepollenites convexus Thiergart, 1937

Sparganiaceaepollenites polygonalis Thiergart, 1937
(Pl. XVI, Fig. 4a, b)

1937. *Sparganiaceaepollenites polygonalis* Thierg.; F. Thiergart, p. 307, Pl. 24, Fig. 11.

Material. — A dozen or so specimens.

Description. — Suboblate in outline, equatorial diameter 20 to 25 μ. Pore irregular in outline, about 3 μ in diameter. Lack of annulus. Exine about 1 μ thick, composed of two layers. Inner layer columellar, outer having a sculpture consisting of fine, about 0.5 μ high, baculate processes forming a reticulum. Meshes polygonal, varying in size, smaller, nearer the pore, gradually increasing proximally. Maximum mesh diameter about 1.5 μ.

Remarks. — Common in the Miocene.

Botanical affinity. — As the whole genus, primarily the Sparganiaceae, but a similar pollen type is also recorded in the *Typha.*

Occurrence (in the area under study). — Middle Oligocene, Tarnówka; Upper Miocene, Ślepuchowo.

Sparganiaceaepollenites sparganioides (Meyer, 1956) Krutzsch, 1970
(Pl. XVI, Fig. 5a, b)

1956. *Monoporopollenites sparganioides* Meyer; B. L. Meyer, p. 111, Pl. 4, Fig. 28.

Material. — Ten specimens.

Description. — Spheroid in equatorial view, 23 to 28 μ in diameter.

Porae elongate, 3 to 5 μ in diameter, devoid of annulus. Exine slighty more than 1 μ thick, composed of two layers. Outer layer with a reticulate sculpture composed of baculate processes. Meshes polygonal larger in proximal part. Maximum mesh diameter about 2 to 3 μ.

Remarks. — This species is common from the Middle Oligocene through the Pliocene. Krutzsch's (1970*d*) specimens, determined by Stuchlik (1964) as *Typha* type *angustifolia*, may be assigned to this morphological species. Specimens described by Doktorowicz-Hrebnicka (1961) as cf. *Sparganium*, cf. *Potamogeton* forma *suprema* may also be here assigned.

Botanical affinity. — *Typha angustifolia*?

Occurrence (in the area under study). — In all profiles, as single specimens or abundant.

Sparganiaceaepollenites neogenicus Krutzsch, 1970
(Pl. XV, Fig. 7a, b)

1970*d*. *Sparganiaceaepollenites neogenicus* W. Kr.; W. Krutzsch, p. 82, Pl. 13, Figs 1—6.

Material. — Six specimens.

Description. — Rounded in outline, 25 to 30 μ in diameter. Pore roundish, 3 to 4 μ in diameter, without an annulus. Exine 1.5 μ thick, composed of two layers. Inner layer columellar, outer with a reticulate sculpture formed by baculate processe. Meshes polygonal, on the proximal face nearly identical in size with those on the distal face.

Remarks. — According to Krutzsch (1970*d*), this species probably includes a specimen of *Pollenites polygonalis*, described by Doktorowicz-Hrebnicka (1954) from Żary (Fig. 42).

Botanical affinity. — Probably the family Sparganiaceae.

Occurrence (in the area under study). — Various horizons: single specimens in Upper Miocene at Oczkowice, in Middle Miocene at Ślepuchowo and Lower Miocene at Ustronie and Nowa Wieś.

Genus *Milfordia* Erdtman 1960 emend. Krutzsch, 1970

Type species: Milfordia incerta (Thomson & Pflug, 1963) Krutzsch, 1961

Milfordia incerta (Thomson & Pflug, 1963) Krutzsch, 1961
(Pl. XVI, Fig. 13)

1953. *Inaperturopollenites incertus* Th. & Pf.; P. W. Thomson & H. Pflug, p. 66, Pl. 5, Fig. 34.

Material. — A dozen or so specimens.

Description. — Subspheroidal in outline, 35 to 40 μ in diameter. On distal face, an elongate pore with an irregular margin, about 18 μ long and 7 μ wide. Exine, composed of two equally thick layers, the outer one having microfaveolae regularly distributed on its surface.

Remarks. — This species was first described from the territory of Poland by Stuchlik (1964) who considered it as a representative of the family Restionaceae. Elsewhere in Europe, it is cited mostly from the German Democratic Republic (Krutzsch, 1970) as a typically warmlike element, appearing in the warmest climatic phases only from the Eocene through the Middle Miocene.

Botanical affinity. — Undoubtedly the family Restionaceae.

Occurrence (in the area under study). — Only in the Middle Oligocene of the Mosina and Trzcianka boreholes.

Milfordia minima Krutzsch, 1970
(Pl. XVI, Fig. 10a, b)

1970*d*. *Milfordia minima* W. Kr.; W. Krutzsch, p. 76, Pl. 10, Figs 7—8.

Material. — Three specimens.

Description. — Subspheroidal in outline, 27.5 to 30 μ in diameter. A round, small pore 1.5 to 2.5 μ in diameter, with an indistinct annulus. Exine composed of two equally thick layers. Outer layer with a sculpture formed by regular microfaveolae.

Remarks. — The regular shape of pore and a small annulus are, in addition to size, characters which differ *Milfordia minima* from *M. incerta* (Krutzsch, 1970).

Botanical affinity. — Family Restionaceae, genus *Milfordia.*

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Genus *Algaoreidia* Erdtman, 1960

Type species: Aglaoreidia cyclops Erdtman, 1960

Aglaoreidia cyclops Erdtman, 1960
(Pl. XVI, Fig. 14)

1960. *Aglaoreidia cyclops* Erdtman; G. Erdtman, p. 47, Pl. 1, Figs b—c.

Material. — Three well preserved specimens.

Description. — Subprolate in outline, 48 to 50 μ in diameter. Polar axis 28 to 32 μ long. Pore round, about 5 μ in diameter, surrounded by annulus. Exine about 2 μ thick, composed of two layers and having a reticulate sculpture. Meshes varying in size, near pore larger, to 3 μ in diameter and on the opposite side of the pollen grain smaller, with lumina reaching about 1 μ.

Remarks. — According to Krutzsch (1970*d*), this species, known from a dozen or so localities in Europe, is, along with *Boehlensipollis*, an index form of the Middle Oligocene deposits. In Poland, described so far only by Stuchlik (1964) from the lower part of the Rypin profile.

Botanical affinity. — According to Stuchlik (1964), similar pollen grains occur in the species *Haemanthus filiflorus* Baker of the family Amarylidaceae.

Occurrence (in the area under study). —Middle Oligocene, Mosina.

Class **Dicotyledonae**

Genus *Mioceanipollis* Krutzsch, 1966

Type species: Miocaenipollis miocaenicus Krutzsch, 1966

Miocaenipollis miocaenicus Krutzsch, 1966
(Pl. XVI, Fig. 6a, b)

1966. *Miocaenipollis miocaenicus* W .Kr.; W. Krutzsch, p. 34, Pl. 7, Figs 1—3.

Material. — Two specimens.

Description. — Spheroidal in equatorial view, 28 to 32 μ in diameter. Exine somewhat more than 1 μ thick, composed of two layers. Inner layer psilate, outer formed by very closely spaced baculae which make up a fine-reticulate sculpture. Pores about 10 μ in diameter, irregularly subprolate, surrounded by a small atrium.

Remarks. — Specimens from the material under study are somewhat larger than those described by Krutzsch (1966).

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Upper Miocene, Gierlachowo.

Genus *Liquidambarpollenites* Raatz, 1937

Type species: Liquidambarpollenites stigmosus (R. Potonié, 1931) Raatz, 1937

Liquidambarpollenites stigmosus (R. Potonié, 1931) Raatz, 1937
(Pl. XVI, Fig. 8)

1931*a*. *Pollenites stigmosus* R. Pot.; R. Potonié, p. 332, Pl. 2, Fig. 1.

Material. — Several dozen specimens.

Description. — Round, pollen grains 23 to 30 μ in diameter with 10 to 12 pores. Pores round or oval in outline, 3.5 to 5 μ in diameter, with a rough margin. The outer membrane of pore with a distinct granulation and processes more than 0.5 μ in diameter. Neither annulus nor atrium occur around pores. Exine about 1.5 μ thick, composed of two distinct layers. Inner layer thinner, indistinct in structure, outer columellar. Columellae form a fine reticulum with meshes about 0.5 μ in diameter.

Remarks. — This species is assigned to the collective genus containing many "liquidambaroid" forms occurring in the Later Tertiary. They are assigned by Krutzsch (1966) to the genus *Periporopollenites* Th. & Pf. 1953, whose diagnosis he corrected. It seems, however, that the description of

Liquidambar-Pollenites stigmosus (R. Pot., 1931), given by Raatz in 1937, is sufficiently accurate to be a diagnosis of the genus *Liquidambarpollenites*, which as an earlier one should be kept in force in conformity with R. Potonié (Synopsis III, 1960). This species is considered by Mai (1967) and Krutzsch & Majewski (1967) as an Arctic-Tertiary element.

Botanical affinity. — Family Hamamelidaceae, genus *Liquidambar*, but also possible are the genera *Altingia* and *Syncopsis.*

Occurence (in the area under study). — Oligocene, Miocene, in many samples from various profiles.

Genus *Chenopodiipollis* Krutzsch, 1966

Type species: Chenopodiipollis multiplex (Weyland & Pflug, 1957) Krutzsch, 1966

Chenopodiipollis stellatus (Mamczar, 1960), Krutzsch, 1966
(Pl. XVI, Fig. 12a, b)

1960. *Pollenites stellatus* Mamczar; J. Mamczar, p. 56, Pl. 14, Fig. 199a, b.

Material. — More than twenty specimens.

Description. — Spheroidal in equatorial view, 21—25 μ in diameter. Pores oval, a dozen or so to twenty per one hemisphere. Pores 1.5 to 2.5 μ in diameter, spaced at 3 to 5 μ, regularly distributed over the entire surface of grain. Exine 1.5 to 2 μ thick. Outer layer fine-columellar with punctate structure.

Remarks. — This species is common in Miocene deposits, sometimes occurring in them abundantly. This is probably connected with ecological needs of the family Chenopodiaceae and primarily with an increased salt content of the substrate.

Botanical affinity. — Family Chenopodiaceae.

Occurrence (in the area under study). — In many samples from various profiles.

Genus *Multiporopollenites* Pflug, 1953

Type species: Multiporopollenites maculosus (R. Potonié, 1931) Thomson & Pflug, 1953

Multiporopollenites maculosus (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. XVI, Fig. 11)

1931. *Pollenites maculosus* R. Pot.; R. Potonié, p. 28, Fig. V 19d.

Material. — More than twenty specimens.

Description. — Rounded or polygonal in equatorial outline, 34 to 42 μ in diameter. Exine about 1.5 μ thick, composed of three layers. Inner layer the tinnest, middle and outer nearly identical in thickness. Middle layer columellar. Structure finely punctate. Pores numerous, small, open, irregularly and loosely scattered over the entire surface of grain, and surrounded by a wide atrium composed of many layers.

Remarks. — *M. maculosus* was redefined by Krutzsch (1966), who separated it from the species *Juglanspollenites verus* Raatz, from which it differs in the equatorial outline and the structure and size of pores.

Botanical affinity. — Family Juglandaceae.

Occurrence (in the area under study). — Rare, mostly in the upper parts of the Middle Miocene (phase IX) at Gierlachowo and Ustronie.

Genus *Juglanspollenites* Raatz, 1937

Type species: Juglanspollenites verus Raatz, 1937

Juglanspollenites verus Raatz, 1937
(Pl. XVI, Fig. 9)

1937. *Juglanspollenites verus* Raatz; G. V. Raatz, p. 18, Pl. 1, Fig. 9.

Material. — Several dozen specimens.

Description. — Spheroidal in equatorial outline. Equator 23 to 32 μ in diameter. Pores few, six to eight per one hemisphere, large, 2.5 to 3.5 μ in diameter, irregularly and loosely distributed. Narrow annulus is developed around the pore. Exine composed of two layers equal in thickness, outer structural, structure punctate.

Remarks. — Grains with a similar type of structure were described from the territory of Poland by Doktorowicz-Hrebnicka (1957) as *Pollenites cribellatus* and by Oszast (1960) as cf. *Celtis*. From the USSR they were described by Pokrovskaya (1956) and from Hungary by Nagy (1958). Grains identical in structure type were described from the Ustronie profile as *Juglans* sp. (Ziembińska & Niklewski, 1966).

Botanical affinity. — Family Ulmaceae and probably the genus *Celtis*.

Occurrence (in the area under study). — Relatively frequent in all profiles, particularly so in the Middle and Upper Miocene's intermediate or cooler climatic phases.

Genus *Triporopollenites* Thomson & Pflug, 1953

Type species: Triporopollenites coryloides Pflug, 1953

Triporopollenites coryloides Pflug, 1953
(Pl. XVII, Fig. 12)

1953. *Triporopollenites coryloides* Pf.; P. W. Thomson & H. Pflug, p. 84, Pl. 9, Figs 20—24.

Material. — Several dozen specimens.

Description. — Triangular in outline, with three pores in an angular-equatorial position, 23 to 32 μ in diameter. Exine to 2 μ thick, composed of two layers. Outer layer slightly thickened and forming a small labrum near pore. Endopore slightly wider than exopore, round in outline. Endoexine punctate.

Remarks. — This species is a typical representative of the genus *Triporopollenites* with the structure of germinal apparatus identical with that of the Recent genus *Corylus*. It is frequently described in literature as *Corylus* or cf. *Corylus*.

Botanical affinity. — Grains with their morphological structure of the *Corylus* type (mostly pollen grains from the Oligocene (Rogoźno) and Miocene (Babina) deposits) are compared by Romanowicz (1962) with pollen grains of the Recent American species *Corylus rostrata*.

Occurrence (in the area under study). — As a low percentage in various Upper Miocene profiles (phases XI, XII, XIII, less frequently in phase X).

Triporopollenites robustus (Mürriger & Pflug, 1951) Thomson & Pflug, 1953
(Pl. XII, Fig. 11a, b)

1951. *Pollenites granifer robustus* Mürr. & Pf.; F. Mürriger & H. Pflug, p. 93, Pl. 6, Fig. 41.
1953. *Triporopollenites robustus* (Mürr. & Pf.) Th. & Pf.; P. W. Thomson & H. Pflug, p. 82, Pl. 8, Figs. 109—149.

Material. — A dozen or so specimens.

Description. — Triangular obtuse-convex in outline, 28 to 36 μ in equatorial diameter. Pores arranged angularly, sometimes slightly subequatorially. Exine 1.5 to 2 μ thick, composed of several layers. Inner layer distinctly columellar, in structure, outer with a granulate sculpture. An interloculum, extending near pores, occurs between the endo- and ectoexine. Pores round, annulus indistinct, atrium composed of several layers, wide.

Remarks. — The species was given its name by Mürriger & Pflug (1951), but described only by Thomson & Pflug (1953). According to Krutzsch (in press), this is a group of species, including three of them, *T. granifer*, *T. megagranifer* and *T. robustus*. Their definitions used so far display differences between them of the rank of at most a subspecies.

Botanical affinity. — Unknown. According to Gruas-Cavaganetto (1968) probably the family Betulaceae.

Occurrence (in the area under study). — Relatively frequent in the Middle Oligocene of Tarnówka, Mosina and Ślepuchowo.

Triporopollenites urticoides Nagy, 1969
(Pl. XVII, Fig. 1a, b)

1969. *Triporopollenites urticoides* Nagy; E. Nagy, p. 453, Pl. 51, Figs 11—12.

Material. — Four specimens.

Description. — Spheroid-triangular in outline, 12 to 16 μ in equatorial diameter. Exine thin, less than 1 μ in thickness. Pores arranged angularly, somewhat subequatorially, round, with a small annulus. Structure fine, punctate.

Remarks. — These few, small pollen grains appear in upper parts of northern profiles. *T. urtiocoides* differs from the remaining species of the genus *Triporopollenites* primarily in very small dimensions and thin exine.

Botanical affinity. — According to Nagy (1969) — the family Urticaceae.

Occurrence (in the area under study). — The uppermost Miocene, in Krosinko and Ślepuchowo borings.

Genus *Platycaryapollenites* Nagy, 1969

Type species: Platycaryapollenites miocaenicus Nagy, 1969

Platycaryapollenites miocaenicus Nagy, 1969

(Pl. XVII, Fig. 5a, b)

Material. — Ten specimens.

Description. — Triangular in outline, with three pores arranged angularly. Equatorial diameter 16 to 22 μ. Exine thin, les than 1 μ in thickness, composed of two layers. Ectoexine with chagrenate or punctate structure. Endoexine considerably thinner, without a distinct structure. On each polar hemisphere of this species two strips of an exine solution are arranged parallel to each other, alternating on the two hemispheres. Pore devoid of annulus, but having atrium.

Remarks. — According to Krutzsch (in press), this species is frequent in the deposits of the Earlier Tertiary, occurring only sporadically in warmer phases of the Miocene.

Botanical affinity. — Family Junglandaceae, most probably the genus *Platycarya.*

Occurrence (in the area under study). — Middle Miocene (phases VI and VIII), single pollen grains occurring in the Gierlachowo, Nowa Wieś and Ustronie profiles.

Platycaryapollenites uformis Krutzsch, in press, 1969

(Pl. XVII, Fig. 4a, b)

Material. — Three specimes.

Description. — Triangular in outline, with three pores arranged somewhat subequatorially. Equatorial diameter about 20 μ. Exine thin, composed of two layers. The layer of ectoexine with a fine, punctate structure, thinner. Germinalium in the form of oval exopore, with a wide, outer atrium. Characteristic, U-shaped exine solutions occur on one hemisphere.

Remarks. — This species undoubtedly include specimens illustrated by Grabowska (1968, Pl. 3, Fig. 1), who termed them as *Triatriopollenites* cf. *Platycarya* and a specimen called by Gruas-Cavagnetto (1968, Pl. 4, Fig. 10) a *coryphaeus group.*

Botanical affinity. — Family Juglandaceae.

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Triatriopollenites rurensis Pflug, 1953

Type species: Triatriopollenites rurensis Pflug, 1953

Triatriopollenites rurensis Pflug, 1953
(Pl. XVII, Fig. 7a, b)

1953. *Triatriopollenites rurensis* Pf.; P. W. Thomson, H. Pflug, p. 79, Pl. 7, Figs 81—109.

Material. — Abundant, more than 200 specimens.

Description. — Convex-triangular or triangular in equatorial outline, with three pores arranged angularly-equatorially and 22 to 23 μ in equatorial diameter. Exine about 2 μ thick, composed of two layers. Ectoexine twice as thick as endoexine. Exopores with annulus, having a frayed margin, are developed from ectoexine. An atrium with a fine structure and composed of many layers is developed from endoexine. An interlocum occurs between the ecto- and endogerminal part.

Remarks. — This species, frequently cited in literature, is usually related with the genus *Myrica.* It is the most common representative of the morphological structure of the *Myrica* type in the Tertiary deposits.

Botanical affinity. — Family Myricaceae, the genus *Myrica*

Occurrence (in the area under study). — In all profiles in some horizons abundant.

Triatriopollenites rurobituitus Pflug, 1953
(Pl. XVII, Fig. 9a, b)

1953. *Triatriopollenites rurobituitus* Pf.; P. W. Thomson & H. Pflug, p. 79, Pl. 7, Figs 110—115.

Material. — A dozen or so specimens.

Description. — Triangular or rounded triangular in equatorial outline and 22 to 35 μ in equatorial diameter. Exine about 1.5 to 2 μ thick, composed of two layers. Ectoexine on the germinal part strongly thickened, forming a strongly swollen annulus, composed of two layers. Its inner layer with a fine structure. A many-layer atrium is developed from endoexine. An interlocum occurs between the inner and outer layer of exine.

Remarks. — The species *T. rurobituitus* is very strongly related morphologically to the species *T. rurensis,* from which it differs in (1) a different development of outer pore and (2) the presence of interlocum over the entire length of walls (in *T. rurensis* interloculum only in the germinal part).

Botanical affinity. — Family Myricaceae.

Occurrence (in the area under study). — Middle Oligocene, Tarnówka, Mosina, Ślepuchowo.

Triatriopollenites coryphaeus (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. XVII, Fig. 12)

1931. *Pollenites coryphaeus* R. Pot.; R. Potonié, p. 329, Pl. 2, Fig. 15.

Material. — A dozen or so specimens.

Description. — Triangular or trangular obtuse-convex in equatorial outline and 22 to 28 μ in equatorial diameter. Exine psilate, 1 to 1.5 μ thick, composed of two layers. Ecto- and endoexine closely adhere to each other along the wall. Their solution occurs only in the germinal part. Exopore surrounded by a slightly thickened annulus. An atrium consisting of many layers, is developed from the endoexine.

Remarks. — This species was separated from *T. punctatus,* transferred by Krutzsch (in press) to the genus *Momipites* on the basis of the structure of germinal apparatus.

Botanical affinity. — Family Myricaceae.

Occurrence. (in the area under study). — Lower Miocene (phases III and IV), Ustronie, Gierlachowo and Nowa Wieś.

Genus *Momipites* Wodehouse, 1933

Type species: Momipites coryloides Wodehouse, 1933

Momipites punctatus (R. Potonié 1931) Nagy, 1969
(Pl. XVII, Figs 2a, b; 3a, b)

1931*a*. *Pollenites coryphaeus punctatus* R. Pot.; R. Potonié, p. 329, Pl. 2, Figs 7, 11.

Material. — Several hundred specimens.

Description. — Triangular in equatorial view, with convex sides. Three pores arranged angularly, slightly depressed. Equator 18 to 25 μ in diameter. Exine composed of two layers. Ectoexine with a punctate or finely granulate sculpture, in the germinal part forming an oval exopore. No thickening of exine occurs around exopore. Endoexine forms a wide atrium in the germinal part.

Remarks. — The species *Momipites punctatus* was related with the genus *Momipites* (Krutzsch, in press), on the basis of the structure of germinal apparatus, which is the same as in the entire family Juglandaceae.

Botanical affinity. — Family Junglandaceae.

Occurrence (in the area under study). — Middle Oligocene through Upper Miocene. All profiles.

Genus *Trivestibulopollenites* Thomson & Pflug, 1953

Type species: Trivestibulopollenites betuloides Pflug, 1953

Trivestibulopollenites betuloides Pflug, 1953
(Pl. XVII, Figs 8a, b and 10a, b)

1953. *Trivestibulopollenites betuloides* Pf.; P. W. Thomson & H. Pflug, p. 85, Pl. 9, Figs 25—34.

Material. — Several dozen specimens.

Description. — Triangular or rounded in equatorial outline; pores aranged angularly, equatorially, strongly projecting. Equator 22 to 34 μ in diameter. Wall composed of two layers, to 2 μ thick in the middle part and thickening in the area of germinalia. Outer germinal apparatus developed in the form of an oval pore with a small labrum. Inner germinal apparatus composed of two layers, its outer part with a narrow annulus, inner with a wide atrium.

Remarks. — Genus *Trivestibulopollenites* Th. & Pf. includes several species differing considerably from *Betulaepollenites* Thiergart 1937. It seems that a more extensive concept of genus, that is, *Trivestibulopollenites* is more appropriate in this case despite Thiergart's priority name.

Botanical affinity. — Most likely the genus *Betula*.

Occurrence (in the area under study). — Middle and Upper Miocene, all profiles.

Genus *Brosipollis* Krutzsch, 1968

Type species: Brosipollis salebrosus (Pflug, 1953) Krutzsch, 1968

Brosipollis salebrosus (Pflug, 1953) Krutzsch, 1968
(Pl. XVII, Fig. 13a—c)

1953. *Trivestibulopollenites salebrosus* Pf.; P. W. Thomson & H. Pflug, p. 85, Pl. 9, Figs 39—41.

Material. — Egiht specimens.

Description. — Spheroid in outline, with three very strongly projecting germinal apparatus. Equator 25 to 30 μ in diameter, germinal apparatus about 7 μ high. Exine to 2 μ thick, composed of two layers. Outer layer, with a distinct sculpture in the form of rollers, produces an elliptical exopore in the germinal part. The inner part of ectoexine, strongly thickened in the germinal part, forms a labrum circular in cross section. A one-layer endoexine forms a broad atrium.

Remarks. — On the basis of the peculiar characters of the structure of germinal apparatus of the species *Trivestibulopollenites salebrosus* and *T. striatobrosus*, Krutzsch (1968c). erected the genus *Brosipollis*. *B. salebrosus* is a typical element of the Earlier Tertiary and it occurs in the Later Tertiary in the deposits which correspond to warmer climatic phases.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene of Tarnówka and Middle Miocene (phase VIII) of Gierlachowo.

Genus *Pterocaryapollenites* Thiergart, 1938

Type species: Pterocaryapollenites stellatus (R. Potonié, 1931) Thiergart, 1938

Pterocaryapollenites stellatus (R. Potonié, 1931) Thiergart, 1938
(Pl. XVIII, Figs 8, 10a, b)

1931. *Pollenites stellatus* R. Pot.; R. Potonié, p. 28, Pl. 2, Fig. V 476.

Material. — Several dozen specimens.

Description. — Polygonal in equatorial outline. Pores arranged angularly or somewhat subequatorially. They do not project outside the outline. A few pores are irregularly distributed on both hemispheres of the grain. Equator 24 to 36 μ in diameter. Ectoexine, slightly swollen in the germinal part, forms a round exopore; endoexine thinner, forming a broad, many-layer atrium.

Remarks. — In Thomson's & Pflug's (1953) paper, the grains of this species are included in the morphological genus *Polyatriopollenites.* Since the genus *Pterocaryapollenites* is, however, well defined in Thiergart's (1938) paper, it should be acknowledged as a priority name in force.

Botanical affinity. — Family Juglandaceae and most likely the genus *Pterocarya.* In some of the Recent species of the genus *Junglans*, e.g. *Junglans cinerea*, pollen grains are similar in morphological structure.

Occurrence (in the area under study). — In many profiles of the warm and intermediate phases of the Middle and Upper Miocene.

Genus *Caryapollenites* Raatz, 1937 emend. Krutzsch, 1961

Type species: Caryapollenites simplex (R. Potonié, 1931) 1960

Caryapollenites simplex (R. Potonié, 1931) 1960
(Pl. XVIII, Figs 6, 7)

1931*b*. *Pollenites simplex* R. Pot.; R. Potonie, p. 3, Fig. 4.

Material. — A dozen or so specimens.

Description. — Spheroid or triangular obtuse-convex in equatorial view. Germinal apparatus in the form of round pores arranged angularly and somewhat equatorially. Equator 26 to 35 μ in diameter. Exine composed of two layers. Outer layer with a fine structure, psilate or intragranulate, slightly thickened in the germinal area, forms a smal labrum. Endoexine, devoid of distinct structure, forms a broad atrium near the pore.

Remarks. — In the polar parts of pollen grains this genus has variously shaped exine solutions which, according to Krutzsch, represent an important specific character. In the species *Caryapollenites simplex*, these solutions are round and cover both polar areas.

Botanical affinity. — Family Juglandaceae and probably the genus *Carya.*

Occurrence (in the area under study). — Few pollen grains of this species occur in transitional, or cooler climatic phases of all profiles.

Genus *Carpinuspollenites* Thiergart, 1938

Type species: Carpinuspollenites carpinoides (Pflug, 1953) Nagy, 1959

Carpinuspollenites carpinoides (Pflug, 1953) Nagy, 1959
(Pl. XVIII, Figs 8, 9, 11)

1953. *Polyporopollenites carpinoides* Pf.; P. W. Thomson, H. Pflug, p. 92, Pl. 10, Figs 79—84

Material. — Twenty-three specimens.

Description. — Rounded-polygonal in outline, 22 to 36 μ in equatorial diameter. Four to five pores, arranged angularly, somewhat subequatorially and distinctly projecting. Germinal apparatus are developed as an oval exopore, elongate equatorially and surrounded by labrum and as an endopore in the form of a small, one- or two-layer atrium.

Remarks. — The genus *Carpinus? pollenites,* described by Thiergart (1938) with a question mark, was later replaced in literature by the generic name *Polyporopollenites* (Thomson & Pflug, 1953). The previous name was used once again by Nagy (1969). Doktorowicz-Hrebnicka (1957, 1960, 1961, 1964) distinguishes, in the genus *Carpinus*, several morphological forms, some of which might turn out, after, a close study, to be new species of the genus *Carpinuspollenites*.

Botanical affinity. — Family Betulaceae, the genus *Carpinus*.

Occurrence (in the area under study). — Upper Miocene of Ustronie, Oczkowice, Nowa Wieś, Gierlachowo, Mosina and Ślepuchowo.

Genus *Alnipollenites* R. Potonié, 1931

Type species: Alnipollenites verus R. Potonié, 1931

Alnipollenites verus R. Potonié, 1931

(Pl. XVIII, Figs 1 and 2)

1931*b*. *Alni-pollenites verus* R. Pot.; R. Potonié, p. 4, Fig. 18.

Material. — More than 200 specimens.

Description. — Polygonal in equatorial view, 15 to 30 μ in equatorial diameter. Four to five pores arranged angularly and equatorially; germinal apparatus developed in the form of an exopore round or elongate meridionally and surrounded by a large, projecting labrum; endoexine forming an extensive vestibulum. The surface of walls smooth.

Remarks. — The genus *Alni-pollenites*, erected by R. Potonié (1931*b*), was subsequently changed by this same author (1960) into *Alnipollenites* *Alnipollenites* Raatz, 1937 and *Polyvestibulopollenites* Thomson & Pflug, 1953 are the best known synonyms. It has hitherto been a one-species genus.

Botanical affinity. — Genus *Alnus*.

Occurrence (in the area under study). — Frequent in various climatic phases of all profiles; abundant in Miocene, phase III of Ustronie and Gierlachowo.

Genus *Ulmipollenites* Wolff, 1934

Type species: Ulmipollenites undulosus Wolff, 1934

Ulmipollenites undulosus Wolff, 1934

(Pl. XVIII, Figs 3—5)

1934. *Ulmi-pollenites undulosus* Wolff; H. Wolff, p. 75, Pl. 5, Fig. 25.

Material. — Several dozen specimens.

Description. — Rounded or polygonal in equatorial outline, 23 to 25 μ in diameter. Exine 1.5 to 2.5 μ thick with a sculpture rugulate forming a sort of reticulum. Ectoexine thickened around pores, forms an annulus. Four or five pores usually arranged equatorially, round, depressed, to 2.5 μ in diameter.

Remarks. — Erected by Wolff (1932) for pollen grains of the family Ulmaceae, the genus *Ulmi-pollenites* included only one species, *U. undulos-*

us. The genus *Polyporopollenites* Pf. (Th. & Pf., 1953) includes several species varying in botanical origin. It seems, therefore, that Potonié (1956) correctly acknowledged the generic name *Ulmipollenites* as having a priority, as being in force and including one species only. Three new species of the genus *Ulmipollenites*, differing from the type species in the thickness of exine and type of sculpture, were described by Nagy (1969).

Botanical affinity. — Family Ulmaceae and probably the genus *Ulmus*.

Occurrance (in the area under study). — Single pollen grains of this species occur in all profiles and more numerously in the Upper Miocene deposits.

Genus *Intratriporopollenites* Pflug & Thomson, 1953

Type species: Intratriporopollenites instructus (R. Potonié, 1931) Thomson & Pflug, 1953

Intratriporopollenites instructus (R. Potonié, 1931) Thomson & Pflug, 1953

(Pl. XVIII, Fig. 14a—c)

1931c. *Tiliae-pollenites instructus* R. Pot.; R. Potonié, p. 556, Fig. 9.

Material. — Twenty-three specimens.

Description. — Triangular obtuse-convex in outline, 28 to 39 μ in equatorial diameter. Germinal apparatus arranged equatorially in the central parts of wall. Exine about 2.5 μ thick, composed of two layers. Ectoexine with a reticulate sculpture consisting of the murri type processes (mesh lumina between about 0.5 and 1.5 μ in diameter) and forming a strongly swollen annulus around the pore. Exopore elongate meridionally, 2.5 to 3 μ in equatorial diameter. Endopore round, to 5 μ in diameter. An atrium is formed by a layer of endoexine.

Remarks. — This species differs from others of this genus in a distinct reticulate sculpture and large swellings of ectoexine near pores.

Botanical affinity. — Mai (1960) relates this species with the extinct genus *Burretia* of the family Tiliaceae.

Occurrence (in the area under study). — Single specimens occurring in many profiles of warmer Miocene phases.

Intratrioporopollenites insculptus Mai, 1961

(Pl. XVIII, Figs 12, 13a, b)

1961. *Intratriporopollenites insculptus* Mai; D. H. Mai, p. 65, Pl. 11, Figs 16—19.

Material. — Eighteen specimens.

Description. — Subspheroid in outline and 28 to 39 μ in equatorial diameter. Outer pore surrounded by an annulus. A distinct inner germinalium in the form of a short furrow. Sculpture reticulate, composed of the duplibaculate murri type processes. Mesh lumina less than 1.5 μ in diameter. Exine to 2 μ thick.

Remarks. — Specimens of *I. inscupltus* from the material under study were mostly slightly smaller than those described by Mai (1961).

Botanical affinity. — According to Mai (1961), the subfamily Brownlowioideae of the family Tiliaceae.

Occurrence (in the material under study). — Relatively rare in cooler phases of the Miocene, particularly phases V and VII; Ustronie, Gierlachowo and Nowa Wieś.

Genus *Porocolpopollenites* Thomson & Pflug, 1953

Type species: Porocolpopollenites vestibuloformis Pflug, 1953

Porocolpopollenites calauensis Krutzsch, 1961
(Pl. XIX, Fig. 9a, b)

1961. *Porocolpopollenites calauensis* W. Kr.; W. Krutzsch, p. 318, Pl. IV, Figs 94—97.

Material. — Seven specimens.

Description. — Triangular obtuse-convex in equatorial outline and 30 to 36 μ in equatorial diameter. Exine with a gemmate sculpture in the form of irregularly scattered beadlike processes, between which a fine structure of ectoexine is visible. Wall composed of several layers. The outer layer of ectoexine forms an about 15 μ-long furrow in the germinal part. The inner layer forms an annulus around the pore. A broad atrium is produced by endoexine.

Remarks. — Specimens of *P. calauensis*, found in the Middle Oligocene deposits of the profiles discussed, are slightly smaller than those described by Krutzsch (1961).

Botanical affinity. — Uncertain, maybe the family Symplocaceae.

Occurrence (in the area under study). — Middle Oligocene of the Tarnówka, Mosina and Krosinko profiles.

Porocolpopollenites vestibulum (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. XIX, Figs 4 and 8)

1931*a*. *Pollenites vestibulum* R. Pot.; R. Potonié, p. 329, Pl. 2, Fig. 23.

Material. — A dozen or so specimens.

Description. — Triangular in outline, 20 to 34 μ in equatorial diameter. Exine thick, composed of many layers, its sculpture gemmate. In the germinal part, the outer layer of ectoexine less than 1 μ thick and forming a short furrow. Inner layer of ectoexine forms a high annulus around the pore and endoexine forms a wide atrium.

Remarks. — A considerable variability in the development of sculpture is displayed by specimens of this species.

Botanical affinity. — Family Symplocaceae.

Occurrence (in the area under study). — Occurring sporadically in the Gierlachowo and Ustronie profiles.

Porocolpopollenites latiporis Pflug & Thomson, 1953
(Pl. XIX, Fig. 1a, b)

1953. *Porocolpopollenites latiporis* Pf. & Th.; P. W. Thomson & H. Pflug, p. 93, Pl. 10, Figs 123—124.

Material. — Five specimens.

Description. — Triangular-concave in equatorial outline, 29 to 33 μ in equatorial diameter. Outer layer of exine with a fine, gemmate sculpture, in the germinal area forming a short furrow. Inner layer forms a small annulus around the pore. A wide vestibulum is formed by endoexine.

Remarks. — This species differs from *P. vestibulum* primarily in a somewhat different structure of germinal apparatus, that is, a larger furrow and smaller annulus around the pore.

Botanical affinity. — Family Symplocaceae.

Occurrence (in the area under study). — Upper Miocene of the Oczkowice profile.

Procolpopollenites maturus (Doktorowicz-Hrebnicka, 1960) n.comb.
(Pl. XIX, Figs 5, 6)

1960. *Symplocos-Pollenites vestibulum* R. Pot.; forma *matura* Doktorowicz-Hrebnicka; J. Doktorowicz-Hrebnicka, p. 111, Pl. 43, Fig. 227.

Material. — Twenty-five specimens.

Description. — Triangular obtuse-convex in equatorial outline. Three germinal apparatus arranged angularly. Equator 22 to 30 μ in diameter. Exine 1.5 to 2 μ thick, composed of many layers. Outer layer of ectoexine with a gemmate sculpture, forming a short furrow in the germinal area. Inner layer forms an annulus around the pore and endoexine — a narrow vestibulum.

Remarks. — *P. maturus* was described by Doktorowicz-Hrebnicka (1960) as a from of the species *Pollenites vestibulum*, from which it differs in equatorial outline, more distinct and coarser sculpture and, slightly, in the structure of germinal apparatus.

Botanical affinity. — Perhaps the family Symplocaceae.

Occurrence (in the area under study). — Miocene, single specimens occurring in various profiles, Niedźwiedzice, Oczkowice, Wirczyn, Ustronie, Gierlachowo.

Porocolpopollenites triangularis (R. Potonié, 1931), Thomson & Pflug, 1953

(Pl. XIX, Fig. 3)

1931*a*. *Pollenites triangularis* R. Pot.; R. Potonié, p. 332, Pl. 2, Fig. 9.

Material. — Three specimens.

Description. — Triangular in equatorial outline and 18 to 23 μ in equatorial diameter. Exine very thick, with a fine sculpture. Three germinal apparatus arranged angularly. Outer layer of ectoexine forming a very short furrow in germinal area, inner thickening in this part and forming an annulus surrounding the pore. A relatively small vestibulum is formed by endoexine.

Remarks. — This species differs from other species of the genus *Porocolpopollenites* in small dimensions, psilate exine and structure of germinal apparatus.

Botanical affinity. — Family Symplocaceae.

Occurrence (in the area under study). — Upper Miocene, Ustronie and Gerlachowo.

Porocolpopollenites sp.

(Pl. XIX, Fig. 2)

Material. — Eight specimens.

Description. — Spheroid or triangular obtuse-convex in equatorial outline. Equator 20 to 28 μ in diameter. Three germinal apparatus arranged angularly, depressed. Exine psilate or chagrenate. Furrows very short, pores wide, vestibulum distinct.

Remarks. — Specimens of *Porocolpopollenites* sp. differ from others of the genus *Porocolpopollenites* in their thin exine devoid of sculpture, depressed germinal apparatus and nearly circular equatorial outline. The structure and arrangement of germinal apparatus and thinner exine are characters in which they also differ from specimens of *Symplocospollenites orbis.*

Botanical affinity. — Family Symplocaceae?

Occurrence (in the area under study). — In the deposits of the Later Miocene, the Ustronie profile.

Genus *Symplocospollenites* R. Potonié, 1960

Type species: Symplocospollenites rotundus (R. Potonié, 1931) 1960

Symplocospollenites anulus-rotundus Krutzsch, 1970

(Pl. XIX, Fig. 7)

1970*b*. *Symplocospollenites anulus-rotundus* Krutzsch; W. Krutzsch, p. 336, Pl. 8, Fig. 181; Pl. 15, Fig. 159.

Material. — Fourteen specimens.

Description. — Spheroid or convex-square in equatorial outline, 21 to

26 μ in diameter. Four germinal apparatus slightly projecting, arranged equatorially. Exine thick, composed of many layers, sculpture and structure invisible. Structure of germinal apparatus vague.

Remarks. — This is a group of older Tertiary species, similar to each other in shape and the structure of exine and germinal apparatus, which, according to Krutzsch (1967, 1970), due to their separate morphological character, should be excluded from the genus *Porocolpopollenites.* They represent a paleotropical element occurring in warmer Miocene phases.

Botanical affinity. — Family Symplocaceae. A type of pollen similar morphologically is observed in the Recent *Symplocous octopeta* (Potonié, 1960).

Occurrence (on the area under study). — Middle Oligocene deposits and some of the warmer phases of Upper Oligocene and Miocene, for example, the Oczkowice profile's phase II and the Gierlachowo profile's phase VI.

Genus *Corsinipollenites* Nakoman 1965

Type species: *Corsinipollenites oculus-noctis* (Thiergart, 1940) Nakoman, 1955

Corsinipollenites oculus-noctis (Thiergart, 1940) Nakoman, 1955
(Pl. XIX, Fig. 13a, b)

1940. *Pollenites oculus-noctis* Thg.; F. Thiergart, p. 47, Pl. 7, Fig. 1.

Material. — Five specimens.

Description. — Convex-triangular in outline, 42 to 56 μ in equatorial diameter. Three very large germinal apparatus are arranged angularly and equatorially. Wall 2 to 2.5 μ thick, composed of many layers, fairly thin as compared with size. Outer part of germinal apparatus developed from ectoexine in the form of a high and wide ring about 15 to 20 μ wide at the base and 7 to 9 μ high. Inner part, consisting of endoexine, forms a wide vestibulum. Exopore slightly elongate meridionally.

Remarks. — Two subspecies, differing in size only, are distinguished by Krutzsch (1968*b*) in this species. This is the species *Crosinipollenites,* the most common in the Tertiary (synonymy — see Krutzsch, 1968*b*).

Botanical affinity. — Family Oenotheraceae.

Occurrence (in the area under study). — Relatively rare in the Lower Miocene, of the Ustronie and Gierlachowo profiles.

Corsinipollenites ludwigioides Krutzsch, 1968
(Pl. XIX, Fig. 11a, b)

1968*b*. *Corsinipollenites ludwigioides* W. Kr.; W. Krutzsch, p. 782, Pl. 4, Figs 12—15.

Material. — Three specimens.

Description. — Triangular or triangular obtuse-convex in equatorial outline and 34 to 40 μ in equatorial diameter. Exine 1.5 to 2 μ thick, composed of many layers with a distinct punctate sculpture. Outer germinalium in the form of a pore meridionally elongate. Inner germinalium in the form of a high (3 to 4 μ) annulus surrounding a round inner pore.

Remarks. — This species differs from other of this genus in a less thickened germinal apparatus and smaller size.

Botanical affinity. — Family Oenotheraceae and most probably the genus *Ludwigia.*

Occurrence (in the area under study). — Middle Oligocene, Mosina.

Corsinipollenites graciliporus minor Krutzsch & Pactlová, 1968
(Pl. XIX, Fig. 10)

1968. *Corsinipollenites graciliporus minor* W. Kr. & Pactl.; W. Krutzsch, p. 781, Pl. 4. Fig. 19; Pl. 5, Figs 5, 6.

Material. — One specimen.

Description. — Triangular obtuse-convex in equatorial outline. Equator 35 μ in diameter. Exine 1.5 μ thick, with a gemmate sculpture. Three wide (13 μ), but low germinal apparatus do not project outside the outline.

Remarks. — The specimen described corresponds in its size and the structure of its germinal apparatus to the illustration and description of *C. graciliporus minor*, from which it differs in a coarser sculpture only.

Botanical affinity. — Family Oenotheraceae. Pollen grains similar morphologically are observed in the genus *Jussieua.*

Occurrence (in the area under study). — Middle Miocene (phase VIII) of the Nowa Wieś profile.

Genus *Lonicerapollis* Krutzsch, 1962

Type species: Lonicerapollis gallwitzii Krutzsch, 1962

Lonicerapollis gallwitzii Krutzsch, 1962
(Pl. XIX, Fig. 12)

1962. *Lonicerapollis gallwitzii* W. Kr.; W. Krutzsch, p. 275, Pl. 5, Figs 1—6.

Material. — Two specimens.

Description. — Triangular in polar view. Equator 38 to 40 μ in diameter, polar axis about 10 μ long. Exine 3 to 4 μ thick, composed of many layers, covered with loosely scattered spiny processes about 1 μ high and in diameter at the base. Processes spaced at 3 to 5 μ intervals. Central layer of ectoexine with an indistinct granulate structure, inner layer columellar. Three germinal apparatus developed in the form of short furrows (egzocolpi) and pores surrounded by annulus which is formed by the inner layer of ectoexine.

Remarks. — Pollen grains of this type, slightly varying in the size and development of spiny processes, were described in Soviet literature by Tziguryayeva (1956) and Pokrovskaya (1956) as the pollen of *Lonicera*. In Poland, they were described by Stuchlik (1964) from Rypin. Krutzsch (1962) believes that in the Tertiary of Germany this element occurs sporadically but consistently in the Middle and Lower Miocene.

Botanical affinity. — The pollen with a similar morphological structure occurs in the family Caprifoliaceae.

Occurrence (in the area under study). — Middle Miocene, Oczkowice.

Genus *Tricolporopollenites* Thomson & Pflug, 1953

Type species: *Tricolporopollenites dolium* R. Potonié, 1931

Tricolporopollenites ipelensis Pacltová, 1966
(Pl. XX, Fig. 11a—c)

1966. *Tricolporopollenites ipelensis* Paclt.; B. Pacltová, p. 25, Pl. 19, Figs 14—19, 22—24.

Material. — Eighteen specimens.

Description. — Subprolate in equatorial view. Polar axis 20 to 28 μ long, equator 14 to 18 μ in diameter. Exine without tectum with sculpture of the clavate type. Baculae small, less than 0.5 μ high, closely spaced, forming a reticulum with 0.5 μ mesh lumina. The height of baculae somewhat larger on poles than on equator. Furrows, not reaching poles, are relatively shallow on equator, to about 2 μ in depth. Pores narrow, oval, elongate polarly, 3 to 5 μ long.

Remarks. — Krutzsch (oral communication) considers *T. ipelensis* as a characteristic component of cooler climatic phases, occurring throughout the Miocene. It differs from the species *T. retiformis*, most closely related morphologically, in a more elongate polar axis, different type of sculpture and a different structure of germinal apparatus.

Botanical affinity. — Unknown.

Occurrence (in the area under study). Gierlachowo, Oczkowice and Ustronie profiles.

Tricolporopollenites villensis (Thomson, 1950) Thomson & Pflug, 1953
(Pl. XX, Figs 15a—c, 17a—c)

1950. *Tricolporopollenites cingulum villensis* Th.; R. Potonié, P. W. Thomson & F. Thiergart, p. 55, Pl. B, Figs 28—29.

Material. — Several dozen pollen grains.

Description. — Grains tricolporate, widely subprolate in equatorial view. Polar axis 28 to 36 μ long, equator 18 to 26 μ in diameter. Exine with tectum. Sculpture baculate. Baculae small, higher on poles than on equator, forming on the surface a reticulum with about 0.5 μ mesh lumina on equator. Towards poles, lumina increase to 1 μ. Furrows deep, strongly developed, formed by the outer layer of ectoexine and not reaching poles. Pores round or slightly elongate polarly, surrounded by an annulus formed by the thickened inner layer of ectoexine.

Remarks. — This is a collective species, including many forms related morphologically and which occur in the Middle Tertiary.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene deposits — Tarnówka, Mosina, Ślepuchowo, Krosinko and Gierlachowo borings.

Tricoloporopollenites cingulum fusus Thomson & Pflug, 1953

(Pl. XX, Figs 10a—b; 13a—c; 14a—b)

1953. *Tricolporopollenites cingulum fusus* Th. & Pf.; P. W. Thomson & H. Pflug, p. 100, Pl. 12, Figs 15—27.

Material. — Several dozen specimens.

Description. — Pollen grains, tricolporate, elongate-subprolate in equatorial view. Polar axis 22 to 26 μ long, equator 13 to 18 μ in diameter. Sculpture finely baculate, baculae less than 1 μ high over the entire sufrace of grain. Furrows deep, long, reaching poles. Pores round, situated on equator. Around pores exine strongly swollen.

Remarks. — Pollen grains with similar morphological structure are determined by Krutzsch (1957) as group 112 of the fusus type, characteristic of the Earlier Tertiary deposits. Among them, forms similar morphologically to the genus *Ptelea* are distinguished by Stuchlik (1964). According to Krutzsch (1957), macroscopic remains of *Ptelea* genus were found in the Oligocene only.

Botanical affinity. — It includes the family Rutaceae and the genus *Ptelea*, but also several other genera similar in the morphology of their pollen grains.

Occurrence (in the area under study). — Middle Oligocene of all profiles.

Tricolporopollenites cingulum pusillus (R. Potonié, 1934) Thomson & Pflug, 1953

(Pl. XX, Fig. 9a—c)

1934. *Pollenites quisqualis pusillus* R. Pot.; R. Potonié, p. 72, Pl. 3, Fig. 21.

Material. — Several dozen specimens.

Description. — Pollen grains subprolate in equatorial view, tricolporate.

Polar axis 17 to 22 μ long, equator 11 to 13 μ in diameter. Exine psilate or finely punctate. Germinal apparatus similar in structure to those of the former subspecies.

Remarks. — Like in the former subspecies, pollen grains are here included with a similar morphological structure and with a similar stratigraphic range, coming from various botanical groups.

Botanical affinity. — Sometimes they are related with the genus *Castanopsis* (Doktorowicz-Hrebnicka, 1957, 1960; Thiergart, 1940; Mamczar, 1960).

Occurrence (in the area under study). — All profiles of the Middle and Upper Oligocene and Lower and Middle Miocene.

Tricolporopollenites cingulum oviformis (R. Potonié, 1931) Thomson & Pflug, 1953

(Pl. XX, Figs 3—5)

1931*a*. *Pollenites oviformis* R. Pot.; R. Potonié, p. 328, Pl. 1, Fig. 20.

Material. — Several dozen specimens.

Description. — Elongate-subprolate in equatorial view. Polar axis less than 18 μ long. Exine psilate, composed of many layers, furrows strongly developed, pores round, situated on equator.

Remarks. — Like the former two subspecies, this is a collective group of small tricolporate forms related morphologically.

Botanical affinity. — Related with small forms of the genus *Castanea* (Thomson & Pflug, 1953).

Occurrence (in the area under study). — Common in all profiles.

Tricolporopollenites haanradensis Manten, 1958

(Pl. XX, Fig. 12a—c)

1958. *Tricolporopollenites haanradensis* Manten; A. A. Manten, p. 463, Figs 12, 13.

Material. — Three specimens.

Description. — Widely subprolate in equatorial view. Polar axis 17 to 20 μ long, equator 19 to 21 μ in diameter. Furrows not very deep, with a characteristic bend on equator, pores small, round. Sculpture clavate, forming a reticulum with irregularly polygonal meshes larger in the equatorial than polar part.

Botanical affinity. — Similar pollen grains were assigned by Oszast (1960) and Stuchlik (1964) to the family Rhamnaceae.

Occurrence (in the area under study). — Middle Oligocene, Mosina boring.

Genus *Cyrillaceaepollenites* (Mürriger & Pflug, 1951) emend. R. Potonié, 1960

Type species: Cyrillaceaepollenites megaexactus (R. Potonié, 1931) 1960

Cyrillaceaepollenites megaexactus (R. Potonié, 1931) 1960
(Pl, XX, Figs 6, 7)

1931*d*. *Pollenites megaexactus* R. Pot.; R. Potonié, p. 26, Pl. 2, Fig. V42b.

Material. — Several dozen specimens.

Description. — Pollen grains tricolporate, widely subprolate in equatorial view, swollen on equator. Polar axis 17 to 25 μ long, equator 13 to 20 μ in diameter. Polar areas widely rounded or somewhat flattened. Furrows bent on equator, deep. Pores 1.5 to 2.5 μ in diameter, surrounded by a somewhat swollen inner layer of ectoexine. Exine to 2.5 μ thick, composed of several layers. Sculpture clavate, forming a fine-meshed reticulum.

Remarks. — The species *Pollenites cingulum brühlensis* was erected by Mürriger & Pflug (1951) as typical of the genus *Cyrillaceaepollenites.* In 1953, Thomson & Pflug considered this species as a synonym of *Pollenites megaexactus* assigned by them to the genus *Tricolporopollenites.* In this species, they distinguished two subspecies, *brühlensis* and *exactus.* R. Potonié (1960) cancelled out the subspecies *brühlensis* as identical with *Cyrillaceaepollenites megaexactus,* and raised the subspecies exactus to the rank of species.

Botanical affinity. — Probably the family Cyrillaceae.

Occurrence (in the area under study). — A common component of all profiles in the Upper and Middle Miocene, less frequent in deeper deposits.

Cyrillaceaepollenites exactus (R. Potonié, 1931) 1960
(Pl. XX, Figs 1, 2)

1931*d*. *Pollenites exactus* R. Pot.; R. Potonié, p. 26, Pl. 1, Fig. V42b.

Material. — More than 100 specimens.

Description. — Pollen grains tricolporate, widely subprolate in equatorial view, extended on equator. Polar axis less than 15 μ long, equator 10 to 13 μ in diameter. Polar areas widely rounded or slightly flattened. Furrows on equator bent, relatively deep. Pores round, depressed. Exine thin, composed of two layers, devoid of a sculptured layer.

Remarks. — The species *C. exactus* differs from *C. megaexactus* primarily in smaller dimensions and the lack of sculpture. It is a common component of Miocene profiles, particularly numerous in warmer climatic phases and usually connected with coal deposits.

Botanical affinity. — Probably the family Cyrillaceae.

Occurrence (in the area under study). — In all profiles, abounding in some horizons.

Tricolporopollenites cf. *wallensenensis* Pflug, 1953
(Pl. XXI, Figs 1a—c, 3a—c)

1953. *Tricolporopollenites wallensenensis* Pf.; P. W. Thomson & H. Pflug, p. 103, Pl. 13, Figs 1—4.

Material. — Five specimens.

Description. — Grains tricolporate, elongate-subprolate in equatorial view. Polar axis 33 to 35 μ long, equator 22 to 24 μ in diameter. Furrows very distinct, short, not reaching poles. Pores small, round, depressed, surrounded by a not very large annulus. Exine relatively thick, composed of many layers, with a distinct baculate sculpture forming a reticulum, whose mehes are polygonal and smaller on equator than in polar areas.

Remarks. — In the material under study, pollen grains of this species occur rarely and are to the greatest extent similar to the specimens described by Thomson & Pflug (1953) as *T. wallensenensis*, from which they differ in somewhat smaller dimensions.

Botanical affinity. — Pollen grains similar in morphological structure occur in the family Araliaceae.

Occurrence (in the area under study). — Upper Miocene; few grains in the Oczkowice profile.

Genus *Araliaceoipollenites* R. Potonié, 1951

Type species: Araliaceoipollenites euphorii (R. Potonié, 1961) 1960

Araliaceoipollenites edmundi (R. Potonié, 1931) 1960
(Pl. XXI, Figs 2; 4—7)

1931*d*. *Pollenites edmundi* R. Pot.; R. Potonié, p. 26, Pl. 1, Fig. V53a.

Material. — More than thirty specimens.

Description. — Pollen grains tricolporate. Polar axis 32 to 45 μ long, equator 30 to 39 μ in diameter. Grains widely subprolate in equatorial view, sometimes even spheroid. Exine thick with a distinct, baculate sculpture. Furrows very strongly developed, with exine swollen on margins, roller-like in shape and surrounding round, large pores.

Remarks. — The species *A. edmundi* was included by Thomson & Pflug (1953) in the genus *Tricolporopollenites* and became a collective concept for all large pollen forms, having a thick exine. Krutzsch (1958) collected them and formed a group of "edmundoid forms". In 1960, Potonié excluded all these forms from the collective species *T. edmundi* and separated them as a species of the genus *Araliaceoipollenites.* Mamczar (1962) separated two fundamental groups of edmundoid forms, Group I with the same morphological structure as that of the family Araliaceae (cf. *Aralia*) and Group II identical in morphological structure with the family Cornaceae (cf. *Cornus*). Nagy (1969) divided the specific group *A. emundi* into two genera, *Araliaceoipollenites edmundi*, to which she assigned morphological form with a structure of the *Aralia* type and *Tricolporopollenites edmundi* in which she included forms with a structure of the *Cornus* type. The entire group of forms of *Araliaceoipollenites edmundi* requires an accurate morphological elaboration.

Botanical affinity. — The Araliaceae and the Cornaceae.

Occurrence (in the area under study). — Sporadically in warmer phases of all profiles.

Tricolporopollenites marcodurensis Pflug & Thomson, 1953

(Pl. XXI, Figs 13—18)

1953. *Tricolporopollenites marcodurensis* Pf. & Th.; P. W. Thomson & H. Pflug, p. 103, Pl. 13, Figs 5—9.

Material. — Thirty-two specimens.

Description. — Prolate in equatorial view. Polar axis 32 to 45 μ long, equator 13 to 25 μ in diameter. Furrows narrow, long, reaching poles. Pores small, round. Exine sculpture baculate, nearly twice as prominent on poles than on equator, forming on the surface a reticulum with fine, irregular meshes.

Remarks. — Like the previous ones, this is a collective species, including several forms, marked by a similar though not identical morphological structure. It is compared with the species which represent the genus *Parthenocissus*. Krutzsch (1967) believes this species, or rather a group of forms related morphologically to *Parthenocissus*, to be a component of the intermediate element, occurring in the Miocene floras.

Botanical affinity. — Genus *Parthenocissus*.

Occurrence (in the area under study). — Single grains occurring in many samples from all profiles.

Genus *Rhoipites* Wodehouse, 1933

Type species: *Rhoipites bradleyi* Wodehouse, 1933

Rhoipites pseudocingulum (R. Potonié, 1931) 1960

(Pl. XXIII, Figs 2—5; 10a, b)

1931*a*. *Pollenites pseudocingulum* R. Pot.; R. Potonié, p. 328, Pl. 1, Figs 2—4, 19, 24, 26, 27.

Material. — More than fifty specimens.

Description. — Grains tricolporate, widely subprolate in equatorial view. Polar axis 27 to 45 μ long, equator 22 to 30 μ in diameter. Exine 2 to 3 μ thick, composed of two layers. Ectoexine with a baculate or gemmate sculpture. Furrow deep, thinwalled, with a bend on equator. Pores oval, elongate meridionally,

Remarks. — A collective species, in which many various morphological forms have been included and which requires a very penetrating analysis. The first, tentative analysis of this type was conducted by Mamczar (1962), who distinguished in this species four principal morphological groups whose pollen grains are similar to those of various genera (*Mangifera, Rhus* and *Spondius*).

Botanical affinity. — A purely morphological species, heterogeneous botanically.

Occurrence (in the area under study). — In all profiles, sometimes abundant.

Genus *Cupuliferoidaepollenites* R. Potonié, Thomson & Thiergart, 1950

Type species: *Cupuliferoidaepollenites liblarensis* Thomson, 1950

Cupuliferoidaepollenites librarensis Thomson, 1950
(Pl. XXII, Figs 1—4a—c)

1950. *Cupuliferoidae-pollenites liblarensis* Th.; R. Potonié, P. W. Thomson & F. Thiergart, p. 55, Pl. B, Figs 26—27.

Material. — More than 100 specimens.

Description. — Subprolate in equatorial view. Polar axis 10 to 26 μ long, equator 11 to 15 μ in diameter. Exine 1 μ thick, composed of two layers without a distinct sculpture, and displaying a fine structure, psilate or chagrenate. Furrows long, reaching poles. Pores narrow, very strongly elongate polarly.

Remarks. — Potonié *et al.* (1950) illustrated both the form having narrow pores characteristic of the species *C. liblarensis* (Fig. 26) and that with small, round pores characteristic of the subspecies oviformis of the species *Tricolporopollenites cingulum* (Fig. 27). Only Fig. 26 should be typical for *Cupuliferoidaepollenites.* Thomson & Pflug (1953) changed the generic name into *Tricolpopollenites* and separated from the species *T. liblarensis* two subspecies, a larger one, *liblarensis* and a smaller, *fallax.*

Botanical affinity. — Probably the family Leguminosae.

Occurrence (in the area under study). — Sometimes very numerous in all profiles.

Genus *Quercoidites* R. Potonié, Thomson & Thiergart, 1950

Type species: *Quercoidites henrici* (R. Potonié, 1931) R. Potonié, Thomson & Thiergart, 1950

Quercoidites henrici (R. Potonié, 1931) R. Potonié, Thomson & Thiergart, 1950

(Pl. XXII, Figs 9a, b—11a, b)

1931*a*. *Pollenites henrici* R. Pot.; R. Potonié, p. 329, Pl. 2, Fig. 19.

Material. — More than fifty specimens.

Description. — Subprolate in equatorial view. Polar axis 30 to 45 μ long, equator 22 to 30 μ in diameter. Furrows long, reaching poles. Pores indistinct, narrow, strongly elongate meridionally. Exine thin, composed of two layers, its structure punctate.

Remarks. — This species, determined morphologically as tricolpate, was assigned by Thomson & Pflug (1972) to the genus *Tricolpopollenites*. The structure of its furrows and pores is similar to that in the genus *Quercus*. At present, this is a collective species, including several forms related, but not identical morphologically.

Botanical affinity. — (?) Fagaceae.

Occurrence (in the area under study). — Numerous in all profiles.

Quercoidites microhenrici (R. Potonié, 1931) R. Potonié, Thomson & Thiergart, 1950

(Pl. XXII, Fig. 6a, b—8)

1931*d*. *Pollenites microhenrici* R. Pot.; R. Potonié, p. 26, Pl. 1, Fig. V19c.

Material. — More than fifty specimens.

Description. — Subprolate in equatorial view, with widely rounded poles, polar axis 23 to 30 μ long and equator 15 to 22 μ in diameter. Furrows long, reaching poles, sometimes bent in equatorial part. Pores narrow, strongly elongate meridionally. Exine relatively thick, reaching 2 μ, composed of two layers, with an uneven, granulate sculpture.

Remarks. — Two subspecies differing from each other in sculpture are distinguished in this species by Thomson & Pflug (1953).

Botanical affinity. — Various botanical taxons similar in the morphology of pollen are here assigned.

Occurrence (in the area under study). — Numerous in the Middle Oligocene of all profiles, less so in the Lower and Middle Miocene.

Genus *Nyssapollenites* Thiergart, 1937

Type species: *Nyssapollenites pseudocruciatus* (R. Potonié, 1931) Thiergart, 1937

Nyssapollenites pseudocruciatus (R. Potonié, 1931) Thiergart, 1937

(Pl. XXIII, Fig. 8a, b)

1931*a*. *Pollenites pseudocruciatus* R. Pot.; R. Potonié, p. 328, Pl. 1, Fig. 10.

Material. — Twelve specimens.

Description. — Spheroid in equatorial view, with polar axis 28 to 32 μ long and equator 28 to 30 μ in diameter. Furrows do not reach poles. Exine around pores strongly thickened. Pores round. Exine 1.5 μ thick, composed of two layers. Structure punctate.

Remarks. — A holotype illustrated by Potonié (1931) has the structure of its pollen grains similar to that of *Fagus* and different than that of the morphological type *Nyssa.*

Botanical affinity. — *Fagus?*

Occurrence (in the area under study). — Upper Miocene of the Krosinko, Gołębin Stary and Mosina profiles.

Nyssapollenites kruschi (R. Potonié, 1934) Nagy, 1969
(Pl. XXIII, Fig. 6, 7)

1934. *Pollenites kruschi* R. Pot.; R. Potonié, p. 65, Pl. 2, Figs 36—38.

Material. — More than fifty specimens.

Description. — Subspheroid in equatorial view, with polar axis 23 to 35 μ long and equator 27 to 30 μ in diameter. Furrows short, not reaching poles, with exine surrounding them strongly thickened. Pores round, sometimes elongate equatorially, situated in the central parts of furrows. Exine thick, composed of two layers. Outer layer with a punctate structure.

Remarks. — The species *N. kruschi* was assigned by Thomson & Pflug (1953) to the genus *Tricolporopollenites.* Nagy (1969) defined its generic assignment precisely, including it in the genus *Nyssapollenites.* This is a morphological type common throughout the Tertiary.

Botanical affinity. — Genus *Nyssa.*

Occurrence (in the area under study). — In all profiles, sometimes abundant.

Genus *Faguspollenites* Raatz, 1937

Type species: *Faguspollenites verus* Raatz, 1937

Faguspollenites verus Raatz, 1937
(Pl. XXIII, Fig. 9a—c)

1937. *Faguspollenites verus* Raatz; G. V. Raatz, p. 23, Pl. 1, Fig. 17.

Material. — Twenty-two specimens.

Description. — Spheroid in equatorial view, with polar axis and equator diameter amounting to 32 to 43 μ. Furrows short, very narrow, with large, round pores occurring equatorially in the middle of a furrow. Exine with a punctate or granulate structure.

Remarks. — According to Raatz (1937), this species differs from *N. pseudocruciatus,* a species the nearest morphologically, in a considerably smaller swelling of exine near furrows.

Botanical affinity. — Genus *Fagus.*

Occurrence (in the area under study). — This pollen type occurs particularly often in cooler phases of the Upper Miocene including the Nowa Wieś and Oczkowice borings.

Genus *Ilexpollenites* Thiergart, 1937

Type species: Illexpollenites iliacus (R. Potonié, 1931) Thiergart, 1937

Illexpollenites iliacus (R. Potonié, 1931) Thiergart, 1937
(Pl. XXIV, Fig. 3a—c)

1931c. *Pollenites iliacus* R. Pot.; R. Potonié, p. 556, Fig. 5.

Material. — Many, well-preserved specimens.

Description. — Subprolate in equatorial and rounded in polar view. Polar axis 35 to 55 μ long, equator 30 to 45 μ in diameter. Polar areas large, furrows straight, deep, not reaching poles. Pores round, well developed, 3.5 to 5 μ in diameter. Grain surface covered with baculate processes to 4 μ long and to about 3 μ in diameter, higher in polar area than in equatorial part.

Remarks. — Pollen grains of *Ilexpollenites iliacus* occur in many samples from all the borings under study. Considered as a facies element, they are not particularly connected with climatic phases of the Earlier Tertiary. They were described and illustrated by many authors. Two forms, *f. major* and *f. medius,* are distinguished between them. The two forms are represented in the material under study, *f. medius* being more frequent.

Botanical affinity. — Family Aquifoliaceae, genus *Ilex.*

Occurrence (in the area under study). — Common in all profiles.

Ilexpollenites margaritatus (R. Potonié) Thiergart, 1937
(Pl. XXIV, Fig. 6a—c)

1931a. *Pollenites margaritatus* R. Pot.; R. Potonié, p. 332, Pl. 1, Fig. 33.

Material. — A dozen or so specimens.

Description. — Subprolate-elongate in equatorial and trilobate in polar view. Polar axis 27 to 45 μ long, diameter 20 to 35 μ. Furrows straight, short, not reaching poles. Pores round 2.5 to 3 μ in diameter. Grain surface covered with baculate processes to 2 μ long and 1 to 1.5 μ in diameter. Baculae usually higher in polar area than on equator.

Remarks. — *I. margaritatus* differs from *I. iliacus* in a more elongate shape and primarily in sculpture which is finer and consists of smaller, slimmer and more closely spaced baculae. The two species are shown together in diagrams.

Botanical affinity. — Family Aquifoliaceae and the genus *Ilex*.

Occurrence (in the area under study). — As the former species.

Genus *Caprifoliipites* Wodehouse, 1933

Type species: Caprifoliipites viridi-fluminis Wodehouse, 1922

Caprifoliipites sambucoides Nagy, 1969
(Pl. XXIV, Fig. 8a, b)

Material. — Five specimens.

Description. — Subspheroid in equatorial view. Polar axis 24 to 28 μ long, equator 26 to 28 μ in diameter. Exine about 2 μ thick with baculate processes about 1.5 μ high, forming on the surface a network with large, polygonal meshes. Ectoexine distinctly columellar. Endoexine thin (about 0.5 μ) without a distinct structure. Furrows narrow, bent near equator, reaching poles. Pores round, about 1.5 μ in diameter.

Remarks. — Specimens coming from the material under study are lightly larger than those described by Nagy (1969) but having an identical morphology. The specific name *C. sambucoides*, selected by Nagy (1969) is not exactly the most appropriate, since the morphology of these pollen grains and in particular the sculpture of their surface, as well as the shape of furrows and structure of germina apparatus resemble in fact the pollen gains of the genus *Viburnum*.

Botanical affinity. — Family Caprifoliaceae, the genus *Viburnum*.

Occurrence (in the area under study). — Single specimens in the Upper Miocene, at Oczkowice and Gierlachowo.

Tricolporopollenites sp. (cf. Oleaceae)
(Pl. XXII, Fig. 12a, b)

Material. — A dozen or so specimens.

Description. — Subprolate in equatorial view, with widely rounded polar areas. Polar axis 34 to 42 μ long, equator 27 to 31 μ in diameter. Exine about 1.5 μ thick, with columellar layer to 1 μ high and forming on the surface a reticulum with polygonal, irregular meshes to 0.5 μ in diameter. Columelle are on the whole somewhat lower on equator than in polar areas. Furrows straight, rather shallow, not reaching poles. Pores elongate meridionally, about 1.5 μ wide and about 4 μ long.

Remarks. — Pollen grains similar in morphological structure are relatively frequent in the material under study. They are shown in the diagrams as cf. Oleaceae.

Botanical affinity. — A similar type of the morphological structure of pollen occurs not only in the Oleaceae, but also in some genera of the families Caprifoliaceae, Celastraceae and Araliaceae.

Occurrence (in the material under study). — In many profiles, but rather few.

Tricolporopollenites indeterminatus (Romanowicz, 1961) n.comb
(Pl. XXIV, Fig. 9a, b)

1961. *Pollenites indeterminatus* Romanowicz; I. Romanowicz, p. 355, Pl. 21, Fig. 275.

Material. — A dozen or so specimens.

Description. — Pollen grains triocolporate, widely subprolate in equatorial view. Polar axis 35 to 42 μ long, equator 27 to 31 μ. Exine about 1 to 1.5 μ thick, composed of two layers. Outer layer with regularly arranged baculate processes making up a reticulum with 1 to 1.5 μ mesh lumina. Baculae uniform in height over the entire surface of grain, or somewhat higher in the equatorial zone. Furrows relatively deep, to 2.5 μ on equator. Pores round well developed, about 2 μ in diameter (Fig. 9a).

Remarks. — This species was not exhaustively defined by Romanowicz (1961). In 1965, elaborating stratigraphically the Toruń clays, Grabowska changed the generic name to *Tripopollenites* and once again illustrated this species. Stuchlik (1964) illustrated a similar morphological type (Pl. 11, Figs 23 and 24), calling it cf. *Quercus*. Similar morphological pollen type was found by Stachurska *et al.* (1973) from Sośnica nad was determined as *Parrotia* sp. In the material under study, this species appears only on the Middle Oligocene brackish deposits.

Botanical affinity. — According to Stachurska *et al.* (1973) the family Hamamelidaceae, genus *Parrotia*.

Occurrence (in the area under study). — Middle Oligocene, Tarnówka boring.

Tricolporopollenites starosedloensis Krutzsch & Pactlová, 1969
(Pl. XXIV, Fig. 7a, b)

1969. *Tricolpollenites starosedloensis* W. Kr. & Pactl.; W. Krutzsch, p. 474, Pl. 2, Figs 26—30.

Material. — A few well-preserved specimens.

Description. — Pollen grains tricolporate, subprolate in equatorial view. Polar axis 30 to 35 μ long, equator 20 to 30 μ in diameter. Exine thin (about 1 μ), composed of two layers. Sculpture in the form of closely spaced baculate processes about 1 μ high making up a reticulum with about 1.5 to 2 μ lumina. Furrows rather shallow, nearly reaching poles. Polar area small. Pores poorly developed, obscured by sculpture, usually strongly elongate meridionally.

Remarks. — This species differs from *T. indeterminatus* described by Romanowicz (1961) in a different structure of pores which in the latter species are distinct and round.

Botanical affinity. — Probably genus *Parrotia* (according Stachurska *et al.*, 1973).

Occurrence (in the area under study). — Middle Oligocene deposits of the Mosina profile.

Tricolporopollenites vegetus (R. Potonié, 1934) Krutzsch, 1967

(Pl. XXIV, Fig. 5)

1934. *Sporites vegetus* R. Pot.; R. Potonié, p. 45, Pl. 1, Fig. 31; Pl. 6, Fig. 14.

Material. — Eight specimens.

Description. — Widely subprolate in equatorial view. Polar axis 30 to 36 μ long, equator 25 to 28 μ in diameter. Exine composed of two layers. Outer layer of ectoexine covered with closely spaced baculate processes varying in height from 1 μ in equatorial part to 1.5 μ in polar areas. The processes of sculpture form a reticulum with irregular, polygonal meshes, their lumina varying between 2.5 and 3 μ. Furrows shallow, reaching the region of poles and bent near equator. Pores small, round.

Remarks. — A whole group of pollen forms similar in morphology was distinguished by Krutzsch (1958) who called it a *vegetus* group. At present, he (1967) acknowledges pollen grains of this type as related with the genus *Hedera* and considers them an important component of the subtropical element of the Miocene pollen flora.

Botanical affinity. — Genus *Hedera.* A similar type of the structure of pollen is also known in the families Caprifoliaceae and Celestraceae.

Occurrence (in the material under study). — Miocene, single grains in warmer phases of various profiles.

Tricolporopollenites satzveyensis Pflug, 1953

(Pl. XXIV, Figs 10, 11)

1953. *Tricolporopollenites satzveyensis* Pf.; P. W. Thomson & H. Pflug, p. 103, Pl. 13, Figs 10—13.

Material. — Twelve specimens.

Description. — Subprolate in equatorial and triangular obtuse-convex in polar view. Polar axis 38 to 53 μ long, equator 30 to 36 μ in diameter.

Exine composed of two layers, about 2 μ thick. Sculpture foveolate. Structure intrabaculate. Furrows very deep, about 6 to 7 μ on equator long, nearly reaching poles. Pores large, deep elongate meridionally.

Remarks. — Pollen grains with this type of morphological structure were collected by Krutzsch (1958) in a group of forms he called "*satzveyensoid*" (group 109), whose occurrence is limited to the Earlier Tertiary only. They seem, however, to occur sporadically also in younger deposits of various profiles. Thus, for example, Mamczar (1960, Pl. 7, Figs 71 and 72) illustrates a grain with a similar morphology, defining it as *Quercus* forma *robusta.* Nagy (1969) records the species *T. satzveyensis* in the Tortonian deposits.

Botanical affinity. — Unknown. According to Nagy (1969) maybe the family Araliaceae?

Occurrence (in the area under study). — Sporadically in the Lower Miocene of Krosinko nad Ustronie and Middle Miocene of Oczkowice.

Tricolporopollenites parmularius (R. Potonié, 1934) Krutzsch, 1960
(Pl. XXIV, Fig. 12a, b)

1934. *Pollenites parmularius* R. Pot.; R. Potonié, p. 52, Pl. 2, Fig. 7.

Material. — Thirteen specimens.

Description. — Widely subprolate in equatorial view. Polar axis 31 to 36 μ long, equator 26 to 28 μ in diameter. Furrows deep, to 4 μ on equator, rectilinear, short, not reaching poles. Pores large, round or elongate meridionally, slightly depressed. Exine to 3 μ thick, its structure psilate.

Remarks. — The occurrence of this type of pollen is related by Krutzsch & Majewski (1967) with warmer phases of the Miocene.

Botanical affinity. — Genus *Eucommia.*

Occurrence (in the area under study). — Not numerous in many samples from warmer phases of the Middle Oligocene and Middle and Upper Miocene of Mosina, Ustronie and Gierlachowo.

Tricolporopollenites dolium (R. Potonié, 1931) Thomson & Pflug, 1953
(Pl. XXII, Fig. 5a, b)

1931*d*. *Pollenites dolium* R. Pot.; R. Potonié, p. 26, Pl. 1, Fig. V38a.

Material. — Fourteen specimens.

Description. — Subprolate in equatorial view, with a projecting equatorial part. Polar axis 21 to 25 μ long, equator 15 to 17 μ in diameter. Furrows rather shallow, strongly bent on equator, nearly reaching poles. Pores very large, to 5 μ in diameter. Exine about 1 μ thick, without a distinct structure and sculpture.

Remarks. — Due to its poorly illustrated holotype, this species became a collective group of many tricolporate morphological forms.

Occurrence (in the area under study). — Sporadically in warmer phases of various profiles; Ustronie, Krosno.

Tricolporopollenites spinus Krutzsch, 1962
(Pl. XXV, Fig. 14)

1962*a*. *Tricolpoporopollenites spinus* W. Kr.; W. Krutzsch, p. 278, Pl. 6, Figs 16—26.

Material. — Eight specimens.

Description. — Subprolate in equatorial view. Polar axis 26 to 30 μ long, equator 17—21 μ in diameter. Sculpture finely punctate with widely spaced spiny processes to 5 μ long. Wall about 2 μ thick, composed of many layers. Furrows long, reaching poles, surrounded by a thickened exine. Endopores round, depressed.

Remarks. — Loosely scattered, long, spiny processes on the surface differ this species from all others of the genus *Tricolporopollenites*. Krutzsch (1962) considers it is an important representative of the Turgay flora.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene deposits of Mosina nad Krosinko.

Genus *Spinulaepollis* Krutzsch, 1962

Type species: Spinulaepollis arceuthobioides Krutzsch, 1962

Spinulaepollis arceuthobioides Krutzsch, 1962
(Pl. XXV, Figs 5a, b; 6a—c)

1962*a*. *Spinulaepollis arceuthobioides* W. Kr.; W. Krutzsch, p. 278, Pl. 6, Figs 11—15.

Material. — Eighteen specimens.

Description. — Subpheroid in equatorial view, with polar axis 15 to 28 μ long. Furrows short, wide. Pores distinct, round, surrounded by an annulus. In polar view, rounded polygonal in outline, with six depressions. Three of them alternating, occupied by germinal apparatus, the other three formed by strips of exine solutions. Surface covered with relatively loosely and irregularly scattered, spiny processes.

Remarks. — Krutzsch (1962 *b*) described this genus as monospecific one, while Stuchlik (1964) distinguished in it a new form.

Botanical affinity. — A similar morphology is displayed by pollen grains of the Recent family Loranthaceae, in particular its species *Arceuthobium oxydri.*

Occurrence (in the area under study). — Single grains in the Lower and Middle Miocene from Gierlachowo and Oczkowice profiles.

Spinulaepollis arceuthobioides major Stuchlik, 1964
(Pl. XXV, Figs 7a, b—9)

1964. *Spinulaepollis arceuthobioides major* Stuchlik; L. Stuchlik, p. 43, Pl. 13, Figs 5—8.

Material. — Nine specimens.

Description. — Grains tricolporate with polar axis 24 to 30 μ long. Elongate-subprolate in equatorial view. Polygonal, with six depressions in polar view. Three of them occupied by germinals. Six distinct strips of a thickened exine arranged meridionally have a prominent, spinose sculpture. The structure of germinals as in the type species.

Remarks. — Forms illustrated by Stuchlik (1964) have not so distinctly developed strips of thickened and sculptured exine as specimens coming from the material under study.

Botanical affinity. — Probably the family Loranthaceae.

Occurrence (in the area under study). — Only in the Middle Oligocene deposits of the Mosina, Trzcianka and Krosinko boreholes.

Genus *Dicolporopollis* Krutzsch, 1970

Type species: Dicolporopollis middendorfi (R. Potonié, 1931) Krutzsch, 1970

Dicolporopollis middendorfi (R. Potonié, 1931) Krutzsch, 1970
(Pl. XXV, Fig. 4a, b)

1931*a*. *Pollenites middendorfi* R. Pot.; R. Potonié, p. 332, Pl. 1, Fig. 17.

Material. — Five specimens.

Description. — Subspheroid in equatorial view, with polar axis 18 to 23 μ long. Exine thick, many-layered and punctate on surface. Two furrows reaching poles, strongly depressed on equator and with small round pores.

Remarks. — This is a relatively rare element, not occurring in the Miocene. On the whole, it occurs in horizons with a considerable quantity of pollen of the *Tricolporopollenites cingulum fusus*. The structure of furrows and pores in *D. middendorfi* resembles that in *T. cingulum fusus*. Maybe, this is only an abnormal form.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene deposits from the Tarnówka profile and Upper Oligocene of the Ustronie borehole.

Genus *Oligopollis* Krutzsch, 1959

Type species: Oligopollis asymmetricus Krutzsch, 1959

Oligopollis pentaporis Krutzsch, 1959
(Pl. XXV, Fig. 10a—c)

1959. *Oligopollis pentaporis* W. Kr.; W. Krutzsch, p. 147, Pl. 34, Figs 57—62.

Material. — Eleven specimens.

Description. — In polar view, pollen grains triangular in outline with convexities in angular parts. Five endopores situated in the middle part of furrows, two of them on the proximal and three on the distal face. Three furrows run meridionally and three equatorially. Equator about 20 μ in diameter. Exine about 2 μ thick with a punctate sculpture.

Remarks. — Pollen grains of this species display a complex system of furrows and pores, compared by Krutzsch (1959 *b*) with that in the *Pericolpate* group (according to Faegri & Iversen, 1964).

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene of the Tarnówka, Mosina and Krosinko profiles.

Genus *Iteapollis* gen. n.

Type species: *Iteapollis angustiporatus* (Schneider, 1965) comb.n.

Diagnosis. — Grains small, biporate, plano-convex in equatorial and subprolate in polar view. Exopores small, round, surrounded by annulus. Exine psilate, composed of two layers. Inner part of exine forming an atrium.

Iteapollis angustiporatus (Schneider, 1965) comb. n.
(Pl. XXV, Figs 2, 3)

1965. *Psilodiporites angustiporatus* Schneider; W. Schneider, p. 205, Pl. 1, Fig. 10.

Material. — Twenty pollen grains.

Description. — Grains biporate, subprolate in equatorial outline and shaped like a plano-convex lens. Equator 17 to 23 μ in diameter, polar axis 10 to 14 μ long. Pores arranged angularly, somewhat subequatorially, 1.5 to 2 μ in diameter surrounded by a small annulus. Exine to 2 μ thick, composed of two layers. Ectoexine three times as thick as endoexine. The latter forms a small atrium around pore.

Remarks. — Biporate pollen grains have relatively frequently been described in Tertiary literature. Traverse (1955) assigns them to *Corylus* and Mamczar (1960) to the genus *Itea*. Stuchlik (1964) considers them to be *Corylus americana*. Schneider (1965) erects for this type of pollen the species *angustiporatus*, including it in the genus *Psilodiporites*, erected for biporate pollen grains from the Tertiary of India, but considerably differing in morphology, in particular in the structure of pores and development of exine, from the species *P. angustiporatus*. Pollen grains of this type were determined by Ziembińska & Niklewski (1966) as cf. *Itea*. According Sadowska (1973) the Recent genus *Itea* of the family Saxifragaceae has pollen grains with an identical morphology.

Botanical affinity. — Family Saxifragaceae.

Occurrence (in the area under study). — In various profiles, in the Middle and primarily Upper Miocene deposits, in warmer climatic phases (VIII, X and XII).

Genus: *Cupanieïdites* Cookson & Pike, 1954

Type species: Cupanieïdites eucalyptoides Krutzsch, 1962

Cupanieïdites eucalyptoides Krutzsch, 1962
(Pl. XXV, Fig. 1a, b)

1962*a*. *Cupanieïdites eucalyptoides* W. Kr.; W. Krutzsch, p. 271, Pl. 3, Figs 11—17.

Material. — Ten specimens.

Description. — Pollen grains syncolporate, 14 to 17 μ in equatorial diameter, triangular in polar view, with germinal apparatus situated angularly. Distinct three furrows reaching pole. Endoporus very small, without annulus, about 1 μ in diameter. Exine formed by two layers, outer layer psilate.

Remarks. — The species *C. eucalyptoides* which differs from other species of this genus in a psilate exine and small dimensions, is a valuable stratigraphic index. In the deposits of Northern and Central Europe, it does not occur above the Middle Oligocene and is the most frequently cited species of the genus *Cupanieïdites*. Doktorowicz-Hrebnicka (1961) describes forms identical morphologically from the deposits of Rogoźno as *Pollenites commenticus* and *Pollenites paululus*.

Botanical affinity. — Probably *Eucalyptus*, but this type of the structure of pollen is also observed in the family Myrtaceae.

Occurrence (in the area under study). — Middle Oligocene deposits of Mosina, Tarnówka, Krosno and Gołębin Stary.

Genus *Olaxipollis* Krutzsch, 1962

Type species: Olaxipollis matthesi Krutzsch, 1962

Olaxipollis matthesi Krutzsch, 1962
(Pl. XXV, Fig. 12)

1962*a*. *Olaxipollis matthesi* W. Kr.; W. Krutzsch, p. 276, Pl. 5, Fig. 79.

Material. — Eight specimens.

Description. — Pollen grains triporate 23 to 30 μ in diameter. Convex-triangular in polar view, with pores projecting and arranged angularly. Exine about 1 μ thick, composed of two layers. Outer layer psilate or very slightly finely-punctate. Pores devoid of annulus. Outer layer of exine irregularly frayed around pore, inner forming an atrium.

Remarks. — According to Krutzsch & Majewski (1967), this species is one of the most characteristic elements, indicative of warmer climatic phases of the Later Tertiary. Rare in deposits.

Botanical affinity. — According to Krutzsch (1962 *a*) — the family Olacaceae.

Occurrence (in the area under study). — Middle Miocene (phases VI and VIII) of Gierlachowo, Oczkowice, Pecno and Krosinko.

Genus *Boehlensipollis* Krutzsch, 1962

Type species: Boehlensipollis hohli Krutzsch, 1962

Boehlensipollis hohli Krutzsch, 1962
(Pl. XXV, Fig. 15)

1962*a*. *Boehlensipollis hohli* W. Kr.; W. Krutzsch, p. 272, Pl. 3, Fig. 18—20.

Material. — Eight specimens.

Description. — Pollen grains syncolporate, triangular or slightly concavo-triangular in polar view. Equator 38 to 48 μ in diameter. Germinalia arranged angularly, in the form of short furrows and an endopore devoid of annulus. On proximal face, undulate extensions of furrows reaching the pole. Exine composed of many layers. Outer layer separated by a distinct interloculum from inners, having a fine, granulate structure.

Remarks. — It is an only species of the genus *Boehlensipollis* very common in the deposits of the upper part of the Lower Oligocene and in those of the Middle Oligocene. It makes up a characteristic stratigraphic index. Doktorowicz-Hrebnicka (1961) describes forms identical morphologically as *Sporites avius.*

Botanical affinity. — According to Stuchlik (1964), probably the genus *Elaeagnus.*

Occurrence (in the area under study). — Middle Oligocene of Mosina and Tarnówka.

Genus *Reevesiapollis* Krutzsch, 1970

Type species: *Reevesiapollis triangulus* (Mamczar, 1960) Krutzsch, 1970

Reevesiapollis triangulus (Mamczar, 1960) Krutzsch, 1970
(Pl. XXV, Fig. 11)

1960. *Pollenites triangulus* Mamczar; J. Mamczar, p. 57, Pl. 14, Fig. 202.

Material. — Ten specimens.

Description. — Grains colporate, spheroid or polygonal in equatorial view, with equator 24 to 33 μ in diameter and with 4 to 6 germinals distributed equatorially. Furrows very short, pores round in outline, with a well developed annulus. Exine composed of two layers equalling each other in thickness, covered with baculate processes distributed regularly and forming a reticulum. Reticular meshes polygonal in outline, smaller on equator, growing larger towards poles. Inner layer of exine with a distinct columellar structure.

Remarks. — Pollen grains of this type are described in literature under various names, such as *Polyporopollenites silesiae* (Mazancova, 1962); *P. rotundus* (R. Pot.) forma *reticulata* with the indication of the relationship to the family Oleaceae (Stuchlik, 1964); *Reevesia* cf. *pubescens* (Manykin, 1966) and *Reevesia* sp. (Stachurska *et al.*, 1973). Complete synonymy see Sadowska (1973). This is a species occurring from the Upper Eocene through the Pliocene and connected with warmer climatic phases.

Botanical affinity. — Family Sterculiaceae, the genus *Reevesia.*

Occurrence (in the area under study). — Middle Oligocene of Trzcianka and Middle Miocene of Oczkowice.

Genus *Sporotrapoidites* Klaus, 1954

Type species: *Sporotrapoidites illigensis* Klaus, 1954

Sporotrapoidites illigensis Klaus, 1954
(Pl. XXV, Fig. 16)

1954. *Sporotrapoidites illigensis* Klaus; W. Klaus, p. 122, Pl. 1, Figs 1—3.

Material. — Two well-preserved pollen grains.

Description. — Subprolate in equatorial and triangular in polar view; three pores situated angularly. Furrows running meridionally, strongly obscured by three collars of exine, situated between the poles. Polar axis 72 to 75 μ long, equator 69 to 75 μ in diameter including collar. Polar axis of grain corpus 37 to 42 μ long, equator 30 to 35 μ in diameter. Exine about 2.5 to 3 μ thick, finely punctate. Collars formed by baculate processes of exine fused together. Collar 9 μ wide on pole and to 19.5 μ in the equatorial part. Collar arranged at an angle of 120° to each other.

Remarks. — Pollen grains from the Gierlachowo boring differ from those described by Klaus (1954) in slightly larger dimensions only (in the case of Klaus's specimens, the total length of grain amounts to 64 μ and that of the grain corpus to 34 μ, while in the Polish material respective figures are 75 and 42 μ).

Botanical affinity. — Family Trapaceae, the genus *Trapa*.

Occurrence (in the area under study). — Upper Miocene, Gierlachowo.

Genus *Tetracolporopollenites* Thomson & Pflug, 1953

Type species: *Tetracolporopollenites sapotoides* Thomson & Pflug, 1953

Tetracolporopollenites sapotoides Thomson & Pflug, 1953

(Pl. XXV, Fig. 13)

1953. *Tetracolporopollenites sapotoides* Th. & Pf.; P. W. Thomson & H. Pflug, p. 110, Pl. 15, Figs 6—12.

Material. — Eight specimens.

Description. — Grains tetracolporate, widely subprolate in equatorial outline with flately rounded poles. Polar axis 28 to 36 μ long. Exopore narrow, slightly elongate meridionally, Furrows short, not reaching poles, thickened near pore. Exine about 2 μ thick with a punctate structure.

Remarks. — Krutzsch (1970) includes in this species a considerable number of forms slightly varying morphologically, but marked by a "*sapotaceoid*" type of structure. In 1958, he erected for them a group of "*sapotaceoid*" forms which appear more frequently in the spectra of the Earlier Tertiary and only sporadically in warmer climatic phases of the Miocene.

Botanical affinity. — Probably the family Sapotaceae.

Occurrence (in the area under study). — Middle Oligocene of Tarnówka and Mosina and Lower and Middle Miocene of Ustronie and Gierlachowo.

Genus *Diervillapollenites* Doktorowicz-Hrebnicka, 1957

Type species: *Diervillapollenites megaspinosus* Doktorowicz-Hrebnicka, 1957

Diervillapollenites megaspinosus Doktorowicz-Hrebnicka, 1957

(Pl. XXV, Fig. 17)

1957. *Diervilla-Pollenites megaspinosus* Dokt.-Hreb.; J. Doktorowicz-Hrebnicka, p. 110, Pl. 22, Fig. 6.

Material. — Five specimens.

Description. — Triangular in polar view, with germinal apparatus situated angularly in the form of three exopores elongate meridionally. The thickened part of ectoexine forms a labrum surrounding an atrium composed of a thin layer of endoexine. Exine consisting of two layers. Outer layer strongly thickened in germinal part with a punctate structure and a sculpture formed by high (to 4 μ) spiny processes.

Remarks. — The specimen described and illustrated by Doktorowicz-Hrebnicka (1957) came from Pliocene deposits. In 1960, the described a pollen with this type of structure and gave it a different specific name, *D. spinosus*. The differences between the two specimens are not sufficiently important so that they might be considered as different species.

Botanical affinity. — The family Caprifoliaceae, the genus *Diervilla*.

Occurrence (in the area under study). — Lower Miocene, Gierlachowo.

Genus *Persicariopollis* Krutzsch, 1962

Type species: *Persicariopollis meuseli* Krutzsch, 1962

Persicariopollis meuseli Krutzsch, 1962

(Pl. XXVI, Fig. 6a—c)

1962*a*. *Persicariopollis meuseli* W. Kr.; W. Krutzsch, p. 282, Pl. 8, Figs 9—16.

Material. — Seven specimens.

Description. — Pollen grains polyporate, 43 to 48 μ in equatorial diameter. Exine consisting of two layers. Outer layer with processes in the form of palisade forming a reticulum. Exine structure gemmate. Reticular meshes irregularly polygonal, 4 to 5 μ in diameter. Small, round pores occur in mesh centers.

Remarks. — According to Krutzsch (1962), pollen grains with a similar morphological structure are known chiefly, as a rare element, from the Miocene and Pliocene.

Botanical affinity. — Similar pollen grains are observed in *Polygonum persicarioides*.

Occurrence (in the area under study). — Upper Miocene, Gierlachowo.

Genus *Erdtmanipollis* Krutzsch, 1962

Type species: *Erdtmanipollis pachysandroides* Krutzsch, 1962

Erdtmanipollis pachysandroides Krutzsch, 1862

(Pl. XXVI, Fig. 4a—c)

1962*a*. *Erdtmanipollis pachysandroides* W. Kr.; W. Krutzsch, p. 281, Pl. 8, Figs 1—8.

Material. — Two specimens.

Description. — Pollen grains polyporate, round in equatorial outline. Equator 25—32 μ in diameter. Exine thick, composed of two layers. Outer layer with sculpture in form of beanlike processes making a reticulum of crotonoidal type. Diameter of reticular meshes 4—5 μ. Pores small, about 1—2 μ in diameter, situated in the center of some reticular meshes.

Remarks. — This species differs in its characteristic sculpture from all others having a reticulate sculpture. Krutzsch & Majewski (1967) consider it to be a representative of Turgay-flora in the Tertiary.

Botanical affinity. — Similar pollen grains occur in the genera *Pachysandra* and *Sarcococca* of the family Buxaceae.

Occurrence (in the area under study). — Middle Oligocene, Gierlachowo.

Genus *Spinaepollis* Krutzsch, 1961

Type species: *Spinaepollis spinosus* (R. Potonié, 1931) Krutzsch, 1961

Spinaepollis spinosus (R. Potonié, 1931) Krutzsch, 1961
(Pl. XXV, Fig. 1a, b)

1931*a*. *Pollenites spinosus* R. Pot.; R. Potonié, p. 332, Pl. 1, Figs 29—30.

Material. — Three specimens.

Description. — Spheroid in equatorial view, 23 to 27 μ in equatorial diameter. Three germinal apparatus developed in the form of equatorially arranged pores and short, equatorially extended furrows. Exine composed of many layers. Outer layer with a distinctly developed, reticulate sculpture and projecting pilae.

Remarks. — This species, described by Potonié (1931 *a*), has many times been cited in literature. Its generic name was changed by Krutzsch (1961) from *Tricolporopollenites* into *Spinaepollis.*

Botanical affinity. — Uncertain. Similar pollen grains occur in the family Euphorbiaceae.

Occurrence (in the area under study). — Middle Oligocene, Mosina.

Genus *Thymelipollis* Krutzsch, 1966

Type species: *Thymelipollis retisculpturius* Krutzsch, 1966

Thymelipollis retisculpturius Krutzsch, 1966
(Pl. XXVI, Figs 5a, b, 7)

1966. *Thymelipollis retisculpturius* W. Kr.; W. Krutzsch, p. 33, Pl. 6, Figs 19—22.

Material. — Four specimens.

Description. — Pollen grains polyporate, round in equatorial outline and spherical in shape. Equator 34 to 47 μ in diameter. Exine thick (3 to 5 μ), composed of many layers. Outer layer with a very complex structure and a sculpture in the form of several beanlike processes making up a reticulum. 15 to 25 pores small, about 1.5 μ in diameter, irregularly distributed in the centers of some reticular meshes.

Remarks. — This species, known from the Miocene, occurs in many a Central European locality. It probably includes the specimens which were determined by Nagy as *Liliacidites ellipticus* (Nagy, 1969, Pl. 55, Figs 22 and 23). A similar type of pollen is described by Stuchlik (1964) as *cf. Barleria.*

Botanical affinity. — The family Thymeliceae.

Occurrence (in the area under study). — In the Middle Oligocene deposits of Mosina and Tarnówka.

Genus *Australopollis* Krutzsch, 1966

Type species: *Australopollis obscurus* (Harris, 1965) Krutzsch, 1966

Australopollis obscurus (Harris, 1965) Krutzsch, 1966

(Pl. XXVI, Fig. 2a, b)

1965. *Stephanoporopollenites obscurus* Harris; W. K. Harris, p. 95, Pl. 29, Figs 15—17.

Material. — Two specimens.

Description. — Grains polyporate, polygonal in equatorial outline, 25 to 27 μ in equatorial diameter, with pores situated angularly, equatorially or somewhat subequatorially. Six to seven pores, 5 μ in diameter. The layer of exine, bounding a pore, has an uneven margin. Exine about 1.5 μ thick, with a densely punctate sculpture.

Remarks. — This species has hitherto been described from Australia only (Harris, 1965). Due to a characteristic structure of its pores Krutzsch (1966) erected a new genus for it.

Botanical affnity. — So far, not stated precisely. Erd (Krutzsch, 1966) believes that it may be related to older representatives of the family Ranunculaceae.

Occurrence (in the area under study). — Middle Miocene, Oczkowice.

Genus *Cristaepollis* Krutzsch, 1966

Type species: *Cristaepollis megaforaminis* Krutzsch, 1966

Cristaepollis sp.

(Pl. XXVI, Fig. 3a, b)

Material. — Three specimens.

Description. — Grains polyporate, spheroid in equatorial view, equator 26 to 30 μ in diameter. About twenty round pores, 2.5 to 3.5 μ in diameter, closely and regularly spaced on both hemispheres of grain. Exine thick, composed of many layers. Outer layer with a sculpture formed by 2 μ high, baculate processes having a columellar structure and fused together at the base. Pores depressed and surrounded by the processes of sculpture.

Remarks. — Due to a similar type of the structure and sculpture of exine and distribution of pores, this species may be assigned to the genus *Cristaepollis*. It differs, however, from all of its species, described so far, in the number of pores and differently distributed elements of sculpture.

Botanical affinity. — Unknown.

Occurrence (in the area under study). — Middle Oligocene, Tarnówka.

Genus *Ericipites* Wodehouse, 1933

Type species: *Ericipites longisulcatus* Wodehouse, 1933

Ericipites ericius (R. Potonié ,1931), Krutzsch, 1972
(Pl. XXVI, Fig. 9)

1931*a*. *Pollenites ericius* R. Pot.; R. Potonié p. 322, Pl. 2, Fig. 25.

Material. — Fourteen specimens.

Description. — Tricolporate grains in tetrads. Particular parts of a tetrad subtriangular in polar view. Germinal apparatus are situated in the middle part of the walls of this triangle. Furrows very short and narrow, pores small. Grains strongly varying in size, 28 to 35 μ in diameter. Exine thick, composed of many layers, psilate.

Remarks. — In Potonié's (1931) original photograph, pollen grains of *P. ericius* are larger than those in *P. callidus*. According to Krutzsch (1972) this is of minor importance. The structure of exine, which in the species *E. ericius* is, according to Potonié's holotype, thicker than that in *E. callidus* is in this case a diagnostic character.

Botanical affinity. — Family Ericaceae.

Occurrence (in the area under study). — Frequent in all profiles, particularly numerous in the Upper Miocene.

Ericipites callidus (R. Potonié, 1931) Krutzsch, 1972
(Pl. XXVI, Figs 8, 10)

1931*a*. *Pollenites callidus* R. Pot.; R. Potonié, p. 332, Pl. 2, Figs 24 and 27.

Material. — More than fifty specimens.

Description. — Pollen grains tricolporate, occurring always in tetrads. Particular grains in tetrads shaped spherically, 13 to 23 μ in equatorial diameter, with three relatively short and narrow furrows elongate meridionally and three pores occurring on equator. The entire tetrad 18 to 35 μ in diameter. Exine composed of two layers, outer layer distinctly punctate in structure.

Remarks. — The length of furrows, the smaller thickness and the different structure of exine in *E. callidus* are important characters differing this species.

Botanical affinity. — Family Ericaceae.

Occurrence (in the area under study). — Common in all profiles, particularly numerous in the Miocene.

Institute of Geology
Warsaw University
02-089 Warszawa, Al. Żwirki i Wigury 93
November, 1973

REFERENCES

ABUZJAROVA, R. J. 1954. Tretičnye sporovo-pylcevye kompleksy Turgaja i Pavlodarskogo Priirtyša. — *Awtoref. diss. Kazach. SSR.*

AHRENS, H. & LOTSCH, D. 1967. Die geologischen Grundlagen der Aufstellung der Florenzonen im jüngeren Tertiär der Lausitz. — *Abh. Zent. Geol. Inst.*, **10**, 39—54, Berlin.

ANANOVA, E. H. 1952. Novye dannye o sarmatskoj rastitelnosti v nizoviach Dnepra — *Bot. Żurn.*, **2**, Moskva.

— 1954. Novye dannye o flore i rastitelnosti pliocena. — *Dokl. Akad. Nauk SSSR*, **96**, 3, Moskva.

AVERDIECK, F. R. 1958. Pollen vom Chenopodiaceen-typ im Flöz Frimmersdorf — ein Hinweis auf seine strandnahe Entstehung. — *Fortschr. Geol. Rheinld. Westf.*, **1**, 101—112, Krefeld.

BERRY, F. W. 1927. Flora of the Esmeralda Formation in W. Nevada. — *Proc. U.S. National Mus.*, **72**, 1—5, Washington.

BOJTZOVA, E. P. 1957. Palinologičeskoe obosnovanie stratigrafičeskogo rasčlenenia melovych i tretičnych otloženij Turgajskogo progiba. — *Avtoref. diss.* Leningrad.

— & al., 1960. Sporovo-pylcevye kompleksy paleogenovych i neogenovych otloženij SSSR. — *Mežd. Geolog. Kongr., Dokl. Sov. Geol.*, 211—221, Moskva.

BRELIE G. 1961. Pollenstratigraphische Gliederung und fazielle Entwicklung des jüngeren Tertiärs (Oberoligozän bis Pliozäns) in der niederrheinischen Bucht. — *Meyniana*, **10**, 75—88, Kiel.

— 1967. Quantitative Sporenuntersuchungen zur stratigraphischen Gliederung des Neogens in Mitteleuropa. — *Rev. Palaeobot. Palynol.*, **2**, 147—162, Amsterdam.

— 1968. Zur mikrofloristischen Schichtengliederung im Rheinischen Braunkohlenrevier. — *Fortschr. Geol. Rheinld. Westf.*, **16**, 85—102, Krefeld.

CHERNYAVSKA, S. 1967. Charakteristika na sporopolenovite kompleksi ot gornoeocenskije Bulglišta u Istočna Bulgaria. — *Izv. Geol. Inst., ser. paleont.*, **16**, 95—130, Sofia.

— 1969. Kategorii na sporopolenovia metod i technik vzaimootnošenia s osnovite podelenia v stratigrafita. — *Ibidem*, **18**, 8—89.

— 1970. Sporopolenovi zoni v niakoj starotercierni vuglenosni sedimenti v Bulgaria. — *Ibidem*, **19**, 79—100.

CIUK, E. 1957. Złoża węgli brunatnych w Polsce i perspektywy ich poszukiwań. — *Przegl. Geol.*, **5**, 208—216, Warszawa.

— 1967. Litostratygrafia trzeciorzędu w rejonie Leszna. — *Kwart. Geol.*, **11**, 4, 920—922, Warszawa.

— 1970. Schematy litostratygraficzne trzeciorzędu Niżu Polskiego. — *Ibidem*, **14**, 4, 754—771, Warszawa.

CZECZOTT, H. 1970. O wieku trzeciorzędowej flory Turowa koło Bogatyni (Górne Łużyce). — *Kwart. Geol.*, **14**, 4, Warszawa.

DOKTOROWICZ—HREBNICKA, J. 1954*a*. Z badań paleobotaniczno-stratygraficznych w Polsce centralnej. — *Przegl. Geol.*, **7**, 264—268, Warszawa.

— 1954*b*. Analiza pyłkowa węgla brunatnego z okolic Żar na Dolnym Śląsku. — *Biul. Inst. Geol.*, **71**, 41—92, Warszawa.

— 1957*a*. Wzorcowe spektra pyłkowe plioceńskich osadów węglonośnych. — *Prace Inst. Geol.*, **15**, 87—137, Warszawa.

— 1957*b*. Z badań mikroflorystycznych węgla brunatnego w Mirosławicach Górnych na Dolnym Śląsku. — *Ibidem*, **15**, 167—183, Warszawa.

— 1957*c*. Wiek węgla brunatnego z terenu Babiny na Dolnym Śląsku w świetle analizy pyłkowej. — *Ibidem*, **15**, 187—197, Warszawa.

— 1959. Niektóre ziarna pyłku rodziny Taxodiaceae w trzeciorzędowym węglu brunatnym Polski. — *Kwart. Geol.*, **3**, 4, 1033—1047, Warszawa.

— 1960. Paralelizacja pokładów węgla brunatnego województwa bydgoskiego i poznańskiego. — *Biul. Inst. Geol.*, **157**, 69—133, Warszawa.

— 1961. Paleobotaniczne podstawy paralelizacji pokładów węgla brunatnego ze złoża Rogoźno pod Łodzią. — *Ibidem*, **158**, 113—303.

— 1964. Palynologiczna charakterystyka najmłodszych pokładów węgla brunatnego złoża Rogoźno. — *Ibidem*, **283**, 7—88.

DYJOR, S. 1968. Poziomy morskie w obrębie serii iłów poznańskich. — *Kwart. Geol.*, **12**, 4, 941—957, Warszawa.

ERDTMAN, G. 1960. On three new genera from the Lower Headon Beds, Berkshire. — *Bot. Not.*, **113**, 1, 46—48, Lund.

FRADKINA, A. F. *et al.* 1971. Pozdne oligocenovaja i miocenovaja flora bassejna Andana i ee sravnenie s florami severo-vostoka SSSR i Alaski. — *Tr. Inst. Geol.-Geogr. Sib. otdel.*, **135**, 22—39, Moskva.

GLADKOVA, A. N. 1953. Flora majkoposkich otloženij severnogo Kavkaza po dannym sporovo-pylcevogo analiza. Paleobot. sbor. — *Tr. VNIGRI*, n.s. **75**, Leningrad.

GOTHAN, W., PICKARD, E. & THIERGART, F. 1940. Das geologische Alter der Bitterfelder und Lausitzer Kohlen. — *Braunkohle*, **39**, 6, 51—56, Halle.

GRABOWSKA, I. 1965. O środkowooligoceńskim wieku iłów toruńskich na podstawie analizy sporowo-pyłkowej. — *Kwart. Geol.*, **9**, 4, 815—836, Warszawa.

— 1968. Paleogen z wiercenia Szczecin I.G.-I w świetle analizy sporowo-pyłkowej. — *Ibidem*, **12**, 1, 155—166, Warszawa.

GRUAS—CAVAGNETTO, C. 1968. Étude palynologique des divers gisements du Sparnacien du Basin de Paris. — *Mém. Soc. Géol. France*, **110**, 1—144, Paris.

HAMMEN, T. van der, 1967. Climatic periodity and evolution of South American Maestrichtian and Tertiary floras. — *Bol. Geol.*, **5**, 2, 49—91, Bogota.

HARRIS, W. K. 1965. Basal Tertiary microfloras from the Princetown Area, Victoria, Australia. — *Palaeontographica*, B, **115**, 4—6, 75—106, Stuttgart.

HUNGER, R. 1953. Mikrobotanisch-stratigraphische Untersuchungen der Braunkohlen der südlichen Oberlausitz und die Pollenanalyse als Mittel zur Deutung der Flözgenese. — *Freiberger Forschhf., R.C.*, **8**, 5—38, Berlin.

KIRCHHEIMER, F. 1941. Bemerkenswerte Funde der Mastixioideen Flora II. Vorkommen der Mastixioideen in Steinsaltz von Wieliczka. — *Braunkohle*, **40**, 610—617, Halle.

— 1950*a*. Das Vorkommen von Sciadopitys im mittel-europäischen Tertiär und die

Bedeutung ihres Pollens für die Stratigraphie der Braunkohlenschichten. — *N. Jb. Geol. Pal. Mtshf.*, 1950, 59—64, Stuttgart.

— 1950*b*. Mikrofossilien aus Salzablagerungen des Tertiäres. — *Palaeontographica*, B, **90**, 127—160, Stuttgart.

— 1957. Die Laubgewächse der Braunkohlenzeit. 1—783, Halle.

KONDRATIEVA, O. P. 1971. Paleobotaničeskaja charakteristika opornych razrezov. Strojenie, litologia i stratigrafia otloženij nižnego pleistocena Litvy. 57—115, Vilnius.

KOSTYNIUK, M. 1938. Trzeciorzędowe drewna i pyłki z Mazowsza i Wołynia. — *Kosmos*, A, **63**, 1—53, Lwów.

KREMP, G. 1949. Pollenanalitische Untersuchungen des miozänen Braunkohlenlagers von Konin an der Warthe. — *Palaeontographica*, B, **90**, 53—93, Stuttgart.

KRISHTOFOVICH, A. N. 1955. Razvitie botaniko-geografičeskich oblastej severnogo polšaria s načala tretičnogo perioda. — *Vopr. geol. Azji*, **2**, 1—650, Moskva.

KRUTZSCH, W. 1954. Bemerkungen zur Benennung und Klassifikation fossiler (insbesondere Tertiär) Pollen und Sporen. — *Geologie*, **3**, 3, 258—311, Berlin.

— 1958. Sporen und Pollengruppen aus der Oberkreide und dem Tertiär Mitteleuropas und ihre stratigraphische Verteilung. — *Ztschr. angew. Geol.* **4**, 11/12, 509—548, Berlin.

— 1959*a*. Mikropaläontologische (Sporenpaläontologische) Untersuchungen in der Braunkohle des Geiseltales. — *Geologie, Beih.* **21/22**, 1—425, Berlin.

— 1959*b*. Einige neue Formgattungen und -arten von Sporen und Pollen aus der mitteleuropäischen Oberkreide und dem Tertiär. — *Palaeontographica*, B, **105**, 5/6, 117—125, Stuttgart.

— 1961. Beitrag zur Sporenpaläontologie der präoberoligozänen kontinentalen und marinen Tertiärablagerungen Brandenburgs. — *Ber. Geol. Ges. D.D.R.*, **5**, 290—343, Berlin.

— 1962*a*. Stratigraphisch bzw. botanisch wichtige neue Sporen und Pollenformen aus dem deutschen Tertiär. — *Geologie*, **11**, 3, 265—308, Berlin.

— 1962*b*. Atlas der mittel- und jungtertiären dispersen Sporen- und Pollen sowie der Mikroplanktonformen des nördlichen Mitteleuropas. I, 1—108; II, 1—141; III, 1—128, Berlin.

— 1963*b*. Zur regionalen und stratigraphischen Verbreitung der Pollenform Aglaoreidia cyclops Erdtman 1960. — *Grana Palynologica*, **4**, 3, 121—129, Stockholm.

— 1966. Zur Kenntnis des präquartären periporaten Pollenformen. — *Geologie, Beih.* **55**, 16—71, Berlin.

— 1967*a*. Die sporenstratigraphische Gliederung des Alttertiärs im nördlichen Mitteleuropa (Paläozän — Mitteloligozän) — Metodische Grundlagen und gegenwärtiger Stand der Untersuchungen. — *Abh. Zentr. Geol. Inst.*, **8**, 157—203, Berlin.

— 1967*b*. Atlas der mittel- und jungtertiären dispersen Sporen- und Pollen sowie Mikroplanktonformen des nördlichen Mitteleuropas. — IV/V, Berlin.

— 1967*c*. Der Florenwechsel im Alttertiär Mitteleuropas auf Grund von sporenpaläontologischen Untersuchungen. — *Abh. Zentr. Geol, Inst.*, **10**, 17—37, Berlin.

— 1968*a*. Über weitere stratigraphisch bzw. botanisch wichtige neue Pollenformen aus dem mitteleuropäischen Alttertiär. — *Mtsber. deutsch. Akad. Wiss.*, **10**, 791—801, Berlin.

— 1968*b*. Zur Kenntnis des dispersen Oenotheraceen-(Onagraceen-) Pollens insbesondere aus dem mitteleuropäischen Tertiär. — *Paléont. Abh.* B, **2**, 4, 655—693, Berlin.

— 1968*c*. Brosipollis und Labrapollis, zwei neue Pollengenera aus dem Tertiär Mitteleuropas. — *Rev Palaeobot., Palynology*, **6**, 61—70, Amsterdam.

— 1969*a*. Über einige stratigraphisch wichtige neue Longaxoner-Pollen aus dem mitteleuropäischen Alttertiär. — *Geologie*, **18**, 472—847, Berlin.

— 1969*b*. Taxonomie syncolp(or)ater und morphologisch benachbarten Pollengattungen und -arten (Sporae dispersae) aus der Oberkreide und dem Tertiäer. — T. I.: Sycolp(or)ate und syncolp(or)atoide Pollenformen. — *Pollen et Spores*, **11**, 397—424, Paris.

— 1970*a*. Reevesiapollis, ein neues Pollengenus der Sterculiaceen aus dem mitteleuropäischen Tertiär. — *Feed. Report.*, **81**, 371—386, Berlin.

— 1970*b*. Die stratigraphisch verwertbaren Sporen- und Pollenformen des mitteleuropäischen Alttertiärs. — *Jb. Geol.*, **3**, 309—379, Berlin.

— 1970c. Einige neue Pollenformen aus den Familien der Tiliaceen, Bombaceen und Sterculiaceen aus dem mitteleuropäischen Alttertiär. — *Ibidem*, **3**, 275—307.

— 1970*d*, 1971. Atlas der mittel-und jungtertiären dispersen Sporen- und Pollen sowie der Mikroplanktonformen des nördlichen Mitteleuropas. VI, VII, Berlin.

— 1972. Zur Kenntnis fossiler Tetradenpollen. — *Paläont. Abh.*, B, **3**, 399—433.

— (in press). Revision einiger sogennanter "Dreieck"-Pollenformen aus dem Tertiär. — *Jb. Geol.*, **4**, Berlin.

— & LOTSCH, D. 1960a. Tertiär exkursionsführer Brandenburg. — 7 *Jahrestagung Geol. Ges. D.D.R.*, 10—12, Berlin.

— & — 1960*b*. Tertiär und Braunkohle de Lausitz. Tertiär in Ostbrandenburg. — *Ibidem*, 89—113.

— & — 1966. Das Oligo-Miozän-Profil der Lausitz. — *Int. Union Geol. Sc. Can. Mediter. Neogene Strat. Proc. III ses., Bern* 1964, 158—161, Leiden.

— & MAJEWSKI, J. 1967. Zur Methodik der pollenstratigraphischen Zonengliederung im Jungtertiär Mitteleuropas. — *Abh. Zentr. Geol. Inst.*, **10**, 83—93, Berlin.

— PACHALEK, J. & SPIEGLER, D. 1960. Tieferes Paläozen (?Mont) in Westbrandenburg. — *Proc. XXI Int. Geol. Congr., sect.* 8, 135—143, Kopenhagen.

— & VANHOORNE, R. (in press). Die Pollenflora von Epinois und Koksbergen in Belgien, Antwerpen.

MACKO, S. 1957. Lower Miocene pollen flora the valley of Kłodnica near Gliwice (Upper Silesia). — *Prace Wrocł. Tow. Nauk.* B, **88**, 1—312, Wrocław.

— 1959. Pollen grains and spores from Miocene brown coals in Lower Silesia I. — *Ibidem*, **96**, 1—175.

MAI, D. H. 1961. Über eine Tiliaceen-Blüte und tilioiden Pollen aus dem deutschen Tertiär. — *Geologie, Beih.* **32**, 54—93, Berlin.

— 1964. Die Mastixioideen-Floren in Tertiär Iberlausitz. — *Paläont. Abh.*, B, 2, 1—92, Berlin.

— 1967. Die Florenzonen, der Florenwechsel und die Vorstellung über den Klimaablauf im Jungtertiäer der D.D.R. — *Abh. Zentr. Geol. Inst.*, **10**, 55—81, Berlin.

— 1970. Subtropische Elemente im europäischen Tertiär I. — *Paläont. Abh.*, **2** 1, 5—192, Berlin.

MAMCZAR, J. 1960. Wzorcowy profil miocenu środkowego Polski środkowej. *Biul. Inst. Geol.*, **157**, 13—69, Warszawa.

— 1961. Wzorcowy profil sporowo-pyłkowy z górnomioceńskiego węgla brunatnego z Polski środkowej (złoże Rogoźno). — *Ibidem*, **158**, 305—325, Warszawa.

— 1962. Przynależność botaniczna kopalnego pyłku Rhoidites, Pollenites edmundi R. Pot. i Pollenites euphorii R. Pot. oraz ich znaczenie stratygraficzne. — *Ibidem*, **162**, 7—125, Warszawa.

MANTEN ,A. A. 1958. Palynology of the Miocene browncoal mined at Haanrade (Limburg, Netherlands). — *Acta Bot. Neerl.*, **7**, 445—488, Amsterdam.

MANUM, S. 1960. On the genus Pityosporites Seward, 1914, with a description of Pityosporites antarcticus Seward. — *Nytt. Mag. Bot.*,**8**, 11—17, Oslo.

MANYKIN, S. S. 1966. Pylca verchne oligocenovych i neogenovych otloženij Belorussi i ee stratigraficeskoje značenie. — *Paleontologia i stratigrafia B.S.S.R.*, **5**, 144—263, Mińsk.

Materialy ko Meždunarodnoj Palinogičeskoj Konferencii k metodike palinologičeskich issledovanij. 1—256, Leningrad, 1966.

Materialy ko Meždunarodnoj Palinologičeskoj Konferencii. Paleopalinologičeskij metod v stratigrafii. 1—228, Leningrad, 1968.

MAYER, L. 1956. Mikrofloristische Untersuchungen an jungtertiären Braunkohle im östlichen Bayern. — *Geol. Bavarica*, **25**, 100—128, München.

MAZANCOVÁ, M. 1962. Pflanzlichen Mikrofossilien aus der Braunkohlenlagerstädte Uhelna in Schlesien. — *Sborn. Ú.Ú.G., paleont.*, **27**, 159—203, Prag.

MERKYLOVA, K. A. 1971. O granice paleogena i neogena v Zapadnoj Sibirii (po dannym sporovo-pylcevogo analiza). Kajnozojskie flory Sibiri po palinologičeskim dannym. — *Tr. Inst., Geol.-Geogr. Sib. otdel.*, **135**, 5—60, Moskva.

MÜLLER-STOLL, W. R. 1950. Bemerkungen zur quantitativen Pollenanalyse tertiär Ablagerungen. — *Planta*, **38**, 2, 209—212, Berlin-Göttingen-Heidelberg.

MÜRRIGER, F. & PFLANZL G. 1955. Pollenanalytische Datierung einer hessischer Braunkoheln. — *Notizbl. Hess. L.-Amt. Bodenforsch.*, **8**, 3, 71—89, Wiesbaden.

— & PFLUG H. 1951. Über die Alterstellung der Braunkohlen von Burghasungen, Bezirk Kassel, auf Grund pollenanalytischer Untersuchungen und Vergleich mit anderen Braunkohlenvorkommen. — *Ibidem*, **6**, 2, 87—97.

— & 1952. Über eine palynologische Untersuchung des Braunkohlenlagers der Grube Emma bei Marxheim (Untermeingebiet). — *Ibidem* **6**, 3, 56—66.

NAGY, E. 1958. Palynologische Untersuchung der am Fusse der Matra-Gebirges gelagerten Oberpannonischen Braunkohle. — *Ann. Inst. Geol. Publ. Hung.*, **47**, 1—353, Budapest.

— 1962. New pollen species from the Lower Miocene of the Bakony mountain (Varpalota) of Hungary. — *Acta Bot. Ac. Sc. Hung.*, **8**, 1—3, 153—163, Budapest.

— 1969. Palynological elaboration of the Miocene layers of the Mescek Mountains. — *Ann. Inst. Geol. Hung.*, **52**, 2, 1—537, Budapest.

NAKOMAN, E. 1966. Contribution à l'étude palynologique des formations tertiaires du bassin de Thrace. I. — *Ann. Soc. Géol. Nord.*, **86**, 65—107, Lille.

— 1967. Microflore de dépôts tertiaires du Sud-Ouest de l'Anatolie. — *Pollen et Spores*, **9**, 121—142, Paris.

NEU-STOLZ, G. 1958. Zur Flora der Niederrheinischen Bucht während der Hauptflözbildung unter besonderer Berücksichtigung der Pollen und Pilzreste in den hellen Schichten. — *Fortschr. Geol. Rheinl. Westf.*, **2**, 503—525, Krefeld.

NOREM, W. L. 1956. Tertiary spores and pollen related to paleoclimates and stratigraphy of California. *Micropaleontology*, **1**, 261—267, New York.

— 1958. Keys for the classification of fossil spores and pollen. — *J. Paleont.*, **32**, 666—676, Menasha.

OSZAST, J. 1960. Analiza pyłkowa iłów tortońskich ze Starych Gliwic. — *Monogr. Bot.*, **9**, 1, 1—47, Warszawa.

— 1967. Mioceńska roślinność złoża siarkowego w Piasecznie koło Tarnobrzega. — *Acta Paleobot.*, **8**, 1, 1—24, Kraków.

PACLTOVÁ, B. 1960. Rostlinné mikrofosilie (hlavne sporomorphy) z Česckobudejovické pánvi. — *Sb. Ú.Ú.G.*, **25**, 109—176, Praha.

— 1966. Vysledky mikropaleobotanických studii chatakvitánského souvrstvi na Slovensku. — *Rozp. Českosl. Akad. Véd, Řada Matem. Přirod. Véd*, **76**, 13, 3—68, Praha.

PANOVA, L. A. 1971. Oligocen Zapadno-Sibirskoj nizmiennosti. Kajnozojskie flory Sibiri po palinologičeskim dannym. — *Tr. Inst. Geol.-Geogr., Sib. otled.*, **135**, 40—50, Moskva.

PFLUG, H. 1953. Zur Entstehung und Entwicklung der Angiospermidenpollens in der Erdgeschichte. — *Palaeontographica*, B, **95**, 60—171, Stuttgart.

— 1957. Zur Altersfolge und Faziesgliederung mitteleuropäischen (insbesondere hessischer) Braunkoheln. — *Notizbl. hess. L.-Amt. Bodenforsch.*, **85**, 152—159, Wiesbaden.

— 1965. Bemerkungen zur Sporenstratigraphie im höheren Tertiär. — *Ztschr. deutsch. Geol. Ges.*, **115**, 1, 69—77, Hannover.

PIWOCKI, M. 1971. Trzeciorzęd i jego węglonośność między Rawiczem a Chobienią. — *Kwart. Geol.*, **15**, 1, 149—154, Warszawa.

POKROVSKAJA, I. M. 1956*a*. Atlas miocenovych sporovo-pylcevych kompleksov različnych rajonov SSSR. 1—460, Moskva.

— 1956*b*. Atlas oligocenovych sporovo-pylcevych kompleksov različnych rajonov SSSR. 1—310, Moskva.

— 1966. Paleopalinologija. — Tr. *WSEGEI*, n.s. **141**, 1, 1—351, 2, 1—446, 3, 1—366, Leningrad.

POPOV, P. A. 1956. Pylca Trapa v tretičnych otloženiach Jenisejskogo Kriaža — *Dokl. Akad. Nauk SSSR*, **110**, 3, 453—456, Moskva.

POTONIÉ, R. 1931a. Zur Mikroskopie der Braunkohlen. Tertiäre Blütenstaubformen. — *Braunkohle*, **30**, 16, 325—33, Halle.

— 1931*b*. Pollenformen aus tertiären Braunkohlen. — *Jb. Preuss. Geol. Land.*, **52**, 1—7, Berlin.

— 1931*c*. Zur Mikroskopie der Braunkohlen. Tertiäre Sporen- und Blütenstaubformen. — *Braunkohle*, **30**, 27, 554—556, Halle.

— 1931*d*. Pollenformen der miozänen Braunkohle. — *Sitzber. Ges. Naturf. Fr. Berlin*, **1—3**, 24—27, Berlin.

— 1934. Zur Mikrobotanik des eozönen Humodils des Geiseltales. — *Arb. Inst. Paläobot. Petrogr. Brenng.*, **4**, 25—125, Berlin.

— 1935. Pollen und Sporen als „Leitfossilien" der Braunkohlenflöze. — *Braunkohle*, **34**, 681—685, Halle.

— 1951. Revision stratigraphisch wichtiger Sporomorphen des mitteleuropäischen Tertiärs. — *Paläontographica*, B, **91**, 5—6, 131—151, Stuttgart.

— 1958—1970. Synopsis der Gattungen der Sporae dispersae I—V. — *Beih. Geol. Jb.*, **23** (1956), 1—103; **31** (1958), 1—114; **39** (1960), 1—189; **72** (1966), 1—2014; **87** (1970), 1—222, Hannover.

— 1962. Synopsis der Sporae in Situ. — *Ibidem*, **52**, 1—204.

— & GELLETICH, J. 1933. Über Pteridophytensporen einer eozäner Braunkohle aus Dorog in Ungarn. — *Sitzber. Ges. Naturf. Fr. Berlin*, Jg. 1932, 317—528, Berlin.

— , THOMSON, P.W. & THIERGART, F. 1950. Zur Nomenklatur und Klassifikation der neogenen Sporomorphae (Pollen und Sporen). — *Geol. Jb.*, **65**, 35—70, Hannover.

— & VENITZ, H. 1934. Zur Mikrobotanik des miozänen Humodils der niederrheinischen Bucht. — *Arb. Inst. Paläobot. Petrogr. Brenng.* **5**, 5—53, Berlin.

RAATZ, G. V. 1937. Mikrobotanisch-stratigraphische Untersuchungen der Braunkohle des Muskauer Bogens. — *Abh. Preuss. Geol. Land.*, N. F., **183**, 1—48, Berlin.

RANIECKA-BOBROWSKA, J. 1954. Trzeciorzędowa flora liściowa z Konina. — *Biul. Inst. Geol.*, **71**, 5—41, Warszawa.

— 1957. Rodzaj Decodon J. F. Gmel. z polskiego neogenu. — *Prace Inst. Geol.*, **15**, 77—87, Warszawa.

— 1959. Trzeciorzędowa flora nasienna z Konina. — *Biul. Inst. Geol.*, **130**, 159—252, Warszawa.

— 1962. Trzeciorzędowa flora z Osieczowa nad Kwisą. — *Prace Inst. Geol.*, **30**, 3, 81—223, Warszawa.

— 1965. Kilka uwag o wieku kopalnej flory z Osieczowa oraz węgla brunatnego z Turowa. — *Przegl. Geol.* **11**, 469—470, Warszawa.

— 1970. Stratygarfia młodszego trzeciorzędu Polski na podstawie badań paleobotanicznych. — *Kwart. Geol.* **14**, 4, 728—753, Warszawa.

ROMANOWICZ, I. 1961. Analiza sporowo pyłowa osadów trzeciorzędowych z okolic Bolesławca i Zebrzydowej. — *Biul. Inst. Geol.*, **158**, 325—375, Warszawa.

— 1962. Z badań nad przynależnością systematyczną pyłku Myricaceae i niektórych Betulaceae w różnych piętrach trzeciorzędu. — *Ibidem*, **162**, 125—163, Warszawa.

ROTMAN, R. N. 1962. Pro vik kontinentalnych vidkladiv poltavskoj svity. — *Tr. Inst. Geol. Nauk AN. URSR, ser. zag. geol.*, **1**, Moskva.

RUDOLPH, K. 1935. Mikrofloristische Untersuchung tertiärer Ablagerungen im nördlichen Böhmen. — *Bot. Ztbl. Beih.* **54**, 244—328, Dresden.

SADOWSKA, A. 1973. Rodzaje Reevesia (Sterculiaceae) i Itea (Saxifragaceae) w osadach neogeńskich Dolnego Śląska. — *Acta Univ. Wratisl.* **192**, Pr. geol.-miner. III, 247—256, Wrocław.

SCHATILOVA, I.I. 1967. Palinologičeskaja charakteristika kujalnickogurijskich i čaudanskich otloženij Gurii. Tbilisi.

SCHNEIDER, W. 1965. Zur faziellen Entwicklung im „Oberbegleiter des Lausitzer Unterflözes" im Tagebau Spreetal. — *Freiberger Forschhf.* C, **189**, 203—214, Leipzig.

SHCHEKINA, N. A. 1962. Sporovo pylcevye kompleksy tretičnych otloženij ukrainskoj SSR. K pervoj mežd. palinol. konf. (Takson SSA). — *Dokl. Sov. palinol.*, 126—130, Moskva, Leningrad.

STACHURSKA A., SADOWSKA A., DYJOR S. 1973. The Neogene flora at Sośnica near Wrocław in the light of geological and palynological investigations. — *Acta Palaeobot.*, **14**, 3, 147—176 Kraków.

STANLEY, E. A. 1965. Upper Cretaceous and Paleocene plant microfossils and Paleocene Dinoflagellates and Hystrichosphaerids from Northwestern South Dakota. — *Bull. Amer. Paleont.*, **49**, 222, 179—282, New York.

STUCHLIK, L. 1964. Pollen analysis of the Miocene deposits at Rypin. — *Acta Palaeobot.*, **5**, 2, 1—113, Kraków.

SZAFER, W. 1954. Plioceńska flora okolic Czorsztyna i jej stosunek do plejstocenu. — *Prace Inst. Geol.*, **11**, 1—239, Warszawa.

— 1961. Mioceńska flora ze Starych Gliwic na Śląsku. — *Ibidem*, **33**, 1—197, Warszawa.

TEICHMÜLLER, M. 1958. Rekonstruktionen verschiedener Moortypen des Hauptflözes der niederrheinischen Braunkohle. — *Fortschr. Geol. Reinl. Westf.*, **2**, 599—612, Krefeld.

THIERGART, F. 1937. Die Pollenanalyse der Niederlausitzer Braunkohle, besonders im Profil der Grube Marga bei Senftberg. — *Jb. Pr. Geol. Land.*, **58**, 282—351, Berlin.

— 1940. Pollenanalytische Untersuchungen von Ober- und Niederlausitzer Kohlen. — *Braunkohle*, **39**, 475—477, Halle.

— 1949. Die Sciadopityszone und der Sciadopitys-Vorstoss in der niederrheinischen Braunkohle. — *Braunkohle, Wärme und Energie*, **1**, 9/10, 153—156, Düsseldorf.

THOMSON, P. W. 1949. Alttertiäre Elemente in der Pollenflora der rheinischen Braunkohle und einige stratigraphisch wichtige Formen derselben. — *Paläontographica*, B, **90**, 1—3, 94—98, Stuttgart.

— 1951. Zur Geologie der rheinischen Braunkohle 5. — *Geol. Jb.* **65**, 113—126, Hannover.

— & PFLUG, H. 1952. Die alttertiäre Braunkohle der Grube Zievel im Autwieler Graben bei Satzvey/Bl. Euskirchen. — *N. Jb. Geol. Pal. Abh.* **96**, 1, 1—26, Stuttgart.

— & — 1953. Pollen und Sporen des mitteleuropäischen Tertiärs. — *Paläontographica*, B, **94**, 1—4, 1—138, Stuttgart.

TRAVERSE, A. 1955. Pollen analysis of the Brandton Lignits of Vermont. — *Bur. Min. rept. invest.* **5151**, 1—101.

TREVISAN, L. 1967. Pollini fossili Miocene superiore nei Tripoli del Gabbro (Toscana). — *Palaeontographica Italica*, **62** (N. S. 32), 1—33, Pisa.

VARMA, C. P., & RAWAT, M. S. 1963. A note on some diporate grains recorded from Tertiary horizons of India and their potential marker value. — *Grana Palynologica*, **4**, 1, 130—139, Stockholm.

WODEHOUSE, R. P. 1933. Tertiary Pollen II. The ort shales of the Eocene Green River Formation. — *Bull. Torrey Bot. Club*, **60**, 479—524.

WOLFF, H. 1934. Mikrofossilien des pliozänen Humodils der Grube Freigericht bei Dettingen a.M. und Vergleich mit ältern Schichten des Tertiärs sowie posttertiären Ablagerungen. — *Arb. Inst. Paläobot. Peterogr. Brenng.*, **5**, 555—86, Berlin.

WOLF, M. 1961. Sporenstratigraphische Untersuchungen in der Gefalteten Molasse der Murnauer Mulde (Oberbayern). — *Geol. Bavar. Bayer. Geol. Land.*, **46**, 54—89, München.

WOŹNY, E. 1962. Fauna mioceńska z okolic Bolesławca (Dolny Śląsk). — *Prace Inst. Geol.*, **30**, 3, 225—233, Warszawa.

ZAGWIJN, W. H. 1960. Aspects of the Pliocene and early Pleistocene vegetation in the Netherland. — *Modedel. Geol. Şticht.*, ser. C-III-1, **5**, 5—78, Maastricht.

ZAKLINSKAJA, E. D. 1957. Stratigrafičeskoe značenie pylcy golosemianych kajnozojskich otlozenij Pavlodarskogo Priirtyša i severnogo Priob'ja. — *Tr. Inst. Geol. Nauk AN*, **6**, Moskva.

ZIEMBIŃSKA, M. & NIKLEWSKI, J. 1966. Stratygrafia i paralelizacja pokładów węgla brunatnego złoża Ścinawa na podstawie analizy pyłkowej. — *Biul. Inst. Geol.*, **202**, 27—48, Warszawa.

MARIA ZIEMBIŃSKA-TWORZYDŁO

PALINOLOGICZNA CHARAKTERYSTYKA NEOGENU ZACHODNIEJ POLSKI

Streszczenie

W pracy niniejszej przedstawiono wyniki badań palinologicznych próbek, pochodzących z wierceń na obszarze Niziny Wielkopolskiej (Text-fig. 1). Badaniami objęte zostały osady młodszego trzeciorzędu, od środkowego oligocenu po górny miocen. Ogólny schemat wykształcenia tych osadów i ich podział litostratygraficzny wg. nomenklatury Ciuka (1970) został uwidoczniony na przekroju geologicznym opisywanego obszaru (Text.-fig. 2).

W rozważaniach stratygraficznych oparto się na wynikach prac paleobotanicznych z obszaru Łużyc (Mai 1964, 1967; Krutzsch & Majewski 1967) gdzie zaobserwowane zostały cykliczne zmiany roślinności, świadczące o cyklicznych zmianach klimatu w neogenie. Fazy klimatyczne na terenie Łużyc zostały wydzielone głównie w oparciu o analizę makroskopowych szczątków roślin. W przedstawionej pracy dokonano próby prześledzenia tych zmian na większym obszarze, w oparciu jedynie o wyniki analiz palinologicznych. Jako reper posłużył profil palinologiczny Ustronie, najbliższy obszarowi Łużyc. Pozostałe opracowane profile pochodziły z terenu Niziny Wielkopolskiej. Z siedmiu z nich pobrano próby w odstępach 0,5—1 m; z innych pobrano i opracowano próbki wyrywkowe w celu uzupełnienia całości obrazu zmian roślinności. Diagramy pyłkowe (za wyjątkiem diagramu z profilu Ustronie i Gierlachowo) przedstawiono w postaci skróconej, przyjmując pięć przedziałów określających częstość pojawienia się sporomorf.

Na podstawie wyników analiz palinologicznych stwierdzono, że wiele typów sporomorf, które zostały uznane przez Krutzscha (Krutzsch & Majewski 1967) za reprezentantów elementu subtropikalnego i arktyczno-trzeciorzędowego na terenie Łużyc, występuje również w profilach z terenu Wielkopolski. Na podstawie zmiennego występowania tych dwóch elementów florystycznych w opracowanych profilach udało się wyróżnić większość faz klimatycznych zaobserwowanych na terenie Łużyc. Na tej podstawie zsynchronizowano na obszarze Niziny Wielkopolskiej warstwy litostratygraficzne Ciuka (1970) z fazami florystyczno-klimatycznymi Maia (1967). Przy zestawieniu wyników palinologicznych dla poszczególnych faz klimatycznych zaobserwowano znamienną prawidłowość, a mianowicie stałą tendencję do eliminowania kolejnych składników ciepłolubnych w młodszych cieplejszych fazach miocenu. Stwierdzono również konsekwentne ubożenie w elementy ciepłolubne profilów położonych w części północnej opracowanego terenu.

W części szczegółowej podano opisy 174 ważniejszych i częściej występujących gatunków oraz uwagi w stosunku do nich. Utworzono jeden nowy rodzaj: *Iteapollis* n.gen., jeden nowy gatunek: *Microfoveolatisporis minutus* sp.n. oraz kilka nowych kombinacji.

МАРИЯ ЗЕМБИНЬСКА-ТВОЖИДЛО

ПАЛИНОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА НЕОГЕНА ЗАПАДНОЙ ПОЛЬШИ

Резюме

В настоящей работе представлены результаты палинологического изучения образцов, отобранных из керна буровых скважин, пройденных на площади Великопольской низменности (фиг. 1). Исследованиями охвачен верхнетретичный интервал со среднего олигоцена по верхний миоцен. Общая схема литологического состава и стратиграфического расчленения рассматриваемого интервала, согласно номенклатуре Цюка (1970), изображена на геологическом разрезе через исследованную площадь (фиг. 2).

Стратиграфический анализ был основан на данных палеоботанических работ в Лужицком регионе (Маи 1964, 1967; Круцш, Маевски 1967), в котором были кон-

статированы циклические изменения растительности, свидетельствующие о циклических колебаниях климата в неогене. Климатические фазы на площади Лужицкого региона определялись, главным образом, на основании анализа макроскопических растительных остатков. В настоящей работе предпринимается попытка установления таких климатических изменений на более обширной площади на основании одних палинологических анализов. В качестве репера был избран палинологический профиль Устроне, ближайший по отношению к Лужицкому региону. Остальные исследованные профили располагаются на площади Великопольской низменности. В семи профилях отбирались образцы в интервалах 0,5—1 м. в остальных — лишь спорадические образцы, дополняющие общую обстановку развития растительного мира. Пыльцевые диаграммы, за исключением диаграмм профилей Устроне и Герлахово, представлены в сокращенном виде с указанием пяти интервалов частоты распространения спороморф.

По данным палинологического анализа доказано, что некоторые типы спороморф, считавшиеся Круцшем (Круцш, Маевски 1967) представителями субтропического и арктического третичных элементов на территории Лужицкого региона, распространены также и в профилях на территории Великопольши. На основании особенностей в распространении этих флористических элементов в изученных профилях удалось установить большинство климатических фаз, которые были отмечены в Лужицком регионе. На таких основах была проведена корреляция литолого-стратиграфических слоев, выделенных Цюком (1970) на площади Великопольской низменности, с флоро-климатическими фазами Маиа (1967). При корреляции палинологических данных по отдельным климатическим фазам была выявлена интересная закономерность — последовательное выпадение теплолюбивых компонентов в младших, более теплых фазах миоцена. Констатировано также закономерное убывание теплолюбивых элементов в профилях северной части рассматриваемой площади.

В следующей части работы приведены описания 174 важнейших и чаще встречающихся видов. Образован один новый род: *Iteapollis* gen. n., один новый вид: *Microfoveolatisporis minutus* sp. n. и несколько новых сочетаний.

EXPLANATION OF PLATES

Plate I

Leiotriletes maxoides maxoides W. Kr.

Fig. 1 (T/14a); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Fig. 7 (U/96); boring Ustronie, depth 243.6—244.1 m, Lower Miocene, phase III

Punctatisporites sp.

Fig. 2 (U/67); boring Ustronie, depth 227.8—228.4 m, Lower Miocene, phase V

Leiotriletes maxoides maximus (Pf.) W. Kr.
Fig. 3 (G/41); boring Gierlachowo, depth 208.0—208.6 m, Middle Miocene, phase IX

Leiotriletes triangulatoides W. Kr.
Fig. 4. (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Leiotriletes sp. aspect *microsinusoides*
Fig. 5 (G/116); boring Gierlachowo, depth 273.1—273.6 m, Lower Miocene, phase IV

Leiotriletes sp. aspect *sinomaxoides*
Fig. 6 (U/104); boring Ustronie, depth 305.5—306.0 m, Upper Oligocene, phase II
All specimens × 1000

Plate II

Monoleiotriletes minimus W. Kr.
Fig. 1 (O/1a); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI

Stereisporites (Stereisporites) stereoides gracilioides W. Kr. & Sontag
Fig. 2 (O/1a); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI

Stereisporites (Stereigranisporis) cf. *granulus* W. Kr. & Sontag
Fig. 3 (U/15b); boring Ustronie; depth 140.0—140.7 m, Upper Miocene, phase XI

Microfoveolatisporis minutus sp. n.
Fig. 4 (U/15a); boring Ustronie; depth 140.0—140.7, Upper Miocene, phase XI

Stereisporites (Stereisporites) involutus involutus W. Kr.
Fig. 5a, b (O/1a); boring Oczkowice, depth 140.0—140.7 m, Upper Miocene, phase XI

Stereisporites (Stereisporites) megastereis W. Kr.
Fig. 6 (O/1a); boring Oczkowice, depth 140.0—140.7 m, Upper Miocene, phase XI

Trilites microvallatus W. Kr.
Fig. 7 (U/67); boring Ustronie, depth 227.8—228.4 m, Upper Miocene, phase V
Fig. 8 (T/10); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20

Favosisporites trifavus W. Kr.
Fig. 9a, b (M/173); boring Mosina, depth 334.9—349.4 m, Middle Oligocene, phase 20

Trilites multivallatus W. Kr.
Fig. 10a, b (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Camarozonosporites (Hamulatisporites) rarus (Dokt.-Hrebn.) W. Kr.
Fig. 11 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20
Fig. 12a, b (M/b); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20
All specimens × 1000

Plate III

Cicatricosisporites chattensis W. Kr.
Fig. 1a, b, c (G/126); boring Gierlachowo, depth 279.0—279.9 m, Lower Miocene, phase III

Neogenisporis neogenicus W. Kr.
Fig. 2a, b (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20
Fig. 3 (T/12a); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20
All specimens × 1000

Plate IV

Cicatricosisporites dorogensis R. Pot. & Gell.
Figs 1a, b (M/173/I); boring Mosina, depth 334.9—349.4 m, Middle Oligocene, phase 20
Polypodiaceoisporites marxheimensis (Mürr. & Pf.) W. Kr.
Figs 2a, b (T/12); boring Tarnówka, depth 264.0—265.0, Middle Oligocene, phase 20
Cicatricosisporites chattensis W. Kr.
Figs 3a, b (G/126a); boring Gierlachowo, depth 279.0—279.9 m, Lower Miocene, phase III
All specimens × 1000

Plate V

Baculatisporites primarius primarius W. Kr.
Fig. 1 (W/153); boring Wirczyn, depth 136.1—137.0 m, Middle Miocene
Baculatisporites nanus nanus W. Kr.
Figs 2a, b (U/59); boring Ustronie, depth 223.1—223.4 m, Middle Miocene, phase VI
Baculatisporites nanus baculatus (W. Kr.) W. Kr.
Figs 3a, b (G/15); boring Gołębin Stary, depth 195.5—197.3 m, Middle Miocene, phase VIII
Fig. 4a, b (G/7); boring Gierlachowo, depth 137.4—138.1 m, Upper Miocene, phase XIII
Baculatisporites quintus quintus W. Kr.
Fig. 5a, b (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20
Baculatisporites primarius major (Raatz) W. Kr.
Fig. 6 (M/173); boring Mosina, depth 334.9—349.4 m, Middle Oligocene, phase 20.
All specimens × 1000

Plate VI

Retitriletes lusaticus W. Kr.
Fig. 1a, b (G/126); boring Gierlachowo, depth 279.0—279.9 m, Lower Miocene, phase III
Fig. 3a, b, c (T/10a); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20
Retitriletes oligocenicus W. Kr.
Fig. 2 (M/173); boring Mosina, depth 334.9—349.4 m, Middle Oligocene, phase 20
Reticulosporis miocaenicus (Selling) W. Kr.
Fig. 4 (G/41); boring Gierlachowo, depth 208.0—208.6 m, Middle Miocene, phase X
Reticulosporis polonicus W. Kr.
Fig. 5 (G/25); boring Gierlachowo, depth 199.5—200.0 m, Middle Miocene, phase X
All specimens × 1000

Plate VII

Levigatosporites nutidus nutidus W. Kr.
Fig. 1 (O/1a); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI
Levigatosporites haardti haardti W. Kr.
Fig. 2 G/17); boring Gierlachowo, depth 195.5—19.0 m, Middle Miocene, phase X
Levigatosporites gracilis Wilson & Webster
Fig. 3 (U/61); boring Ustronie, depth 224.2—224.8 m, Lower Miocene, phase V

Verrucatosporites balticus balticus W. Kr.
Fig. 4a, b (U/56); boring Ustronie, depth 221.5—222.0 m, Middle Miocene, phase VI
Verrucatosporites megabalticus W. Kr.
Fig. 5a, b (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Verrucatosporites histiopteroides W. Kr.
Fig. 6a, b (U/45); boring Ustronie, depth 215.7—216.6 m, Middle Miocene, phase VII

Verrucatosporites irregularis W. Kr.
Fig. 7 (U/75); boring Ustronie, depth 232.3—232.8 m, Lower Miocene, phase IV

Reticulosporites cf. *dentatus*
Fig. 8 (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Verrucatosporites favus (R. Pot.) Th. & Pf.
Fig. 9 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20
All specimens × 1000

Plate VIII

Pityosporites scopulipites (Wdh.) W. Kr.
Fig. 1 (U/8); boring Ustronie, depth 136.1—136.6 m, Upper Miocene, phase XI

Abiespollenites latisaccatus (Trevisan) W. Kr.
Fig. 2 (NW/7); boring Nowa Wieś, depth 93.0—94.0 m, Upper Miocene, phase XI

Pityosporites microalatus (R. Pot.) Th. & Pf.
Fig. 3 (U/6); boring Ustronie, depth 135.1—135.6 m, Upper Miocene, phase XI

Pityosporites alatus (R. Pot.) Th. & Pf.
Fig. 4 (U/57); boring Ustronie, depth 222.0—222.5 m, Middle Miocene, phase VI

Pityosporites labdacus labdacus W. Kr.
Fig. 5 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Pityosporites labdacus pseudocristatus (Dokt.-Hrebn.) W. Kr.
Fig. 6 (O/17); boring Oczkowice, depth 108.3—109.3 m, Middle Oligocene, phase

Pityosporites labdacus reticulatus (Dokt.-Hrebn.) W. Kr.
Fig. 7 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20
All specimens × 1000, except Fig. 2 × 500

Plate IX

Podocarpidites podocarpidites (Thierg.) W. Kr.
Fig. 1 (T/12); boring Tarnówka, depth 264.0—265.0, Middle Oligocene, phase 20

Podocarpidites libellus (R. Pot.) W. Kr.
Fig. 2 (G/56); boring Gierlachowo, depth 217.6—218.2 m, Middle Miocene, phase VIII

Pityosporites insignis (Naumova & Bolchovitina) W. Kr.
Fig. 3 (NW/8); boring Nowa Wieś, depth 126.0—127.0, Upper Miocene, phase XII

Pityosporites labdacus pseudocristatus (Dokt.-Hrebn.) W. Kr.
Fig. 4 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Pityosporites peuceformis (Zaklinskaja) W. Kr.
Fig. 5 (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Pityosporites labdacus labdacus W. Kr.
Fig. 6 (U/567); boring Ustronie, depth 222.0—222.5 m, Upper Miocene, phase XI
All specimens × 1000

Plate X

Abiespollenites latisaccatus (Trevisan) W. Kr.
Fig. 1 (U/57); boring Ustronie, depth 222.0—222.5 m, Middle Miocene, phase VI

Abiespollenites dubius (Chlonova) W. Kr.
Fig. 2 (N/180); boring Niedźwiedzice, depth 176.5—178.0 m, Lower Miocene

Abiespollenites microsaccoides W. Kr.
Fig. 3 (U/25); boring Ustronie, depth 205.3—205.8 m, Middle Miocene, phase VII
All specimens × 750

Plate XI

Piceapollis tobolicus (Panova) W. Kr.
Fig. 1 (T/15); boring Tarnówka, depth 267.0—268.0 m, Middle Oligocene, phase 20

Abiespollenites maximus W. Kr.
Fig. 2 (U/7); boring Ustronie, depth 135.6—136.1 m; Upper Miocene, phase XI

Cedripites miocaenicus W. Kr.
Fig. 3 (G/47); boring Gierlachowo, depth 212.2—212.8 m, Middle Miocene, phase VIII
Figs 1—3 × 750; Fig. 2 × 500

Plate XII

Zonalapollenites spinosus (Dokt.-Hrebn.) comb. n.
Fig. 1a, b (U/43); boring Ustronie, depth 214.9—215.7 m, Middle Miocene, phase VII

Zonalapollenites maximus (Raatz) W. Kr.
Fig. 2 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Zonalapollenites spectabilis (Dokt.-Hrebn.) comb. n.
Fig. 3 (O/11); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI

Zonalapollenites verrucatus W. Kr.
Fig. 4 (G/42); boring Gierlachowo; depth 208.6—209.2 m, Middle Miocene, phase IX
All specimens × 1000, except 1b × 2000

Plate XIII

Zonalapollenites igniculus (R. Pot.) Th. & Pf.
Fig. 1 (G/43); boring Gierlachowo, depth 209.2—209.8 m, Middle Miocene, phase IX

Zonalapollenites neogenicus W. Kr.
Fig. 2 (U/61); boring Ustronie, depth 224.2—224.8 m, Lower Miocene, phase V

Zonalapollenites minimus W. Kr.
Fig. 4 (O/11a); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI

Sciadopityspollenites varius W. Kr.
Fig. 3 (O/17a); boring Oczkowice, depth 108.3—109.3 m, Middle Miocene.

Sciadopityspollenites serratus (R. Pot & Ven.) Raatz
Fig. 5 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Sciadopityspollenites quintus W. Kr.
Fig. 6 (U/19); boring Ustronie, depth 202.2—202.7 m, Middle Miocene, phase VIII

Sciadopityspollenites verticillatiformis W. Kr.
Fig. 7 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Sciadopityspollenites tuberculatus (Zakl.) W. Kr.
Fig. 8 (G/42); boring Gierlachowo, depth 208.6—209.2 m, Middle Miocene, phase IX

Ephedripites (*Distachyapites*) *bernheidensis* W. Kr.
Fig. 9 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Ephedripites (*Distachyapites*) *eocenipites* (Wdh.) W. Kr.
Fig. 10 (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20
All specimens × 1000

Plate XIV

Inaperturopollenites concedipites (Wdh.) W. Kr.
Fig. 1 (O/48); boring Oczkowice, depth 249.5—250.0 m, Upper Oligocene, phase II

Sequoiapollenites sculpturius W. Kr.
Fig. 2a, b (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Inaperturopollenites dubius (R. Pot. & Ven.) Th. & Pf.
Fig. 3 (U/63); boring Ustronie, depth 225.4—226.0 m, Lower Miocene, phase V

Inaperturopollenites radiatus W. Kr.
Figs 4a, b (O/17); boring Oczkowice, depth 108.3—109.3 m, Middle Miocene

Inaperturopollenites verrupapillatus Trevisan
Fig. 5 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Sequoiapollenites rotundus W. Kr.
Fig. 6a, b (G/43); boring Gierlachowo, depth 209.2—209.8 m, Middle Miocene, phase IX

Sequoiapollenites polyformosus Thierg.
Fig. 7a, b (G/86); boring Gierlachowo, depth 245.1—245.6 m, Middle Miocene, phase VII

Psophosphaera pseudotsugoides W. Kr.
Fig. 8 (K/98); boring Krosinko, depth 185.8—188.0 m, Middle Miocene, phase IX

Sequoiapollenites gracilis W. Kr.
Fig. 9a, b (O/23); boring Oczkowice, depth 114.4—115.3 m, Middle Miocene, phase VIII
All specimens × 1000

Plate XV

Arecipites pseudoconvexus W. Kr.
Fig. 1a—e (Gs/8); boring Gołębin Stary, depth 164.5—165.2 m, Upper Miocene, phase X

Arecipites sp.
Fig. 2a—c (O/43); boring Oczkowice, depth 245.6—246.4 m, Lower Miocene, phase II

Arecipites papillosus (Mürr. & Pf.) W. Kr.
Fig. 3a—c (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Liriodendroipollis verrucatus W. Kr.
Fig. 4 (W/ 143); boring Wirczyn, depth 123.0—124.0 m, Lower Miocene

Arecipites butomoides butomoides W. Kr.
Fig. 5 (Kr/12); boring Krosno, depth 122.6—123.0 m, Middle Miocene, phase VII

Magnolipollis neogenicus minor W. Kr.
Fig. 6 (NW/11); boring Nowa Wieś, depth 186.0—187.0 m, Middle Miocene, phase VIII

Magnolipollis neogenicus neogenicus W. Kr.
Fig. 7 (O/11); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase II
All specimens × 1000

Plate XVI

Graminidites soellichauensis W. Kr.
Fig. 1a—c (M/173); boring Mosina, depth 344.9—349 m, Middle Oligocene, phase 20

Graminidites laevigatus W. Kr.
Fig. 2a, b (G/78); boring Gierlachowo, depth 241,1—241,6 m, Middle Miocene, phase VII

Graminidites crassiglobosus (Trevisan) W. Kr.
Fig. 3a, b (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Sparganiaceaepollenites polygonalis Thierg.
Fig. 4a, b (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Sparganiaceaepollenites sparganioides (Mayer) W. Kr.
Fig. 5a, b (O/1); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI

Miocaenipollis miocaenicus W. Kr.
Fig. 6a, b (G/7); boring Gierlachowo, depth 137.4—138.1 m, Upper Miocene, phase XIII

Sparganiaceaepollenites neogenicus W. Kr.
Fig. 7a, b (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Liquidambarpollenites stigmosus (R. Pot.) Raatz
Fig. 8 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Juglanspollenites verus Raatz
Fig. 9 (U/10); boring Ustronie, depth 137.1—137.6 m, Upper Miocene, phase XII

Milfordia minima W. Kr.
Fig. 10 (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Multiporopollenites maculolosus (R. Pot.) Th. & Pf.
Fig. 11 (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Chenopodiipollis stellatus (Mamczar) W. Kr.
Fig. 12a, b (O/11); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI

Milfordia incerta (Th. & Pf.) W. Kr.
Fig. 13 (M/173b); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Aglaoreidia cyclops Erdtman
Fig. 14 (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Plate XVII

Triporopollenites urticoides Nagy
Fig. 1a, b (Ś/3); boring Ślepuchowo, depth 86.8—87.4 m, Upper Miocene, phase XIII

Momipites punctatus (R. Pot.) Nagy
Fig. 2a, b (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20
Fig. 3a, b (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Platycaryapollenites uformis W. Kr.
Fig. 4a, b (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Platycaryapollenites miocaenicus Nagy
Fig. 5a, b (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Triporopollenites coryloides Pf.
Fig. 6a, b (O/11a); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI

Triatriopollenites rurensis Pf.
Fig. 7a, b (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Trivestibulopollenites betuloides
Fig. 8a, b (O/11); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI
Fig. 10a, b (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Triatriopollenites rurobituitus
Fig. 9a, b (T/10); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20

Triporopollenites robustus (Mürr. & Pf.) Th. & Pf.
Fig. 11a, b (T/10); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20

Triatriopollenites coryphaeus (R. Pot.) Th. & Pf.
Fig. 12 (U/36); boring Ustronie, depth 211.6—212.1 m, Middle Miocene, phase VIII

Brosipollis salebrosus (Pf.) W. Kr.
Fig. 13a—c (T/14); boring Tarnówka, depth 266.0—267 m, Middle Oligocene, phase 20
All specimens × 1000

Plate XVIII

Alnipollenites verus R. Pot.
Fig. 1 (U/54); boring Ustronie, depth 220.5—220.9 m, Middle Miocene, phase VI
Fig. 2 (W/146); boring Wirczyn, depth 180.5—181.0 m, Lower Miocene,

Ulmipollenites undulosus Wolff
Fig. 3 (U/10); boring Ustronie; depth 137.1—137.6 m, Upper Miocene, phase XI
Fig. 4 (U/11); boring Ustronie; depth 137.6—138.2 m, Upper Miocene, phase XI
Fig. 5 (U/59); boring Ustronie; depth 223.1—223.4 m, Middle Miocene, phase VI

Caryapollenites simplex (R. Pot.) R. Pot.
Fig. 6 (U/67); boring Ustronie; depth 227.8—228.4 m, Middle Miocene, phase V
Fig. 7 (U/61); boring Ustronie; depth 224.2—224.8 m, Middle Miocene, phase V
Fig. 11 (G/126); boring Gierlachowo, depth 279.0—279.9 m, Lower Miocene, phase III

Pterocaryapollenites stellatus (R. Pot.) Thierg.
Fig. 8 (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI
Fig. 10a, b (O/18); boring Oczkowice, depth 109.3—110.8 m, Middle Miocene

Carpinuspollenites carpinoides (Pf.) Nagy
Fig. 9 (U/8); boring Ustronie, depth 136.1—136.6 m, Upper Miocene, phase XI

Intratriporopollenites insculptus Mai
Fig. 12 (W/143); boring Wirczyn, depth 179.3—179.6 m, Lower Miocene
Fig. 13a, b (G/94); boring Gierlachowo, depth 249.1—249.6 m, Middle Miocene, phase VI

Intratriporopollenites instructus (R. Pot.) Th. & Pf.
Fig. 14a—c (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20
All specimens × 1000

Plate XIX

Porocolpopollenites latiporis Th. & Pf.
Fig. 1a, b (O/1); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI

Porocolpopollenites sp.
Fig. 2 (U/26); boring Ustronie, depth 205.8—206.2 m, Middle Miocene, phase VIII

Porocolpopollenites triangulus (R. Pot.) Th. & Pf.
Fig. 3 (W/114); boring Wirczyn, depth 119.3—119.7 m, Middle Miocene

Porocolpopollenites vestibulum (R. Pot.) Th. & Pf.
Fig. 4 (U/39); boring Ustronie, depth 213.2—213.9 m, Middle Miocene, phase VII
Fig. 8 (G/12); boring Gierlachowo, depth 140.7—141.3 m, Upper Miocene, phase XIII

Porocolpopollenites maturus (Dokt.-Hreb.) comb. n.
Fig. 5 (W/114); boring Wirczyn, depth 119.3—119.7 m, Middle Miocene
Fig. 6 (N/167); boring Niedźwiedzice, depth 93.1—93.6 m, Middle Miocene

Symplocospollenites anulus rotundus W. Kr.
Fig. 7 (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Porocolpopollenites calanensis W. Kr.
Fig. 9a, b (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Corsinipollenites graciliporus minor W. Kr. & Pactl.
Fig. 10 (NW/14); boring Nowa Wieś, depth 189.0—190.0, Middle Miocene, phase VIII

Corsinipollenites ludwigioides W. Kr.
Fig. 11a, b (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Lonicerapollis gallwitzii W. Kr.
Fig. 12 (O/11); boring Oczkowice, depth 87.4—88.5 m, Upper Miocene, phase XI

Corsinipollenites oculis-noctis (Tgh.) Nakoman
Fig. 13a, b (G/11); boring Gierlachowo, depth 134.0—134.5 m, Upper Miocene, phase XIII

All specimens × 1000

Plate XX

Cyrillaceaepollenites exactus (R. Pot.) R. Pot.
Fig. 1 (U/8); boring Ustronie, depth 136.1—136.6 m, Upper Miocene, phase XI
Fig. 2 (U/57); boring Ustronie, depth 222.0—222.5 m, Upper Miocene, phase VI

Tricolporopollenites cingulum oviformis (R. Pot.) Th. & Pf.
Fig. 3 (U/52); boring Ustronie, depth 219.7—220.1 m, Middle Miocene, phase VI
Fig. 4 (U/52); boring Ustronie, depth 219.7—220.1 m, Middle Miocene, phase VI
Fig. 5 (U/57); boring Ustronie, depth 222.0—222.5 m, Middle Miocene, phase VI

Cyrillaceaepollenites megaexactus (R. Pot.) R. Pot.
Fig. 6 (U/6); boring Ustronie, depth 135.1—136.6 m, Upper Miocene, phase XI
Fig. 7 (U/26); boring Ustronie, depth 205.8—206.2 m, Middle Miocene, phase VIII

Tricolporopollenites retiformis (R. Pot.) Th. & Pf.
Fig. 8 (G/18); boring Gierlachowo, depth 196.0—196.5 m, Upper Miocene, phase X

Tricolporopollenites cingulum pusillus (R. Pot.) Th. & Pf.
Fig. 9a—c (T/13); boring Tarnówka, depth 260.0—266.0 m, Middle Oligocene, phase 20

Tricolporopollenites cingulum fusus Th. & Pf.
Fig. 10a—c (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Fig. 13a—c (G/138); boring Gierlachowo, depth 316.4—317.0 m, Middle Oligocene, phase 20

Fig. 14a, b (G/138); boring Gierlachowo, depth 316.4—317.0 m, Middle Oligocene, phase 20

Tricolporopollenites ipelensis Pactl.

Fig. 11a—c (U/42); boring Ustronie, depth 213.9—214.9 m, Middle Miocene, phase VII

Tricolporopollenites haanradensis Manten

Fig. 12a—c (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Tricolporopollenites villensis (Th) Th. & Pf.

Fig. 15a—c (GS/18); boring Gołębin Stary, depth 305.0—306.7 m, Middle Oligocene, phase 20

Fig. 17a—c (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Tricolporopollenites sp.

Fig. 16a, b (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Tricolporopollenites sp.

Fig. 18a, b (O/11); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI

All specimens × 1000

Plate XXI

Tricolporopollenites wallensenensis Pf.

Fig. 1a—c (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Fig. 3a—c (O/4); boring Oczkowice, depth 82.5—83.5 m, Upper Miocene, phase XI

Araliaceoipollenites edmundi (R. Pot.) R. Pot.

Fig. 2 (U/57); boring Ustronie, depth 222.0—222.5 m, Middle Miocene, phase VI

Fig. 4 (U/26); boring Ustronie, depth 205.8—206.2 m, Middle Miocene, phase VIII

Fig. 5a—c (NW/14); boring Nowa Wieś, depth 189.0—190.0 m, Middle Miocene, phase 20

Fig. 6a, b (U/58); boring Ustronie, depth 222.5—223.1 m, Middle Miocene, phase VI

Fig. 7 (G/138); boring Gierlachowo, depth 316.4—317.0 m, Middle Oligocene, phase 20

All specimens × 1000

Plate XXII

Cupuliferoidaepollenites liblarensis Th.

Fig. 1 (W/146); boring Wirczyn, depth 180.5—181.0 m, Lower Miocene

Fig. 2 (U/61); boring Ustronie, depth 224.2—224.8 m, Middle Miocene, phase V

Fig. 3 (N/180); boring Niedźwiedzice, depth 92.2—92.6 m, Middle Miocene

Fig. 4a—c (GS/8); boring Gołębin Stary, depth 201.0—201.5 m, Middle Miocene, phase VIII

Tricolporopollenites dolium (R. Pot.) Th. & Pf.

Fig. 5a, b (K/17); boring Krosinko, depth 161.9—165.0 m, Upper Miocene, phase X

Quercoidites microhenrici (R. Pot.) R. Pot., Th., Thierg.

Fig. 6a, b (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Fig. 7a, b (G/138); boring Gierlachowo, depth 316.4—317 m, Middle Oligocene, phase 20

Fig. 8 (U/55); boring Ustronie, depth 220.9—221.5 m, Middle Miocene, phase VI

Quercoidites henrici (R. Pot.) R. Pot., Th., Thierg.

Fig. 9a, b (O/23); boring Oczkowice, depth 114.4—115.3 m, Middle Miocene

Fig. 10a—c (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Fig. 11a—c (GS/5); boring Gołębin Stary, depth 165.0 — Upper Miocene, phase X

Tricolporopollenites sp.
Fig. 12a, b (W/140); boring Wirczyn, depth 173.2—173.7 m, Middle Miocene.

Tricolporopollenites marcodurensis Pf. & Th.
Fig. 13 (W/128); boring Wirczyn, depth 154.4—154.9 m, Middle Miocene
Fig. 14 (U/45); boring Ustronie, depth 215.7—216.6 m, Middle Miocene, phase VII
Fig. 15 (W/143); boring Wirczyn, depth 179.3—179.6 m, Lower Miocene
Fig. 16 (N/171); boring Niedźwiedzice, depth 114.6—115.2 m, Lower Miocene
Fig. 17 (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI
Fig. 18 (W/144); boring Wirczyn, depth 169.6—179.8 m, Lower Miocene
All specimens × 1000

Plate XXIII

Nyssapollenites kruschi (R. Pot.) Nagy
Fig. 1 (U/33); Boring Ustronie, depth 210.5—211.0 m, Middle Miocene, phase VIII
Fig. 6 (K/1); boring Krosinko, depth 100.0—100.7 m, Upper Miocene
Fig. 7 (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Rhoipites pseudocingulum (R. Pot.) R. Pot.
Fig. 2 (U/23); boring Ustronie, depth 204.3—204.7 m, Middle Miocene, phase VIII
Fig. 3 (U/77); boring Ustronie, depth 233.3—233.8 m, Lower Miocene, phase IV
Fig. 4 (U/39); boring Ustronie, depth 213.2—213.9 m, Middle Miocene, phase VII
Fig. 5 (U/39); boring Ustronie, depth 213.2—213.9 m, Middle Miocene, phase VII
Fig. 10a, b (O/19); boring Oczkowice, depth 110.8—111.7 m, Middle Miocene

Nyssapollenites pseudocruciatus (R. Pot.) Thierg.
Fig. 8a, b (O/7); boring Oczkowice, depth 84.6—85.7 m, Upper Miocene, phase XI

Faguspollenites verus Raatz
Fig. 9a—c (O/18); boring Oczkowice, depth 109.3—110.8 m, Middle Miocene

Tricolporopollenites sp.
Fig. 11a, b (O/17); boring Oczkowice, depth 108.3—109.3 m, Middle Miocene

Tricolporopollenites sp.
Fig. 1a, b (O/18); boring Oczkowice, depth 109.3—110.8 m, Middle Miocene

Tricolporopollenites sp.
Fig. 2a—c (O/18); boring Oczkowice, depth 109.3—110.8 m, Middle Miocene

Ilexpollenites iliacus (R. Pot.) Thierg.
Fig. 3a—c (O/1); boring Oczkowice, depth 74.5—74.7 m, Upper Miocene, phase XI
Fig. 4 (O/15); boring Oczkowice, depth 96.6—96.8 m, Upper Miocene, phase X

Tricolporopollenites vegetus (R. Pot.) W. Kr.
Fig. 5 (U/53); boring Ustronie, depth 220.1—220.5 m, Middle Miocene, phase VI

Ilexpollenites margaritatus (R. Pot.) Thierg.
Fig. 6a—c (O/18); boring Oczkowice, depth 109.3—110.8 m, Middle Miocene

Tricolporopollenites starosedloensis W. Kr.
Fig. 7a, b (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Caprifoliipites sambucoides Nagy
Fig. 8a, b (G/43); boring Gierlachowo, depth 209.2—209.8 m, Middle Miocene, phase IX

Tricolporopollenites indeterminatus (Romanowicz) comb. n.
Fig. 9a, b (T/10); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20

Tricoloporopollenites satzveyensis Pf.
Fig. 10 (K/93); boring Krosinko, depth 181.6—182.7 m, Middle Miocene, phase IX
Fig. 11 (U/88); boring Ustronie, depth 239.4—240.1 m, Lower Miocene, phase III

Tricolporopollenites parmularius (R. Pot.) Th. & Pf.
Fig. 12a, b (M/173); boring Mosina, depth 344.9—349.4m, Middle Oligocene, phase 20
All specimens × 1000

Plate XXIV

Cupanieidites eucalyptoides W. Kr.
Fig. 1a, b (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Iteapollis angustiporatus (Schneider) comb.n.
Fig. 2. (U/92); boring Ustronie, depth 241.5—242.0 m, Lower Miocene, phase III
Fig. 3 (GS/7); boring Gołębin Stary, depth 192.0, Middle Miocene phase VIII

Dicolporopollenites middendorfi (R. Pot.) W. Kr.
Fig. 4a, b (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Spinulaepollis arceuthobioides W. Kr.
Fig. 5a, b (O/43); boring Oczkowice, depth 245.6—246.4 m, Lower Miocene, phase II
Fig. 6a—c (G/138); boring Gierlachowo, depth 316.4—317.0 m, Middle Oligocene, phase 20

Spinulaepollis arceuthobioides major Stuchlik
Fig. 7a, b (T/14); borin Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20
Fig. 8 (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20
Fig 9. (T/14); boring Tarnówka, depth 266.0—267.0 m, Middle Oligocene, phase 20

Oligopollis pentapollis W. Kr.
Fig. 10a—c (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Reevesiapollis triangulus (Mamczar) W. Kr.
Fig. 11 (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Olaxipollis matthesi W. Kr.
Fig. 12 (G/98); boring Gierlachowo, depth 251.3—251.9 m, Middle Miocene, phase VI

Tetracolporopollenites sapotoides Th. & Pf.
Fig. 13 (G/98); boring Gierlachowo, depth 251.3—251.9 m, Middle Miocene, phase VI

Tricolporopollenites spinus W. Kr.
Fig. 14 (M/173); boring Mosina, depth 344.9—349.4 m, Middle Oligocene, phase 20

Boehlensipollis hohli W. Kr.
Fig. 15 (T/10); boring Tarnówka, depth 262.0—263.0 m, Middle Oligocene, phase 20

Sporotrapoidites illigensis Klaus
Fig. 16 (G/8); boring Gierlachowo, depth 138.1—138.7 m, Upper Miocene, phase XII

Diervillapollenites megaspinosus Dokt.-Hrebn.
Fig. 17 (U/86); boring Ustronie, depth 238.6—239.0 m, Lower Miocene, phase III
All specimens × 1000

Plate XXV

Spinaepollis spinosus (R. Pot.) W. Kr.
Fig. 1a, b (T/13); boring Tarnówka, depth 265.0—266.0 m, Middle Oligocene, phase 20

Australopollis obscurus (Harris) W. Kr.
Fig. 2a, b (O/23); boring Oczkowice, depth 114.4—115.3 m, Middle Miocene

Cristaepollis sp.

Fig. 3a, b (T/12); boring Tarnówka, depth 264.0—265.0 m, Middle Oligocene, phase 20

Erdtmanipollis pachysandroides W. Kr.

Fig. 4a, b (Kr/96); boring Krosinko, depth 184.2—184.7 m, Middle Miocene, phase IX

Thymelipollis retisculpturius W. Kr.

Fig. 5a, b (M/173); boring Mosina, depth 344.9—439.4 m, Middle Oligocene, phase 20
Fig. 7 (T/11); boring Tarnówka, depth 263.0—264.0 m, Middle Oligocene, phase 20

Persicarioipollis meuseli W. Kr.

Fig. 6a—c (G/39); boring Gierlachowo, depth 206.9—207.4 m, Middle Miocene, phase IX

Ericipites callidus (R. Pot.) W. Kr.

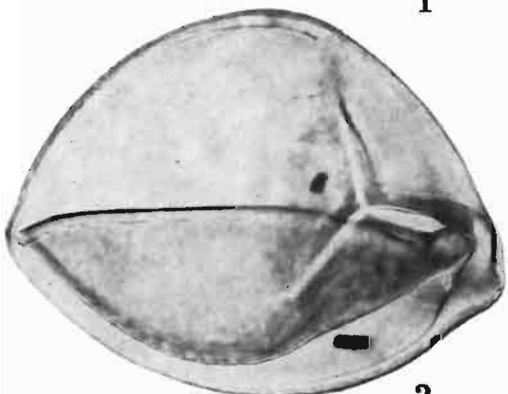
Fig. 8 (U/23); boring Ustronie, depth 204.2—204.7 m, Middle Miocene, phase VIII
Fig. 10 (U/6); boring Ustronie, depth 135,1—135,6 m, Upper Miocene, phase XI

Ericipites ericius (R. Pot.) W. Kr.

Fig. 9 (W/143); boring Wirczyn, Lower Miocene

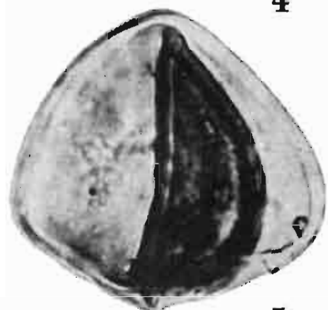
All specimens × 1000

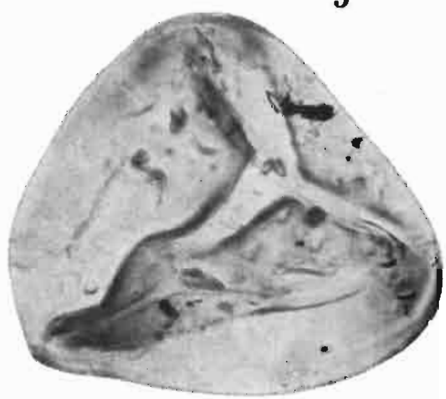

1


2

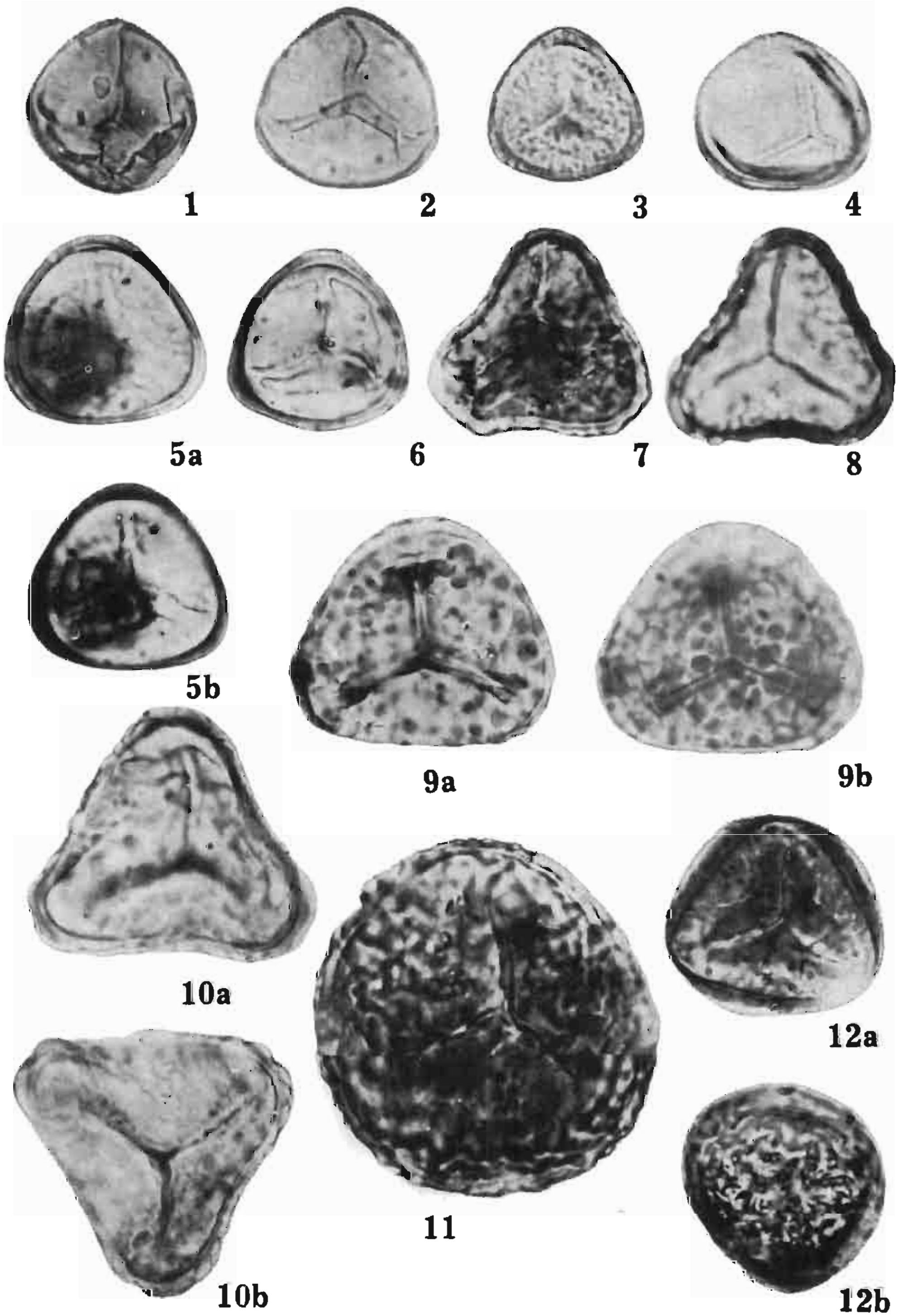

3

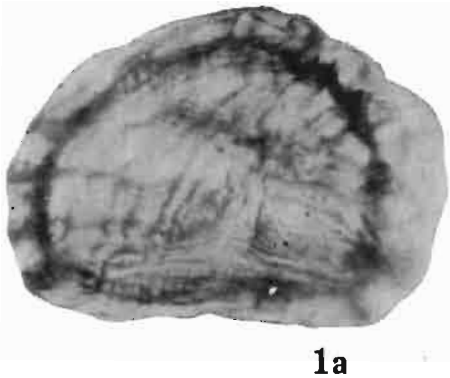

4


5


6


7

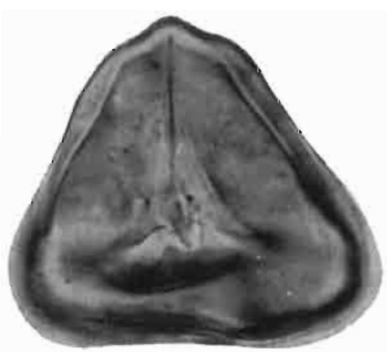



1a


1b


2a

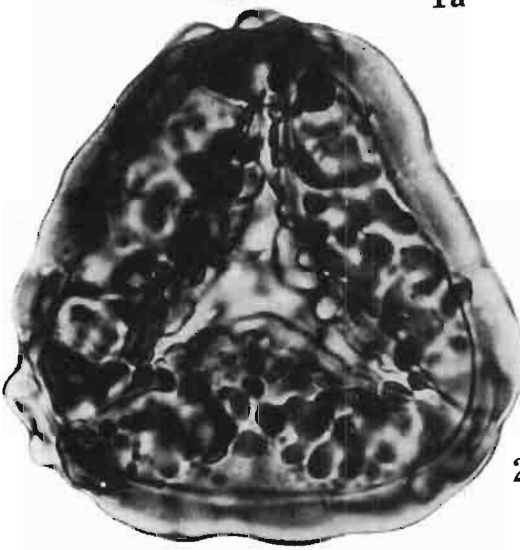

1c


2b


3

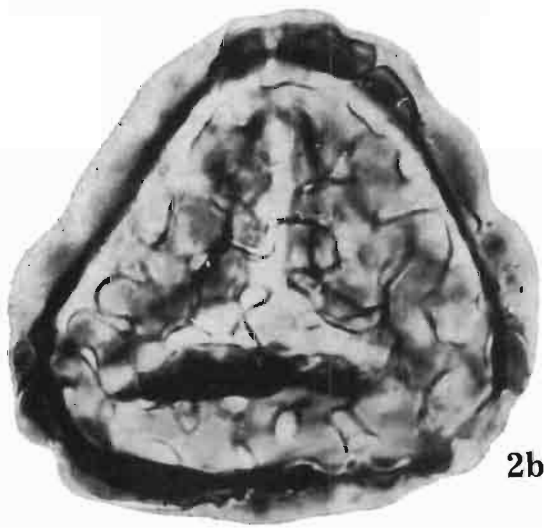

1a

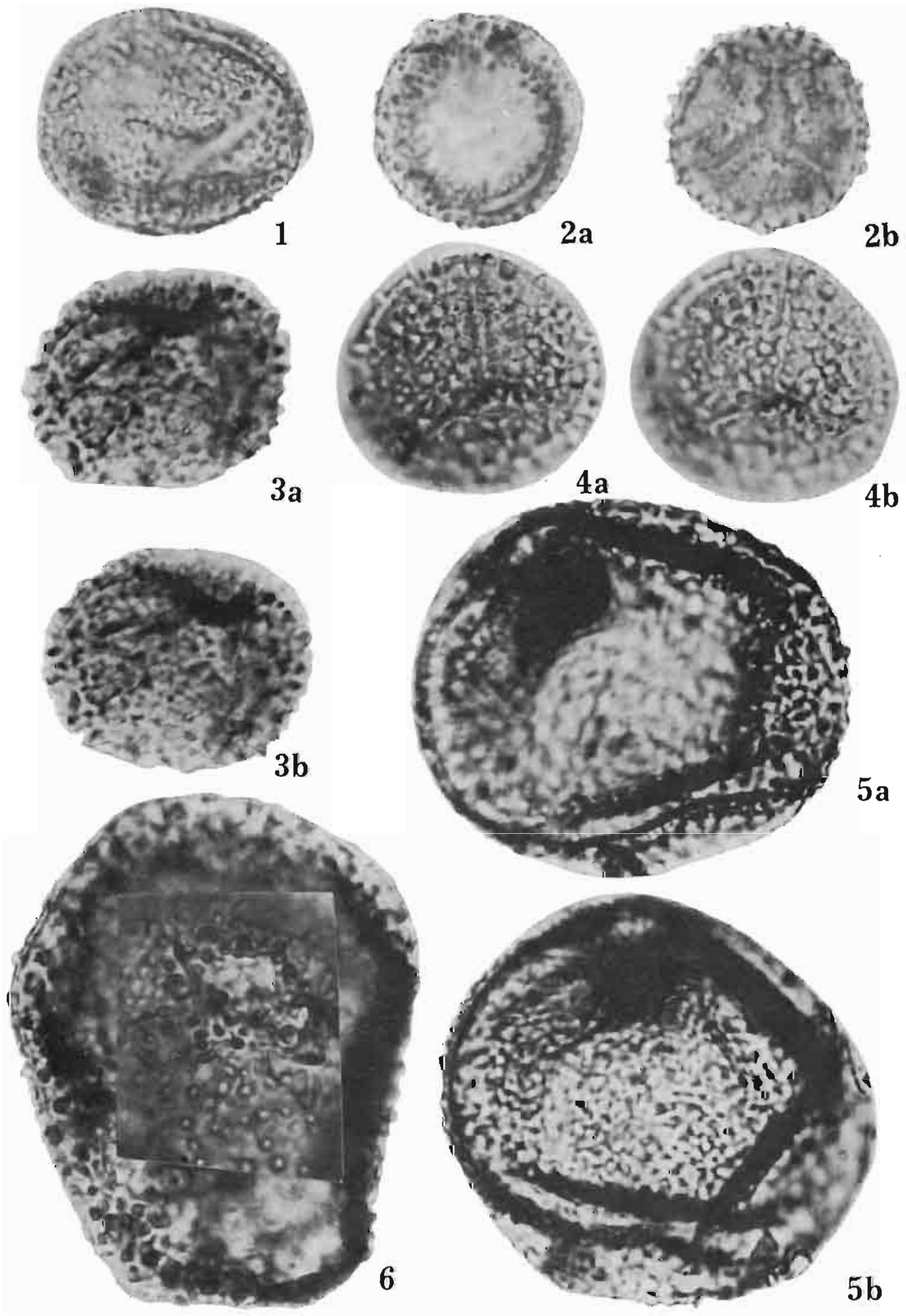

1b

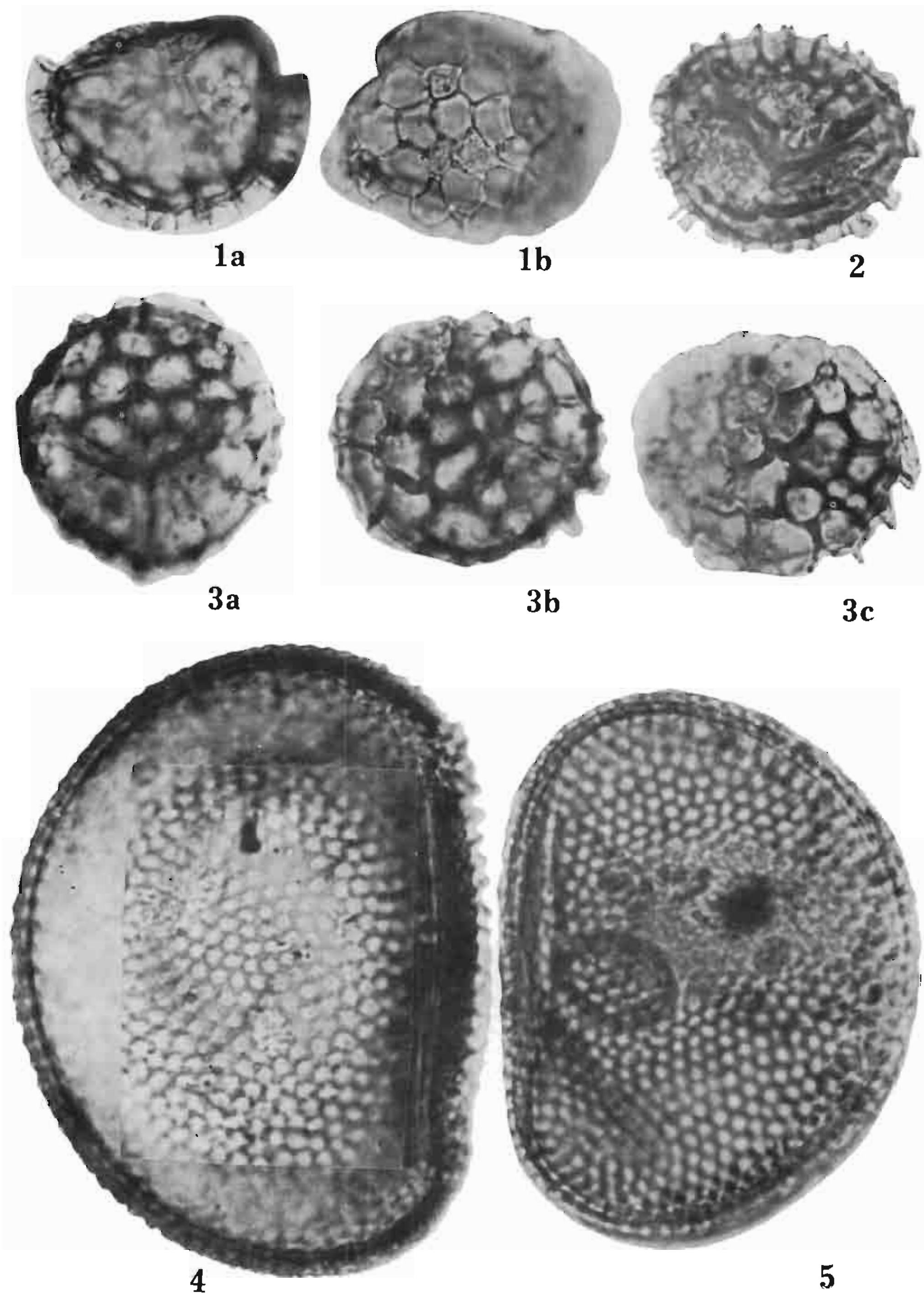

2a

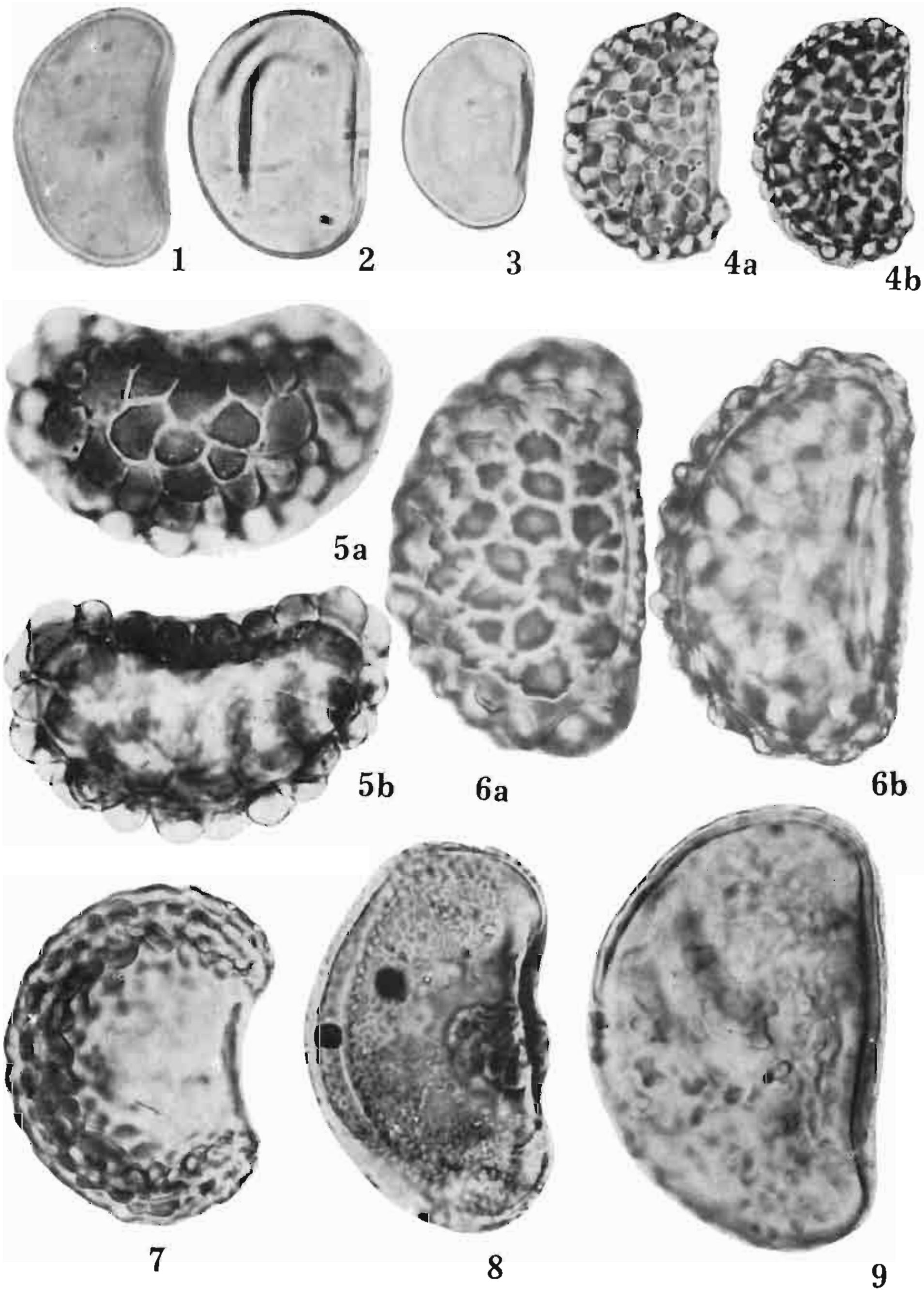

3a


3b


2b

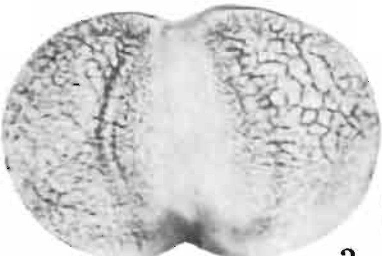

1
2a
2b
3a
4a
4b
3b
5a
6
5b


1a
1b
2
3a
3b
3c
4
5

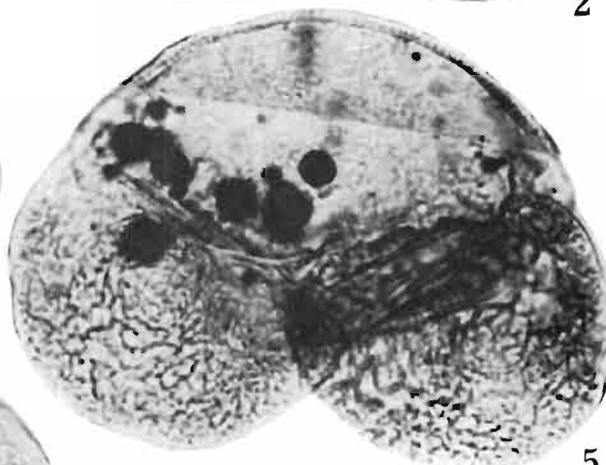

1
2
3
4a
4b
5a
5b
6a
6b
7
8
9


1

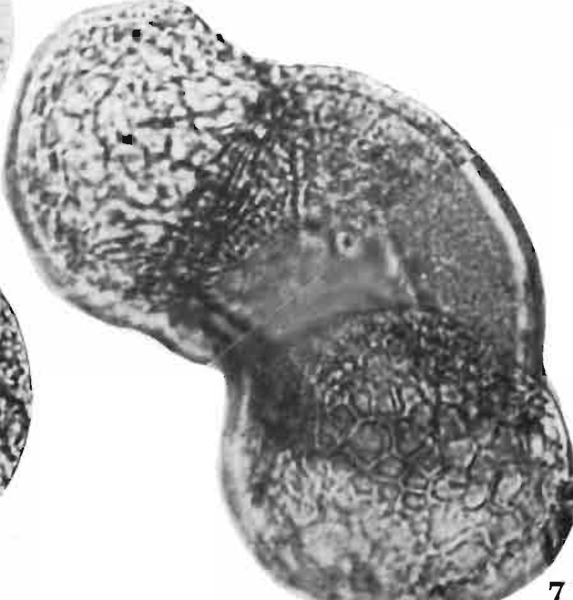

2

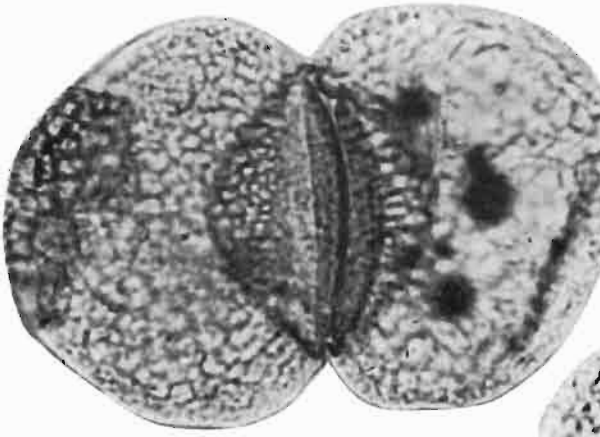

3


4

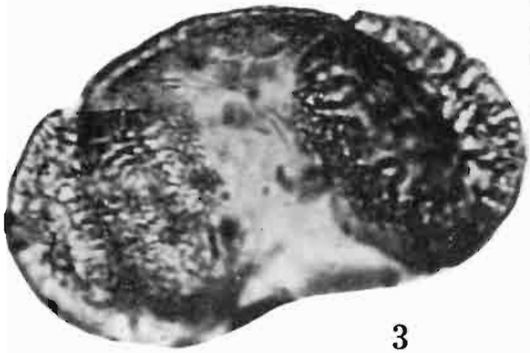

5


6

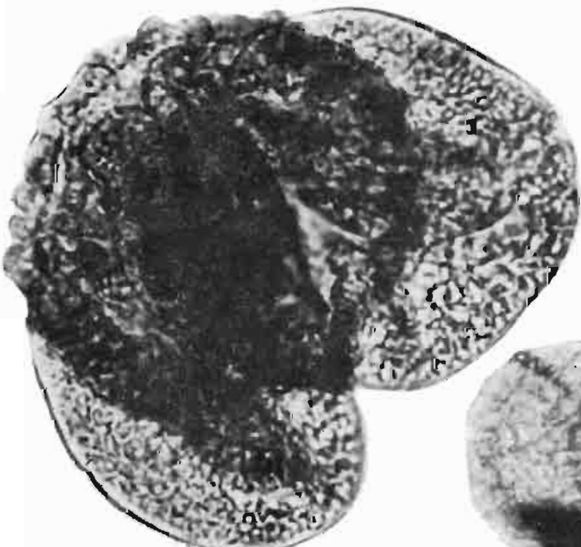

7

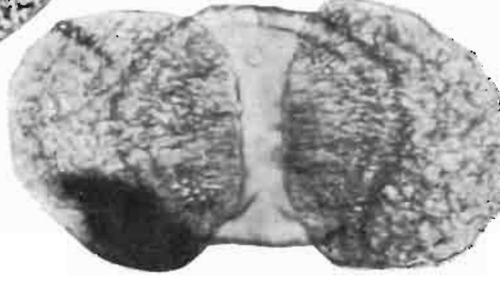

1


2


3


4


5


6

3

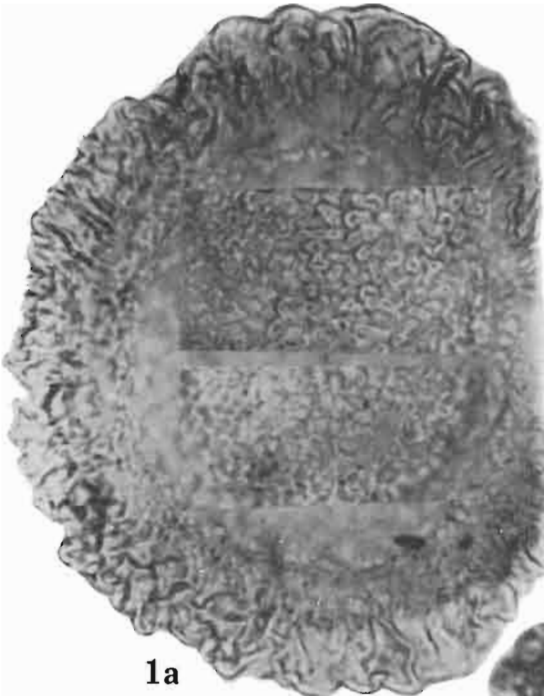
1

2

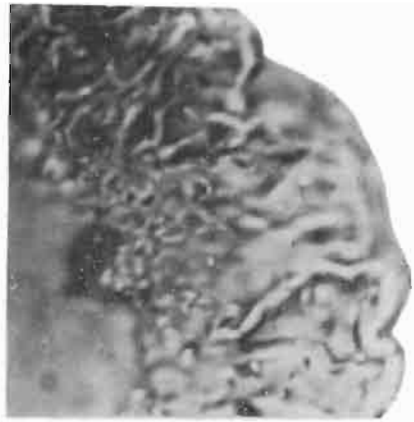
3

1

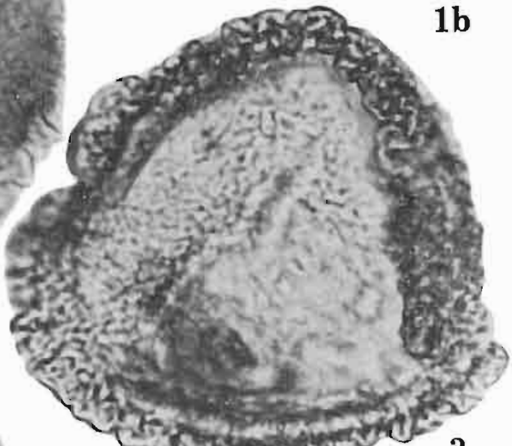
2



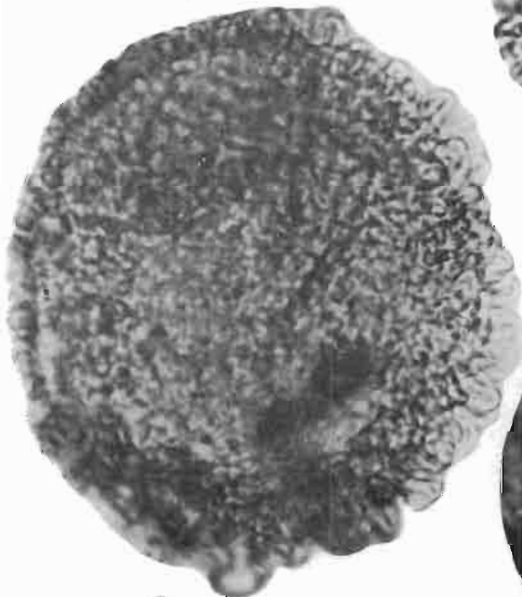
1a



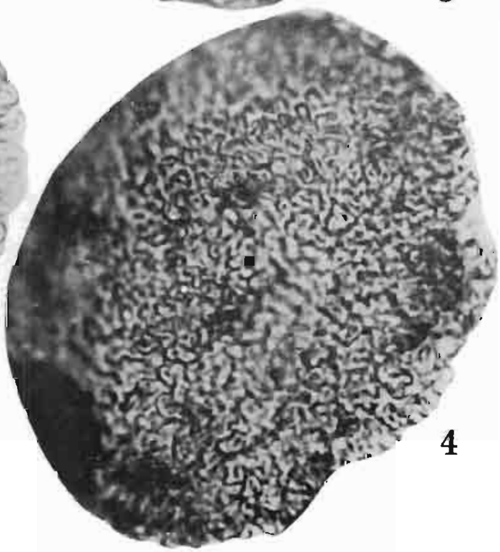
1b



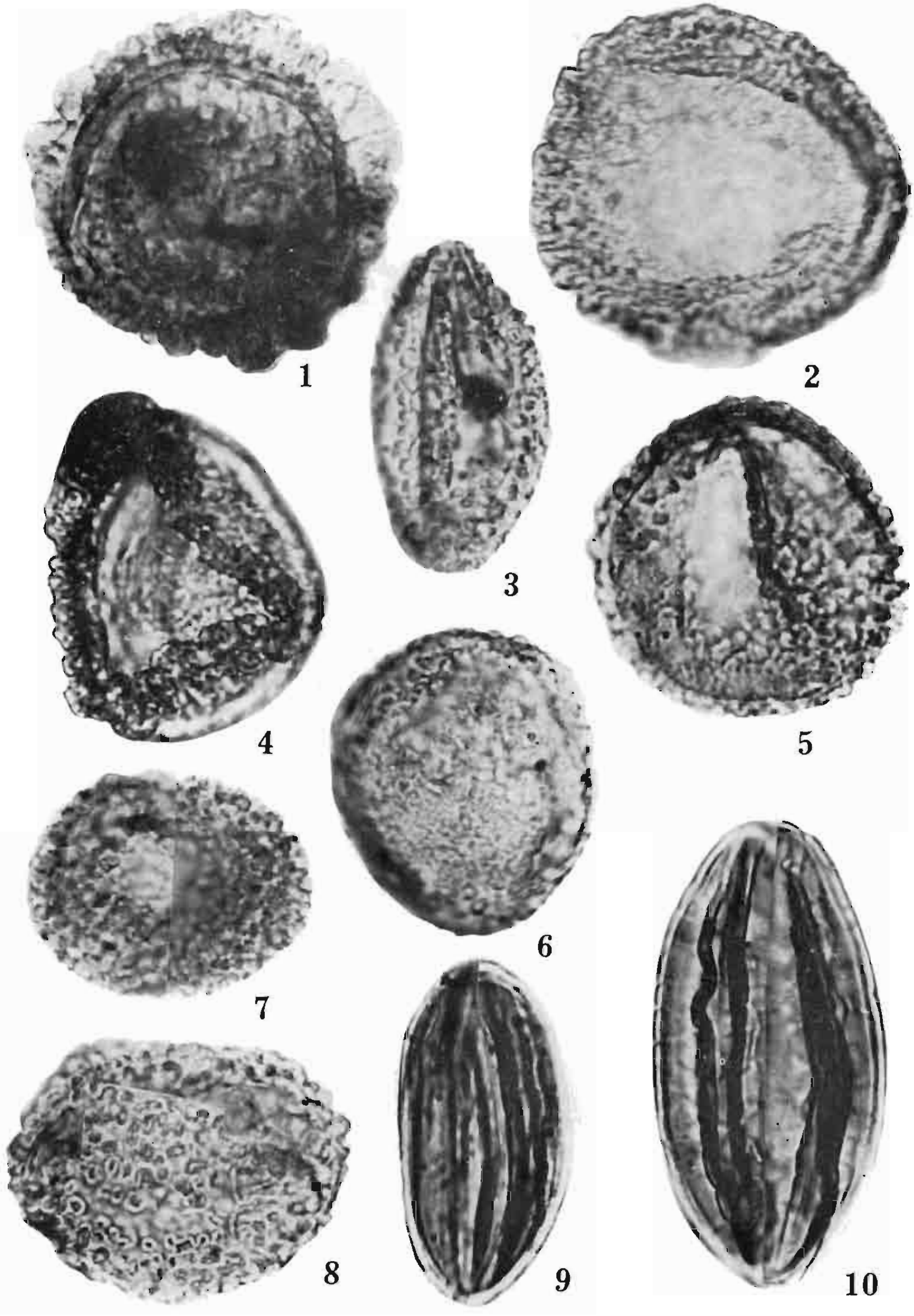
3

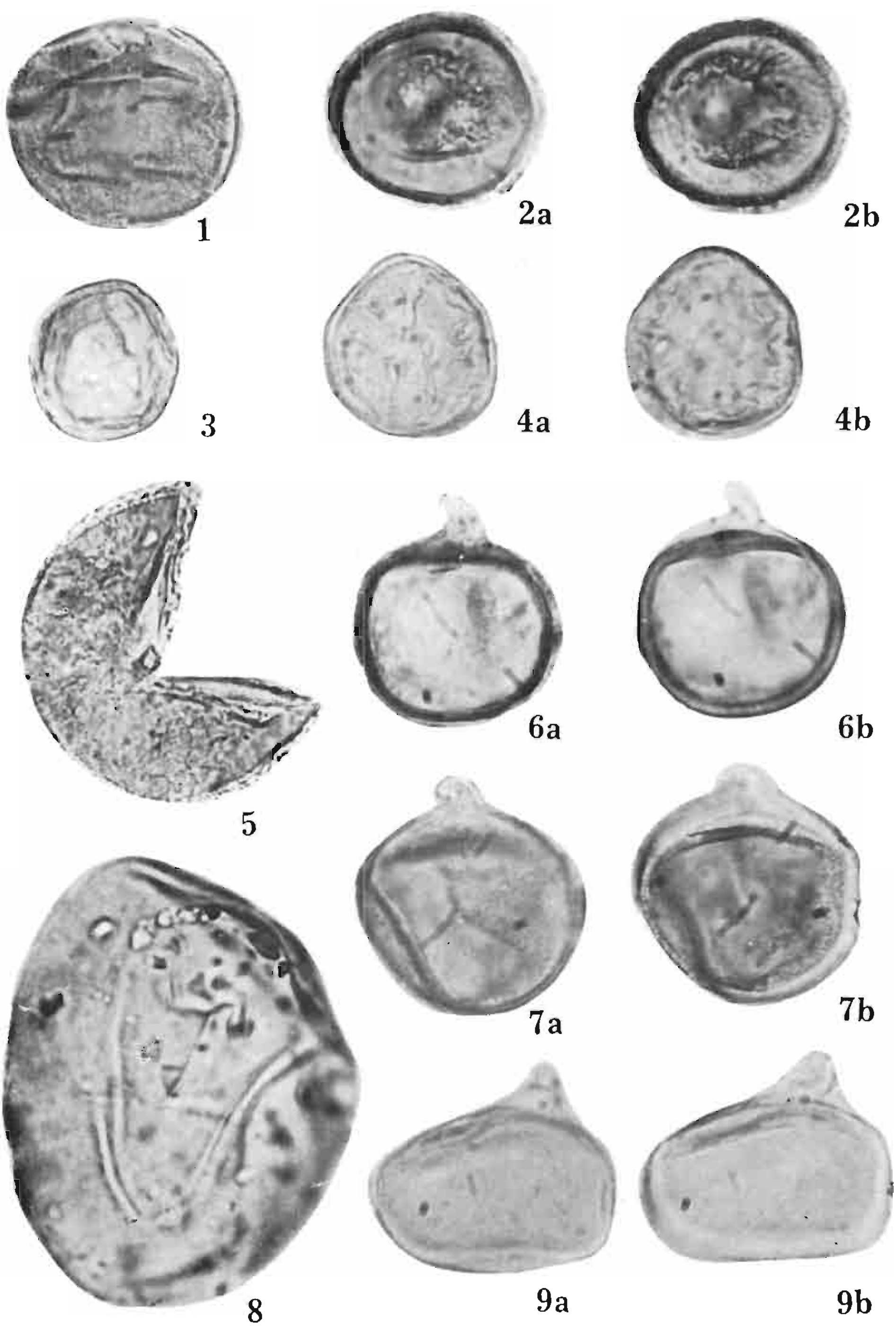


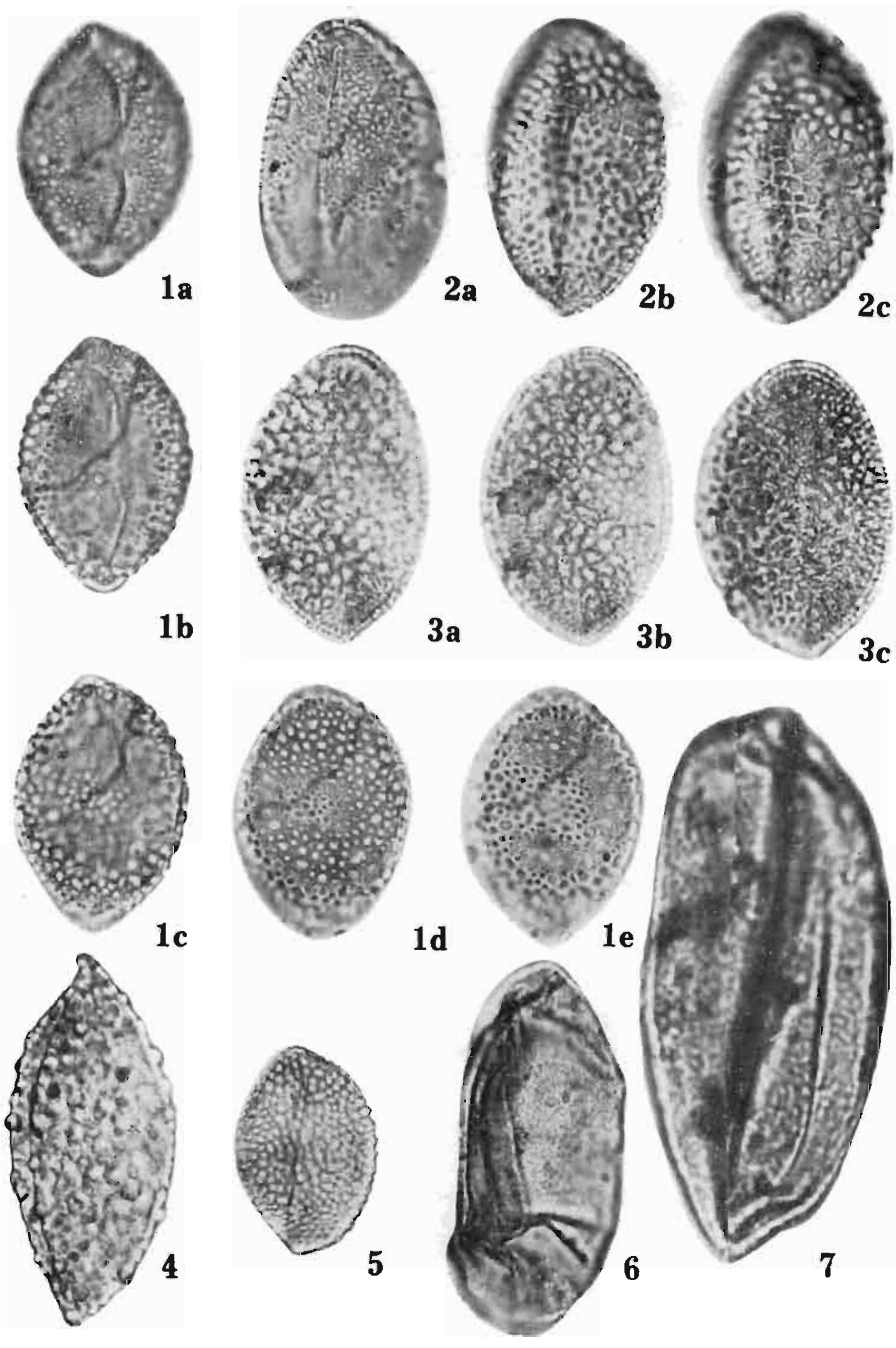
2

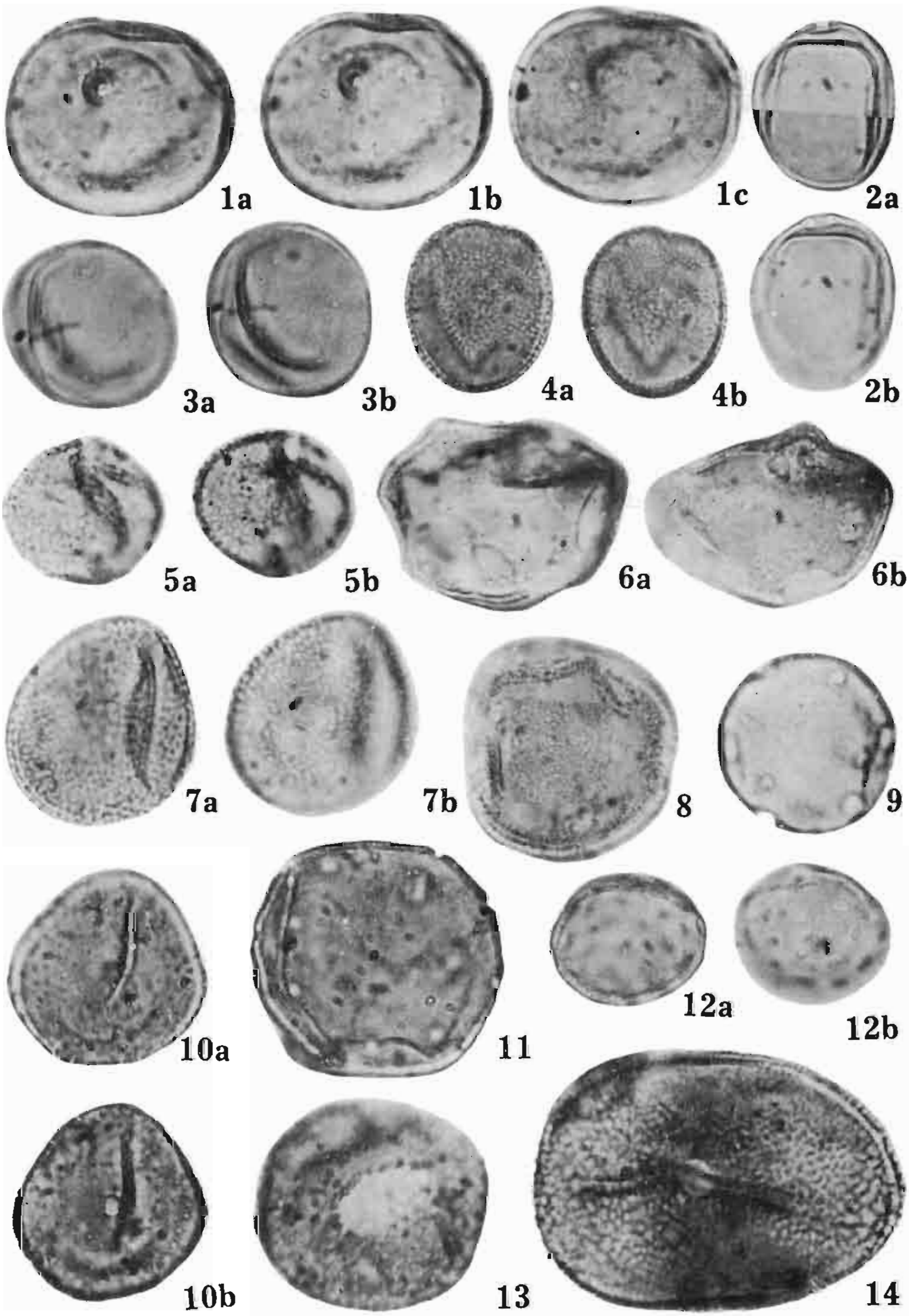


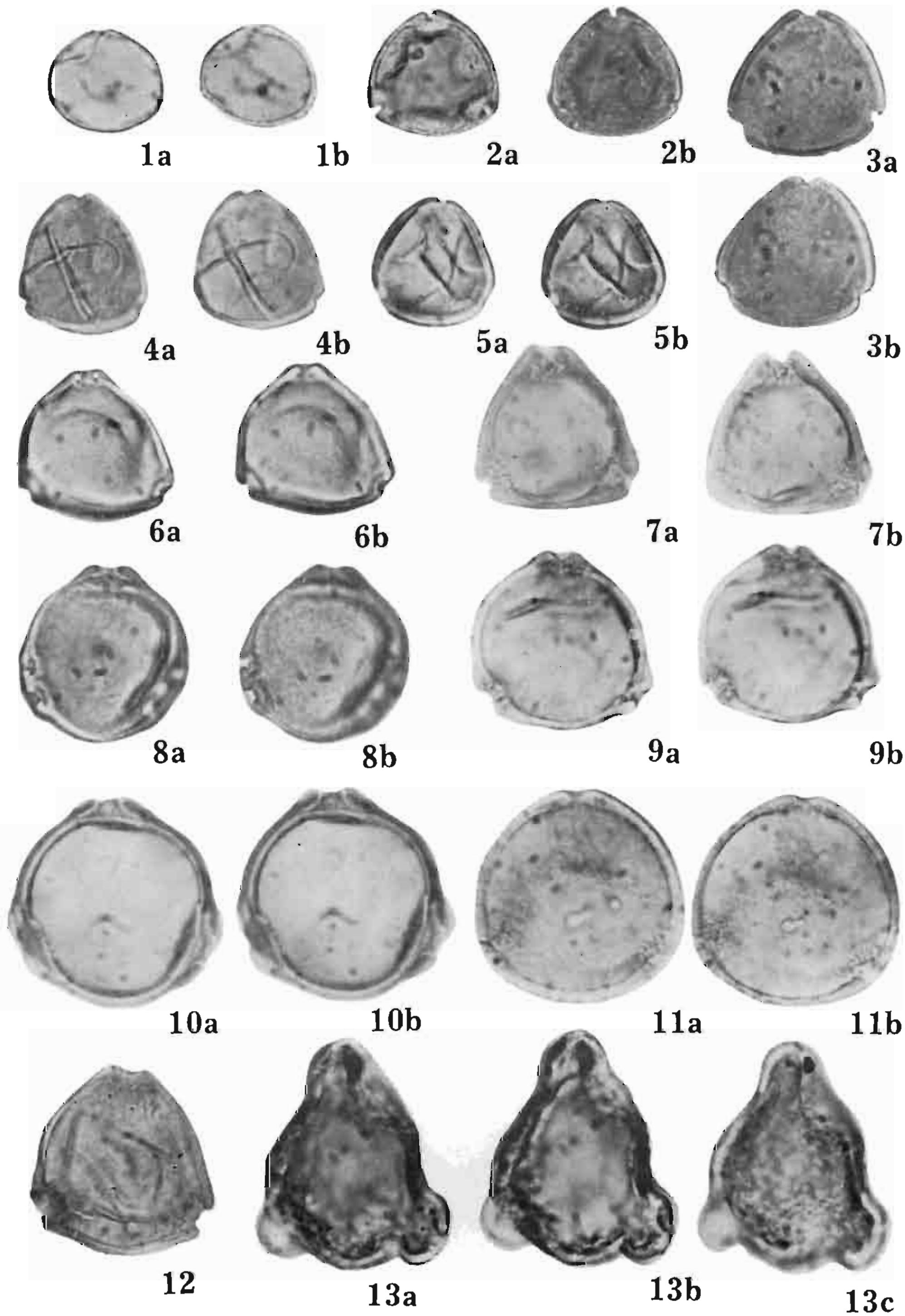
4

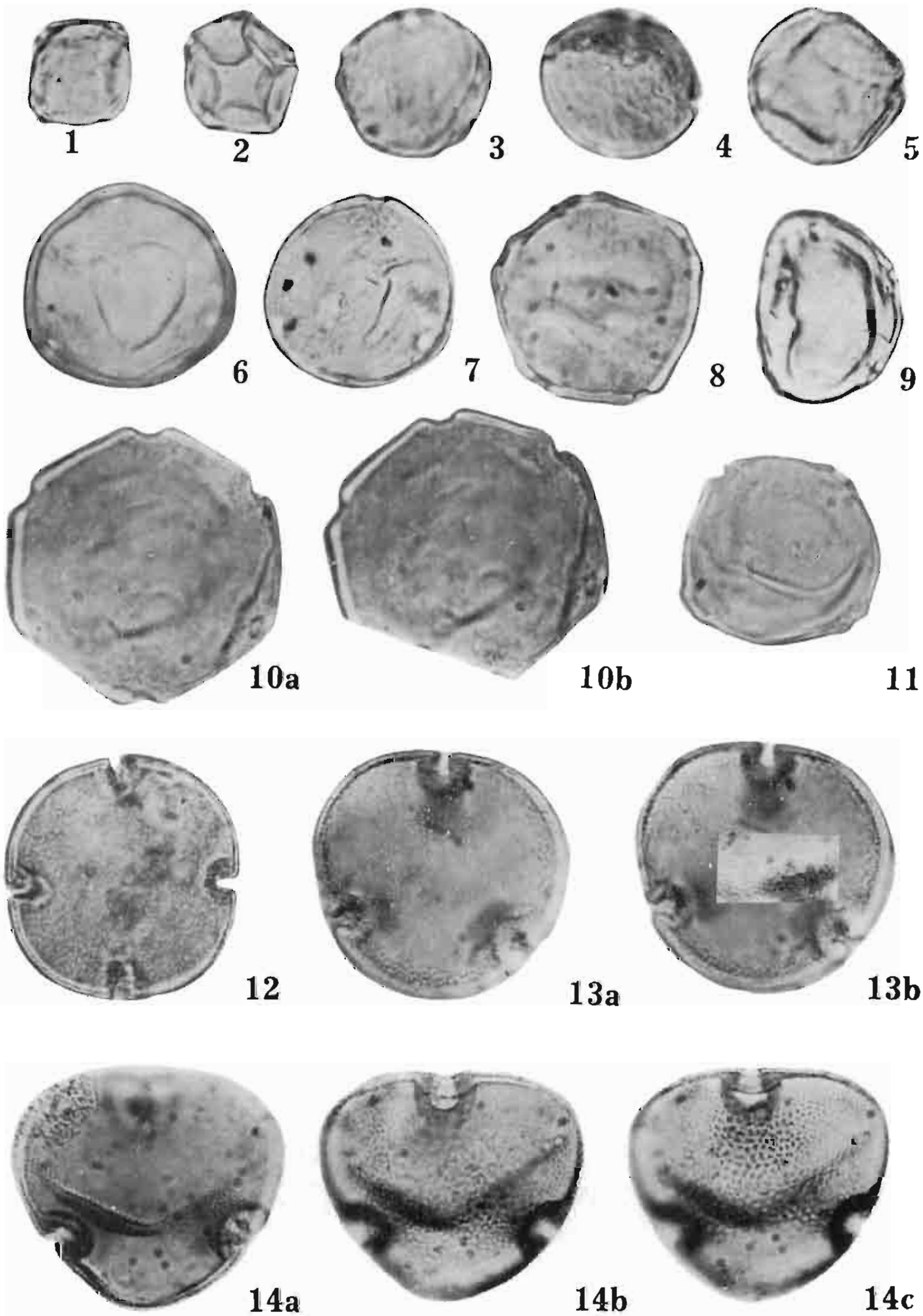

1
2
3
4
5
6
7
8
9
10

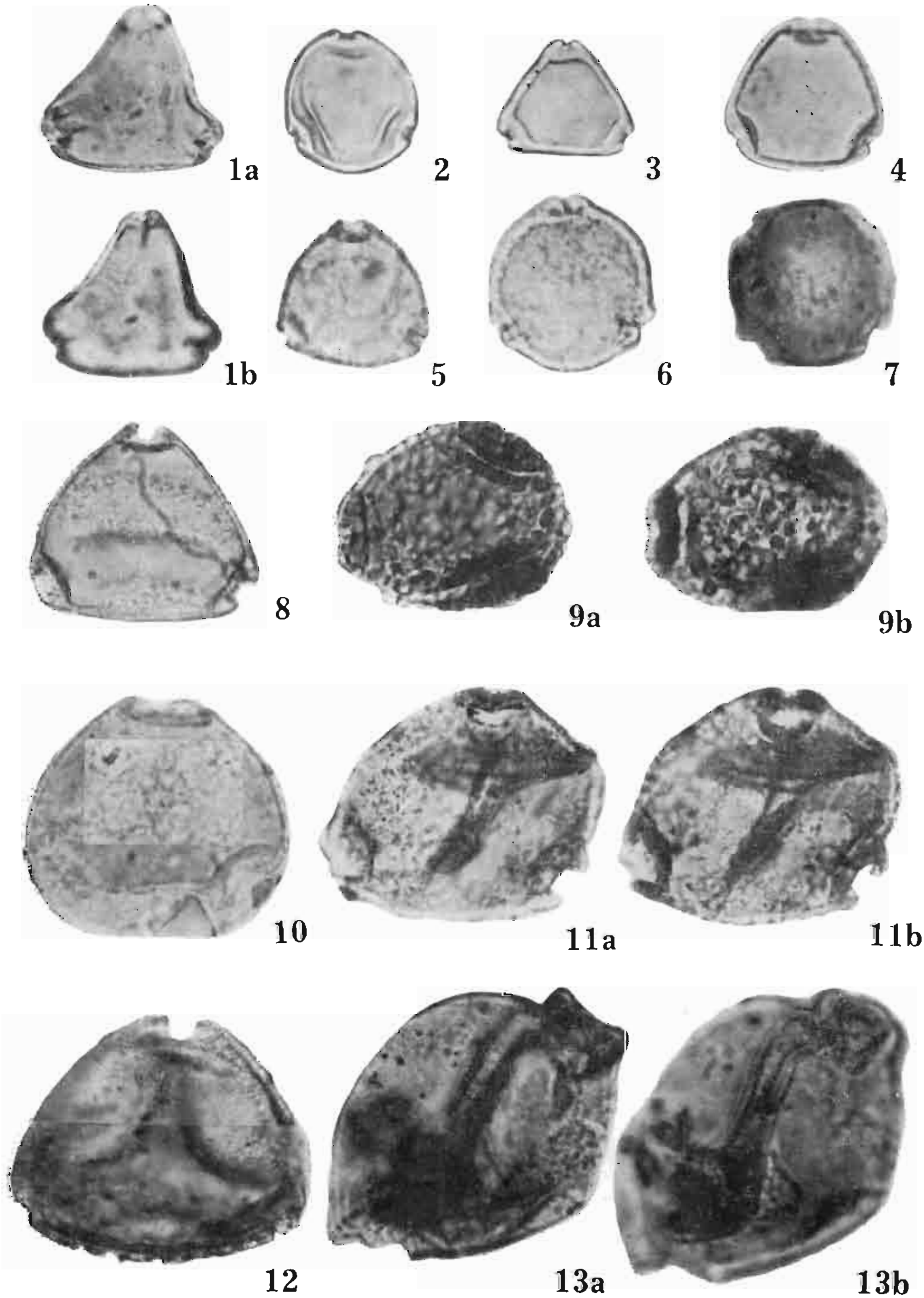

1
2a
2b
3
4a
4b
5
6a
6b
7a
7b
8
9a
9b

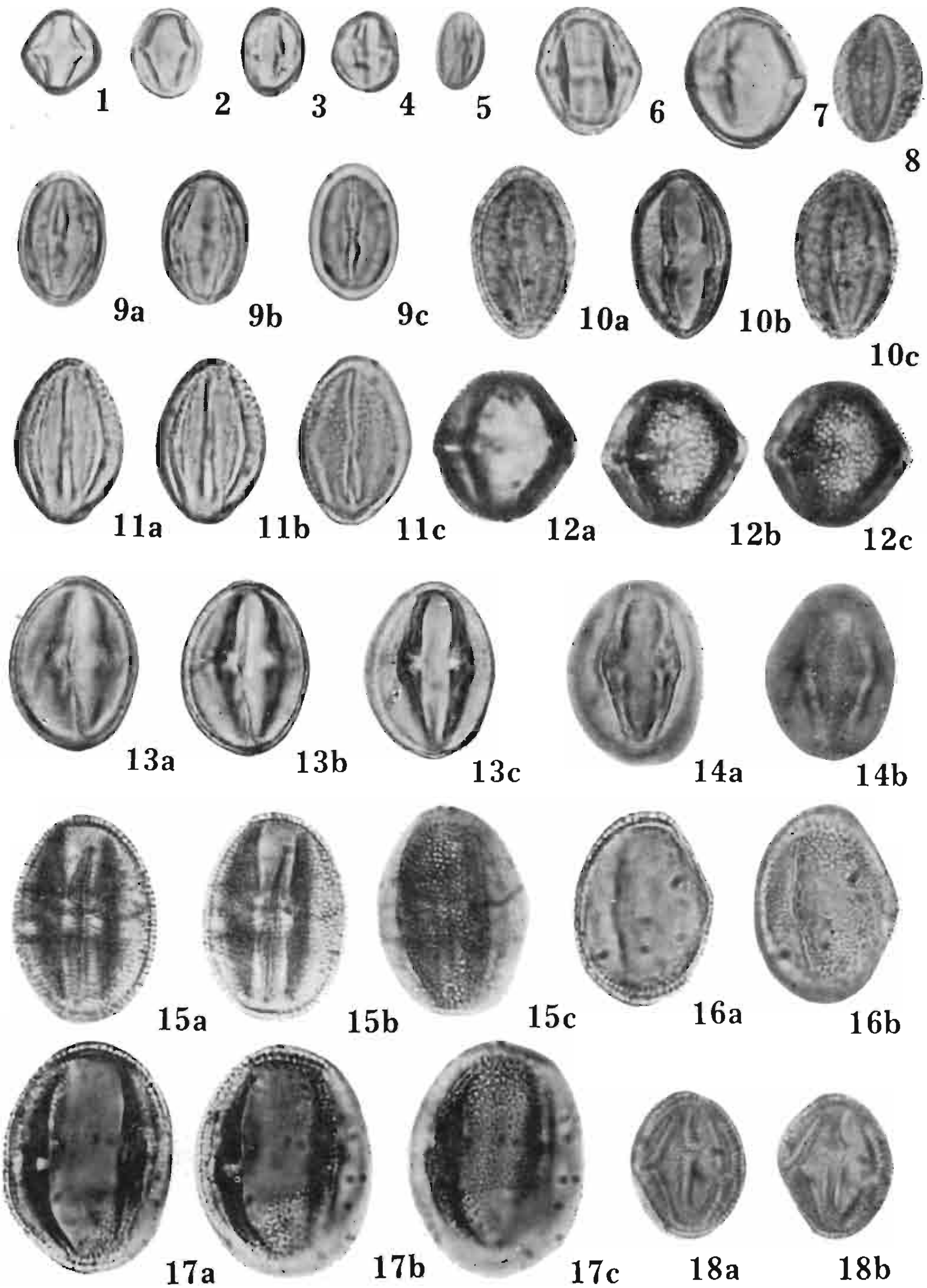

1a
2a
2b
2c
1b
3a
3b
3c
1c
1d
1e
4
5
6
7


1a
1b
1c
2a
3a
3b
4a
4b
2b
5a
5b
6a
6b
7a
7b
8
9
10a
11
12a
12b
10b
13
14


1a
1b
2a
2b
3a
4a
4b
5a
5b
3b
6a
6b
7a
7b
8a
8b
9a
9b
10a
10b
11a
11b
12
13a
13b
13c


1
2
3
4
5
6
7
8
9
10a
10b
11
12
13a
13b
14a
14b
14c


1a
2
3
4
1b
5
6
7
8
9a
9b
10
11a
11b
12
13a
13b


1
2
3
4
5
6
7
8
9a
9b
9c
10a
10b
10c
11a
11b
11c
12a
12b
12c
13a
13b
13c
14a
14b
15a
15b
15c
16a
16b
17a
17b
17c
18a
18b


1a


1b


1c


2


3a


3b


3c


4


5a

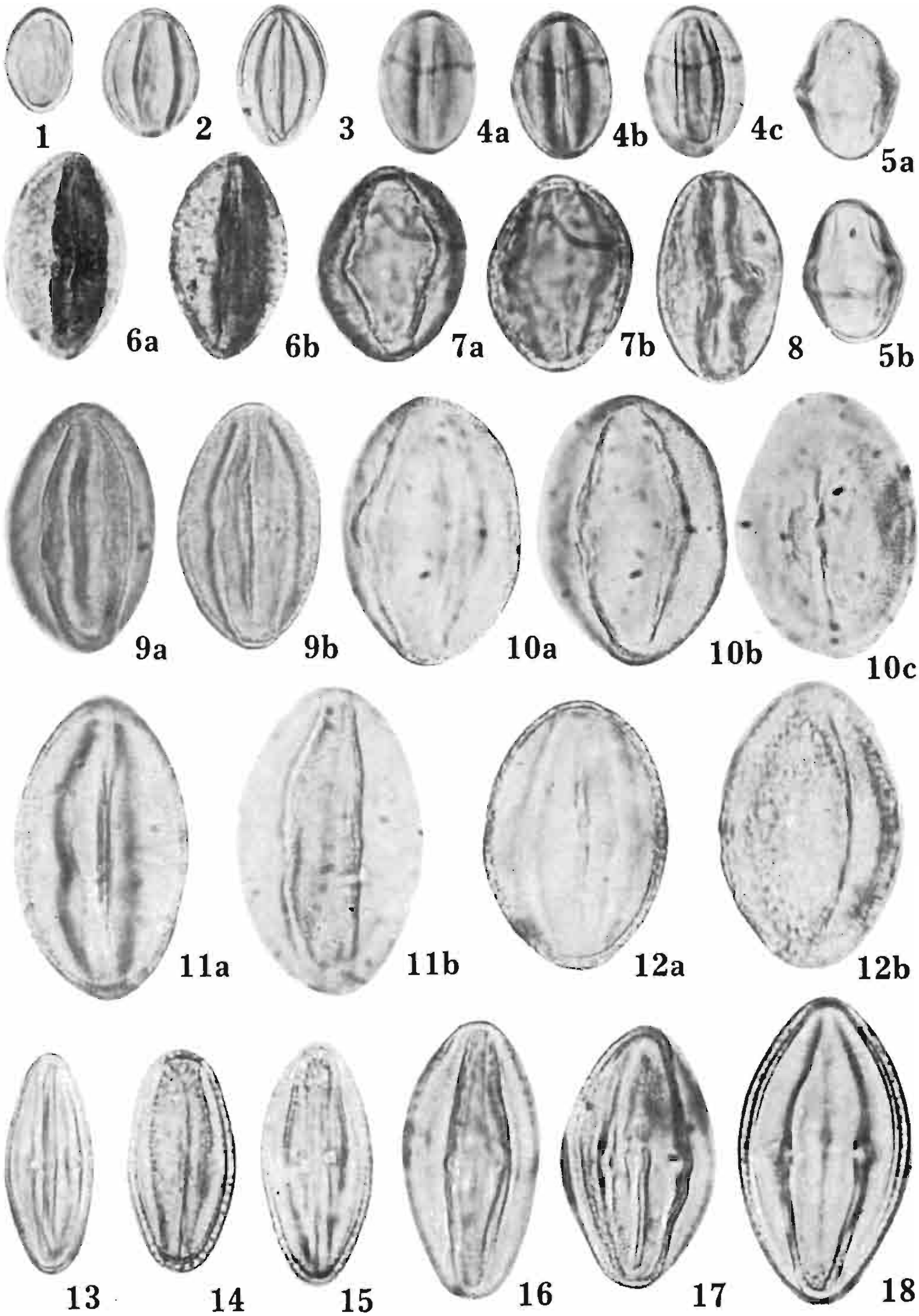

5b

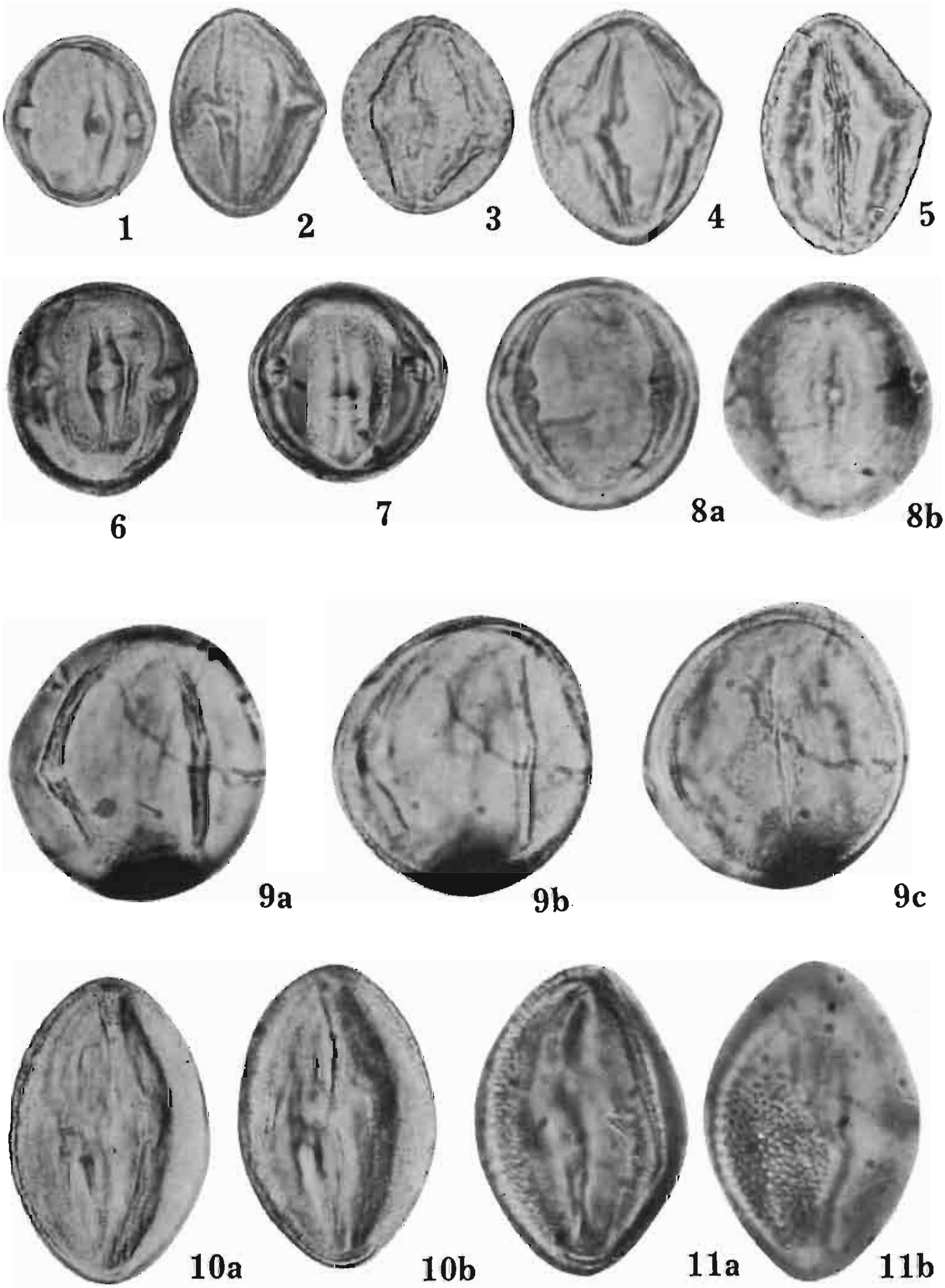

5c

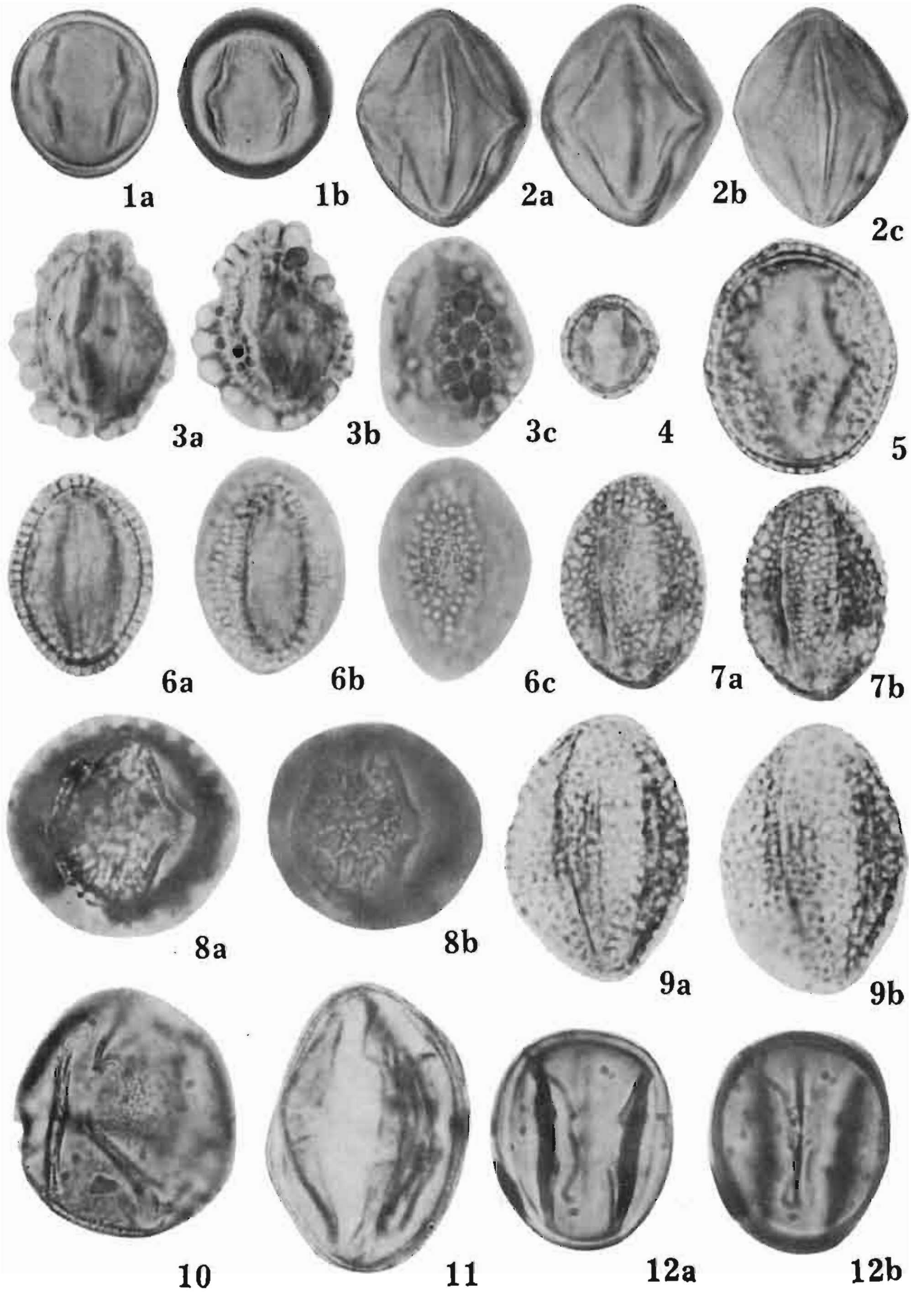

6a

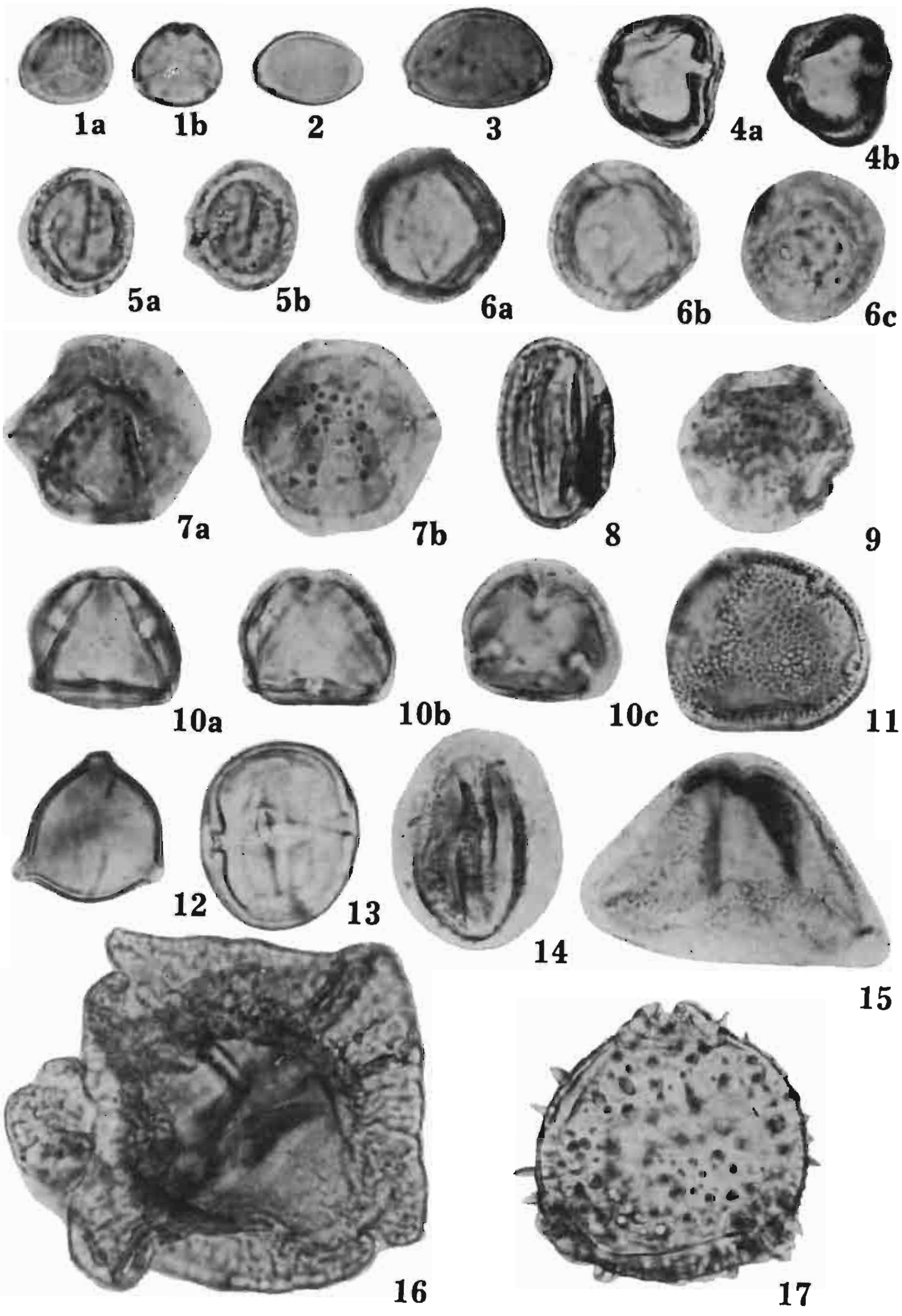

6b

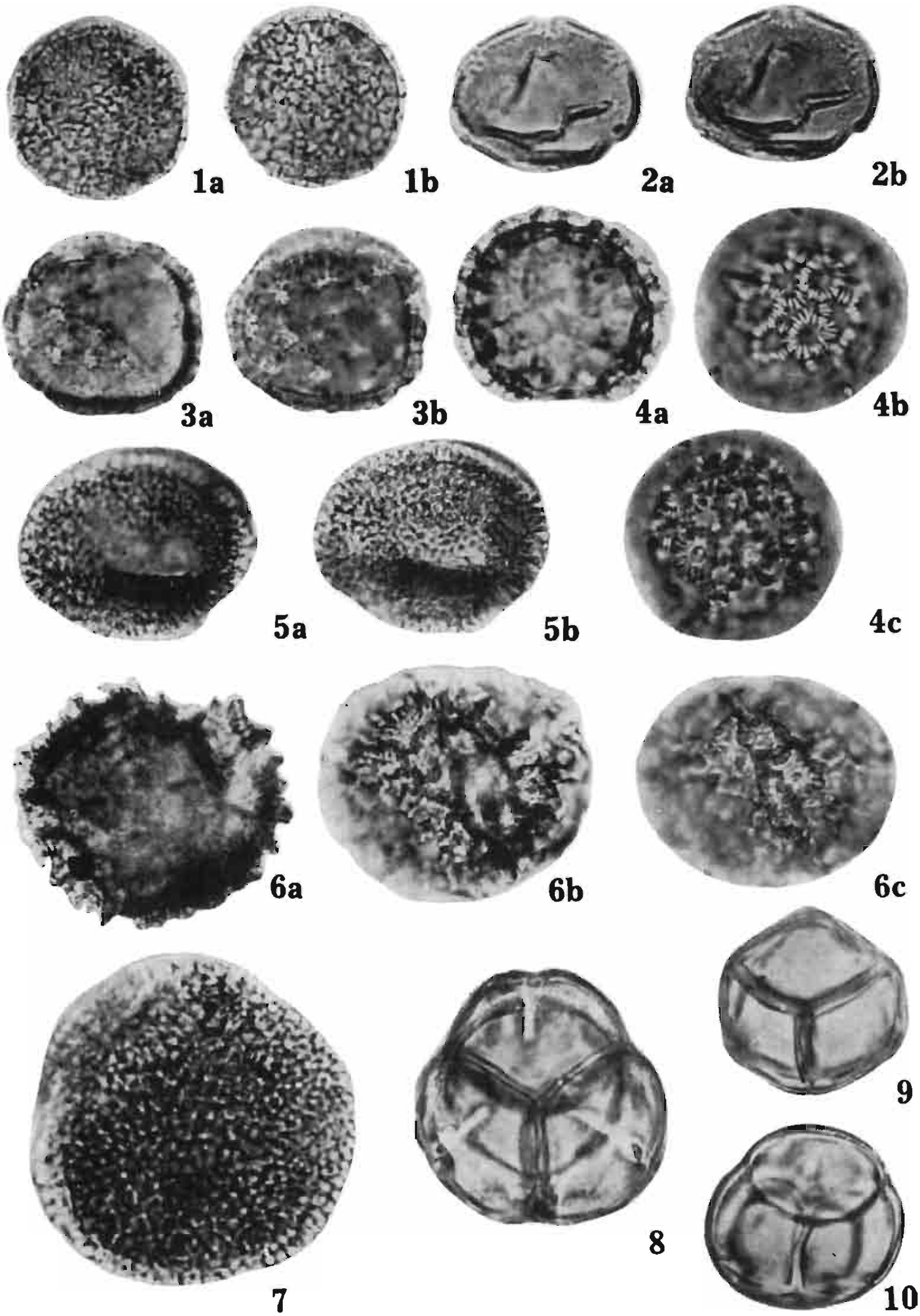

7


1
2
3
4a
4b
4c
5a
6a
6b
7a
7b
8
5b
9a
9b
10a
10b
10c
11a
11b
12a
12b
13
14
15
16
17
18


1
2
3
4
5
6
7
8a
8b
9a
9b
9c
10a
10b
11a
11b


1a
1b
2a
2b
2c
3a
3b
3c
4
5
6a
6b
6c
7a
7b
8a
8b
9a
9b
10
11
12a
12b


1a
1b
2
3
4a
4b
5a
5b
6a
6b
6c
7a
7b
8
9
10a
10b
10c
11
12
13
14
15
16
17


1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
4c
6a
6b
6c
9
8
7
10

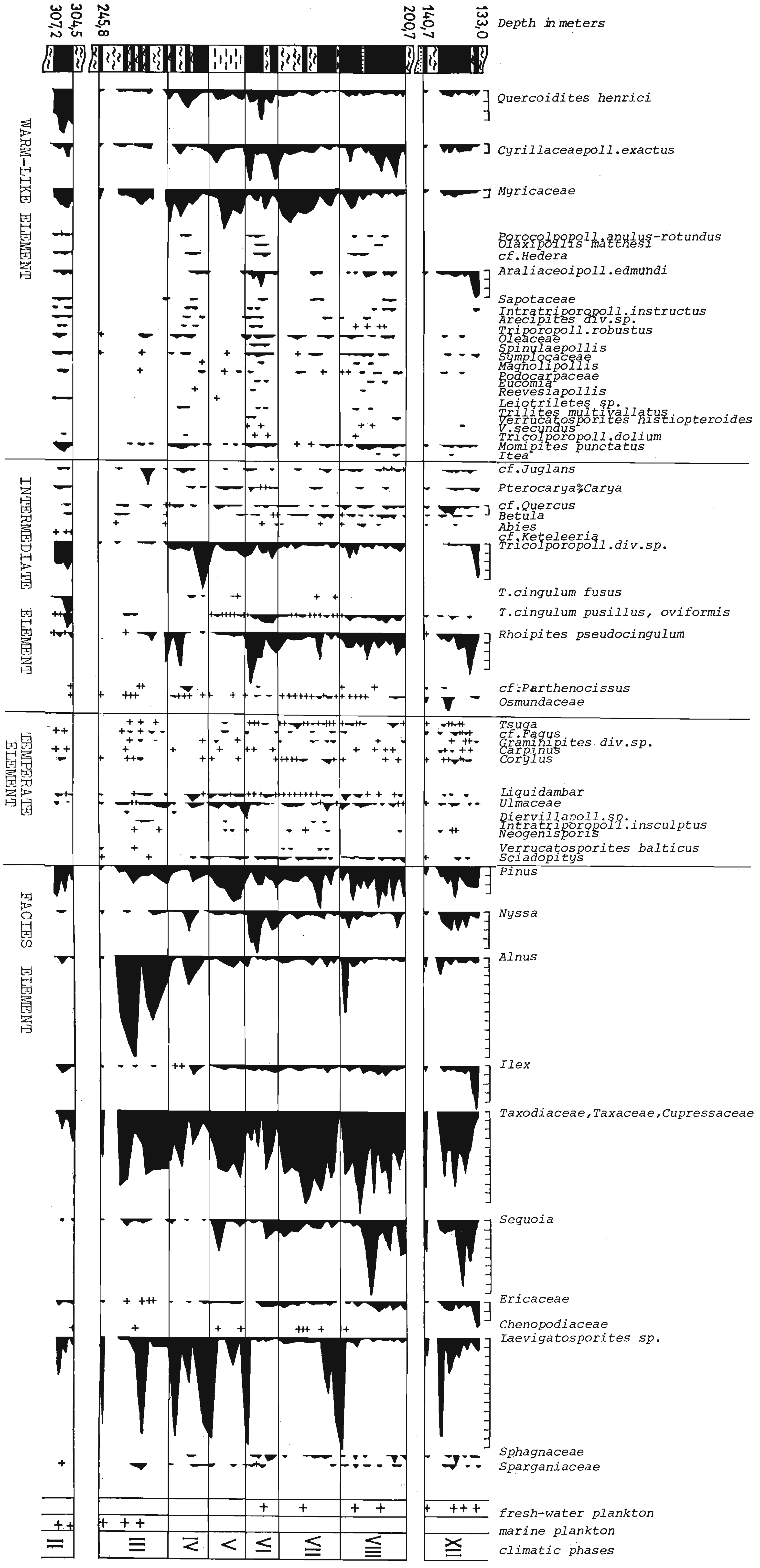


Fig. 3 — Pollen diagram of the profile Ustronie. Explanations to the all profiles: A — frequency of specimens: *1* very rare 0.2 %, *2* rare 0.2—1 %, *3* regulary 1.1—5 %, *4* frequent 5.1—20 %, *5* aboundant > 20%. B — signature system of sediments: *I* clay, *II* sand, *III* brown coal, *IV* silt, *V* mund.

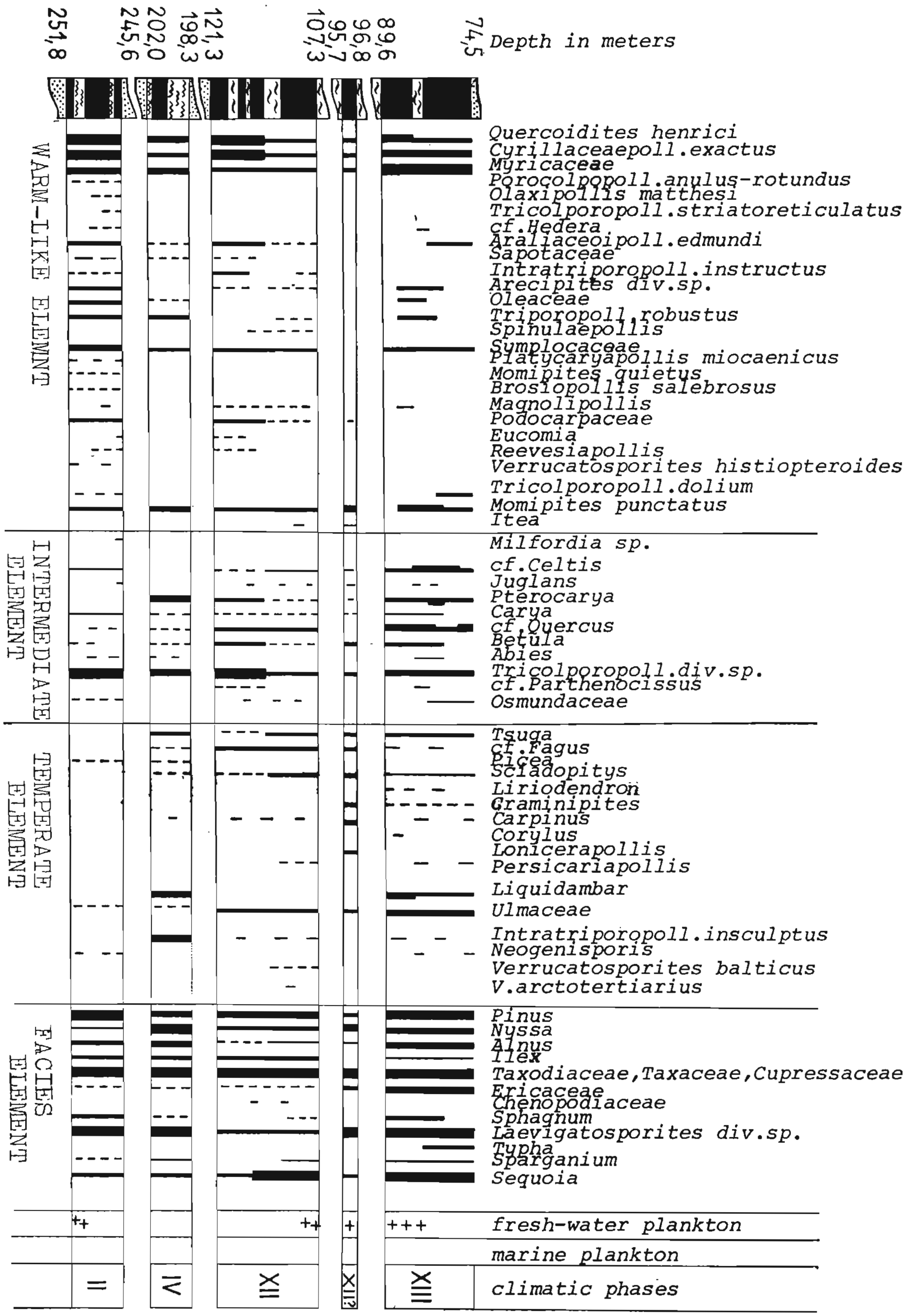


Fig. 4 — Pollen diagram of the profile Oczkowice (expl. see Text-fig. 3)

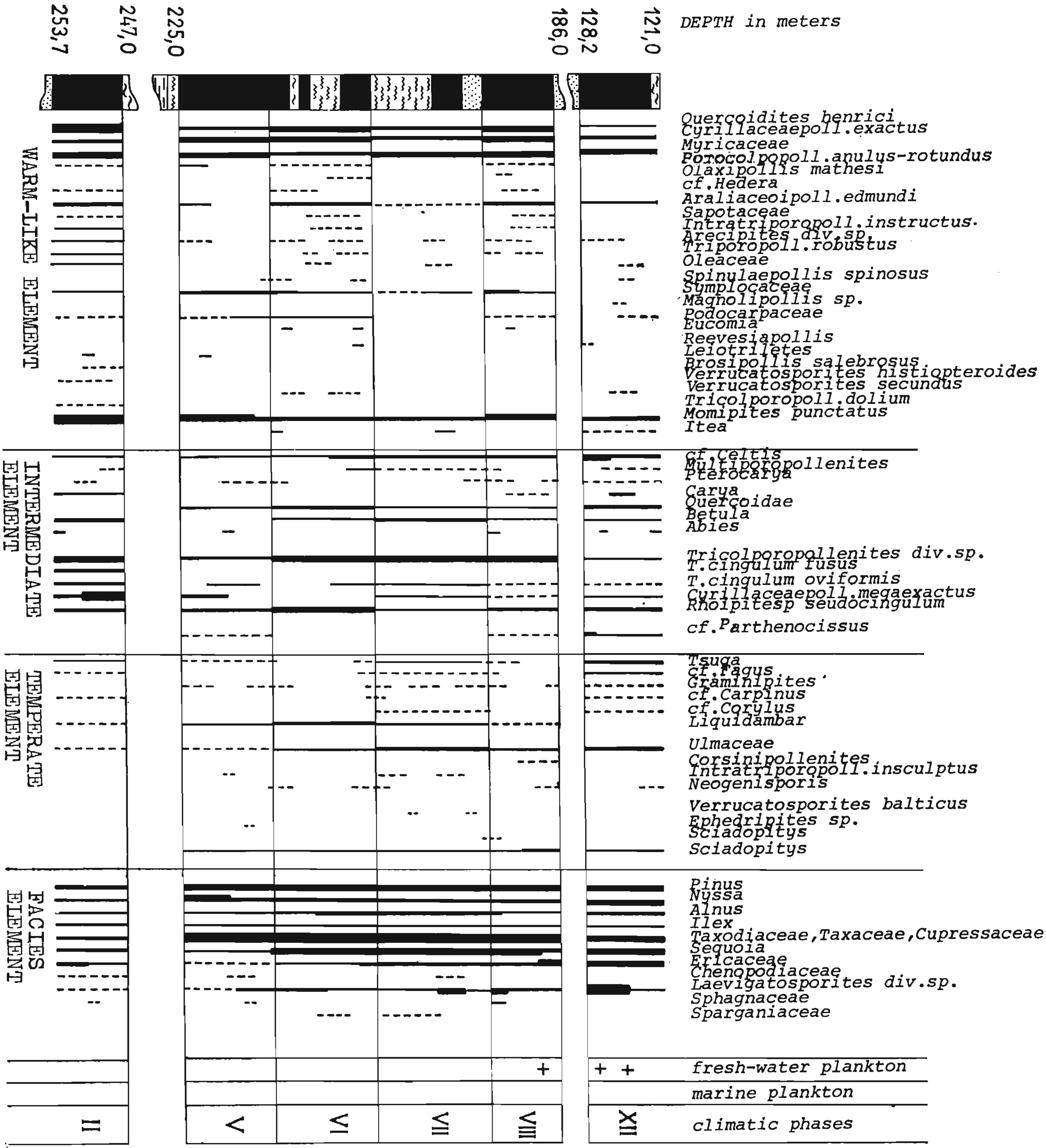


Fig. 5 — Pollen diagram of the profile Nowa Wieś (expl. see Text-fig. 3)

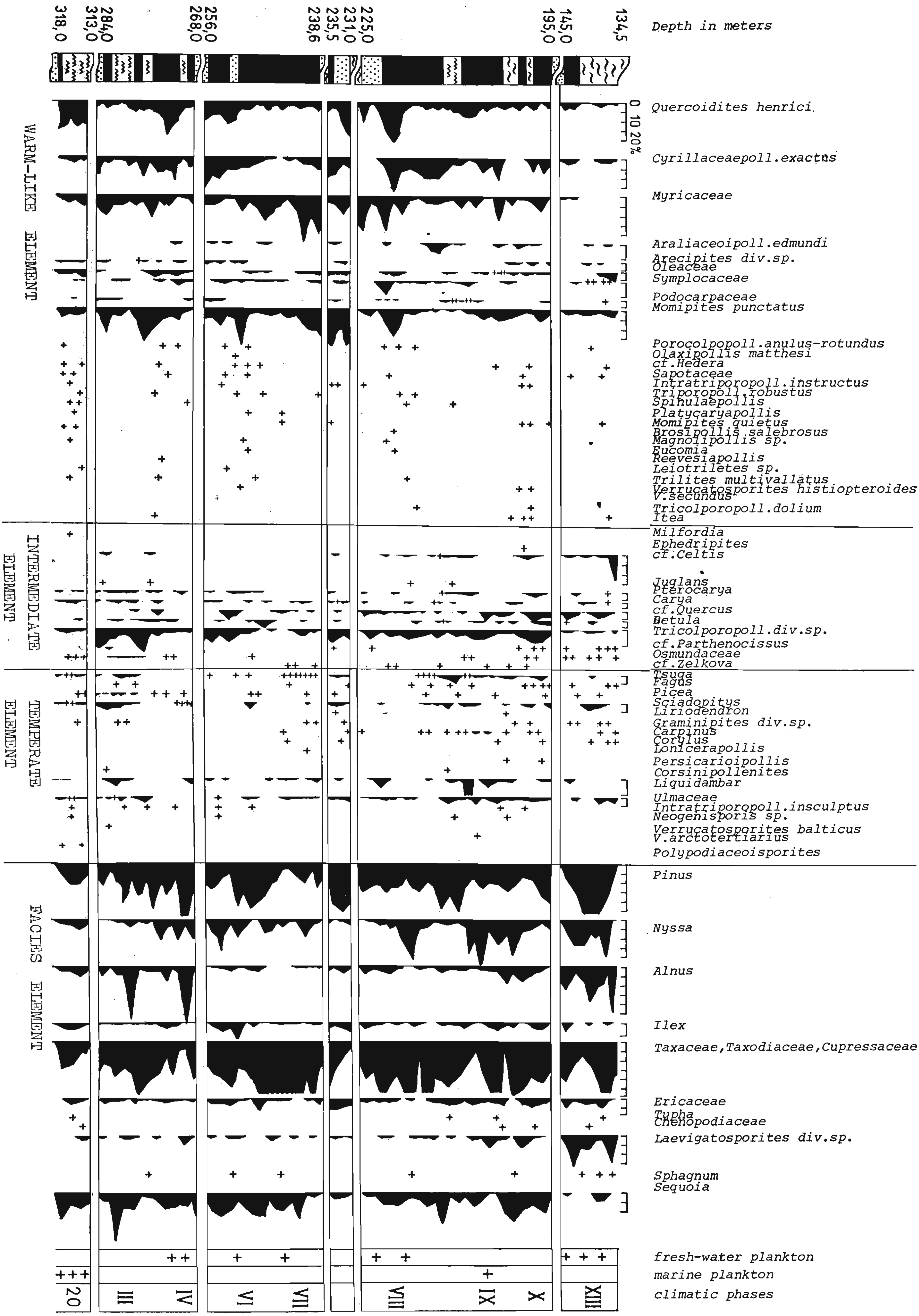


Fig. 6. — Pollen diagram of the profile Gierlachowo (expl. see Text-fig. 3)

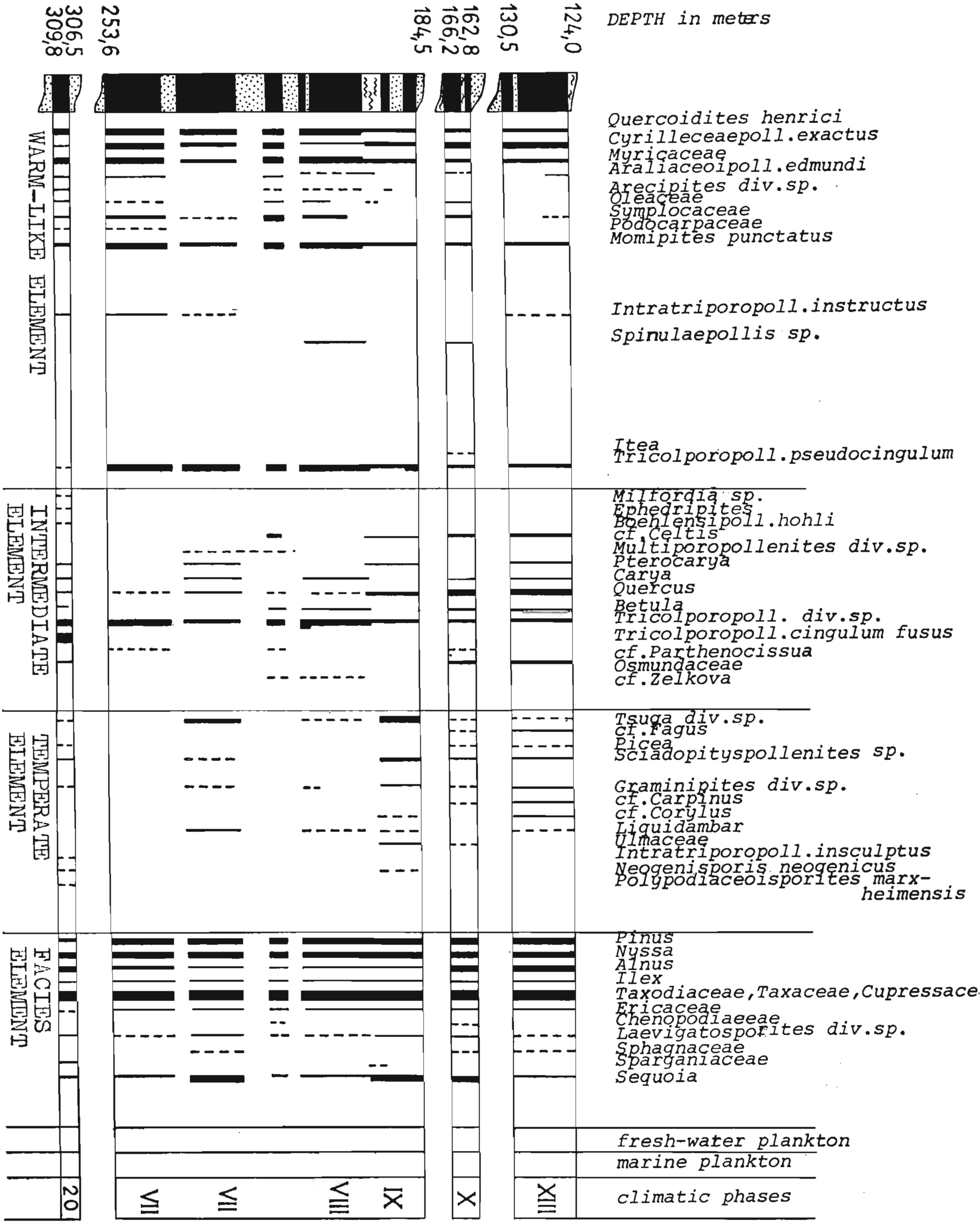


Fig. 7. — Pollen diagram of the profile Gołębin Stary (expl. Text-fig. 3)

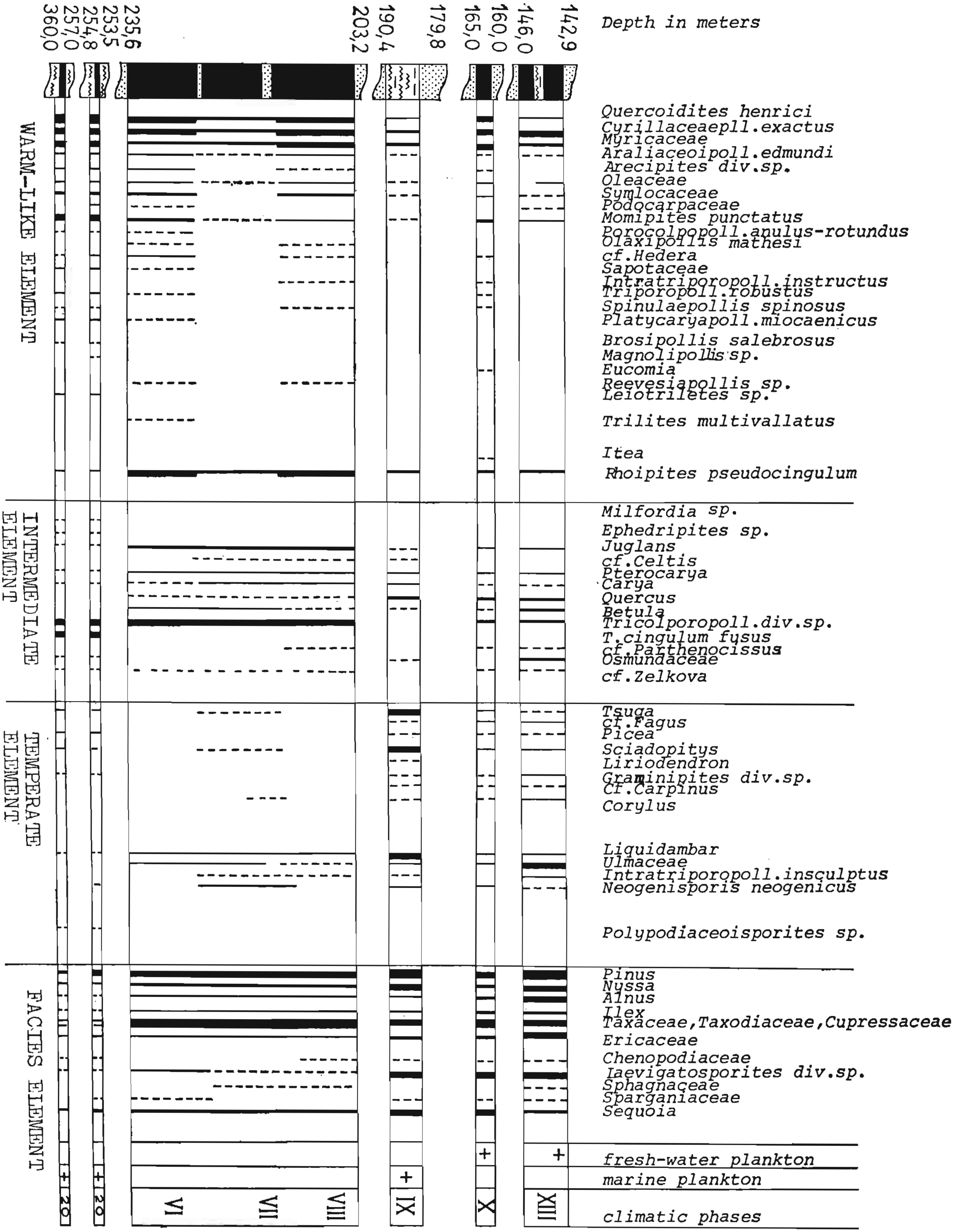


Fig. 8. — Pollen diagram of the profile Krosinko (expl. see Text-fig. 3)

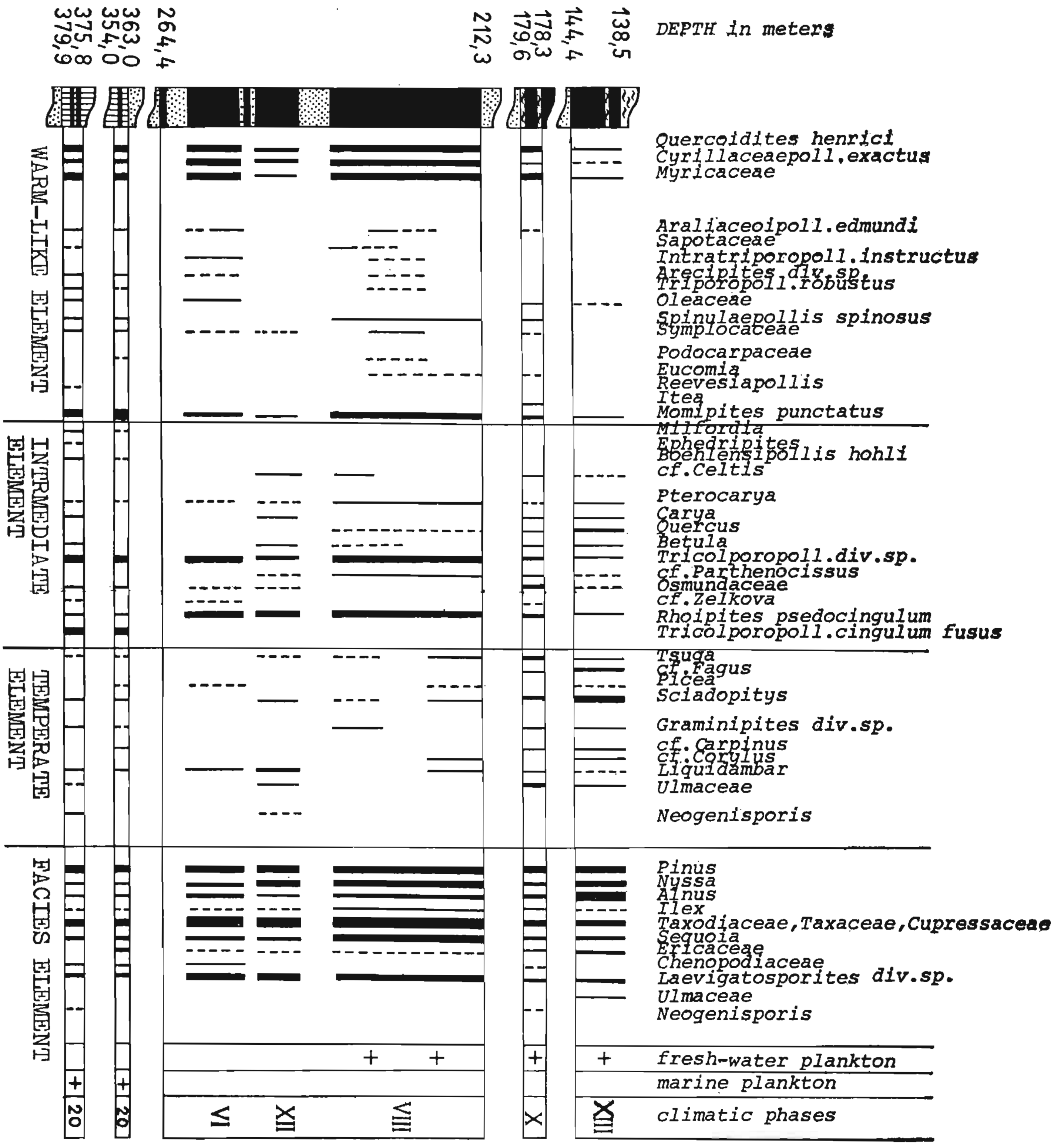


Fig. 9. — Pollen diagram of the profile Mosina (expl. see Text-fig. 3)

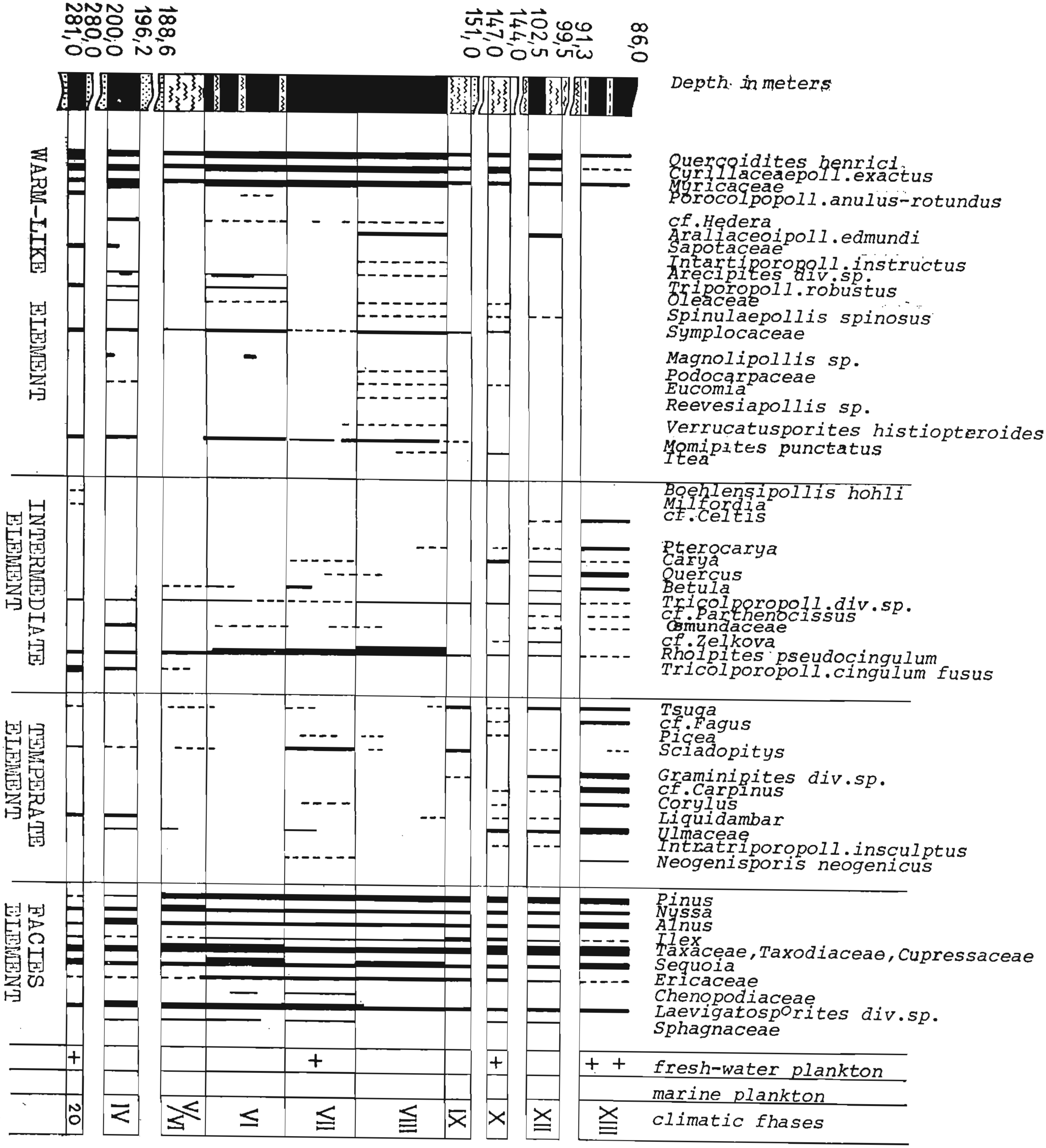


Fig. 10. — Pollen diagram of the profile Ślepuchowo (expl. see Text-fig. 3)