LEON STUCHLIK

POLLEN ANALYSIS OF THE MIOCENE DEPOSITS AT RYPIN (N. W. OF WARSAW)

Analiza pyłkowa osadu mioceńskiego z Rypina

CONTENTS

1. INTRODUCTION

The Tertiary on the Polish Lowland has been for a long time the subject of research. As far as palynology is concerned the Neogene especially has been relatively well examined thanks to many works carried out mainly by palynologists from the Warsaw Geological Institute. Up to now the papers have had a chiefly stratigraphic character and the elaborated profiles comprised as a rule only brown coal deposits some few to a dozen or so metres thick, whereas the mediate strata, clayey or sandy, have not been subjected to palynological investigation. Our profile covers a 49.70 m thickness of the deposit and the chief aim of this paper, besides the determination of the younger Tertiary stratigraphy in the Rypin region, is an analysis of the flora and vegetation of that period from the standpoint of its ecological requirements.

Samples for palynological examinations derive from a boring made in 1949 by the Warsaw Geological Institute. The macroscopic remains were elaborated by Dr M. Łańcucka-Środoniowa (1957) and at the suggestion of Professors W. Szafer and A. Środoń the present author began in 1958 the palynological elaboration of these materials. Of the three profiles one, namely profile No II, was chosen for palynological investigation as it lent itself best to this purpose, being the longest profile and containing the smallest quantity of sandy sediment.

All documentary materials, i.e. microscopic slides of individual samples, photographs of all determined sporomorphs, and quantitative tables and records drawn up for each sample are to be found in the archives of the Paleobotanical Laboratory of the Botanical Institute of the Polish Academy of Sciences in Kraków.

2. DESCRIPTION OF THE GEOLOGICAL PROFILE

The geological character of the Rypin II profile is cited after Dr Łańcucka-Środoniowa (1957) and supplementary additions are given from the Register of the Bore-hole Rypin II.

Depth in metres	Quantity of examined samples	Description of the material
0·00 — 0·30		rubble soil
0·30 — 14·00		boulder-clay alternating with variously grained sand (Quaternary)
14·00 — 14·80	3	strongly mineralized peat with rich admixture of clayey particles (clayey brown coal)
14·80 — 15·60	1	dustlike sand, grey, with mica
15·60 — 16·70	1	black, coaly loam with intervening dustlike strata and dustlike sand
16·70 — 17·40	2	dustlike sand, grey, with intervening dustlike strata
17·40 — 17·90	2	dustlike loam with rich organic remains and intervening dustlike strata and dustlike sand
17·90 — 20·00	4	dustlike loam, grey, with dustlike horizons and admixture of colloidal particles

Depth in metres	Quantity of examined samples	Description of the material
20·00 — 20·70	1	black, compact loam
20·70 — 21·10	2	loam with copious lignites
21·10 — 24·20	4	compact loam, black with a greasy lustre
24·20 — 24·50	2	peaty loam strongly mineralized
24·50 — 25·00	1	compact, black loam
25·00 — 26·50	3	compact loam, dark grey, with dustlike intervening strata
26·50 — 26·80	1	dustlike product with colloidal remains, compact, grey
26·80 — 27·90	2	compact loam, black, coaly
27·90 — 28·60	4	dustlike sand, dull grey, profusely water-bearing
28·60 — 29·00	1	dustlike sand with lignites
29·00 — 30·50	4	dustlike loam, dark grey, with intervening coaly and dustlike strata
30·50 — 34·10	7	compact loam, grey, with small dustlike strata
34·10 — 34·50	1	dustlike loam
34·50 — 40·20	4	grey loam with intervening dustlike strata
40·20 — 41·00	3	dustlike product with admixture of loamy particles
41·00 — 41·90	2	compact loam, schistous, grey
41·90 — 44·10	4	dustlike and fine-grained sand
44·10 — 44·20	1	dustlike sand with copious plant detritus
44·20 — 45·10	3	dustlike loam and dustlike sand with intervening coaly strata
45·10 — 46·60	3	dustlike loam, grey and light grey, with intervening dustlike strata
46·60 — 48·20	3	dustlike clay, grey, with gravel up to 1 cm diameter
48·20 — 48·60	2	quartz dust
48·60 — 49·50	1	quartz dust and quartz sand, dustlike, water-bearing
49·50 — 50·70	2	dustlike sand and quartz dust
50·70 — 51·00	1	sand with copious plant detritus
51·00 — 52·40	3	dustlike and fine-grained sand with strongly mineralized peaty (lignite) strata
52·40 — 53·50	2	fine sand, dustlike with copious plant detritus
53·50 — 59·60	7	dustlike and fine-grained sand
59·60 — 60·60	3	dustlike product, dark grey, with intervening loamy strata and abundant mica
60·60 — 63·80	6	quartz sand, dustlike, with small fragments of mica, light grey, water-bearing
63·80 — 64·00	1	quartz dust, grey, with mica
64·00 — 64·50	5	peaty loam with abundant, strongly mineralized plant remains

3. REMARKS CONCERNING METHOD

The samples for palynological examinations were drawn from the boring at various intervals, from 5 cm to 1 m. Since all samples contained much mineral material they were prepared for analysis by the flotation method of Knox (1942). As heavy medium a mixture of acetone with bromoform of specific gravity from 1·85—2·00 was used. In the event of a large content of organic material after flotation it was subjected in a water bath, before acetolysis, to the action of 30% hydrogen peroxide at a raised temperature. The material was then treated with acetolysis of Erdtman (1943, 1960a). All microscopic slides were made up in pure glycerol as sporomorphs placed in this way are easily actuated by gentle tapping with a needle on the cover glass. To protect the slides against destruction the cover glasses were wrapped in vinyl polyacetate before the evaluation of the pollen spectra. The granulated vinyl polyacetate was dissolved in a mixture of ethyl acetate and benzene in the ratio of 1 : 1 (Reymanówna and Stuchlik, 1960). When preparing this seal care was taken not to make it too thick, in order to avoid the formation of bubbles in the polymer during the wrapping of the cover glasses. Slides fixed in vinyl polyacetate can be preserved for a long time without fear of their drying and, at the same time, it is possible to actuate the sporomorphs at will. Slides preserved in such a way permit repeated verification of the designations of the individual sporomorphs when their coordinates on the microscope (cross-stage) are known.

The frequency was, on the whole, satisfactory with all samples except a few that did not contain any sporomorphs. On the average at least 300 pollen grains and spores were counted from each sample. In samples of exceptionally good frequency up to 500 and even 1.000 sporomorphs were counted whereas in those where the frequency was very low only up to 100 or even smaller quantities of pollen grains and spores were found. Photographs of all determined sporomorphs were made. Frequently one object was photographed in various optical sections. Sporomorphs that were distinguished by a great morphological variability were photographed several times from various profile horizons. All distinguished taxonomic units (species, genera, and families) were assembled in a table comprising absolute quantities of particular sporomorphs in particular samples (Tab. 1, 2) *.

4. REMARKS ON THE NOMENCLATURE AND MORPHOLOGY OF SPOROMORPHS

The nomenclature of sporomorphs is not as yet uniform in the palynology of the Tertiary and the older periods. Some authors, when describing sporomorphs, take as a basis exclusively artificial morphographic

---

* Tab. 1, 2 are to be found on the back cover.

systems and give no comparison with any existing or fossil plant. Such views are represented by, among others, Erdtman (1947), Potonié (1955), and Krutzsch (1954, 1955). Krutzsch (1954) maintains that the use of purely botanical denominations in the palynology of the Tertiary and the older periods is completely useless for stratigraphy. In a later paper on brown coal from Geiseltal (Krutzsch, 1959) he acknowledged that, in palynology as in micropalaeontology, stratigraphy should be based on leading forms and that even whole groups of leading forms should be distinguished for the individual periods. Only such a treatment of sporomorphs can, in this author's opinion, be useful in geological practice for the determination of the stratigraphy of each particular period. A completely opposite view is held by some Soviet scientists who associate all Tertiary and even older sporomorphs with species of plants existing today. Of an intermediary opinion are Potonié, Thomson, and Thiergart (1950); they consider that an artificial system should be used which is, however, similar to the natural one. Potonié (1956) even considers that in the palynology of the younger Tertiary the use of artificial sporomorph denominations is not always essential. Thomson and Pflug (1953) also originated an artificial system that is in a certain sense connected with the natural one. Still another view of the nomenclature of the Tertiary sporomorphs is held by the American scientist Traverse (1955). He is of the opinion that, if it is possible to class a sporomorph among any genus in the botanical sense, the various forms of that sporomorph should be characterized as species belonging to that genus. When, on the other hand, its appurtenance to a family only is known, then the forms of the given sporomorph should be characterized as genera belonging to that family.

On the whole, however, palynologists working with botanical departments use rather the natural system for the classification of sporomorphs, citing the artificial denominations for guidance only, whereas palynologists working for geological purposes lay the main stress on the classification of sporomorphs according to the artificial systems.

In the present paper an attempt has been made to designate the distinguished sporomorphs botanically as to their species, genus, or at least their family on the basis of plants existing today. In each case, however, an effort has been made to give the appurtenance of the given sporomorph to the artificial system of Thomson and Pflug (1953) and others. In the author's opinion to dispense entirely with the artificial morphological systems would be premature as the obtained results would then be incomparable with other palynological papers. Where it was impossible to number the given sporomorph among the system of Thomson and Pflug and no analogues were found in other systems, only the nomination of the genus or family has been given.

If such an appurtenance was uncertain, the denomination of the species, genus, or family has been marked by an additional comment: „type" or „cf".

The abbreviation „type" has been used where the described sporomorph showed a type of structure similar to several species or genera among the comparative material.

The abbreviation „cf." has been used in cases where the appurtenance of the given sporomorph to a higher systematic unit (genus, family) was certain and, at the same time, most resembled pollen grains or spores of some of the lower ranked units (species, genus) in the comparative material. In the case of *Osmunda* cf. *bromeliifolia,* for instance, the appurtenance of the spore to the genus *Osmunda* was certain and resembled most the spores of the species *bromeliifolia.* This abbreviation has also been used in cases when macroscopic remains belonging exclusively to one species were known from the same samples where the palynological material of the given genus appeared abundantly and was uniform from the morphological point of view. As an example we may quote here *Glyptostrobus* cf. *europaeus,* whose macroscopic remains were determined from the same levels where pollen of that genus was found in abundance.

In the determination of sporomorphs the comparative method has been used; here numerous atlases of sporomorphs, original publications, and comparative collections of pollen slides of recent plants have been consulted. These collections, which are to be found at the Botanical Institute of the Polish Academy of Sciences in Kraków, amount to more than 6.000 microscopic slides, at least half of which are exotic plants.

Altogether 216 sporomorphs have been described — 43 as to species or approximate species, 95 as to genus, 29 to families, and finally 49 sporomorphs of unknown botanical appurtenance have been numbered among various units of the artificial morphological system *.

In the morphological descriptions of sporomorphs, the terminology quoted by Dyakowska (1959), based mainly on Erdtman (1952) and Iversen and Troels-Smith (1950) has been used.

5. SYSTEMATICAL REVIEW OF SPOROMORPHS **

BRYOPHYTA

MUSCI

Sphagnaceae

Genus *Sphagnum*

Spores considered as belonging to this genus are morphologically greatly differentiated. It is possible to distinguish among them five types

---

* The taxonomic units (species, genera or families) recognized by the author are printed in bold types.

** Systematical order after Wettstein (1935); *Coniferae* after Florin (1931).

corresponding, perhaps, to five different species. Three of them are described in literature as different organ species.

Stereisporites megastereoides (Pf.) Th. & Pf.

Pl. I, Figs. 4, 5

Spores trilete; equatorial contour rounded-triangular, diameter up to 50 μ. Tetrad mark broad; laesura arms extend almost to the equator of the spore. Exosporium more than 3—4 μ thick.

This type of spore is somewhat rarely encountered in the European Tertiary. It is reported by, among others, Neu-Stolz (1958) from Rhineland brown coals and compared with the present-day species *Sphagnum acutifolium* (Hedw.) Nees.

Stereisporites psilatus (Ross) Th. & Pf.

Pl. I, Fig. 6

Spores trilete, somewhat smaller than the foregoing; equatorial contour more triangular. Exosporium somewhat thinner (3 μ); laesura arms do not reach the equator of the spore. Spore surface psilate.

Similar spores are fairly often encountered in the European Tertiary. They have been described from Poland by Doktorowicz-Hrebnicka (1954) as *Stereisporites stereoides* R. Pot. & Ven. Neu-Stolz (l. c.) compares spores of such an appearance with those of *Sphagnum cuspidatum* Schimp.

Stereisporites stereoides (R. Pot. & Ven) Th. & Pf.

Pl. I, Fig. 7

Spores trilete, not exceeding 30 μ in size; equatorial contour triangular. Tetrad mark very narrow, undulated; laesura arms reach almost to the equator of the spore. Exosporium less than 2 μ thick, somewhat swollen on the apices of the triangle.

This type of spore occurs regularly in the Tertiary sediments of central Europe. In our profile these spores are, besides the previous form, the most frequently encountered. Neu-Stolz (l. c.) compares this type of spores with the present-day species of *Sphagnum cymbifolium* Ehrh.

Sphagnum sp. 1

Stereisporites sp. 1

Pl. I, Figs. 1, 2

Trilete spores having a rounded-triangular equatorial contour with rounded apices have been included here. Their sizes attain up to 37 μ. Tetrad mark fairly narrow and undulate, almost reaching the equator.

Thickness of exosporium attains 3—4 μ, and on the apices of the triangle 5 μ. These spores show intermediate features between *Stereisporites stereoides* (the undulated tetrad mark reaches as far as to the equator) and *Stereisporites megastereoides* (the same thickness of the exosporium and similar size of the spore).

***Sphagnum* sp. 2**

Stereisporites sp. 2

Pl. I, Fig. 3

These spores differ quite considerably from those previously described. The equatorial contour has the form of a quadrilateral rounded on its apices. In size the spores attain up to 60 μ. Laesura arms, furcate on two ends, reach barely halfway between the pole and the equator of the spore and have a somewhat undulated course. Exosporium fairly thick (3—4 μ), thickening still more on the apices. Surface of the spore psilate.

A similar form has been described by E. Nagy (1958) from the Hungarian Pliocene as *Sphagnum* sp. *forma major*. At Rypin it was found in one sample only (No 62).

The spores of *Sphagnum* in the pollen diagram are delineated as a summary curve of all the above-described forms. They appear in the whole profile in insignificant quantities, reaching their maximum 4·64% in the middle part.

HEPATICAE

Anthocerotaceae

Genus *Anthoceros*

***Rudolphisporis rudolphi* Krutzsch ssp. *major* n. spm.**

Pl. I, Figs. 8—10

Spores trilete; equatorial contour rounded-triangular with the apices of the triangle broadly rounded. Size ranges from 60—65 μ. Tetrad mark in a slight hollow; laesura arms reach the equator. With some specimens the mark ,,Y'' in the polar area on the proximal side is wide open, forming a triangle with very pointed and elongated apices. Exosporium without spines 2—3 μ thick. On the surface of the spore there are numerous spines, whose length attains up to 7 μ. They have broad bases, are pointed or flattened and furcate at the ends. Our forms differ from the typical ones described by Krutzsch (1963) only as to their size, which with the typical specimens amounts to 45—55 μ.

The first to find fossil spores of *Anthoceros* was Rudolph (1935) who described them as *Anthoceros* cf. *punctatus* L. Hitherto they have been known only from Czechoslovakia (Pacltová 1960) and from the territory of East Germany; however, they belong to another organ species closely related to ours (Krutzsch 1963).

In the profile of Rypin II the above-described spores occur only sporadically in the top part.

PSILOTINAE ?

Psilotaceae ?

cf. Genus *Psilotum*

Pl. I, Figs. 11, 12

Spores bilateral, monolete, ovate or kidney-shaped, ranging in size from 38—55 μ. Exosporium fairly thick, characteristically dense, and regularly foveolate.

Similar forms have been described by Krutzsch (1959) from the Geiseltal Eocene as *Microfoveolatisporis pseudodentatus* Krutzsch. In the opinion of this author they may correspond to the spores of the genus *Schizaea.* Simoncsics (1959) has described similar forms from the Hungarian Miocene as ***Rugulatosporites** salgótarjánensis* nsp. Kedves (1961a, b) considers similar forms also as belonging to the *Psilotaceae.* Our spores are, however, somewhat smaller than those described above. They occur only sporadically in two samples of the profile.

LYCOPODINAE

Lycopodiaceae

Genus *Lycopodium*

Among the spores ranked with this family the following species may be distinguished:

Lycopodium annotinum L. type

Pl. II, Figs. 1, 2, 7, 8

Spores trilete; equatorial contour triangular, apices slightly rounded; laesura arms almost reach the equator of the spore. Exosporium thin with a very distinct reticulum on its surface; lumina diameter from 6—15 μ. Height of the muri about 4 μ. Such a reticulum is to be found on the distal side of the spore only, the proximal one being psilate or of a very fine, indistinct sculpture.

Spores of this type were described for the first time by Rudolph (1935) as *Lycopodium „Annotinum"* — type Rudolph from the younger Tertiary of Bohemia but the form shown in the table (Rudolph 1935, Pl. V, Fig. 24) is smaller than ours and has a finer reticulum. Our spores are somewhat similar to the form cf. *Lycopodium annotinum* reported by Reissinger (1950), (Pl. 18, Fig. 1) and they probably belong to two organ species described by Krutzsch (1963) as *Retitriletes frankfurtensis* Krutzsch, corresponding possibly to the species *Lycopodium obscurum* L. (Pl. II, Figs. 1, 2) and *Retitriletes annotinoides* Krutzsch, which probably accords with the species *Lycopodium annotinum* L. (Pl. II, Figs. 7, 8) .From Poland spores resembling *Lycopodium annotinum* have been reported from, among other regions, the neighbourhood of Gliwice (Macko 1957 and Oszast 1960).

In the profile Rypin II these spores are very rarely encountered.

Lycopodium cernuum L. type

Pl. II, Fig. 3

Spores trilete; equatorial contour rounded-triangular with convex sides and broadly rounded apices. Size varies between 35—40 μ. Exosporium on the apices of the triangle thin and only slightly exceeding 1 μ; on the side walls, however, it is considerably thickened and attains up to 5 μ. Laesura arms do not reach the equator of the spore but only to 3/4 of the radius between the pole and the equator and are situated as if in a hollow. Sculpture on distal side well developed, consisting of an irregular reticulum with thick, hamate muri and small irregular lumina. On the proximal side the sculpture elements are indistinct.

Spores of this type have been described by Thiergart (1940) as *Zonales sporites* R. Pot. from the Oligocene at Ellenhausen. Krutzsch (1959) includes these forms in another combination as *Camarozonosporites (Camarozonosporites) heskemensis* (Pflanzl) n. comb. They appear in the Eocene brown coal at Geiseltal. From Poland similar forms, though not identical with ours, have been characterized from the brown coal at Rogóżno by Doktorowicz-Hrebnicka (1961) as *Lycopodium forma* III *priva.*

In our profile these spores occur only at the very bottom.

Lycopodium clavatum L. type

Pl. II, Fig. 6

Spores trilete; equatorial contour rounded-triangular of a diameter up to 35—40 μ. Laesura arms reach to the equator of the spore. On the distal side a distinct reticulum with lumina not exceeding 5 μ. On the proximal side the reticulum reaches only to 1/4 of the spore from the edge; it is less regular and breaks off rather sharply in the direction of the pole. Height of the muri barely reaches 3 μ.

Similar forms were described for the first time by Rudolph (1935) as *Lycopodium „Clavatum"* — type. Krutzsch (1963) includes similar spores in a provisional organ subspecies *Retitriletes (Clavatisporis).*

In our profile these spores occur sporadically in various parts, forming a continuous curve at the bottom only in a not very long sector.

Lycopodium inundatum L. type

P. II, Figs. 9—11

Spores trilete, large; size 45—55 μ. Equatorial contour triangular with widely rounded apices. Laesura arms do not reach the equator of the spore but only to 2/3 of the radius and lie as if in a hollow. Exosporium thick with a very thick but not distinct sculpture on the surface. Sculpture elements consist of irregular, thick, hamate, and undulated muri forming indistinct and narrow lumina. On the proximal side the sculpture is granulate and radiate.

Similar forms were described for the first time by Rudolph (1935) as *Lycopodium „inundatum"* and by R. Potonié, Thomson and Thiergart (1950) as *Lycopodium inundatoidal* type. Krutzsch (1963) includes this type of spores in a separate subspecies *Camarozonosporites (Inundatisporis)* distinguishing a number of organ species among which, however, it would not be possible to number our forms, the material being too scanty.

From Poland *Lycopodium inundatum* type has been reported, among others, by Doktorowicz-Hrebnicka (1960).

Lycopodium sp. 1

Pl. II, Figs. 4, 5

Spores trilete, 35—50 μ in size; equatorial contour rounded-triangular, laesura arms reach to $^2/_3$ of the radius between the equator and the pole of the spore. On the distal surface a distinct, hamulate sculpture passing on to the proximal side, though insignificantly and at the margin only.

These spores resemble slightly those described by Krutzsch (1959) as *Camarozonosporites (Camarozonosporites) decorus* (Wolf) n. comb. known from numerous localities of Germany from the Oligo-Miocene till the Pliocene (Krutzsch 1963). In our profile they were found only sporadically.

Lycopodium sp. 2

Pl. II, Fig. 9

Spore trilete, somewhat similar to those previously described, but differing from them in sculpture on the proximal side where the characteristics for *Lycopodium inundatum* granules are lacking but the surface is rugate with radiate elements. Exosporium in the middle of the side walls not thickened. The shape of this spore seen from above is rounded-triangular, 50 μ in diameter.

This form corresponds to the *Camarozonosporites (Hamulatisporis) helenensis* n. fsp. described by Krutzsch (1963) and it may belong to the species *Lycopodium carolinianum* L. At Rypin II it occurs sporadically.

The spores shown in Pl. VI, Figs. 10, 11 also belong to the subspecies *Camarozonosporites (Hamulatisporis)* but their closer determination was not possible.

Lycopodium selago L. type

Pl. II, Figs. 12, 13

Spores trilete; equatorial contour triangular with apices somewhat truncate and sides strongly concave. On their surface they possess a distinctly faveolate sculpture. Faveolae 2—3 μ wide and uniformly spread on the whole surface of the distal side. On the proximal side the faveolae are to be found at the margin of the spore only. Size of spores about 30 μ. Laesura arms reach up to $^3/_4$ of the area between the pole and the equator of the spore.

This type of spore has been described by Krutzsch (1963) as *Selagosporis selagoides* n. fsp. In the profile of Rypin II it occurs only in two samples.

The spores of all species of *Lycopodium* have been drawn together in the pollen diagram.

Selaginellaceae

Lusatisporis **sp.**

Pl. VI, Figs. 1, 2

In sample 58 one spore was found that resembles in its structure the spores described by Hunger (1953) as *Lycopodium-sporites lusatensis* n. sp.; it probably belongs to the *Selaginellaceae* (cf. Sladkov 1951). Krutzsch (1963) numbers these spores among a separate organ genus *Lusatisporis*.

This is a spore of rounded equatorial contour about 45 μ in size. Walls about 3 μ thick and of a slightly foamy composition. The surface of the spore has a fine sculpture. Tetrad mark surrounded by roll-like thickenings; laesura arms reach almost the equator of the spore.

Equisetinae

Equisetaceae

Genus *Equisetum*

Pl. III, Fig. 1

Spores alete, round, about 45 μ in size, the thin and limp perisporium surrounding the spore not counted. Exine about 2 μ thick. The surface of the perisporium shows a very fine, granulate sculpture.

The *Equisetales* have already been reported in Tertiary sediments. In the profile Rypin II only two spores of *Equisetum* were found.

FILICINAE

Osmundaceae

The spores of *Osmundaceae* from our profile are fairly differentiated from the morphological point of view. Three types are to be distinguished among them, belonging to three different species or species groups.

Genus *Osmunda*

Osmunda cf. *bromeliifolia* Copel

Pl. III, Fig. 8

Spores trilete; equatorial contour round; size up to 50 μ. Tetrad mark very narrow; laesura arms do not reach the equator of the spore. Exosporium very thin with minute processes very densely distributed. Processes very short so that they are faintly seen on the margin. These spores are the most similar to the present-day species *Osmunda bromeliifolia*.

Up till now they have not been found in fossil state. In our profile they are very rare.

Osmunda claytoniana L. type

Pl. III, Figs. 2—6

Spores trilete; equatorial contour round; 45—55 μ in diameter. Laesura arms almost reach the equator of the spores. Exosporium comparatively thick with numerous loosely arranged processes 2—3 μ high and 1·5—4·5 μ broad with flatly truncate tops. Their distribution on the surface of the spore is irregular and loose.

Spores similar to ours have been described in the palynological literature under various organ denominations. *Osmunda claytoniana* type was found in Poland for the first time by Oszast (Szafer 1953); it has also been reported from Poland by Szafer (1954), Rogalska (1954, 1956), Macko (1957) and Oszast (1960).

Among our specimens ranked among this type more than once spores were encountered with considerably narrower processes reminiscent of spores encountered in the present-day species *Osmunda cinnamomea* L. (cf. Andersen, 1961). Owing, however, to the small quantities of these forms in our profile their more accurate designation was not possible.

Osmunda claytoniana type spores were fairly often encountered in various parts of our profile but always in small quantities only.

Osmunda regalis L. type

Pl. III, Fig. 7

Spores trilete; equatorial contour round; size up to 50 μ. Laesura arms reach the equator of the spore. On the surface of the exosporium very densely arranged processes barely 1—2 μ in height, irregular in shape and inter-coadunate.

These spores are similar though slightly smaller than those described by Krutzsch (1959) from the brown coal at Geiseltal under the name *Baculatisporites gemmatus* Krutzsch. Spores of *Osmunda regalis* were also found by Zagwijn (1960) in the Pliocene and the older Pleistocene of Holland. From the Tertiary of Poland they have hitherto not been reported. In our profile they occur rarely and only at the bottom.

Schizaeaceae

Spores belonging to this family are represented in our material by three different forms belonging to two genera.

Genus *Lygodium*

***Lygodium* sp. 1**

Pl. IV, Fig. 2

Sporites adriennis R. Pot. & Gell.

Divisisporites maximus (Pf.) Th. & Pf.

Spores trilete; equatorial contour triangular with broadly rounded apices; size up to 65 μ. Surface of exosporium psilate; laesura arms reach only up to $^2/_3$ of the radius on the proximal side furcating at the ends in a characteristic way. Exosporium not more than 2·5 μ thick.

These forms are regarded by Thomson and Pflug (1953) as an element characteristic for the middle Tertiary. From Poland similar spores have been described by Doktorowicz-Hrebnicka (1961) as *Lygodium* forma *illustris* (*Divisisporites maximus* Pf.). In our profile these spores occur only sporadically in the middle part.

***Lygodium* sp. 2**

Pl. III, Figs. 11, 12

Sporites solidus R. Pot.

Corrugatisporites solidus (R. Pot.) Th. & Pf.

Spores trilete; equatorial contour triangular with rounded apices; size varies about 45 μ. Exosporium more than 2 μ thick with a characteristic sculpture on its surface, composed of irregularly spaced verrucae of different sizes.

These forms are regarded as elements characteristic for the older Tertiary (Thomson and Pflug 1953). From Poland they are known from the Paleogene from Rogóżno (Doktorowicz-Hrebnicka 1961). Sculptured forms belonging to this genus may be encountered in our profile only in the bottom samples.

cf. Genus *Mohria*

Pl. III, Figs. 9, 10

Spores trilete; equatorial contour triangular with broadly rounded apices. Exosporium about 1 μ thick excluding muri. The whole surface of the spore is covered by irregular muri up to 4 μ broad, among which are to be found considerably narrower canaliculi. The height of the muri ranges from 1—3 μ. Besides the muri faveolae are sometimes visible (Fig. 12 Pl. III.). The most commonly encountered size of these spores amounts to 45 μ. Laesura arms do not reach the equator but only up to $^3/_4$ of the radius between the pole and the equator of the spore.

The exterior of our forms most resembles that described by Krutzsch (1959) as *Cicatricosporites paradorogensis* Krutzsch. In his opinion these forms are characteristic for the older Tertiary, completely disappearing from Central Europe in the Middle Oligocene. From the younger periods they have been reported only by Thiergart (1940) from the Upper Oligocene from the locality Ellenhausen. The Upper Oligocene age of the flora from Ellenhausen is questioned by Krutzsch (1959), who reckons it to be older (Lower Oligocene). From Poland spores cf. *Mohria* have been reported from the Tortonian loams from Stare Gliwice by Oszast (1960) and from the Paleogene from Rogóżno by Doktorowicz-Hrebnicka (1961). In our profile these spores appear rarely and only in the bottom part.

Gleicheniaceae

Pl. IV, Figs. 1, 3

In our profile spores numbered among this family vary only slightly as regards morphology and they probably belong to one genus *Gleichenia*. Spores trilete; equatorial contour triangular with apices slightly obliquely truncate or rounding. Side walls strongly concave. Laesura arms reach the equator of the spore and are straight. In the pole area the sign „Y" is broadened. The size of these spores reaches up to 55 μ. Exosporium up to 5 μ thick, psilate or with a very fine, indistinct, verrucate sculpture.

Krutzsch (1962a) describes similar forms as *Neogenisporis neogenicus* n. fsp. Our spores, however, are slightly larger, corresponding rather to *N. pseudoneddeni* Krutzsch, and are completely psilate on their surface. According to Krutzsch (l. c.) these forms are very common in the middle and the younger Tertiary of Germany and are to be found as late as the transition stage to the Pleistocene. The author does not define the exact botanical appurtenance of these spores but only suggests that we probably have to do here with forms from the family *Polygodiaceae* and not from the *Gleicheniaceae*. In the opinion of the present author, however, the above described forms from our profile belong to the genus *Gleichenia* since they are strikingly similar to *Gleichenia linearis* (Burn.) Col. (cf. Selling 1946, Pl. 2, Fig. 50), especially the spore from Pl. IV, Fig. 1. From Poland the spores cf. *Gleicheniaceae* have been reported, among others, from the Tortonian loams from Stare Gliwice (Oszast 1960). They occur in not large quantities in various parts of our profile.

Gleicheniaceae?

***Undulatisporites* cf. *pseudobrasiliensis* Krutzsch**

Pl. IV, Fig. 7

Spores trilete; equatorial contour triangular with apices slightly rounded and straight or convex sides; size about 30 μ. Tetrad mark narrow; laesura arms reach the equator of the spore and show an undulate course. Around this mark, on the proximal side, a distinct sculpture consisting of irregular depressions is evident.

Similar spores were described for the first time by Thiergart, (1940) from the Tertiary of Brazil, besides those reported by Krutzsch (1959), (Pl. VI, Figs. 44, 45) from the Tertiary brown coals from Geiseltal. According to Krutzsch (l. c.) their appearance can be traced back as far as the Cretaceous and even the Jurassic periods. At Rypin they are to be found only sporadically.

cf. *Concavisporites rugulatus* Th. & Pf.

Pl. IV, Figs. 5, 6

Spores trilete; equatorial contour triangular with apices slightly rounded. Laesura arms reach almost to the equator and are surrounded by roll-like thickenings of the exosporium. These thickenings may be multilayered. The surface of the spore is psilate, only in the area of the laesura a fine sculpture is to be seen. The size of these spores amounts to 30—35 μ.

Similar spores have quite often been reported from the older Tertiary of Europe (Thomson and Pflug 1953; Krutzsch 1959). At Rypin they are to be found only sporadically.

Concavisporites complicatus Th. & Pf.

Pl. VI, Fig. 12

Spore trilete; 24 μ in size; equatorial contour triangular with concave sides and rounded apices. At some distance from the apices (about 6 μ) folds formed of exine about 1·5 μ thick. Laesura arms reach only to these folds. The surface of the spore is finely sculptured.

cf. *Concavisporites*

Pl. VI, Fig. 13

Spore trilete; equatorial contour triangular with slightly concave sides and rounded apices; size about 22 μ. Exine on the surface very strongly rugate. Laesura arms reach the equator.

Nothing is known as yet concerning the botanical appurtenance of this spore; possibly it has to do with the *Gleicheniaceae*. In our profile only one spore was found in sample 93.

Hymenophyllaceae (?)

Pl. IV, Figs. 8, 9

Spores trilete; equatorial contour rounded-triangular with broadly rounded apices; size varies from 35—40 μ. Tetrad mark very narrow; laesura arms reach to the equator of the spore. On the surface of the exosporium small verrucae or clavae up to 4 μ high. Owing to the very scanty material (only a few grains in the whole of the profile) they could not be closely determined. The possibility of occurrence of the *Hymenophyllaceae* in the Tertiary has already been pointed out by Krutzsch (1959).

Dicksoniaceae

Genus *Dicksonia*

Dicksonia cf. *thyrsopteroides* Moore

Pl. IV, Fig. 4

Spores trilete; equatorial contour triangular with broadly rounded apices and concave sides, about 70 μ in size. Laesura arms barely reach to $^1/_3$ of the radius between the pole and the equator and are formed in the shape of a very narrow laesura. The walls of the spore are monostichous. Their surface is scrobiculate.

Similar spores have not hitherto been found in fossil state. At Rypin they are very rare and could therefore not be determined more closely.

Cyatheaceae

Spores belonging to this family are quite amply represented in our profile. Several forms are to be distinguished among them.

cf. Genus *Alsophila*

Pl. IV, Figs. 10, 11

Spores trilete; equatorial contour in the shape of an equilateral triangle, whose apices are not rounded; sides straight concave; size of spores from 30—35 μ. Tetrad mark formed in the shape of a narrow cleft, laesura arms are straight and reach to the equator of the spore. Exosporium not more than 2 μ thick. On the surface there is a slight, indistinct sculpture.

Alsophila has up till now been reported only from the old Tertiary sediments of East Europe by Zaklinskaja (1953). However, according to Krutzsch (1959) the forms described by Zaklinskaja should be associated with the *Proteaceae (Gothanipollis)* and not with the *Cyatheaceae.*

Our form differs from the spores of the genus *Cyathea* mainly in cuspidate apices and a narrow tetrad mark. In the Rypin II profile only 3 spores belonging to this genus were found.

Genus *Cyathea*

***Cyathea* cf. *propinqua* Molt.**

Pl. V, Figs. 1—3

Spores trilete; equatorial contour triangular with rounded apices and very concave walls. Seen from the pole, the breadth of the arms is the same near the apex and near the pole. Tetrad mark developed in the shape of a 2—3 μ broad laesura, its arms reaching the equator of the spore. Size of the spore in equatorial contour, measured from the apex to the middle of the subtense wall, amounts to about 28 μ. In lateral view, length of the longer axis 40 μ. Exosporium up to 2 μ thick psilate or finely verrucate on the surface.

This type of spore has hitherto not been reported from the Tertiary. In our profile they occur only sporadically.

***Cyathea* cf. *vestita* Mart.** (cf. Erdtman 1957)

Pl. V, Figs. 4—7

Spores trilete; equatorial contour triangular with rounded apices and slightly concave side walls; 35—45 μ in size. Tetrad mark equally broad throughout its length; laesura arms reach the equator of the spore. Exosporium 3 μ thick and with a characteristic sculpture on the distal side of the spore. Sculpture elements consist of verrucae, 5 μ in diameter and densely spaced, convex and rounded on their surface and polygonal at the base. The proximal side of the spore has no verrucae but shows a fine granulate sculpture. The surface of the individual verrucae on the distal side is not psilate but finely sculpturate. In lateral view these spores are ovate and kidney-shaped with an accentuated tetrad mark showing on the inner wall (subtense to the convex one) in the form of a small process in the middle part of the wall. In appearance these spores slightly resemble those of *Botrychium* but they differ from them in their tetrad mark, which in *Botrychium* is considerably distended in the middle part and does not reach to the equator of the spore. Spores of *Botrychium* are also more rounded in shape.

The spores described above have not hitherto been reported from the Tertiary. In our profile they are to be encountered only in the bottom part and in quantities not exceeding 0·75%.

cf. Genus *Hemitelia*

cf. ***Hemitelia maxonii*** **Ros.** (cf. Erdtman 1957)

Pl. V, Fig. 8

Spore trilete; equatorial contour triangular with broadly rounded apices; 80 μ in size. Exosporium 7 μ thick on its apices and as much as 21 μ in the side wall, where there are characteristic swellings. Tetrad mark very narrow and slightly plicate; laesura arms reach the equator of the spore. Spores of this type have hitherto not been described in fossil state.

Forms somewhat differing from ours but also belonging to the genus *Hemitelia* have been described by R. Potonié (1956) as *Kuylisporites*. Bolchovitina (1953) reports *Hemitelia mirabilis* Bolch. from the Cretaceous period. In our profile only one spore belonging to cf. *Hemitelia* was found.

Cyatheaceae-Schizaeaceae

Pl. V, Figs. 9—12

Spores trilete; 35—45 μ in size; equatorial contour triangular with rounded apices. Sides even, straight or slightly concave. Tetrad mark well developed, in its middle part somewhat furcate; laesura arms reach up to $^3/_4$ of the radius. Exosporium 2—3 μ thick.

Owing to scanty material, a closer determination of the forms was not possible.

In our profile these forms occur only sporadicaly.

Polypodiaceae

Genus ***Polypodium***

Pl. V, Fig. 13

Spores bilateral, monolete, about 40 μ in size, with a distinctly visible laesura. The surface of the exosporium shows a pronounced sculpture consisting of irregular verrucae reaching 5·5 μ in breadth and 4·5 μ in height. They are flatly truncate on the surface.

Our forms approximatively correspond to the *Reticuloidosporites (Polypodiisporites) balticus* n. fsp. described by Krutzsch (1962). In the older literature the forms considered to be **Polypodium** were described as ***Verrucatosporites alienus*** Th. & Pf. According to Krutzsch (l. c.) *Reticuloidosporites balticus* appears regularly in the middle and in the younger Tertiary of Europe. In our profile they were found in only one sample.

Laevigatisporites hardtii (R. Pot. & Ven.) Th. & Pf.

Pl. V, Figs. 14—16

Among this group have been classed bilateral, monolete spores, with no perispore and up to 40 μ in size. Tetrad mark visible in the shape of a one-armed laesura. A closer denotation of these forms was not possible owing to the lack of perispore.

The *Polypodiaceae* occur in our profile in all samples, but most of them are to be found in the youngest part (maximum 35%).

Incertae sedis

Toroisporis (Toroisporis) aneddeni Krutzsch

Pl. VI, Figs. 3, 4

Spores trilete; equatorial contour triangular with rounded apices and straight or slightly convex sides; about 50 μ in size. Tetrad mark in a hollow, surrounded by tori on which a punctate sculpture is to be found. Spore wall 3 μ thick.

Similar spores have been reported by Krutzsch (1959, Pl. 10, Figs. 75—76) from Geiseltal. Krutzsch (1962b) gives several species of this organ genus from stations of the younger and the middle Tertiary of Central Europe.

To the organ genus *Toroisporis* belongs also the spore represented in Pl. V, Fig. 9.

The botanical appurtenance of these spores is not as yet known.

Foveotriletes sp.

Pl. VI, Figs. 5—7

Spores trilete; equatorial contour rounded-triangular, about 50 μ in diameter. Apices of the triangle broadly rounded, sides convex. Laesura arms reach up to 3/4 of the radius between the pole and the equator of the spore. On the pole itself, the sign „Y" wide open. On the surface of the spore a characteristic, faveolate sculpture. Faveolae irregular in shape and distributed rather loosely.

Krutzsch (1963) distinguishes 4 organ species of this genus and writes that they are quite common in the younger and the middle Tertiary. In our profile they were found in only one sample.

Pl. VI, Figs. 8, 9

These are spores not exactly determined belonging to the group *Triletes* (Reinsch) Ibrahim. They are strongly corroded so that a closer determination was not possible.

GYMNOSPERMAE

Coniferae

Podocarpaceae

This family is represented in our material by two genera.

cf. Genus ***Dacrydium***

Pl. VII, Figs. 1, 2

These are sporomorphs of large, ovate bodies and relatively small sacs developed in the form of a fringe. The longest axis of the body amounts to about 55—60 μ. Sculpture on the body granulated and characteristically undulated; the cap is poorly developed. Its thickness amounts to barely 2·5—3·0 μ.

Pollen grains of *Dacrydium* have been reported from the Tertiary of New Zealand (Couper 1960) as well as from the Miocene of Hungary (Nagy 1962). From Poland they have been reported by Macko (1957) from the Miocene of the Gliwice area.

In the profile Rypin II pollen grains of this genus occur in only two samples.

According to Florin (1963) the distribution of both the present-day and fossil remains of the genus *Dacrydium* is restricted to South America, Australia, New Zealand, the Malayan Islands, and the south-eastern extremities of the Asian continent. Thus the discovery of pollen grains of this genus in the Miocene of Central Europe still demands confirmation.

Genus *Podocarpus*

Among the sporomorphs ranked with this genus two types, namely 2-saccate and the 3-saccate may be distinguished.

Podocarpus **sp. 1**

Pl. VII, Figs. 3, 4

This sporomorph corresponds to the *Pollenites libellus* described by R. Potonié (1931) and later reported by R. Ponotié, Thiergart, and Thomson (1950) as *Podocarpoidites libellus* R. Pot. These are sporomorphs ranging from 60—100 μ in size. Sacs much larger than the small body; sculpture shows as a thick reticulum.

Thiergart (1940) writes that sporomorphs of *Podocarpus* are found in Tertiary deposits from the Upper Oligocene till the Pliocene. From Poland the pollen of *Podocarpus* has been reported by, among others, Doktorowicz-Hrebnicka (1957a, 1961) and Oszast (1960). In our profile this type of sporomorph occurs only sporadically.

Podocarpus cf. *dacrydioides* A. Rich.

Pl. VII, Fig. 5

The 3-saccate type presumably belonging to this species is, above all, larger than the preceding one, and possesses three sacs and traces of a fourth. Sculpture of the sacs similar to that of the 2-saccate form. Body likewise round but the proportion of the sacs to body sizes is different in this form, the sacs being smaller than the body.

Couper 1960, Pl. IV, Figs. 6, 7) reported a similar type of grains from Tertiary and Quaternary deposits from New Zealand. The description of our forms is also in agreement with a description given for this species· by Ueno (1960).

Pinaceae

The family *Pinaceae* is fairly abundantly represented in the pollen flora of Rypin, both quantitatively and qualitatively.

Genus *Abies*

Pl. VII, Figs. 6—8; Pl. VIII, Fig. 1

Among the sporomorphs numbered with the genus *Abies* various species of this genus are probably represented. The structure of the pollen grains is that typical for the *Abies*; the sizes range from 100—150 μ. Sacs set on the body not with the broadest base; on their surface a characteristic reticulum with large lumina. Body, ovato-longitudinal in shape, shows on the proximal side a characteristically developed cap up to 10 μ broad.

In the system of Thomson and Pflug (1953) grains of the pollen of *Abies* are described as *Pityosporites absolutus* (Thierg.) Th. & Pf. Sporomorphs of the *Abies* are to be encountered in the younger Tertiary but in small quantities. They appear abundantly not earlier than in the Pliocene (Thomson and Pflug l. c.). In our profile *Abies* occurs sporadically throughout its whole course, attaining in samples 60—64 maximal values (3·77%).

◆ Genus *Tsuga*

The sporomorphs bellonging to this genus can be divided into three different types, probably corresponding to three species.

Tsuga diversifolia (Maxim) Mast. type

Pl. VIII, Figs. 2, 4, 7

This type of sporomorph is described in the morphographic system as *Zonalapollenites igniculus* (R. Pot.) Th. & Pf. Inaperturate sporomorphs, round, from 60—130 μ in size, with an undulate (20 μ) fringe on the margin of the grain. On the surface of some grains belonging to this type minute spinules have been observed. Similar spinules are to be found with the present-day species *Tsuga Sieboldii* Carr.

Sporomorphs of the *Tsuga diversifolia* type are encountered regularly but in small quantities in the middle and the younger Tertiary; they appear in abundance not earlier than in the Pliocene (Thomson & Pflug 1953). In our profile they occur only sporadically.

Tsuga canadensis Carr. type

Pl. VIII, Figs. 3—6

Zonalapollenites (Tsuga) viridifluminipites (Wodeh.) Th. & Pf.

Pollen grains inaperturate, somewhat smaller in size than the preceding ones (up to 100 μ), and differing from them mainly in that they lack the broad fringe, which with these forms does not exceed 3 μ, so that the sculpture is similar on the whole surface of the grain. The elements of the sculpture are developed in the form of loosely distributed verrucae.

This type of sporomorph appears regularly in the Tertiary. In our profile they are also encountered in various parts.

Tsuga pattoniana Engelm. type

Pl. VIII, Fig. 5

These sporomorphs are characterized above all by a different development of the fringe than that in the previous types. The fringe is narrow on the dorsal as well as on the ventral side of the grain and is distended characteristically only at the two opposite sides forming something like sacs. The diameter of the grains amounts to about 110 μ. Sculpture elements are verrucae, finer than with the preceding types, clinging together very closely.

A similar grain, though with slightly larger swellings of the fringe on its sides, has been reported by Oszast (1960) from the Tortonian loams from Stare Gliwice. This type of grain occurs only sporadically in the top of our profile.

In the pollen diagram all three types of the sporomorphs belonging to the genus *Tsuga* are given together.

Genus *Picea*

Pl. IX, Figs. 1, 2

Pityosporites alatus (R. Pot.) Th. & Pf.

Pollen grains 2-saccate, of various sizes. Their characteristic features are: the semicircular shape of the sacs and the fact that they are set on the body with a very broad base. On the surface of the sacs there is a reticulum of comparatively small lumina. Sculpture elements of the body consist of densely spaced bacula. The cap is very poorly developed.

Larger forms belonging to this group correspond, according to Thomson and Pflug (1953), to the species *Picea excelsa* (Lam) Lk. and the smaller ones to *Picea omorika* Mart. The pollen of *Picea* appears regularly in the middle and the upper Tertiary though in a low percentage; it appears in abundance not earlier than the Pliocene and Pleistocene periods (Thomson & Pflug l. c.). In our profile the pollen of *Picea* shows only sporadically in various parts, attaining a maximum 2·84%.

Genus *Larix*

Pl. VIII, Fig. 8

Laricioidites magnus R. Pot.

Inaperturopollenites magnus (R. Pot.) Th. & Pf.

Inaperturate, ovate sporomorphs, approximately 75 μ in size. Exine 2—3 μ thick, three-layered. Exine surface psilate or very finely granulate.

In the Tertiary these forms are to be encountered in small quantities quite regularly (Thomson & Pflug 1953). In our profile only two grains belonging to this genus were found in sample 26.

Genus *Cedrus*

Pl. IX, Fig. 3

Pityosporites cedroides Th. & Pf.

Sporomorphs 2-saccate, up to 120 μ in size. Sacs semicircular and larger than the body. Sculpture on their surface developed, as in pollen grains of *Pinus*, in the form of a reticulum. Sacs set on the body by their broadest side. Sculpture of the body developed in the form of densely spaced processes, sometimes radiately arranged. On the proximal side of the body a characteristic cap is formed 8—12 μ in breadth.

Cedrus pollen is to be encountered quite regularly in the middle and the younger Tertiary (Thomson & Pflug 1953). In our profile pollen grains of this genus were found in only two samples.

Genus *Pinus*

***Pinus silvestris* L. type**

Pl. IX, Figs. 4—9

Pityosporites labdacus (R. Pot.) Th. & Pf.

Sporomorphs varying in size, characterized by round sacs fixed to the body not by their broadest side but by the comparatively narrow one. Cap very poorly developed. Sporomorphs ranked among this type were found in our profile in comparatively large quantities (max. 47·03%) in all samples.

Pinus haploxylon Rudolph type

Pityosporites microalatus (R. Pot.) Th. & Pf.

Grains of various size, whose breadth reaches 140 μ. Among this group have been numbered only the so-called classical forms (Rudolph 1935), i.e. those whose sacs are attached to the body by the broadest base and whose bodies show a longitudinally egg-shaped form. The whole grain is, therefore, almost circular in shape. All other forms belonging possibly to this type also but showing no classical appearance have been classed in the pollen diagram among the preceding type.

As to the size of the grains two forms have been distinguished here: f. *minor* (R. Pot.) Th. & Pf. (Pl. IX, Figs. 10, 11) with dimensions below 70 μ and f. *major* (R. Pot.) Th. & Pf. (Pl. IX, Figs. 12—14) with dimensions above 70 μ.

Sporomorphs of *Pinus haploxylon* type are still to be encountered in the middle Tertiary in quite large quantities but they are rarer in the younger periods of that epoch. At Rypin they occur in various parts in not large quantities (max. 5·69%).

Taxodiaceae

Sporomorphs reckoned among this family are morphologically greatly differentiated. Several genera have been distinguished among them.

Genus *Sciadopitys*

Sciadopitys verticillata Sieb. et Zucc.

Pl. X, Figs. 1, 2

Monocolpopollenites serratus (R. Pot. & Ven.) Th. & Pf.

Sporomorphs monocolpate, ovato-rounded; size attains up to 40 and 45 μ. Sculpture on the grains surface consists of irregularly distributed verrucae, the diameter of which varies from 1—3 μ. Verrucae on the surface flatly truncated, about 3 μ high.

These sporomorphs are often found in the floras of the middle and younger Tertiary. In West German brown coal deposits a special leading level with *Sciadopitys* has been distinguished (Thiergart 1949, Kirchheimer 1950). In Poland pollen of *Sciadopitys* is frequent in various Tertiary floras. In our profile it occurs in various parts attaining its maximum (4%) in the bottom samples.

Genus *Sequoia*

Pl. X, Figs. 5, 6

Sequoioidites polyformosus Thiergart

Inaperturopollenites polyformosus (Thierg.) Th. & Pf.

Pollen grains inaperturate, globular, 30—35 μ in size. Exine up to 4 μ thick, with a characteristic papilla which protrudes from the grain at a right angle and is arcuate, rounded at the end or slightly cuspidate. Grain surface finely granulate.

These sporomorphs are very often to be encountered in the Tertiary. At Rypin they occur in various parts attaining their maximum (6·22%) in the middle of the profile.

Genus *Taxodium*

Pl. X, Figs. 3, 4

Inaperturopollenites hiatus (R. Pot.) Th. & Pf.

Pollen grains inaperturate, round, up to 33 μ in size and always ruptured in a characteristic way. At the base of the rupture a small papilla is to be seen standing at a right angle. The exine shows a characteristic, granulate sculpture; the pollen surface is sometimes slightly rugate. Among this genus only sporomophs of typical appearance have been numbered; all others lacking distinct features of the genus *Taxodium* have been numbered together among the group *Taxodiaceae-Cupressaceae*.

Sporomorphs of *Taxodium* appear very often in the Tertiary floras of Europe; they are also frequent in various parts of our profile.

Genus *Glyptostrobus*

***Glyptostrobus* cf. *europaeus* (Brongn.) Heer**

Pl. X, Fig. 7

Pollen grains inaperturate, longitudinally-ovate, characteristically ruptured in the middle; size 40—45 μ (longer axis), 20—25 μ (shorter axis). On the grain wall, on each side of the rupture, there are 3—4 ribs formed of thickened exine. Papilla, not always visible, situated at the base of the rupture. Exine thin (1 μ) with a fine, granulate sculpture on its surface.

Glyptostrobus sporomorphs are described in palynological literature as *Glyptostroboidites* Thiergart.

Our forms can with great probability be defined as *Glyptostrobus europaeus* as macroscopic remains of this species have been found at Rypin by Łańcucka-Środoniowa (1957) and the pollen material was very homogenous. *Glyptostrobus europaeus* is an extinct species, whose analogue is the species *Glyptostrobus pensilis* Koch existing today in China.

In our profile sporomorphs of *Glyptostrobus* occur in various parts, attaining their maximum (12·7%) in the lower part of the youngest one.

Genus *Cryptomeria*

Pl. X, Figs. 8—11

Pollenites largus Kremp

These pollen grains are strikingly similar to pollen grains of the *Sequoia.* They differ from them only in an always straight, broad papilla and in somewhat greater dimensions (up to 40 μ).

In our profile these sporomorphs occur in all parts attaining their maximum (5·33%) in the top part.

cf. Genus *Taiwania*

Pl. X, Fig. 12

In one level only pollen grains were found resembling in general those described above and differing from them mainly in that they have a very small papilla. These grains are ovate, of dimensions 36×26 μ, with a papilla on one of the longer walls. Exine up to 2 μ thick, with a distinct sculpture on its surface. Sculpture elements, densely placed one beside the other, consist of small verrucae.

Sporomorphs of this genus have not to the present author's knowledge been hitherto found in the Tertiary.

cf. Genus *Cunninghamia*

Pl. X, Fig. 13

Pollen grains inaperturate, round in shape; size up to 32 μ. Exine thin with a very distinct, granulate sculpture on the surface. Besides this the whole surface of the grain is covered by a kind of rugae. Papilla very small, often flexed towards the middle of the grain giving the impression of a pore at this place.

Cunninghamia sporomorphs were first found in the European Tertiary in the Tortonian loams from Stare Gliwice by Oszast (1960). In our profile *Cunninghamia* occurs only sporadically in quantities not exceeding 4·12%.

Cupressaceae

cf. Genus *Callitris*

Pl. X. Fig. 14

Inaperturopollenites emmaensis (Mürr. & Pf.) Th. & Pf.

Pollen grains inaperturate, disklike-round, about 32 μ in size. Exine thin consisting of bacula up to 1 μ long very densely placed one beside the other.

Similar sporomorphs are to be encountered quite often in the older and the middle Tertiary e. g. at Marxheim very abundantly (Thomson & Pflug 1953); they have been reported from Czechoslovakia by Pacltova (1960). According to Rein (1961) a massive occurrence of this sporomorph is characteristic of the Chatt-Aquitanian.

In our profile *Callitris* occurs only at the very bottom in sample **101** to the number of 4 grains.

Genus *Cupressus*

Pl. X. Fig. 15

Pollen grains inaperturate, round, under 30 μ in size. They are very often characteristically ruptured. Exine very thin, with a fine, granulate sculpture on the surface. Besides this, on the grain surface single, loosely standing pila, which often undergo avulsion.

In our profile these forms were found only at the bottom, in quantities up to 2·78%.

Taxodiaceae-Cupressaceae

Pl. X. Fig. 16

Inaperturopollenites dubius (R. Pot. & Ven.) Th. & Pf.

Pollen grains inaperturate, varying in size from 20—50 μ, rounded, often secondarily plicate. Exine very thin, psilate or more often with a fine sculpture on the surface. Among this group there have been numbered sporomorphs belonging without doubt to different species and genera which could not be more closely described because of their homogeneous appearance.

These sporomorphs appear in all samples of our profile in fairly variable quantities from 1—50%. On the strength of the quantitative occurrence of the sporomorphs of this group no stratigraphic conclusions can be drawn because this is a group comprising at the bottom, at least partly, other species than in the top of the profile.

GNETINAE

Ephedraceae

Among the sporomorphs numbered with this family two species belonging to the genus *Ephedra* may be distinguished.

Genus *Ephedra*

***Ephedra distachya* L. type**

Pl. X, Figs. 17, 18

Ephedripites (Distachyapites) sp. Krutzsch.

Pollen grains monocolpate, elliptic, with widely rounded poles, up to 60 μ in size. Longitudinal ridges have an undulated course from one pole to the other and from them again there run transversal, anastomosing ramifications.

There are great difficulties in ranking our form with some of the organ species described by Krutzsch (1961). As to its size, our form most corresponds to the species *Ephedripites (Distachyapites) eocenicus* Krutzsch, known from numerous Eocene and Oligocene localities of Germany (Krutzsch, l. c.).

In our profile this sporomorph occurs only at the very bottom in not large quantities.

***Ephedra* sp. 1**

Pl. X, Fig. 19

Ephedripites (Distachyapites) frankfurtensis Krutzsch.

Sporomorphs corresponding in size (37 μ) as well as in the quantity of ridges (17) with the above-quoted organ species. They are elongated, not too broadly rounded at the poles. Exine fairly thick.

This species appears in the German Tertiary only in marine sediments of the Upper Oligocene (Krutzsch 1961).

In our profile they occur only at the very bottom in similar sediments.

ANGIOSPERMAE
DICOTYLEDONES

Betulaceae

Genus *Betula*

Pl. XI, Figs. 1, 2

Trivestibulopollenites betuloides Th. & Pf.

Among the sporomorphs numbered with the genus *Betula* there are various species, which are, however, difficult to identify. These are sporomorphs from 25—35 μ in size. Exine 2—3 μ thick. Surface psilate or with very fine, irregularly spaced processes. At the pores there develop small vestibules formed owing to a separation of the sexine from the nexine in these places.

Betula pollen grains are very often found in the Tertiary. In our profile they were encountered in all samples from the bottom to the top in fairly large quantities. *Betula* attains its maximum values in the top of the profile (28·4%).

Genus *Alnus*

Polyvestibulopollenites (Alnipollenites) verus (R. Pot.) Th. & Pf.

Pollen grains of the alder appear at Rypin in the whole profile in quite considerable quantities. It reaches the lowest values at the bottom of the profile and optimum occurrence falling in the middle part. Among these sporomorphs forms from 3-porate to 6-porate are encountered. Two main types are to be distinguished among them.

***Alnus glutinosa* (L.) Gaertn. type**

Pl. XI, Fig. 3

Pollen grains mostly 5- or 6-porate, about 30 μ in size. They are the nearest to the present-day species *Alnus glutinosa*.

***Alnus Kefersteinii* Goepp. type**

Pl. XI, Fig. 4

Alnipollenites metaplasmus R. Pot.

Pollen grains 4-porate, much smaller in size than the preceding ones (16—23 μ).

This type is more frequent in the Miocene and Upper Oligocene than in the Pliocene (R. Potonié, Thomson & Thiergart 1950). It has been reported from the Pliocene from the locality Wallensen by Altehenger (1959) and from Ptolemais in Greece by Weyland and Pflug (1957). From Poland it is known from the Miocene (Doktorowicz-Hrebnicka 1957 a; Oszast 1960).

In our profile *Alnus Kefersteinii* type occurs only sporadically. In the pollen diagrams the two types of *Alnus* are given together.

Genus *Ostrya*

Pl. XI, Fig. 6

Triporopollenites rhenanus (Thoms.) Th. & Pf.

Pollen grains 3-porate, rounded to triangular, with convex sides, from 25—30 μ in size. Pores on protruding aspides. Exine surface finely granulate.

Similar forms are known from various Tertiary stations of Europe. From Poland *Ostrya* has been reported by Oszast (1960) from the Tortonian loams from Stare Gliwice.

Genus *Carpinus*

Pl. XI, Fig. 5

Pollenites bituitus R. Pot.

Polyporopollenites carpinoides (Pf.) Th. & Pf.

Pollen grains from 3—7-porate (mostly 4—5-porate), 30—40 μ of size, in the form of a polygon with convex sides. Exine thin (about 1 μ), with a fine sculpture on the surface. Pores evenly distributed on the equator of the grain and placed on slight elevations of the exine. Triporate sporomorphs might correspond with the species *Carpinus* cf. *americana* described by Kremp (1949).

Sporomorphs of *Carpinus* are sporadically encountered in all parts of the profile from Rypin. They attain their maximum values in the middle part of the profile (1·66%). These sporomorphs are to be found quite frequently in Tertiary floras.

Genus *Corylus*

Among the sporomorphs numbered here two types, probably belonging to two species, can be distinguished.

Corylus avellana L. type

Pl. XI, Figs. 9, 10

Triporopollenites coryloides Th. & Pf.

Pollen grains 3-porate, triangular, with slightly convex sides. Exine twofold, sexine thicker than nexine. Grain surface psilate or finely scrabate. The size of these grains ranges from 25—30 μ.

They appear in the younger Tertiary quite often but in small quantities. In our profile they are encountered only sporadically and it is solely in the bottom part that they form a continuous curve in the pollen diagram (max. 4·21%).

Corylus americana Walt. type

Pl. XI, Figs. 7, 8

Sporomorphs numbered here are always 2-porate, somewhat kidney-shaped in form; dimensions 17×30 μ. Pores, developed typically for *Corylus*, are at the two opposite sides of the grain. Exine psilate to finely scrabate. Sculpture elements consist of bacula merging in tegillum.

Similar forms are described from the Upper Oligocene by Traverse (1955, Pl. 9, Fig. 35) from lignite strata at the locality Brandon in New England. It is possible that this is a form corresponding to the present-day *Corylus americana* Walt. (cf. Traverse 1955, Pl. 9, Fig. 36). This is a common species in the southern part of North America, in communities of marshy forests (swamps in Florida).

In our profile this form shows only sporadically at the bottom and in some top samples. In the European Tertiary this type of sporomorph has hitherto not been found.

In the pollen diagram the two forms of *Corylus* have been given together in one curve.

Fagaceae

In our profile this family is very richly represented as regards variety of forms. The following genera deserve special mention:

Genus *Castanea*

Pl. XI, Figs. 12, 13

Pollenites exactus R. Pot.

Castaneoidites exactus R. Pot.

Tricolporopollenites megaexactus ssp. *exactus* (R. Pot.) Th. & Pf.

Pollen grains 3-colporate; dimensions about 16×11 μ; in equatorial contour rounded-ovate or cylindrical in shape, on the poles broadly rounded. Pores in the middle of the colpi, round, small. Exine over 1 μ thick, psilate.

Castanea sporomorphs are very common in the European Tertiary, especially in the older Neogene. It is true that they still appear in the Pliocene e.g. at Wallensen (Altehenger 1959) but they have no longer much significance. Altehenger (l. c.) writes that this is a calcite loving genus which occurs today mostly on a calcareous substratum. Its appearance in the Tertiary may be edaphically as well as climatically conditioned.

cf. Genus *Castanopsis*

Pl. XI, Fig. 11

Pollenites cingulum R. Pot.

Pollen grains somewhat larger and more fusiform than in the preceding genus, 20 μ and more in size, on the poles less rounded but slightly cuspidate. Exine surface finely granulate.

These are forms considered by Thiergart (1940) as an old Tertiary element having its greatest significance in the Upper Oligocene though it also occurs in older sediments and occasionally in the younger ones.

The sporomorphs of *Castanopsis* occur mostly in the bottom part of our profile.

cf. Genus *Pasania*

Pl. XI, Figs. 14, 15

Pollen grains in broad outline similar to the sporomorphs of *Castanea* but differing from them in smaller dimensions (12×9 μ) and in shape. They are more elongated in relation to the breadth. Exine thinner than in the *Castanea* and pores less distinctly visible. Grain surface almost completely psilate.

The first to pay attention to similar forms was Doktorowicz-Hrebnicka (1957b) who described them from the Lower Miocene brown coals from Mirosławice Górne as cf. *Castanea* type „C'" n. forma. At Rypin these sporomorphs occur only sporadically.

In the pollen diagram the *Castanea, Castanopsis,* and *Pasania* have been comprised in one curve.

Genus *Fagus*

Pl. XI, Figs. 16—19

Tricolporopollenites pseudocruciatus (R. Pot.) Th. & Pf.

Tricolporopollenites fagoides Krutzsch

Pollen grains 3-colporate, 28—40 μ in size; pores always in the middle of the colpus. A distinct sculpture on the surface of the grain. Sculpture elements consist of bacula densely placed one beside the other. Grains of larger dimensions (40 μ) correspond probably to the present-day species *Fagus silvatica* L., while smaller ones, with dimensions 28—34 μ, are similar to the present-day species *Fagus ferruginea* Ait.

Both types of sporomorphs are frequently to be encountered in the European Tertiary (Thomson & Pflug 1953). At Rypin *Fagus* occurs from the middle part up to the top of the profile, reaching the highest values in the upper section of the middle part (7·36%).

Genus *Quercus*

Pl. XI, Figs. 20—22

Quercoidites R. Pot.

Tricolpopollenites asper Th. & Pf.

This group is especially rich in various morphological forms, which, however, cannot be closer determined. Sporomorphs 3-colpate, 20—40 μ in size, tending to produce also three pores. Exine finely verrucate shows densely and irregularly placed short processes of varying size.

These sporomorphs are often to be encountered in the Tertiary floras of Europe. At Rypin they occur regularly in the whole profile, attaining their maximum in the middle part (6·25%).

Quercus?

Pl. XI, Figs. 23—25

Besides the above-described forms sporomorphs have been encountered resembling in their general appearance pollen grains of *Quercus* but differing from them mainly in a thicker, granulate sculpture.

A similar form has been described from the Miocene brown coals from Konin by Kremp (1949) as *Pollenites henrici* — „Perlige Unterform". Thomson & Pflug (1953) described them as *Tricolpopollenites pudicus* (R. Pot.) Th. & Pf.

Fagaceae?

Quercoidites henrici R. Pot.

Pl. XI, Fig 26

These sporomorphs are similar to pollen grains of *Quercus* but have a somewhat different structure. In equatorial view they are ovate and at the poles rather cuspidate this being one of the features differentiating them from the pollen grains of *Quercus*. Exine about 2 μ thick. On its surface a fine, granulate sculpture. In lateral view colpi spaced parallelly one to the other. The pores are faintly visible in the middle of the colpi.

These sporomorphs are encountered frequently and sometimes in great quantities in the middle Tertiary and at the turn of the Oligocene and The Miocene. In the younger Tertiary they no longer occur, however, being replaced by the typical pollen grains of the *Quercus*. At Rypin the *Quercoidites henrici* are found regularly only at the bottom of the profile.

Myricaceae

Genus *Myrica*

Pl. XI, Fig 27

Triatriopollenites rurensis Th. & Pf.

Pollen grains 3-porate, in polar view triangular, size 25—35 μ. The endoporus formed of nexine is considerably larger than the exoporus formed of sexine and constitutes a distinct vestibule. Exine more than 2 μ thick, towards the pore thickening still more. Sexine surface with densely and somewhat irregularly placed spinules supported by small bacula. In the pore area sexine seems to be slightly granulate.

Sporomorphs of this type are very often found in the European Tertiary. They are also known from numerous Tertiary stations in Poland (Doktorowicz-Hrebnicka 1957b, c; Mamczar 1960; Oszast 1960). In our profile the sporomorphs of *Myrica* occur regularly attaining their maximum in the bottom part (8·19%).

Juglandaceae

Sporomorphs numbered among this family are, with regard to morphology, fairly differentiated. Several genera can be distinguished here.

Genus *Juglans*

Pl. XII, Figs. 1, 2

Multiporopollenites maculosus (R. Pot.) Th. & Pf.

Pollen grains polypantoporate, spheroidal, with numerous large irregularly distributed pores on the equator as well as in one of the hemispheres. Around the spores there is a distinct anulus. The size of these grains varies between 35—45 μ. Exine finely scrabate with small spinuloid processes.

These are sporomorphs found on the whole quite frequently in the European Tertiary but occurring always in small quantities. In the older Tertiary they have not hitherto been found (Thomson & Pflug 1953). From Poland the pollen of *Juglans* is known from Mizerna (Szafer 1954) and from the areas of Bolesławiec and Zebrzydowa in Lower Silesia (Romanowicz 1961).

Genus *Carya*

Pl. XII, Fig. 5

Pollenites simplex R. Pot.

Subtriporopollenites simplex (R. Pot. & Ven.) Th. & Pf.

Pollen grains round, 3-porate; size about 30 μ. Pores situated on the grain peripherally at its equator from the inner side. Exine psilate or very finely scrabate.

Our forms correspond best to the sporomorph described by Thomson & Pflug (1953) under the name *Subtriporopollenites simplex* ssp. *circulus* (Pf.) Th. & Pf.

These sporomorphs occur in our profile only sporadically in quantities not exceeding 1·1%.

Genus *Pterocarya*

Pl. XII, Figs. 3, 4

Polyporopollenites stellatus (R. Pot. & Ven.) Th. & Pf.

Sporomorphs mostly 5- or 6-porate. Pores spaced regularly on the equator of the grain so that equatorial contour is in the form of a regular polygon. Their size varies between 35—45 μ. At the pores there develop small annuli. Exine surface psilate or very slightly scrabate (sculpture visible only after immersion).

According to Thomson and Pflug (1953) these sporomorphs are frequent in the younger and in the older Pleistocene. At Rypin they occur in not large quantities (maximum 5·41%) in the whole profile.

Genus *Engelhardtia*

Triatriopollenites coryphaeus microcoryphaeus **(R. Pot.) Th. & Pf.**

Pl. XII, Figs. 8, 9

Engelhardtioidites microcoryphaeus R. Pot.

Engelhardtioidites forma *minor* Thomson

Sporomorphs 3-porate; equatorial contour triangular, size under 20 μ. Pores on the apices of the triangle are small and circular. Exine thick with a very distinct but fine sculpture on the surface, composed of minute spinules.

These sporomorphs are often found in the Older Neogene (R. Potonié; Thomson and Thiergart 1950). At Rypin they occur in not large quantities in the whole profile, attaining their maximum (10·64%) in the bottom part.

Triatriopollenites coryphaeus punctatus **(R. Pot.) Th. & Pf.**

Pl. XII, Figs. 6, 7

Pollenites coryphaeus punctatus R. Pot.

cf. *Engelhardtioidites* forma *magna* Thomson

Sporomorphs 3-porate; equatorial contour rounded-triangular, 25—32 μ in size. Exine about 2 μ thick. Sexine considerably thicker than nexine. On the sexine surface a very distinct sculpture having elements slightly larger than in the preceding species. Sometimes on the surface of the grain there are secondary „arcoid" streaks.

Krutzsch (1957) numbers similar forms with the group *„microcoryphaeus"* (Pl. 8, Figs. 1—11) and is of the opinion that the Eocene is the main period of their occurrence though they still regularly appear in the Miocene and occur sporadically even in the Pliocene. In our profile these forms occur sporadically in various parts but form a continuous curve only at the bottom of the profile.

Salicaceae

Genus *Salix*

Salix aurita-caprea **n. comb. type**

Pl. XII, Figs. 10, 11

Pollen grains 3-colporoidate; dimensions in equatorial view 25 × 15 μ. In this position the pores are always distinctly visible, formed like recesses in the colpi. Exine up to 3 μ thick. On the sexine surface a distinct reticulum with lumina 1—1·5 μ wide. Muri forming the reticulum about 1·5 μ high. In polar view colpi regularly rounded.

This type of sporomorph has not hitherto been described from the Tertiary. At Rypin they are regularly encountered in the top part of the profile.

Salix sp.

Pl. XII, Figs. 12, 13

Pollenites confinis R. Pot.

Salicioidites Thomson

Pollen grains 3-colporoidate, without distinct pores. In equatorial view size from 20—32 μ in longer axis and 9—13 μ in the shorter one. Grain surface more finely reticulate than in the preceding type. Diameter of the lumina does not reach 1 μ.

In the opinion of R. Potonié, Thomson and Thiergart (1950) these forms occur from the Chatt-Aquitanian to the Upper Pliocene and play a particular role in the marshy forests.

In our profile this form shows in various parts. It reaches its maximum (15%) in the top part of the profile. In the pollen diagram the two forms have been treated together.

Ulmaceae

Genus *Ulmus*

Pl. XII, Figs. 14, 15

Ulmoidites Thierg.

Polyporopollenites undulosus (Wolf.) Th. & Pf.

Sporomorphs 4- or 5-porate, in equatorial contour rounded or square and 35—42 μ in size. Surface characteristically undulated. Exine about 3 μ thick.

These sporomorphs occur regularly in the younger Tertiary but only in small quantities. At Rypin they occur mainly in the top part being very rare at the bottom.

Genus *Celtis*

Pl. XII, Figs. 16,17

Pollen grains 3- to 6-porate, oblate-spheroidal; size 35—42 μ. Pores irregularly distributed on the grain surface. Exine surface shows a characteristic sculpture consisting of flatly truncate verrucae densely placed one beside the other. Pores lie in small hollows.

Sporomorphs of *Celtis* are known from a few Tertiary localities. From Hungary they have been described by Nagy (1958); from Poland they have been reported by Doktorowicz-Hrebnicka (1957a) and Oszast (1960).

In our profile these grains occur regularly in small quantities reaching their maximum (3·61%) in the top samples.

Eucommiaceae

Genus *Eucommia*

Eucommia ulmoides **Oliv.**

Pl. XII, Figs. 18—21

Sporomorphs 3-colporate; in equatorial view dimensions from 28 × × 25 μ to 38 × 35 μ. Not all colpi are of the same length, hence mesocolpia are not symmetrical in polar view. Pores placed in the middle of the colpi and transversally-ovoid in shape. Exine up to 3 μ thick and completely psilate.

Pollen grains of *Eucommia* were found for the first time in fossil state by Oszast (1960) in the Tortonian loams from Stare Gliwice in Upper Silesia. In our profile these sporomorphs occur in very small quantities in the upper and middle parts; at the bottom there are none at all.

Proteaceae ?

Pl. XII, Fig. 22

Pollen grains bilateral elongate, 35 × 19 μ in dimension, with two pores at the opposite sides of the grain, resemble pollen grains of the family *Proteaceae*. Exine thin, with a characteristic sculpture on the surface. Sculpture elements consist of densely placed bacula forming a very fine reticulum. Pores closed by membranes.

Sporomorphs of the family *Proteaceae* are known only from the older Tertiary of New Zealand (Couper 1960). In our profile they occur only sporadically in the bottom part.

Olacaceae

cf. Genus *Chaunochiton*

Pl. XIII, Fig. 1

In sample 54 one pollen grain was found that is strikingly similar to grains of this genus. It is 3-colpate, angulaperturate, with dimensions 35 × 40 μ. Exine twofold, its outer layer, the sexine, characteristically thickened on the pole and the sections running from the pole to the pores.

Breadth of the zone of thickened sexine amounts to about 8 μ. On the exine surface there is a sculpture of quite complicated construction. Studying the sculpture elements by means of „LO" analysis we first see, beginning from the top, single loosely spaced spinules; a further element of the sculpture construction are bacula densely placed one beside the other and tectate.

Grains of this type have not hitherto been described in fossil state.

Loranthaceae

cf. Genus ***Loranthus***

Pl. XII, Figs. 23—25

Pollen grains in polar view have a triangular contour with rounded apices and very concave sides. From the apices of the triangle to the centre i.e. in the direction of the pole of the grain, there run colpi. Length of the radius from the equator of the grain (i. e. the apex of the triangle) to its pole is from 13—22 μ. Exine thin, with a granulate sculpture on the surface.

Sporomorphs of the *Loranthaceae* have not hitherto been found in the European Tertiary. At Rypin they occur very rarely and only in the upper part of the profile.

Genus *Arceuthobium*

Arceuthobium cf. ***oxycedri*** M.B.

Pl. XIII, Figs. 2—4

Spinulaepollis arceuthobioides Krutzsch

Sporomorphs 3-colporate, round in shape; size from 20—24 μ. Exine not uniformly thick on the whole surface but mesocolpium in the middle part thinner, which sometimes causes secondary plicae; these form so-called pseudocolpia. Grain surface covered by small, loosely standing spinules, 1 μ high, uniformly covering the whole surface. The spinules are densest in the middle of the mesocolpium becoming less and less dense the nearer they come to the colpus until at the colpus itself they vanish altogether.

According to Krutzsch (1962a) these sporomorphs occur from the middle Eocene until the Pliocene, their optimum falling within the Upper Eocene and the Miocene. From the territory of East Germany more than 60 stations of this form are known. Our station is the first one in Poland. At Rypin these forms occur sporadically in various parts of the profile.

Spinulaepollis arceuthobioides ssp. *major* n. spm.

Pl. XIII, Figs. 5—8

Besides the above-described sporomorphs pollen grains have been found in the profile of Rypin resembling on the whole the precedent ones but considerably larger (24—30 μ). Exine thicker 1—2 μ (spinules not measured) and spinules of considerably broader bases (up to 2·5 μ) and up to 3 μ long. In general appearance these grains are less limp. It is possible that this form lies within the bounds of intraspecific variability but it may also belong to another species. The presence of mediate forms would seem, among other factors, to indicate its appurtenance to the same species. This type is rarer at Rypin than the preceding one.

Polygonaceae

This family is represented in our profile by two different types belonging to two species or species groups of the genus *Polygonum* and the genus *Rumex*.

Genus *Polygonum*

Polygonum „*avicularia*" Hedberg type

Pl. XIII, Figs. 11—13

Pollen grains 3- to 4-colporate; in equatorial view 25·6 × 34·7 μ in dimension. Pores elliptic and spaced along the equator perpendicularly to the colpus whose dimensions are 5 × 10 μ. Exine up to 4 μ thick and very densely scrabate.' Sculpture elements consist of bacula accreting at the top giving a granulate surface to the sporomorphs. Our forms are most similar to the present species of *Polygonum rhizoxylon* Pau. & Font. Quer. and *P. straphaeoides* Thunb. (cf. Hedberg 1947).

Sporomorphs of this type have not hitherto been found in the European Tertiary. In our profile they occur only sporadically.

Polygonum „*persicaria*" L. type

Pl. XIII, Fig. 14

Persicarioipollis Krutzsch

Pollen grains polypantoporate, round, about 45 μ in diameter. On the exine surface a thick reticulum, its lumina up to 5 μ in diameter. Muri consist of densely placed bacula linked together in twos. Besides, at the base of the reticulum a fine, granulate sculpture.

According to the size and shape of the lumina of the reticulum as well as the size of the whole grain and the quality of the structure elements Krutzsch (1962a) has distinguished 8 species belonging to the organ genus *Persicarioipollis.* Our forms cannot, however, be numbered among any of these species. In size and structure of the reticulum they most resemble the *Persicarioipollis pliocaenicus* Krutzsch, known only from the Miocene and Pliocene of Europe. From the Polish Tertiary these sporomorphs have not hitherto been reported. In our profile they appear only sporadically.

Genus *Rumex*

Pl. XIII, Figs. 9, 10

In the profile Rypin II only one pollen grain belonging to this genus was found. Grain 4-colporate, round, about 26 μ in diameter. Pores in the middle of the colpi and developed in the form of small meshes about 2 μ in diameter. Exine of the grain about 1·5 μ thick. On its surface a fine reticulum with irregular lumina.

Rumex has not, to the present author's knowledge, hitherto, been found from the Tertiary.

Chenopodiaceae

Pl. XIII, Figs. 19, 20

Numbered among this family are sporomorphs that are round, about 24 μ in size, polypantoporate. Diameter of the pores from 2—3 μ. The exine between the pores has a distinct reticulum with irregular lumina.

From the Pliocene brown coals at the locality Ptolemais in northern Greece Weyland and Pflug (1957, Pl. 22, Figs. 18, 19) reported sporomorphs belonging to this family and named them *Periporopollenites multiplex* n. sp. Our forms, however, differ from them in the number of pores. These sporomorphs have also been reported from the Pliocene from Holland (Zagwijn 1960) where they appear in marine sediments together with a great quantity of *Hystrix.* In Zagwijn's opinion (l.c.) the *Chenopodiaceae* are a pioneer element occupying areas after a recession of the sea.

In our profile these sporomorphs occur sporadically.

Caryophyllaceae

Pl. XIII, Figs. 15, 16

Sporomorphs typical of this family were found only in a few samples. They differ, however, from those described by Thomson and Pflug (1953), which belong to the organ species *Periporopollenites multiporatus* n. sp. Our sporomorphs have larger pores, 6 μ in diameter, and are less densely distributed on the grain surface; the size of these grains is about 33 μ. Exine thick, with a distinct reticulum on the surface. Lumina of the reticulum are as large as the muri are thick or slightly smaller.

Sporomorphs of *Caryophyllaceae* are so far known from the Pliocene (Altehenger 1959) and the forms described by Thomson and Pflug (1953) from the Eocene have, in their opinion, no stratigraphic significance.

Euphorbiaceae?

cf. Genus *Discoglypsemma*

Pl. XIII, Figs. 17, 18

Pollen grains 3-colporate, with mesocolpia in polar view cymbiform. In this view the grains „leaflike", extremities with cuspidate apices. Pores in the middle among the colpi. In equatorial view these grains are ovate in shape. Pores lie on the equator and are characteristically thrust outwards. Exine 1·5 μ thick and completely psilate. Dimensions of these grains in equatorial view reach from 11·5 × 15·8 μ to 16·5 × 25·0 μ.

Sporomorphs of this type have not hitherto been found in fossil state. At Rypin they are encountered fairly regularly in the middle and bottom parts of the profile.

Hamamelidaceae

Genus *Liquidambar*

Pl. XIII, Figs. 21—23

Periporopollenites stigmosus (R. Pot.) Th. & Pf.

Sporomorphs polypantoporate, from 30—40 μ in size. Pore diameter usually over 5 μ, shape round or ovate; granulate membranes in the pores. Exine surface foveolate with a tendency to form a reticulum.

Kuprianova (1960) has elaborated the history of the pollen *Liquidambar*, which is to be encountered in fossil sediments. Our sporomorphs most resemble *Liquidambar orientalis* Mill. This species occurs often in the Miocene macroscopic floras of South Poland (Łańcucka-Środoniowa 1963). In our profile the sporomorphs *Liquidambar* occur in all except the bottom parts.

Genus *Corylopsis*

Pl. XIII, Figs. 24, 25

Pollenites cribellatus Dokt.-Hreb.

Pollen grains 3-colpate, with deeply indented colpi, 28—37 μ in size. Exine fine, reticulate, 1·5 μ thick.

Pollen grains of *Corylopsis* have so far been described from the younger Tertiary from a small number of localities (Doktorowicz-Hrebnicka 1957a; Nagy 1958; Oszast 1960). In our profile they are encountered only sporadically up to 2·78%.

Magnoliaceae

Pl. XIII, Fig. 26

cf. *Monocolpopollenites areolatus* (R. Pot.) Th. & Pf.

Pollen grains monocolpate, ovate, with a thin exine, on account of which they are very often secondarily plicate; size up to 50 μ. On the surface of the grain a fine, granulate sculpture.

These forms are frequent in the European Tertiary. They have been reported, among other authors, by Raukopf (1959) from the Miocene brown coals from the locality Mallis in Mecklenburg. At Rypin these sporomorphs were found in only one sample.

Lauraceae

Pl. XIII, Fig. 27

Pollen grains nonaperturate, round, 35 μ in size. On the surface fairly densely and regularly distributed spinules, more than 1 μ long.

Grains of this type have not hitherto been found in the European Tertiary. It is true that Thomson and Pflug (1953) report sporomorphs numbered by them among the family *Lauraceae as Tricolpopollenites spinosus* (R. Pot.) Th. & Pf. but, as results from the denomination itself, they should be 3-colpate sporomorphs. This is also indicated by the figures (Thomson & Pflug 1953, Pl. 11, Figs. 165—172; Pl. 12, Figs. 1—4). However, all the present species from the family *Lauraceae* have round pollen grains and neither pores nor colpi (Erdtman 1952). Thus the determinations of Thomson and Pflug (1953) are erroneous. In our profile only one grain belonging to this family was found.

Ranunculaceae

cf. *Tricolpopollenites culleus* Wey. Pflug

Pl. XIV, Figs. 1—3

Pollen grains belonging to this family were described for the first time from the Greek Pliocene by Weyland and Pflug (1957). Our sporomorphs are 3- and 4-colpate, round in shape. In equatorial view more ovate with lateral colpi running from one pole to the other. In polar view their dimensions vary from 28 × 33 μ to 34 × 38 μ. Exine up to 2 μ thick. Sexine provided with spinuloid processus, irregularly and loosely spaced. Only the bases of spinules adhere closely one to the other.

At Rypin these forms occur only sporadically in the top part of the profile (up to 1·39‰).

Genus *Thalictrum*

Pl. XIV, Figs. 4, 5

Sporomorphs spheroidal, polypantoporate, about 17 μ in size. Pores (7—8) about 4 μ in diameter. Exine 2·5 μ thick, sexine thicker than nexine. On the surface of the grain a distinct sculpture consisting of densely placed pilae, tectate.

Pollen grains of *Thalictrum* have been described by Weyland and Pflug (1957) from the Pliocene brown coals from the locality Ptolemais in northern Greece as *Periporopollenites Ptolemais* type G. The description and illustrations of these forms given by the above-mentioned authors (Pl. 22, Figs. 21—22) show that this is another taxonomical appurtenance of them. They are 20- to 50-porate, which would rather indicate the family *Chenopodiaceae*. This has also been pointed out by Weyland, Pflug and Mueller (1960). The sporomorphs, however, shown in Pl. 22, Fig. 20 by Weyland and Pflug (1957) might correspond to the pollen grains of *Thalictrum*.

From Miocene sediments sporomorphs of *Thalictrum* have not hitherto been reported. In our profile they occur only sporadically.

Nymphaeaceae

Pl. XIV, Fig. 8

Forms numbered here resemble in their structure the sporomorphs from the family *Nymphaeaceae*. Their shape is longitudinally-ovate or round, with a characteristic sulcus in the middle. On the surface loosely distributed spines about 1·5 μ long.

In our profile these forms were encountered only sporadically.

Cruciferae

Pl. XIV, Fig. 9

Pollen grains 3-colpate, round, in equatorial view ovate, with distinct colpi running from one pole to the other parallel to the grain margin. Exine reticulate, sexine somewhat thicker than nexine. Lumina of the reticulum slightly more than 1 μ broad, muri 1·5 μ thick.

Cruciferae have not hitherto been found in the European Tertiary. In our profile they occur only sporadically.

Guttiferae?

cf. Genus *Garcinia*

cf. *Garcinia Mannii* Oliv.

Pl. XIV, Figs. 6, 7

Pollen grains 3-colporate with dimensions 21 × 15 μ in equatorial view and 18 × 18 μ in the polar one. Pores in the middle of the colpi and, in equatorial view, small and round. Colpi are, in this view, slightly pushed apart towards the margins of the grain. Exine thick, sculpture fine, indistinct.

Two grains of this species were found in our profile.

Rosaceae

Pl. XIV, Figs. 10—12

Sporomorphs 3-colporate, various in size (from 15—35 μ). Sexine thicker than nexine. Grain surface finely granulate. In equatorial view the pores and lateral colpi characteristically thrust outwards.

The morphology of pollen grains numbered among this group is somewhat varied but owing to the small quantity of them a closer determination has not been attempted.

Leguminosae

This is a family abundantly represented in our profile. As regards diversity of forms, however, it is comparatively poor.

***Leguminosae* gen. div.**

Pl. XIV, Figs. 16—21

Classed here are sporomorphs 3-colporate, 18—30 μ in size. In equatorial view the middle colpus becomes narrower in the middle. On the surface of the grains a fine sculpture.

Sporomorphs counted among the aff. *Leguminosae* have been reported from the Miocene brown coals at Konin by Kremp (1949), who compared them to *Pollenites quisqualis* R. Pot. and *Poll. fallax* R. Pot.

In our profile similar sporomorphs occur sporadically.

cf. Genus *Caragana*

Pl. XIV, Figs. 13—15

Pollen grains 3-colporate, size in polar view 15—17 μ, in equatorial view 16 × 22 μ. Colpi shallowly indented; in equatorial view distinctly seen lateral colpi with characteristically outwards thrust pores. The middle pore visible as a pointed recess of the colpus. Exine psilate.

Pollen grains of *Caragana* have not hitherto been described from the European Tertiary. In our profile these sporomorphs occur only in the lower part though in quite large quantities. They attain their maximum 13·83% in sample 77.

cf. Genus *Cassia*

Pl. XIV, Figs. 25, 26

Pollen grains 3-colporate, in equatorial view of an ovate outline; dimensions 52 × 36 μ. In the middle of the colpi pores rectangular in shape. The middle pore looks like a recess of the colpus. Sexine thinner than nexine, finely granulate on the surface.

Pollen grains of *Cassia* have not hitherto been reported from the Tertiary. At Rypin they are encountered only in two samples in the middle part of the profile.

cf. Genus *Gynometria*

Pl. XIV, Figs. 22—24

Sporomorphs 3-colporate, with very deeply indented colpi, which reach almost to the pole. Diameter of the grains in polar view 33 μ; in equatorial view polar axis shorter than the equatorial one. Exine up to 3 μ thick, sexine not as thick as nexine. Sexine subpilate to baculate.

These sporomorphs occur rarely in our profile and only in the bottom part.

Elaeagnaceae

Among the sporomorphs ranked with this family two groups belonging to two different genera can be distinguished in our material.

Genus *Hippophaë*

Pl. XIV, Figs. 27, 28

Slovakiipollis hipophaeoides Krutzsch

Pollen grains 3-colporate, spheroidal, equatorial contour triangular with slightly convex sides. Length of one side is about 25 μ. Colpi run across the pores and then towards the pole of the grain reaching almost to the pole. Exine finely granulate. Pores on the apices of the triangle on small aspides.

Pollen grains of such a type as ours have hitherto been reported only from marine sediments from Cotbus deposits from East German areas (Krutzsch 1962a). They are stratigraphically connected with the Upper Oligocene (Chattian). At Rypin they occur only in the bottom part of the profile.

cf. Genus *Elaeagnus*

Boehlensipollis hohli Krutzsch

Pl. XIV, Fig. 29

Sporomorphs 3-colporate, contour in polar view triangular with very elongated apices. In size (30—35 μ) they resemble pollen grains of the present species *Elaeagnus crispa* Thunb. Pores on aspides on the apices of the triangle. Margins of the mesocolpium concave. On the apices besides the pores also short colpi. Exine surface completely psilate or very finely granulate.

Very similar but considerably larger forms (50—60 μ) than ours have been described by Oszast (1960) from the Tortonian loams from Stare Gliwice in Upper Silesia as *Elaeagnoidites* n. spm.

These sporomorphs occur only sporadically in the bottom part (max. 2·7%).

Lythraceae

This family is represented in our material by two different types of sporomorphs belonging to two genera, of which only one could be determined, the other being doubtful.

***Decodon* cf. *globosus* (Reid) Nikit.**

Pl. XV, Figs. 6, 7

Pollen grains 3-colporate; in polar view triangular in outline, with deeply indented colpi. In equatorial view outline longitudinally ovate, 18 × 30 μ in dimensions. Colpi placed parallel one to the other along the lateral sides. Pores in the middle of the colpi round. Exine finely granulate.

Macroscopic remains of *Decodon* are often found in Tertiary floras (Szafer 1950; Bobrowska 1957; Łańcucka-Środoniowa 1957). Since Łańcucka-Środoniowa (l.c.) found at Rypin numerous fruits of *Decodon globosus* in samples where abundant pollen grains of this species were encountered, as well as in adjacent ones, these sporomorphs can, in all probability, be considered as belonging to this species.

They are encountered in quantities up to 61% in the upper part, together with sporomorphs of other water and swamp plants such as: *Sparganium*, *Potamogeton* and others.

cf. Genus *Lythrum*

Pl. XIV, Figs. 1—5

Sporomorphs 3-colporate, spheroidal. Pores always in colpi, between them pseudocolpi regularly appear. Grains from 20—30 μ in size; in polar view of rounded outline with a tendency to become more triangular, especially when pseudocolpi are well developed. In equatorial view outline ovate with dimensions of about 22 × 30 μ. Pores closed by a granulate membrane. Exine comparatively thick, sexine thicker than nexine, tectate.

Sporomorphs of *Lythraceae* have not hitherto been reported from the European Tertiary. In our profile they are encountered only sporadically in the youngest part together with other sporomorphs of water and swamp plants. They attain their maximum (1·55%) in sample 15. These sporomorphs have no stratigraphic significance but they indicate the presence of vegetation on the shore of the sedimentary basin.

Nyssaceae

Genus ***Nyssa***

Tricolporopollenites kruschi (R. Pot.) Th. & Pf.

Nyssa kruschi Nagy

Sporomorphs 3-colporate; in polar view triangularly-rounded but in equatorial view rounded or ovate. Pores in the middle of the colpi. Sexine punctate; tegillum supported by bacula.

Forms found in our profile can be divided into three groups with respect to size. They correspond more or less to the three subspecies described by Thomson and Pflug (1953).

The smallest form (Pl. XV, Figs. 8—11), 23—28 μ in size, corresponds to the subspecies *Tricolporopollenites kruschi* ssp. *analepticus* (R. Pot.) Th. & Pf.

The largest form (Pl. XV, Figs. 12, 13), 45—59 μ in size, corresponds to the subspecies *T. kruschi* ssp. *roddorensis* (Thierg.) Th. & Pf.

The third form (Pl. XV, Figs. 14, 15) of medium dimensions without a distinct demarcation might perhaps correspond to the subspecies *T. kruschi* ssp. *accessorius* (R. Pot.) Th. & Pf.

Sporomorphs belonging to the genus *Nyssa* have very often been found in European Tertiary floras from the Eocene till the Pliocene. At Rypin they are encountered regularly in the whole profile but the greatest quantities occur only in the top part of the profile (maximum 14·79%).

Myrtaceae

This family is represented in our material by three different forms belonging probably to three different genera. These forms have features of general structure in common with the whole family, differing only in some details. All sporomorphs numbered here are 3-colporate, with pores on the apices of the triangle. Pores well developed with small vestibules between sexine and nexine. Exine surface psilate or finely granulate.

Genus ***Myrtus***

Pl. XV, Fig. 18

Pollen grains of the smallest size about 18 μ in polar view. Exine surface psilate. This is the form most often encountered.

cf. Genus *Eucalyptus*

Pl. XV, Fig. 19

Pollen grains about 30 μ in size; in polar view sides of the grain concavo-convex (middle parts concave). Exine finely granulate.

In our profile it occurs only sporadically in two samples (79,97) one grain in each.

Myrtaceae ?

Pl. XV, Figs. 16, 17

Form larger than the preceding ones (up to 35 μ), with exine more distinctly granulate.

Oenotheraceae

Pl. XV, Figs. 20—22

Pollenites oculi noctis Thiergart

Numbered here are sporomorphs most resembling in their structure pollen grains of *Epilobium* or *Oenothera*. Pollen grains 3-colporate, 35—60 μ in size. In polar view contour triangular with large, crassimarginate pores on the apices of the triangle. Exine up to 5 thick, characteristically thickened at the pores and covered by a coarse granulate sculpture. The whole surface of the grain also shows a granulate sculpture but it is somewhat finer.

These sporomorphs occur in the European Tertiary rarely; from Poland they have been reported by Kostyniuk (1938), Oszast (1960), and others. In our profile they occur only sporadically.

Genus *Trapa*

Pl. XVI, Figs. 1—3

Pollen grains 3-colpate, angulaperturate; equatorial contour triangular. Lateral walls straight or slightly concave. From the apices towards the poles run characteristic 3-meridional crests formed of sexine. Grain diameter about 40 μ; exine about 4 μ thick, very finely granulate. Sculpture thicker only on the thickenings of the sexine. Pore seen from above ovate in shape, with dimensions 6 × 17 μ.

Pollen grains of *Trapa* have hitherto been reported only from the Tertiary of the U. S. S. R. by Popov (1956). In our profile one grain was found in sample 39.

Halorrhagidaceae

Among this family have been numbered 3—6-porate sporomorphs, with pores mostly on aspides formed of thickened sexine. Distribution of pores along the equator may be regular or irregular. Detailed descriptions are given with the individual forms distinguished in this family.

Genus *Myriophyllum*

Pl. XVI, Fig. 5

Pollen grains 33 μ in size, 4-porate, with pores spaced irregularly along the equator on aspides formed of sexine, which is here 3 μ thick. Breadth of the aspis together with the pore about 10 μ. Exine on the whole grain about 1·5 μ thick, sexine thinner than nexine. On the exine surface a fine sculpture composed of minute and densely placed spinuloid processes.

Sporomorphs of *Myriophyllum* have hitherto been reported only from the Pliocene by Altehenger (1959).

In our profile these sporomorphs occur only sporadically.

cf. Genus *Myriophyllum*

Pl. XVI, Fig. 4

Numbered here are sporomorphs similar to those previously described but differing from them in a larger size (about 38 μ), 5 pores, and a thicker exine.

Genus *Halorrhagis*

Among the sporomorphs numbered with this genus two forms can be distinguished, a 3-porate and a 6-porate form.

Halorrhagoidites triporatus n. spm.

Pl. XVI, Fig. 6

Pollen grains 3-porate, about 33 μ in size; equatorial contour triangular. Exine comparatively thin, less than 2 μ; pores on the apices of the triangle on not large aspides. On the whole surface of the grain a distinct sculpture composed of numerous flat verrucae up to 3 μ in diameter.

Halorrhagoidites stephanoporatus n. spm.

Pl. XVI, Figs. 7, 8

Pollen grains of smaller size (about 25 μ) than the preceding ones, 6-porate, with pores distributed uniformly along the equator. Exine of these grains thick, more than 3 μ, and in the area of the pore up to 5 μ; verrucate. Verrucae on their tops flatly truncate and lying densely one beside the other.

This type of sporomorph is to be encountered in numerous recent species of the genus *Halorrhagis;* 3-porate forms, on the other hand, are found with only a few genera.

In our profile the 3-porate form as well as the 6-porate one occurs only in two samples.

cf. Genus *Gunnera*

Pl. XVI, Figs. 9—12

Pollen grains 3-colpate, about 20 μ in size. In polar view mesocolpia very regularly arranged, with deeply indented colpi. In equatorial view grains ovate, 18 × 24 μ in dimension. Colpi arranged in similar way as with pollen grains of *Quercus* i.e. they run one beside the other parallelly from one pole to the other. Exine at the colpi slightly thicker (up to 3 μ) than in the middle of the mesocolpium. Exine surface distinctly reticulate; lumina barely 1 μ in diameter.

Sporomorphs similar to those of *Gunnera* have not hitherto been closely described in fossil state. According to oral information from Krutzsch similar sporomorphs are common in the Eocene. In our profile they occur in quite considerable quantities (maximum 6·19%) though only in the bottom part. Today this is a genus occurring in the tropical and subtropical areas of the three continents of the southern hemisphere. The occurrence of *Gunnera* in the Tertiary of Europe still requires confirmation.

Tiliaceae

Genus *Tilia*

Pl. XVI, Fig. 13

Pollenites instructus R. Pot.

Intratriporopollenites instructus (R. Pot. & Ven.) Th. & Pf.

Sporomorphs 3- colporate; in equatorial view of a round or rounded-triangular outline, with 3 pores in the equatorial belt of the grain. At the pores characteristic vestibules. Grain size about 40 μ; exine about 2 μ thick, distinctly reticulate.

According to Thomson and Pflug (1953) these forms are very rare in the older Tertiary and frequent in the middle and younger Tertiary. It cannot be excluded that some of our forms belong to the genus *Burretia*. From Neogene materials of Central and East Germany Mai (1961) has described a number of new organ species of sporomorphs belonging to the family *Tiliaceae*.

Linaceae

Genus *Linum*

Pl. XVI, Fig. 14

Pollen grains 3-colpate, round in shape; colpi very shallowly indented, size about 52 μ. Exine about 5 μ thick, baculate.

Pollen grains of this genus have not hitherto been reported from the Tertiary. In the profile Rypin II they were found in a few samples only.

Rutaceae

Sporomorphs numbered among this family are morphologically very differentiated. Some genera have been distinguished among them.

cf. Genus *Aegle*

Pl. XVI, Fig. 19

Pollen grains 4-colporate, rounded-quadrilateral; colpi fairly deeply indented but pores little visible. Size of these grains about 35 μ. All four mesocolpia equally large. Exine thick, sexine thicker than nexine, reticulate, with lumina up to 3 μ in diameter. Muri up to 2 μ high, consisting of fine bacula.

Sporomorphs of this type have not hitherto been found in fossil state. In our profile they are rare and occur only in the top part. They resemble pollen grains of the recent species *Aegle mormelos* Corr. (cf. Guinet 1962, Pl. 43) growing in India in dry forests on the plains.

cf. Genus *Evodia*

Pl. XVI, Fig. 20

Sporomorphs 3-colporate, about 25 μ in diameter. Grain surface indistinctly reticulate, which, in a properly adjusted optical section, has the appearance of densely placed, single bacula. The sporomorphs are, on the one hand, somewhat similar to the *Fagara* and, on the other, to the *Palea*. They may perhaps belong to one of these genera but it was impossible to establish this because of the scant quantity of them in our profile.

cf. Genus *Palea*

Pl. XVI, Figs. 15—18

Sporomorphs 3-colporate, about 25 μ in size. Exine very thick (up to 3·5 μ), sexine thicker than nexine (about 2 μ), on its surface distinctly reticulate, with lumina 2—3 μ in diameter. Muri more than 2 μ high, composed of loosely spaced bacula.

In our profile these forms occur only sporadically in the middle part.

Genus *Fagara*

Pl. XVI, Figs. 23—25

Pollen grains 3-colporate, with pores little accentuated; size in polar view from 22—25 μ. Exine 2 μ thick, distinctly reticulate on the surface. Lumina less than 1·5 μ in diameter.

Pollen grains of *Fagara* have not hitherto been reported from the Tertiary. In our profile they occur sporadically in various parts.

cf. Genus *Ptelea*

Pl. XVI, Figs. 26—30

Tricolporopollenites cingulum fusus (R. Pot.) Th. & Pf.

Sporomorphs 3-colporate; in equatorial view ovate in outline, dimensions 16 × 28 μ. Pores small, placed transversally to the colpi. In equatorial view lateral colpi run parallel to the grain margin, breaking and coming closer together only in the vicinity of the poles. Exine up to 2 μ thick, sexine thicker than nexine, becoming particularly thick in the area of the pores. Exine surface with a fine sculpture consisting of elongated and irregularly spaced elements.

Thomson and Pflug (1953) number this form among the old Tertiary element appearing abundantly in the older Tertiary and still regularly in the middle Tertiary. As an anemophilous plant it was, in their opinion, mostly a component of swamp forest vegetation. According to Krutzsch (1957, group 112, Pl. XV, Figs. 15—24) this group is morphologically very much differentiated and its forms probably belong to various species that are not closer known. In the opinion of this author mass occurrence of the sporomorphs belonging to this group falls within the period from the Upper Eocene till the Upper Oligocene. Sporomorphs defined as cf. *Ptelea*, from the Miocene brown coals from Morzysław near Konin have been reported by Kremp (1949), who numbered them among the group „*Rhus*”.

According to Kirchheimer (1957) macroscopic remains belonging to the genus *Ptelea* have been found only in the Oligocene. Andreánszky (1959) has reported leaves of *Ptelea* from the Hungarian Sarmatian.

In our profile pollen grains of *Ptelea* occur only in the bottom part, in quantities up to 19·38%. In the younger parts they are altogether lacking.

Recent species of the genus *Ptelea* occur in a moderately warm climate in the southern part of North America, in Central America, and in Mexico (Engler & Prantl 1896).

Rutaceae ?

Pl. XVI, Figs. 21, 22

Pollen grains 3-colporate, size about 25 μ. Exine surface reticulate, with fine lumina and muri up to 2 μ high, which, on the grain margin, have the appearance of bacula standing one beside the other.

These sporomorphs occur at Rypin only sporadically in the upper part of the profile.

In the pollen diagram all forms reckoned among the *Rutaceae* — *Ptelea* excluded — have been drawn as one curve.

Meliaceae

This family is represented in the profile from Rypin by two types of sporomorphs belonging probably to two genera.

cf. Genus *Melia*

Pl. XVII, Figs. 3, 4

Pollen grains 4-colporate; in polar view round in outline and about 28 μ in diameter. Pores about 5 μ in diameter, distributed regularly along the equator of the grain. In equatorial view grains rounded ovate in outline and of dimensions 29 × 33 μ. Exine up to 3 μ thick, on the surface finely foveolate.

Neu-Stolz (1958, Pl. 5, Figs. 18, 19) has reported a similar form from the Rhineland brown coals, numbering it generally among the *Meliaceae*. Sporomorphs from this family have also been reported by Raukopf (1959) as *Tetraporopollenites vulpinus* n. sp. Our sporomorph is, however, slightly dissimilar to that reported by Raukopt.

Genus *Toona*

cf. *Toona ciliata* M. Roem.

Pl. XVII, Figs. 1, 2

Pollen grains 4-colporate, size 17—21 μ. In polar view overlapping colpi visible. Pores small, round or slightly square. Grain surface finely foveolate.

Sporomorphs of *Toona* have not hitherto been reported from the Tertiary. In our profile they occur very occasionally in the bottom part.

Anacardiaceae

Genus *Pistacia*

Pl. XVII, Fig. 5

Pistacioidites Oszast

Sporomorphs globoid, polypantoporate, 40 μ in diameter. Pores sometimes very faintly visible. Exine fine, reticulate, reticulum somewhat more distinct in the pore area.

These sporomorphs were described for the first time from the Tertiary by Oszast (1960) from the Tortonian loams from Stare Gliwice in Upper Silesia.

At Rypin they occur only sporadically in various parts of the profile.

Genus *Rhus*

***Rhus* cf. *typhina* L.**

Pl. XVII, Figs. 11—14

Pollen grains 3-colporate; in equatorial view ovate, dimensions 34×45 μ. Colpi run from one pole to the other parallel to the grain margin, approaching one another in the pole area. Pores developed in the shape of laesurae 2×13 μ in dimensions, arranged transversally to the colpus. Exine about 2 μ thick, very distinctly reticulate on the surface. Lumina ovate, about 1·5×2·5 μ in dimension, arranged in characteristic oblong striae.

These sporomorphs occur in our profile only sporadically.

***Rhus* sp. div.**

Pl. XVII, Figs. 8—10

Rhooidites pseudocingulum R. Pot.

Tricolporopollenites pseudocingulum (R. Pot.) Th. & Pf.

Tricolporopollenites dolium (R. Pot.) Th. & Pf.

Numbered here are 3-colporate sporomorphs in general similar to each other and having the features of pollen grains of *Rhus* or more generally of the *Anacardiaceae,* which, however, were not very closely determined in our profile because of their insignificant quantities. These are grains of various dimensions, from 29×23 μ to 38×33 μ. Pores spaced transversely to the colpi, considerably shorter than the pores of the preceding species (up to 10 μ). Exine sculpture also finer.

These sporomorphs are found very often in the European Tertiary especially in the middle Tertiary. From Poland they have been reported, among others, by Doktorowicz-Hrebnicka (1957c) and Oszast (1960).

In the pollen diagram all sporomorphs of the genus *Rhus* have been drawn together in one curve.

Sapindaceae

cf. Genus *Sapindus*

Pl. XVII, Figs. 6, 7

Pollen grains 3-colporate; contour in polar view triangular. Pores on the apices of the triangle in broad, as it were, excisions, like pincers in shape. Sides of this triangle concave but pores large, ovate 7×10 μ in dimension. Pores on the outside closed by exine projections. Equatorial axis of the grain longer than the polar one, hence grains flattened and always found in polar view. Sexine thicker than nexine, on its surface a fine, indistinct sculpture. Size of these sporomorphs about 25 μ.

Pollen grains of *Sapindus* have not hitherto been reported from the Tertiary. In our profile they occur only sporadically in the top part.

Aceraceae

Genus *Acer*

Pl. XVII, Figs. 15, 16

Pollen grains 3-colpate, colpi very deeply indented. Apocolpium diameter barely about 5 μ. Size of whole grains from 28—44 μ. Exine 2 μ thick, on its surface granulate with elements arranged in lirae.

Sporomorphs of *Acer* are frequent in the European Tertiary. They have been reported by, among others, Altehenger (1959) from the German Pliocene and by Nagy (1958) from the Hungarian Pliocene. From Poland these sporomorphs have been described by Oszast (1960) from the Tortonian from Stare Gliwice in Upper Silesia.

In the profile Rypin II pollen grains of *Acer* occur occasionally (below 1%) in various parts.

Aquifoliaceae

Genus *Ilex*

Tricolporopollenites iliacus **(R. Pot.) Th. & Pf.**

Pl. XVII, Figs. 17—20

Pollenites iliacus R. Pot.

Pollen grains 3-colporate; in polar view rounded in outline, in equatorial view ovate. Depending on the size of the grains two forms can be distinguished here:

f. *major* Th. & Pf. (Pl. XVII, Figs. 18—20) over 45 μ in size. On the whole surface clavae 3—4 μ long and about 3 μ in diameter, somewhat longer in the polar area than on the equator. This form is the rarest one in our sediment.

f. *medius* Th. & Pf. (Pl. XVII, Fig. 17); size less than 45 μ, apart from which it does not differ from the preceding form. This form is the most frequent one in our sediment.

Tricolporopollenites margaritatus (R. Pot.) Th. & Pf.

Pl. XVII, Figs. 21, 22

Pollenites margaritatus R. Pot.

These sporomorphs are approximate to the *Tricolporopollenites iliacus* forma *major* in their shape and size but they differ from them in the character of the sculpture on the grain surface, which is baculate. Bacula only up to 3 μ long, less than 1 μ in diameter.

In our profile such grains are rather rare.

In the quantitative table these two organ species are given separately, whereas in the pollen diagram they have been drawn together in one curve.

Sporomorphs of the genus *Ilex* are regularly found in the Tertiary.

Staphylleaceae

Genus *Staphyllea*

Pl. XVIII, Figs. 7—10

Pollenites perexpressus Dokt.-Hrebn.

Sporomorphs oblongo-ovate, 3-colporate, dimensions in equatorial view 52×32 μ. In polar view mesocolpia very rounded and deeply indented. Pores in the middle of the colpi and transversely elliptic in shape, 5 × 6 μ in diameter. Exine reticulate, with lumina smallest in the equator (about 1 μ) and becoming larger towards the poles where their diameter reaches up to 3 μ. Size of the muri also largest at the poles (1·5 μ) while on the equator they barely reach a height of 1 μ.

Sporomorphs of *Staphyllea* have hitherto been found only in a few Tertiary floras. From Poland from the Middle Miocene they have been described by **Doktorowicz-Hrebnicka** (1957b, c). From the Slovakian Miocene they have been reported by **Planderova** (1961).

Cyrillaceae

Numbered here are 3-colporate sporomorphs, from 23—35 μ in size, psilate on the surface or finely granulate. In polar view exine from the individual mesocolpia overlaps the pores and forms very characteristic projections. Among the sporomorphs numbered with this family three different forms belonging to two genera can be distinguished.

Genus *Cyrilla*

Cyrilla cf. *racemiflora* L.

Pl. XVII, Fig. 26

Pollen grains 3-colporate, about 23 μ in size. In polar view mesocolpia separated one from the other by broad and deeply indented colpi. The indentation reaches deeper than half the area between the equator and the pole. Apocolpium diameter about 10 μ. In polar view exine overhanging the margin of the colpi is to be seen, which forms characteristic eaves above the pores and colpi. In equatorial view the lateral colpi deviate considerably towards the outside of the grain. Grain surface almost completely psilate or with a very fine, granulate sculpture.

Our form most resembles that of *Cyrilla barghoorniana* sp. nov. reported by Traverse (1955, Pl. 10, Figs. 69—71, cf. page 56, 57) from the lignite layers at the locality Brandon in North America and it resembles the recent species *Cyrilla racemiflora* L. This species grows nowadays in swamp cypress forests on the Atlantic shores of North America. These sporomorphs are encountered sporadically in our profile in various parts.

Cyrilla sp. 1

Pl. XVIII, Fig. 6

Sporomorphs larger than the preceding one (35 μ) with colpi not deeply indented (up to 1/4 of the radius), hence diameter considerably greater (over 20 μ). Exine overlaps the colpi only slightly. Exine surface psilate.

These sporomorphs are most frequent in the bottom part of our profile.

cf. Genus *Cliftonia*

Pl. XVII, Figs. 23—25

Pollen grains 3-colporate, about 20 μ in diameter. In polar view the characteristic for the *Cyrilla* exine overhanging the colpi is not to be seen, but in the pore area a separation of the sexine from the nexine becomes marked. Colpi deeply indented but less than with *Cyrilla*. In equatorial view lateral pores together with the colpi thrust out towards the margins of the grain. Exine surface psilate.

These sporomorphs are most frequently encountered in the bottom of the profile.

Cyrillaceae?

Pl. XVIII, Figs. 1, 2

Pollenites cingulum brühlensis Thomson

Tricolporopollenites cingulum brühlensis Th. & Pf.

Pollen grains 3-colporate, size about 16 μ, in polar view round in outline. Equatorial axis considerably elongated in relation to the polar one. Pores in the equator of the grain characteristically thrust out towards the margins. Exine completely psilate.

These sporomorphs are quite often encountered in the younger and the middle Tertiary; at Rypin only sporadically.

Cyrillaceae-Clethraceae

Pl. XVIII, Figs. 3—5

Numbered here is a group of sporomorphs that could not be closer determined. These are 3-colporate sporomorphs, from 30—35 μ in size. In polar view round in outline with three uniformly disposed pores. In the pore area and sometimes also on the whole surface, sexine separate from the nexine forming as it were a double membrane. In equatorial view the grain ovate with colpi and pores thrust out towards grain margins. Grain surface psilate or fine granulate.

These sporomorphs resemble, on the one hand, *Pollenites cingulum brühlensis* Th. (Potonié, Thomson & Thiergart 1950, Pl. B, Figs. 31—33) described by Thomson, but, on the other, *Pollenites pseudolaesus* R. Pot. There is also a certain resemblance to pollen grains from the family *Clethraceae* (cf. Traverse 1955, Pl. 12, Figs. 106, 107). In our profile they are encountered mostly in the younger section of the bottom part.

In the pollen diagram all forms numbered among these two families have been drawn in one curve; in the quantitative table, however, they are presented separately.

Rhamnaceae

Pl. XVIII, Figs. 11—13

Tricolporopollenites haanradensis Manten

Pollen grains 3-colporate, 15—20 μ in size; in polar view outline rounded to triangular, with not very convex sides. In equatorial view lateral pores in the middle of the colpus deflected almost to the very margin of the grain. Exine surface reticulate, lumina irregular. Grains with a less distinct sculpture and more triangular in shape slightly resemble sporomorphs of the present-day genus *Ceanothus*.

Sporomorphs of *Rhamnaceae* are very rarely found in the Tertiary. From Poland they have been reported by Oszast (1960) from the Tortonian loams from the locality Stare Gliwice in Upper Silesia. In our profile pollen grains *Rhamnaceae* are encountered only sporadically.

Vitaceae

Genus *Vitis*

Pl. XVIII, Figs. 14—17

Pollen grains 3-colporate, in polar view triangular in outline and about 15 μ in size. Pores small, placed in the middle of the colpi which become elongated towards the poles. In polar view pores visible in small hollows on the apices of the triangle. Exine finely reticulate, heterobrochate.

Pollen grains of *Vitis* occur in Tertiary sediments very seldom. They have been reported from the Hungarian Pliocene by Nagy (1958). In our profile these sporomorphs are encountered only sporadically in various parts.

Genus *Parthenocissus*

Pl. XVIII, Figs. 18, 19

Tricolporopollenites marcodurensis (Pf. & Th.), Th. & Pf.

Pollen grains oblongo-ovate, 3-colporate, in polar view dimensions from 30×45 μ to 28×48 μ. Lateral colpi parallel one to the other, only near the poles they bend and approach each other. Pores in the middle of the colpi very regular, round, about 4 μ diameter. Exine about 3 μ thick; sexine thicker than nexine, reticulate; lumina small, muri thick.

Our forms strikingly resemble grains of *Parthenocissus* reported from the Pliocene from the locality Wallensen by Altehenger (1959, Pl. 5, Figs. 25, 26). In this author's opinion this genus occurs where there is a massive share of the *Taxodiaceae*. Apart from this, these sporomorphs have no stratigraphic significance and are seldom found in the Tertiary e.g. in the Upper Oligocene — in the Miocene at the locality Eschweiler in the Rhineland (Thomson & Pflug 1953), and in the Yugoslav Miocene at the locality Velenje (Weyland, Pflug, Pantič 1958). In the Rypin sediment they occur very rarely.

Cornaceae

This family is represented in the pollen material of the Rypin profile by two forms belonging probably to two species of the genus *Cornus*.

Genus *Cornus*

Cornoidites major n. spm.

Pl. XIX, Figs. 1—4

Pollen grains 3-colporate; in polar view triangular in outline. Individual mesocolpia with straight margins becoming rounded only on the apex of the triangle in the vicinity of the pores. Colpi fairly broadly and deeply indented to $^4/_5$ of the radius between the equator and the pole of the grain. Apocolpium diameter about 10 μ. In polar view grains from 50—60 μ in size. In equatorial view these sporomorphs are rounded-rhomboidal in outline, dimensions 40× 50 μ to 60×60 μ. Lateral colpi run from one pole to the other deviating very much one from the other at the equator where the distance between two pores amounts to 40 μ. Pores in the middle of the colpi set transversally to them. Shape of the pores more or less rectangular, dimensions 7×15 μ. Exine 4—5 μ thick, sexine thicker than nexine, retipilate.

These sporomorphs occur sporadically in our sediment.

Cornoidites minor n. spm.

Pl. XIX, Figs. 5—7

Pollen grains 3-colporate; in polar view rounded-triangular in outline. Mesocolpia with slightly rounded margin. Colpi deeply indented towards the pole. Apocolpium diameter barely 5 μ, diameter of whole grains 27 μ. In equatorial view grains ovate, at the poles flattened. Length of the polar axis 23 μ, that of the equatorial one 28 μ. In equatorial view lateral colpi running from one pole to the other strongly thrust out towards the grain margin. Exine 2 μ thick, sexine thicker than nexine, on the surface finely and irregularly granulate.

These sporomorphs are very rarely found in our profile.

Araliaceae

cf. Genus *Aralia*

Pl. XVIII, Figs. 25—29

Pollenites euphorii R. Pot.

Tricolporopollenites euphorii (R. Pot.) Th. & Pf.

Pollen grains in polar view triangularly rounded in outline, 27—43 μ in size. Colpi fairly deeply indented and often crosswise imbricate. In equatorial view grain ovate in outline with distinctly visible lateral colpi and pores, dimensions from 25×33 μ to 38×48 μ. Exine on its surface verrucate. Verrucae up to 3 μ in diameter.

Similar sporomorphs have very often been described from the Tertiary. They are encountered in the middle Tertiary as well as in the younger Tertiary (Thiergart 1940; R. Potonié, Thomson and Thiergart 1950; Thomson and Pflug 1953). In the Pliocene they occur only rarely (Altehenger 1959). From Poland they have been reported by, among others, Oszast (1960) from the Tortonian loams from Stare Gliwice in Upper Silesia.

In our profile they occur regularly in various parts, reaching their maximum in the bottom samples (4·82%).

Genus *Polyscias*

Pl. XVIII, Figs. 20—24

Pollen grains 3-colporate, in polar view rounded-triangular in outline, 28—31 μ in size. Colpi very deeply indented, almost reaching the pole. In equatorial view grains ovate in outline, dimensions 26×35 μ. Colpi with pores in the middle are at the equator very much thrust out towards the grain margins. Exine about 2·5 μ thick, sexine thicker than nexine, surface distinctly reticulate with lumina more than 1 μ broad.

These sporomorphs have not hitherto been found in the Tertiary. At Rypin they occur only in the bottom part of the profile and in small quantities.

Araliaceae — *Cornaceae*

Pl. XIX, Fig. 8

Tricolporopollenites edmundi (R. Pot.) Th. & Pf.

Pollenites edmundi R. Pot.

Pollen grains 3-colporate; in equatorial view ovate in outline, dimensions 32×51 μ to 37×49 μ. Exine thick, surface baculate.

Similar sporomorphs are often found in Tertiary floras. They occur regularly in the middle Tertiary (Thomson and Pflug 1953) but are also to be encountered in the Pliocene e.g. at Wallenhausen (Altehenger 1959). From Poland they have been reported by, among others, Doktorowicz-Hrebnicka (1954, 1957b, c) and Oszast (1960).

In our profile these sporomorphs occur in small quantities in various parts.

In the pollen diagram all sporomorphs from the families *Cornaceae* and *Araliaceae* have been shown together.

Umbelliferae

Pl. XIX, Fig. 9

Pollen grains 3-colporate; in equatorial view outline ovate but contracted in the middle, dimensions 10 × 20 μ. Exine up to 2 μ thick, finely granulate.

Sporomorphs of *Umbelliferae* are known only from the Pliocene (Leschik 1951; Nagy 1958). In our profile they occur sporadically.

Pirolaceae

Pl. XIX, Figs. 10, 11

Pollen grains large, appearing always in tetrads of dimensions about 40 μ. Exine up to 3 μ thick, on its surface finely verrucate. Where the individual grains touch in the tetrad there are none of the colpi which constitute a characteristic feature of pollen grains from the family *Ericaceae*.

These sporomorphs have not hitherto been reported from the Tertiary. They occur in our profile only sporadically in its middle and bottom parts.

Ericaceae

Pl. XIX, Figs. 14, 15; Pl. XX, Figs. 1, 2

Pollenites callidus R. Pot.

Pollenites ericus R. Pot.

Tetradopollenites callidus (R. Pot.) Th. & Pf.

Tetradopollenites ericius (R. Pot.) Th. & Pf.

Tetradopollenites concubinatus Manten

Sporomorphs numbered among this family certainly belong to numerous species and various genera, which, however, have not been closer determined. Pollen grains always united in tetrads; size of the whole tetrad from 25—37 μ. Individual grains possess pores and colpi at the contact places in the tetrad. Exine generally with a granulate sculpture on its surface.

These sporomorphs are found regularly in the Tertiary in various periods. In our profile they also occur regularly in all samples reaching their maximum (9·16%) in the middle part.

Genus *Rhododendron*

Pl. XIX, Figs. 12, 13

Pollen grains showing structure similar to those previously described but of considerably larger dimensions of the tetrads (from 45—55 μ), a coarser sculpture, and exine thickened at the pores; strikingly similar to pollen grains of the present-day genus *Rhododendron*.

These sporomorphs were found in the profile from Rypin only sporadically in a very low percentage (up to 1%).

Styracaceae

Genus *Styrax*

cf. *Styrax philadelphoides* Perkins

Pl. XX, Figs. 3, 4

Pollen grains 3-colporate, about 40 μ in size, round in shape. In polar view they have the outline of a triangle with broadly rounded apices. Pores lying in deeply indented colpi. In equatorial view lateral colpi broadly parted towards the grain margins. Exine about 2 μ thick, sexine as thick as nexine, surface baculate.

These sporomorphs have not hitherto been described in fossil state. In our profile they occur only sporadically in the bottom part.

Symplocaceae

Genus *Symplocos*

Pollenites vestibulum R. Pot.

Symplocos pollenites vestibulum clarensis (R. Pot.) Thiergart

Porocolpopollenites vestibulum (R. Pot.) Th. & Pf.

From the sporomorphs numbered with this genus three different forms have been distinguished, a closer determination of which has, however, not been possible.

***Symplocos* sp. 1**

Pl. XX, Fig. 5

Pollen grains 3-colporate; in polar view rounded-triangular in outline, about 37 μ in size. Colpi indented to $^1/_3$ of the radius from equator to pole. Vestibules at the pores very small. Exine about 2 μ thick, surface psilate or very finely granulate.

This form resembles that reported by Neu-Stolz (1958, Pl. 6, Fig. 35).

***Symplocos* sp. 2**

Pl. XX, Figs. 6, 7

Pollen grains 3-colporate; in polar view triangular in outline and 32 μ in size. Colpi indented to barely $^1/_4$ of the radius between equator and pole. Exine 1—1·5 μ thick, distinctly granulate on its surface. Vestibules at the pores comparatively large.

Similar forms are shown by Neu-Stolz (1958) in Pl. 6, Fig. 34.

***Symplocos* sp. 3**

Pl. XX, Figs. 8, 9

Pollen grains 3-colporate, triangular, with large vestibules and almost invisible colpi; size from 26—38 μ.

Similar forms are defined by Thiergart (1940, Pl. 7, Figs. 12, 13; pls. 12, 17, 18) as old Tertiary ones (alttertiäre Formen).

In the profile from Rypin the sporomorphs *Symplocos* occur in small quantities in various parts. Old Tertiary forms occur only at the bottom of the profile.

Sapotaceae

Sapotaceoidae-pollenites manifestus R. Pot.

Pl. XX, Figs. 10—15

Pollen grains 4-colporate; in equatorial view from 25—41 μ (most often 25—30 μ) long. In polar view these sporomorphs show the outline of a quadrilateral with rounded corners. Pores in the middle of the colpi quadrangular in shape. Exine up to 2 μ thick, on its surface completely psilate.

Sapotaceoidae-pollenites micromanifestus Thomson

Pl. XX, Figs. 16, 17

Pollen grains differing from the preceding one in smaller dimensions (longer axis up to 25 μ) and the presence of only three pores and three colpi.

Triporate pollen grains of the *Sapotaceae* have also been reported by Hunger (1953) from the Upper Oligocene of the Zittau basin.

In the paper of Thomson and Pflug (1953) the artificial systematics of sporomorphs from the family *Sapotaceae* are very extended. Our sporomorphs have not, however, been closer determined.

The *Sapotaceae* are considered by Thomson (1949) as an old Tertiary element that played a great part in the Upper Oligocene.

In the profile from Rypin the sporomorphs *Sapotaceae* are encountered only in the bottom part. They do not occur in large numbers, but in a great variety of forms.

Solanaceae

Pl. XX, Figs. 18—20

Pollen grains 3-colporate; mesocolpia in polar view round. Among them broad indentations with pores in them. Shape of the pores rectangular; they are placed transversely to the colpus. In equatorial view the polar axis shorter (25 μ) than the equatorial one (34 μ). Exine on its surface reticulate with lumina tangentially elongated, forming characteristic striae.

To the present author's knowledge these sporomorphs have not hitherto been described from the Tertiary. In our profile they occur only in the bottom part.

Bignoniaceae

cf. Genus *Markhamia*

Pl. XX, Figs. 21, 22

Pollen grains 3-colporate; in polar view round-triangular in outline. Pores on the apices and broadly obtuse. Grain diameter in polar view about 45 μ; in equatorial view grains ovate with dimensions 25×42 μ.

Lateral colpi parallel to the grain margin. Exine reticulate, lumina small, muri thick.

When comparing our sporomorphs with preparations of the recent species *Tecoma stans* Juss. many common features can be seen but our form is more similar to pollen grains of *Markhamia* (cf. Atlas of pollen grains of China, Pl. 18, Fig. 4, Wang Fu-Hsung 1960).

Pollen grains from this family have not, to the present author's knowledge, hitherto been reported from the Tertiary. In our profile only two grains were found in sample 87.

Acanthaceae

cf. Genus *Barleria*

Pl. XX, Fig. 23

Pollen grains 3-colpate; colpi very little indented, grain size up to 65 μ. Exine about 10 μ thick; sexine as thick as nexine, surface reticulate; lumina diameter 4 μ. Muri consisting of bacula densely placed one beside the other sometimes more than 5 μ long.

To the present author's knowledge, sporomorphs of such a type have not hitherto been described in fossil state. At Rypin only two grains were found in two samples.

Verbenaceae

cf. Genus *Vitex*

Pl. XXI, Fig. 1

Pollen grains 3-colpate; in polar view round in outline and in equatorial view rounded-ovate, about 25 μ in size. Mesocolpia in polar view broadly rounded, colpi somewhat imbricated. Exine about 2 μ thick, sexine thicker than nexine, verrucate. Verrucae unequal in size, less than 1 μ in diameter.

Pollen grains of the *Verbenaceae* have not, to the author's knowledge, hitherto been reported from the Tertiary. In the profile from Rypin they occur only sporadically.

Labiatae

Pl. XXI, Figs. 2—4

Numbered here are pollen grains that are mostly 3-colpate, with equal mesocolpia and deeply indented colpi. Size of the grains from 29—45 μ. Exine about 2 μ thick, sexine thicker than nexine, surface distinctly reticulate, lumina differ according to various forms. Beside 3-colpate grains there have also been found, though much less often, 4-colpate forms having unequal mesocolpia and a far finer reticulum on the surface.

These forms slightly resemble pollen grains from the family *Berberidaceae* (Pl. XXI, Fig. 4).

Sporomorphs of *Labiatae*, though slightly different from ours, have been reported from the Hungarian Pliocene by Nagy (1958). Forms like ours have not hitherto been reported from the Tertiary. At Rypin pollen grains of the *Labiatae* occur rarely, although they are morphologically differentiated into various forms.

Plantaginaceae

Genus *Plantago*

***Plantago „major"* L. type**

Pl. XXI, Figs. 5—6

Pollen grains polypantoporate; rounded-quadrilateral, diameter about 23 μ. Exine about 2 μ thick, sexine thicker than nexine, distinctly verrucate.

Plantago has not hitherto been found in Tertiary formations. In our profile pollen grains of this genus are encountered in only three samples.

Apocynaceae

Genus *Apocynum*

Pl. XXI, Fig. 7

Pollen grains occur in fours in a tetrad with dimensions 20 × 32 μ. Individual grains in the tetrad not equal in size, each having a distinct pore surrounded by an annulus. Size of the pores, annulus excluded, about 2·5 μ. Exine 1·5 μ thick, sexine thicker than nexine; on the surface faintly baculate, thickened round the apertures.

Our sporomorph most resembles the present-day species *Apocynum venetum* L. (cf. Atlas of pollen grains of China, Wang Fu-Hsung 1960, Pl. 12, Fig. 1.).

These sporomorphs have not hitherto been reported from the Tertiary. In our profile they occur in only one sample.

Oleaceae

Genus *Forsythia*

Pl. XXI, Figs. 8—11

Pollen grains 3-colporate; in polar view round in outline, size about 33 μ. Exine about 2·5 thick, sexine slightly thicker than nexine. Grain surface reticulate, lumina large (diameter up to 3 μ), muri thin.

Pollen grains of *Forsythia* have not hitherto been described from the Tertiary. According to Thiergart (R. Potonié, Thomson, Thiergart 1950) *Forsythia* may have occurred in the Tertiary.

In our profile three grains of this type were found in one sample.

cf. Genus *Fraxinus*

Pl. XXI, Figs. 14—17

Pollen grains 3-colporoidate, with rounded mesocolpia; from 17—23 μ in size. Exine quite thick (more than 3 μ, muri included), surface reticulate, lumina vary in size (heterobrochate) up to 2·5 μ. Muri about 1·5 μ high, simplibaculate.

Pollen grains of *Fraxinus* are not often reported from the Tertiary. From the Hungarian Pliocene they have been reported by Nagy (1958). In our profile they occur only sporadically.

Porocolpopollenites rotundus (R. Pot.) forma *reticulata* n. spm.

Pl. XXI, Figs. 12, 13

This is a sporomorph similar to the *Pollenites rotundus* described by Potonié (1931) but it is distinctly reticulate on its surface. A psilate form has been reported by Kremp (1949) from the Miocene brown coals from Konin (Pl. 5, Fig. 46). These are 4-porate grains, about 27 μ in size. Pores distributed in the equatorial zone of the grain, somewhat deep set, outwardly communicating only by very thin canalliculi. Shape of these pores round, diameter about 3 μ. Exine thin, not much more than 1 μ, reticulate, lumina 1—2 μ in diameter.

These grains seem to belong to some genus from the family *Oleaceae*, but it was not possible, however, to establish more exactly their systematical appurtenance. These forms were encountered rather seldom in our profile and mainly in the top part.

Rubiaceae

Pl. XXI, Figs. 18, 19

Pollen grains 4-colporate, in the shape of a rounded quadrilateral, size about 22 μ. Pores distributed in the equator of the grain, ovate in shape, with dimensions 2×3 μ, set transversely to the colpus. Exine up to 2 μ thick, sexine thicker than nexine, finely reticulate; lumina slightly less than 1 μ in diameter.

These sporomorphs are somewhat similar to the present-day species *Kadna formosa* Hillebr. (cf. Selling 1946, Pl. 44, Figs. 692—694).

Grains of this type have not hitherto been described from the Tertiary. In our profile they are very rare.

Caprifoliaceae

Genus *Viburnum*

Pl. XXI, Figs. 20—22

Pollen grains 3-colporate, ovate, dimensions in equatorial view 20×27 μ. Pores in the equatorial level, small (diameter less than 2 μ) and round. Exine about 3 μ thick, sexine thicker (2 μ) than nexine, surface reticulate; lumina diameter 1 μ.

Pollen grains of *Viburnum* have hitherto been reported from only a few Tertiary stations. From Poland they were reported by Kremp (1949) from the Miocene brown coal at Konin, from the Middle Miocene of Holland by Manten (1958) under the organ denomination *Tricolporopollenites eureticulatus* n. sp., and from the Pliocene at Wallensen by Altehenger (1959). In our profile these sporomorphs occur only sporadically in the middle part.

Genus *Lonicera*

Pl. XXII, Fig. 2

Pollen grains 3-colporate, round in shape, size about 50 μ. Exine very thick (up to 5 μ), multilayered; on its surface a sculpture consisting of many elements. The whole optical section of the sculpture is shown in the appended photographs. Descending from the top there are first seen on the grain surface single, loosely scattered spinules that do not exceed 1 μ in height. Among the spinules there is a granulate sculpture consisting of fine elements lying very close one to the other. Deeper in a reticulum can be seen and below it densely set baculae merged one with the other.

Similar sporomorphs described as *Lonicerapollis gallwitzi* Krutzsch are known from numerous Lower Miocene and Middle Miocene stations from East Germany (Krutzsch 1962a), besides that reported from the Miocene and Upper Oligocene of the U.S.S.R. (Čigurjaeva 1956; Pokrovskaja 1956). According to Krutzsch (1962a) pollen grains of *Nelumbo jamaicensis* DC, type described by Macko (1957) also belong to *Lonicerapollis gallwitzi* Krutzsch.

At Rypin pollen grains of *Lonicera* occur only sporadically.

Besides the above-described sporomorphs grains were found in the sediment from Rypin also belonging to *Lonicera* but probably to a different species from the preceding ones (Pl. XXI, Fig. 24). These grains differ from the preceding form in a somewhat larger size (55 μ), a more triangular shape, larger pores, and a thinner exine.

cf. Genus *Lonicera*

Pollen grains 3-colporate; triangularly-rounded in outline, size up to 110 μ. Pores up to 15 μ in diameter on the apices of the triangle. Exine comparatively thin (up to 3 μ) with a considerably finer sculpture composed of spinules placed not too densely one beside the other; deeper in sculpture granulate.

Pollen grains of this type were found very rarely in the sediment from Rypin.

Genus *Diervillea*

Pl. XXI, Fig. 23

Pollen grains 3-colporate; in polar view triangular in outline, about 70 μ in size. Pores on the apex of the triangle. Exine at the pores slightly elevated, 2·5 μ thick, on its surface rather loosely distributed spines, sometimes more than 5 μ long and 1—5 μ broad at the base. Spines, narrowed and rounded at the top do not all protrude straight in one plane but are bent in various directions. Below the spines there is a dense, granulate sculpture.

Pollen grains of *Diervillea* have been reported from Poland from several Tertiary localities. Doktorowicz-Hrebnicka (1957a, 1960) describes these sporomorphs as *Pollenites spinosus* Dokt.-Hrebn. They are also known from numerous Tertiary localities of the U. S. S. R. (Pokrovskaja 1956).

In the sediment from Rypin pollen grains of *Diervillea* are rarely found.

Valerianaceae

Pl. XXII, Fig. 4

Pollen grains 3-colpate; in polar view round in outline, mesocolpia separated by broad colpi, size about 60 μ. Colpi reach up to $^1/_3$ of the radius from the equator to the pole. Exine about 5 μ thick, sexine thicker than nexine. Tegillum provided with spinules, supported by thin bacula. Spinules 2 μ high, 5 μ in diameter at the base.

Pollen grains of this type have not hitherto been reported from the Tertiary. In our profile they were found in only two samples.

Campanulaceae

cf. Genus *Phyteuma*

Pl. XXII, Fig. 3

Pollen grains 3-porate, round, about 35 μ in size. Pores 7 μ in diameter, unformly distributed on the equator. Exine 3 μ thick, sexine thicker than nexine. Exine surface rarely but regularly spinulate; tegillum supported by very small bacula.

This type of sporomorphs has not hitherto been reported from the Tertiary. In the sediment from Rypin only one grain belonging to this genus was found.

Compositae

Genus *Centaurea*

***Centaurea cyanus* L. type**

Pl. XXII, Figs. 9—11

Pollen grains 3-colporate; in polar view triangular in outline, with apices slightly rounded and straight sides. Pores in the middle of the lateral sides of the triangle. In equatorial view these grains are broadly elliptical in shape, dimensions 31×45 μ. Pores rectangular, dimensions 4 × 12 μ, set transversally to the colpus. Exine thickest in the middle part of the mesocolpium (7—10 μ) and thinnest at the poles (3—4 μ), with small verrucate processes; tegillum supported by bacula merged densely one with the other. Bacula highest in the middle of the mesocolpium.

Among the species reported by Wagenitz (1955) and belonging to this type, most similar to ours are pollen grains of *Centaurea depressa* M. B. growing nowadays in Asia Minor.

Pollen grains of *Centaurea cyanus* type have not hitherto been reported from the Tertiary. In the sediment from Rypin they are mainly encountered in the middle part of the profile where they attain a maximum 9·09%.

Genus *Artemisia*

Pl. XXII, Fig. 5

Pollen grains 3-colporate; dimensions in polar view about 20×22 μ. Exine thickest (up to 4 μ) in the middle of the mesocolpium and becoming thinner towards the colpi. On the grain surface a reticulum with small lumina.

Pollen grains of *Artemisia* are infrequent in the Tertiary. Hitherto they have been known only from the Hungarian Pliocene (Nagy 1958) and the German Pliocene (Leschik 1951).

Compositae* subfam. *tubuliflorae

Pl. XXII, Fig. 6

Pollen grains 3-colporoidate, round, about 25 μ in size. On the exine surface numerous spinules up to 3 μ long, not pointed at the top but narrowed, broadening at the base.

This type of sporomorph is described as *Pollenites echinatus* R. Pot. & Ven. Leschik (1956) describes two forms belonging to *Compositae tubuliflorae: Pollenites multispinosus* n. sp. and *P. latispinosus* n. sp.

Compositae subfam. *liguliflorae*

Pl. XXII, Figs. 7, 8

Pollen grains 3-colporate, round, 35—45 μ in size. Exine very thick (with muri included, up to 10 μ). Sexine reticulate, thickened; among the thickenings lumina are seen. Exine surface covered by numerous spinules unequal in size.

Pollen grains belonging to these two types occur occasionally in our profile in various parts, most often in the middle one.

In the pollen diagram all forms belonging to the *Compositae* are drawn together except *Centaurea cyanus* type.

MONOCOTYLEDONES

Butomaceae

Genus *Butomus*

Pl. XXII, Figs. 12, 13

Pollen grains rounded-ovate in shape, dimensions 40×45 μ. Exine about 2 μ thick, sexine thicker than nexine; on the surface reticulate. Lumina diameter from 1—4 μ. Muri about 1·5 μ high. On the grain surface frequently secondary plicae.

Pollen grains of *Butomus* have been described by Doktorowicz-Hrebnicka (1957a) from the Pliocene as *Butomus-Pollenites monocolpatus* f. nov.

At Rypin they occur only in the top part of the profile and in small quantities.

Potamogetonaceae

Genus *Potamogeton*

Pl. XXII, Figs. 14, 15

Pollen grains ovate, dimensions about 38×50 μ. Exine thin, reticulate, heterobrochate and with fine lumina.

Pollen grains of *Potamogeton* are not often found in the Tertiary. From Poland sporomorphs belonging to *Potamogeton* or *Sparganium* have been reported from various stations by Doktorowicz-Hrebnicka (1957a, 1961).

At Rypin these sporomorphs are encountered particularly often in the top part of the profile.

Liliaceae

cf. Genus *Tulipa*

Pl. XXII, Figs. 16, 17; Pl. XXIII, Fig. 1

Pollen grains monocolpate, lengthwise ovato-lanceolate with a characteristic colpus running along the whole length of the grain on the distal side. This colpus is always parallel to the convex grain wall. The other grain wall is quite straight or slightly concave. The dimensions of these grains vary greatly, the longer axis having 35—85 μ, the shorter one barely 20—33 μ. Exine up to 2·5 μ thick in the smallest as well as in the largest grains; sexine thicker than nexine. Exine finely reticulate; lumina very fine, less than 1 μ diameter. Muri approximately the same thickness.

Pollen grains of *Tulipa* have not hitherto been described from the Tertiary. At Rypin they appear sporadically in various parts.

Restionaceae

Pl. XXIII, Figs. 2, 3

Pollen grains monoporate, spheroidal-ovoid, about 40 μ in size. On the distal side a pore of dimensions ± 20×8 μ, with jagged margin. Exine about 1·5 μ thick, sexine as thick as nexine with numerous, regularly distributed and fine scrobiculi.

Our grains are most similar to the recent species *Hypolaena lateriflora* Benth. Sporomorphs resembling ours have been described by Erdtman (1960b) from the English Oligocene, from the locality Milford, under the denomination *Milfordia*. They are also known from the Upper Oligocene from New Zealand (Couper 1960). Krutzsch (1959) numbers these sporomorphs among the group „*incertus*" (Pl. X, Figs. 40—45) and writes that they occur in Central Europe from the Paleocene to the Upper Oligocene, their optimum occurrence falling within the Middle Eocene and the Upper Eocene.

At Rypin these sporomorphs are encountered only in the bottom sample. Nowadays representatives of the family *Restionaceae* live in the Southern Hemisphere, mainly in South Africa, Australia, and New Zealand.

Cyperaceae

Genus *Cladium*

Pl. XXIII, Fig. 4

Pollen grains ovate in shape, considerably broadened at one end and narrowed as well as elongated at the other. Dimensions at the broadest place 34 × 74 μ. Exine thin, not more than 1 μ with a distinct, granulate sculpture on the surface.

Sporomorphs of this type are infrequent in fossil state. In our profile they are encountered only sporadically in various parts. *Cladium* formed probably part of swamp vegetation on the shores of open sedimentary basins.

cf. Genus *Dulichium*

Pl. XXIII, Figs. 9, 10

Pollen grains roundish ovate, 40—45 μ in size. Exine comparatively thick (up to 2 μ), sexine thicker than nexine, rather coarse granulate on its surface. Grain surface sometimes secondarily plicate.

Pollen grains of *Dulichium* have not, to the present author's knowledge, hitherto been reported from the Tertiary. At Rypin these sporomorphs are encountered rather rarely in the top part of the profile in quantities up to 3·74%.

Cyperaceae sp. div.

Pl. XXIII, Figs. 5—8

Numbered here are sporomorphs differing from the preceding ones mainly in considerably thinner exine which leads to the fact that these grains are always very limp and secondarily plicate. Grains with thicker exine are far smaller than pollen grains of *Dulichium* (about 30 μ). Size of grains with thin exine reaches up to 45 μ. On the surface of these grains a very fine, granulate sculpture.

Pollen grains of the *Cyperaceae* were encountered in all samples of the profile Rypin II. They reach their maximum in the top part (27·06%).

Gramineae

Among the sporomorphs numbered with this family several types may be distinguished.

Monoporopollenites gramineus **Weyland & Pflug**

Pl. XXIII, Figs. 14—18

Sporomorphs small (25—30 μ), round in shape, with one not large pore 2·5 μ in diameter, surrounded by a narrow annulus. Exine 1·5 μ thick, on its surface pilate or very finely reticulate.

This type of grain is very often found in the Tertiary. In our profile they are regularly encountered in all parts. They attain their maximum in the middle part (9·07%).

Gramineae „Bambusa“ **type**

Pl. XXIV, Figs. 1, 2

Pollen grains roundish-ovate, 50—60 μ in size, with one pore about 4 μ in diameter, surrounded by an annulus also 4 μ broad. Exine very thin (less than 1 μ), limp, hence grains often secondarily plicate. Surface very finely pilate.

These sporomorphs at Rypin are quite frequently encountered in various parts, particularly in the middle one.

The genera *Oryza, Cidonia,* and *Dendrocalamus* have similar pollen grains.

Gramineae type 1

Pl. XXIII, Fig. 13

Pollen grains round, diameter about 30 μ. A very characteristic feature of this type of grain is a thick annulus laid as it were, on the exine around the pore. Its breadth amounts up to 4 μ, but the pore diameter is only about 2 μ. On the surface of the exine, which is comparatively thick (2·5 μ), there is a granulate sculpture.

Similar pollen grains have been reported by Raukopf (1959, Pl. 2, Fig. 13) from Miocene brown coals from Berlin but he has not determined them closer. At Rypin this type of grain occurs only sporadically.

Gramineae type 2

Pl. XXIII, Figs. 11, 12

Pollen grains roundish-elliptical, with dimensions 40 × 57 μ. Exine 2 μ thick, on the surface a fine sculpture. Grains monoporate, pores about 5 μ in diameter, with incrassate margin about 3 μ wide.

These grains correspond morphologically to the type *Secale* and are often encountered in the youngest Holocene sediments. From the Tertiary, however, they have hitherto been reported only by Zagwijn (1960) from Holland.

In our profile they are encountered sporadically in various parts.

Two curves have been given in the pollen diagram for the *Gramineae*; one comprises *Monoporopollenites gramineus*, the other the remaining types.

Palmae

cf. Genus *Corypha*

Pl. XXIV, Figs. 3—7

Pollen grains monosulcate with sulcus running across the grain, roundish ovate, with dimensions 22 × 44 μ to 28 × 42 μ. Exine about 2 μ thick, surface reticulate, lumina diameter 1—1·5 μ. Muri 0·5 μ broad and about 1 μ high.

Sporomorphs of *Palmae* are fairly often found in the older Tertiary, *Corypha* has not, however, been hitherto described. Our sporomorphs slightly resemble *Monocolpopollenites papillosus* (Mürr. & Pflug) Th. & Pf. (Thomson and Pflug 1953, Pl. 4, Figs. 38, 48—49) as well as *Monocolpopollenites parareolatus* n. fsp. described by Krutzsch (1957, Pl. XV, Figs. 39—47).

At Rypin these sporomorphs occur only in some bottom samples.

Sparganiaceae

Genus *Sparganium*

Sparganium ramosum Huds **type**

Pl. XXIV, Figs. 10, 11

Pollen grains monoporate, ovate, 28×38 μ in dimension. Exine up to 2 μ thick, sexine about as thick as nexine, surface reticulate. Lumina diameter up to 2 μ, muri somewhat thick (1 μ). These grains always have a clearly visible pore 3—4 μ in diameter.

At Rypin they occur sporadically in the whole profile but in abundance only in the top part.

Sparganium minimum **Fr. type**

Pl. XXIV, Figs. 8, 9

Pollen grains slightly larger and rounder than the preceding ones (38×35 μ). Exine reticulum shows much larger lumina (diameter up to 7 μ), muri very narrow (less than 1 μ). The pore is never so distinctly visible as in the preceding species.

Pollen grains of this type are much rarer in our profile than the preceding ones but they occur regularly in company with them.

In the pollen diagram the two types are drawn together.

Sporomorphs belonging to *Sparganium* are quite often found in Tertiary sediments. They have been reported by, among others, Weyland and Pflug (1957) as *Monoporopollenites solaris* n. sp. From Poland they have been reported by, among others, Doktorowicz-Hrebnicka (1957a, 1961).

Typhaceae

Genus *Typha*

Typha latifolia **L. type**

Pl. XXIV, Fig. 12

Pollen grains found always in fours in tetrads. Tetrad dimensions 38×43 μ. Individual grains round and monoporate. Exine about 2·3 μ thick, distinctly reticulate on the surface.

Pollen grains of this type have been described by Weyland and Pflug (1957) from the Greek Pliocene as *Tetradopollenites quadrifissus* n. sp. Besides this they have been found from the Hungarian Pliocene by Nagy (1958). From Miocene sediments these sporomorphs have not hitherto been reported. At Rypin they occur only in the middle part of the profile in not large quantities.

Typha angustifolia L. type

Pl. XXIV, Figs. 13, 14

Sporomorphs ovate, monoporate, similar to pollen grains of *Sparganium* but slightly smaller (25×20 μ). Reticulum on the exine surface also finer than in *Sparganium*. These forms were rarely found in the sediment from Rypin.

Incertae sedis

Aglaoreidia cyclops Erdt.

Pl. XXIV, Figs. 15, 16

In sample 97 one pollen grain was found that was strikingly similar to the one described by Erdtman (1960b) from the Berkshire district in England from sediments of an age defined as Oligocene or Upper Eocene. This is a grain 35×55 μ in dimension and ovate in shape. In the middle of the grain one pore about 7·5 μ in diameter. Exine double, sexine thicker than nexine, on the surface distinctly reticulate; lumina unequal in size. Lumina diameter in the pore area, but at the grain margin, more than 2 μ, but at the poles barely 1 μ. In the pole area muri considerably higher than in the equatorial area of the grain which is distinctly visible with a proper adjustment of the optical level in the microscope.

Erdtman (1960b) writes that similar pollen grains are to be encountered in the families of *Amarylidaceae*, *Liliaceae*, and others. Our form resembles the present-day species *Haemanthus filiflorus* Baker from the family *Amarylidaceae*.

Trudopollis pertrudens Pf.

Pl. XXIV, Fig. 17

Pollen grains 3-porate; in polar view triangular in outline with slightly convex sides, size about 25 μ. Pores on the apices of the triangle and fairly deep sunk. Exine surface finely granulate.

These sporomorphs are characteristic of the oldest Tertiary and known from numerous stations of N. Europe (Thomson and Pflug 1953) as well as from southern regions of the European U. S. S. R. and West Siberia (Zaklinskaja 1963). At Rypin only two grains were found in two samples and it may be that this is an impurity from older sediments. Similar forms, though belonging to another organ species, are reported by Zagwijn (1960) from the Pliocene of Holland.

Pollenites microlaesus R. Pot.

Pl. XXIV, Figs. 18, 19

Pollen grains 3-colporate; in polar view triangular in outline; size about 20 μ, angulaperturate. From the pores comparatively broad (2 μ) colpi are running towards the poles. Exine double, sexine thicker than nexine. On the surface a very fine sculpture.

Similar grains are reported by Thiergart (1940). At Rypin they were found only in some bottom samples.

Pollenites laesus R. Pot.

Pl. XXIV, Fig. 20

Pollen grains 3-colpate with mesocolpia broadly parted. They are found always in polar view. Size varies from 30—40 μ. Exine surface with a granulate sculpture.

These sporomorphs are frequent in the Tertiary. At Rypin they are encountered in various parts of the profile.

Other microfossils

Besides a richly represented pollen flora in the profile of Rypin II there were found several other microfossils the taxonomic appurtenance of which is known only approximately. The following forms were distinguished:

Dinoflagellatae

Genus *Rhombodinium*

Cell quadrilateral in shape, 110—120 μ in size, situated in a diaphanous armature, which is characteristically elongated at the corners. Surface may be psilate or finely sculptured.

Rhombodinium has already been reported from the Tertiary (Matthes 1956). In our profile these organisms are encountered only in the top part.

Genus *Wetzeliella*

Pl. XXV, Fig. 2

Cell roundish-quadrilateral in outline, surrounded by a diaphanous armature. This is slightly elongated at the corners but not so much as in the preceding genus. On the armature surface numerous spines up to 10 μ long. Cell dimensions (spine excluded) 114×120 μ.

Wetzeliella is known from Tertiary sediments (Matthes 1956).

Diatomeae

Biddulphiaceae

Genus *Triceratium*

Pl. XXV, Figs. 3, 4

Quadrilateral diatoms with apertures in the cell corners. Size 30—50 μ. Surface psilate or diversely sculptured.

Various forms of this group have been reported from Eocene and Oligocene sediments of the Siberian Lowland (Pokrovskaja 1957). They are also known from the European Tertiary (Altehenger 1959). From the Polish Miocene similar forms have been reported by Macko (1959) as *Triceratium adriaticum* Kg. In our profile they occur sporadically in various parts, most often in the top ones.

Centricae

Discaceae

Pl. XXV, Fig. 5

Diatoms from this group occur quite abundantly but only at the bottom of the profile Rypin II. They are most similar to the genus *Coscinodiscus* or *Stephanodiscus,* shieldlike in shape, 20—40 μ in diameter. On the surface a very distinct sculpture consisting of small shields densely placed one beside the other. On one side, as it were a fissure devoid of sculpture visible.

Among other authors, Kuptzova (1962) describes similar forms from the Pleistocene on the river Kama in the Soviet Union. Macko (1957) has reported similar forms from the Silesian Miocene, calling them *Stephanopyxis.*

Fungi

Pl. XXV, Fig. 15

Spores of fungi were quite often encountered in our sediment but always singly. These were 1—8 celled spores.

Ovoidites ligneolus **R. Pot.**

Pl. XXV, Fig. 14

These are forms oblongo-ovate, 30—200 μ in size. On the surface a very distinct, undulated sculpture.

These forms are often to be found in the Tertiary.

Hystrichosphaerideae

Genus *Hystrichosphaera*

Pl. XXV, Figs. 16, 17

These are organisms whose systematical appurtenance is not as yet known. They are varied in shape and size. On their surface there are always numerous processes either single or dichotomically bifurcate at their tips. Their length varies from a few to several and even to some scores of microns. These forms are morphologically very differentiated and some scientists distinguish here various species (Rossignol 1962; Cookson & Eizenack 1962).

The *Hystrichosphaerideae* are organisms occurring mostly in marine sediments. They are known from numerous Tertiary stations (Kirchheimer 1950a; Reissinger 1950; Matthes 1956) as well as from the Pleistocene (Sobolewska 1956; Zagwijn 1960). In the opinion of some scientists their presence in Tertiary sediments does not always prove a marine origin of these sediments. Brelie (1958) demonstrated the presence of these organisms even in such typically terraneous sediments as brown coal deposits. He explains this phenomenon by the fact that the sedimentary basin in which the brown coal deposits formed must periodically have been connected with the sea. In the profile from Rypin they are encountered only in the bottom part.

Marine Plankton?

Pl. XXV, Figs. 7—13

Round organisms from 15—30 μ in size; surface psilate or distinctly reticulate, walls straight or undulated. Because of the small quantities of these forms a closer determination was not possible.

Foraminifera

Pl. XXV, Fig. 6

In the profile of Rypin II armatures of the *Foraminifera* were found sporadically which have not, however, been closer determined.

6. CLASSIFICATION OF DETERMINED PLANTS INTO CLIMATIC, GEOGRAPHICAL, AND EDAPHIC GROUPS

An exact distinction of geographic elements is very difficult as the majority of the recognized sporomorphs are determined only generically or even merely as to family. Therefore only a classification into the following three groups has been carried out:

1. The group of plants of subtropical and tropical climates, having their main centre of occurrence in subtropical or tropical areas in both hemispheres. The following taxonomic units are numbered here: *Psilotum, Lygodium, Mohria, Gleicheniaceae, Cyathea, Alsophila, Castanopsis, Pasania, Engelhardtia, Gunnera, Meliaceae, Ptelea, Sapindus, Cyrillaceae, Symplocos, Sapotaceae, Bignoniaceae, Vitex, Apocynaceae, Restionaceae, Corypha.* Only those taxonomic units given in spaced type can be recognized as typically thermophilous and associated sufficiently closely with subtropical and tropical climates.

2. The group of plants of a warm temperate climate and of a transitional to temperate one. Numbered here are: *Osmunda claytoniana, O. bromeliifolia, Podocarpus, Cedrus, Sciadopitys, Sequoia, Taxodiaceae, Glyptostrobus, Cryptomeria, Taiwania, Cunninghamia, Callitris, Ephedra, Ostrya, Corylus americana, Myrica, Juglandaceae, Celtis, Eucommia ulmoides, Loranthaceae, Hamamelidaceae, Magnoliaceae, Lauraceae, Garcinia, Cassia, Gynometria, Caragana, Decodon, Nyssa, Myrtaceae, Rutaceae, Elaeagnaceae, Anacardiaceae, Ilex, Staphyllea, Vitis, Parthenocissus, Araliaceae, Styrax, Forsythia, Rubiaceae, Diervillea, Tulipa, Dulichium.*

In the above specification the taxonomic units associated with a warm temperate climate (including the so-called Mediterranean one) are given in spaced type. The others are associated rather with a transitional to temperate climate or even with a temperate one.

3. The group of plants of temperate with transition to a cold temperately climate, occurring nowadays in Europe as well as in other parts of the world. These are: *Osmunda regalis, Polypodiaceae, Lycopodium, Pinus, Tsuga, Abies, Picea, Larix, Betula, Alnus, Carpinus, Corylus, Fagus, Quercus, Salix, Ulmus, Polygonum, Chenopodiaceae, Caryophyllaceae, Ranunculaceae, Cruciferae, Nymphaeaceae, Rosaceae, Lythraceae, Oenotheraceae, Tilia, Acer, Umbelliferae, Cornus, Rhamnaceae, Ericaceae, Pirolaceae, Solanaceae, Labiatae, Plantago, Fraxinus, Viburnum, Lonicera, Valerianaceae, Campanulaceae, Compositae, Butomus, Potamogeton, Liliaceae, Cyperaceae, Gramineae, Sparganium, Typha.*

The greater taxonomic units (families and genera) introduced into this specification comprise, as a rule, numerous species of highly varied climatic demands; since, however, these units could not, on the basis of the characteristic of their sporomorphs, be determined as to species in actual fact, this third group of plants contributes little to the climatic characterisation of our microflora. A species determination of the taxonomic units mentioned here might perhaps shift some of them into the second group.

From the edaphic point of view the following groups of plants may be distinguished:

1. Water, shore, and peat plants: *Lycopodium inundatum, Anthoceros, Sphagnum, Nymphaeaceae, Lythraceae, Decodon, Myriophyllum, Halorrhagis, Trapa, (Gramineae), Potamogeton, Cyperaceae, Cladium, Dulichium, Sparganium, Typha.*
2. Plants of swamp forests (*Taxodium-Nyssa* Swamps): *Taxodiaceae, Glyptostrobus, Alnus, Nyssa, (Rhus), (Vitis), (Parthenocissus), (Araliaceae).* In this specification the systematic units enumerated in brackets comprise species with various ecological demands.
3. Plants of damp brushwoods of the type *Myricaceae* — *Cyrillaceae: Cyatheaceae, Osmunda, Myrica, Betula, Salix, Engelhardtia, Liquidambar, Cyrillaceae, Sapindaceae, Symplocaceae, Sapotaceae, Ericaceae.*
4. Plants of forests and brushwoods on drier habitats: *Lycopodium clavatum, L. annotinum, Polypodium, Tsuga, Pinus, Sequoia, Cryptomeria, Ostrya, Betula, Carpinus, Corylus, Quercus, Pasania, Castanea, Juglandaceae, Cassia, Caragana, Ilex, Cornus, Rhododendron, Ulmus, Acer, Hippophaë.*

7. GENERAL CHARACTER OF THE VEGETATION ON THE BASIS OF THE POLLEN DIAGRAM

On basis of the percentage share of the sporomorphs in the individual samples of the profile Rypin II a pollen diagram has been drawn comprising the more important genera and families. The percentage values were evaluated from the basic total of all counted sporomorphs. Only the aquatic and boggy-herbaceous plants and *Sphagnum* have been excluded from this total. In the pollen diagram they are hatched in contrast to all the remaining ones, marked in black. The taxonomic units are arranged in the diagram in order of their occurrence and domination in the image of the pollen spectra. Among the sporomorphs that dominated in period III some groups have been distinguished according to their ecological habitats. The coniferous plants, whose genera have been placed at the very beginning of the diagram, regardless of the order of their occurrence, form a quite separate group. The sporomorphs of the conifers are divided into two groups: those with pollen grains saccate and inaperturate ones. Among the former the largest role is played by *Pinus silvestris* type, which, in the whole pollen diagram, shows a quantitative preponderance over *Pinus haploxylon* type. The remaining genera of this group: *Abies, Picea,* and *Tsuga* play only a minor role.

Among the group of inaperturates are numbered pollen grains of the families *Taxodiaceae* and *Cupressaceae.* The share of the majority of sporomorphs belonging to this group has been drawn in one curve, the *Taxodiaceae* — *Cupressaceae,* because a closer determination of them was in practice not possible.

On the basis of the pollen diagram of the profile Rypin II * the following periods of vegetation development may be distinguished from the bottom upwards:

Period I — subtropical and partly tropical vegetation, covers the part of the profile from the bottom to sample No 88. Some of the plants of this period, such as *Ptelea* or *Gunnera* are found only in this part of the profile. In this period maximum values are attained by: *Castaneoideae, Araliaceae, Sapotaceae,* and *Cyrillaceae.* In the younger parts of the profile these genera are only sporadically encountered. With period I are also associated the arborescent and liana ferns from the genera: *Cyathea, Lygodium* and *Gleicheniaceae* as well as the certainly subtropical *Engelhardtia, Myrica* and representatives of the family *Leguminosae.* At that time sporomorphs of genera existing in Europe today played a very small part.

In this period three edaphic groups of vegetation may be distinguished. On swampy places grew forests of the *Taxodiaceae* type with the genus *Glyptostrobus* as their main component; here were also *Vitaceae* and *Araliaceae* and small quantities of *Nyssa* and *Alnus.* On bogless but humid areas *Carya, Pterocarya,* and *Juglans* occurred in not large quantities.

Apart from the swamp forests there were also well-developed damp brushwoods where an important part was played by the *Ptelea,* which grows nowadays in the southern part of N. America and in Central America, by the families *Cyrillaceae* and *Sapotaceae,* and genera *Myrica* and *Engelhardtia.* The only tall tree in this type of brushwood and low forest was the genus *Liquidambar.* Among herbaceous vegetation subtropical and tropical ferns of the genera *Lygodium* and *Mohria,* species of the *Cyathea* and the family *Gleicheniaceae* and probably *Gunnera* were frequent. The *Hippophaë* and various *Ericaceae* and *Cyperaceae* grew on more open spaces.

The driest places were occupied by pine forests with patches of *Sequoia, Cryptomeria, Sciadopitys,* several species of oaks, *Castanea, Castanopsis, Pasania,* and *Ilex.* Various shrubs of the family *Leguminosae,* mainly *Caragana* grew as undergrowth of these forests while the ground vegetation consisted, besides ferns, of lycopods. As an admixture there were *Cupressus, Cedrus,* and *Podocarpus.*

The climate of this period was a subtropical, humid one. Only towards the end of period I. the climate gradually became drier.

Period II — (samples 87—72) — subtropical vegetation of a drier climate than that of the preceding one. The dominating group of plants was not swamp forest but thickets of shrubs belonging to the families *Leguminosae, Symplocaceae,* and *Rutaceae,* and to the genera *Engelhardtia, Myrica,* and *Ilex.* The *Leguminosae* and especially *Caragana* attained in this period their maximum values.

---

* Pollen diagram is to be found on the back cover.

The share of *Sciadopitys* and *Glyptostrobus,* however, diminished, the thickets with *Ptelea* and *Gunnera* vanished completely and the share of subtropical ferns decreased to the minimum, forests of *Pinus* and *Sequoia* developing instead. Genera occurring in Europe today were still of little significance. The climate probably became slightly colder but also drier.

Period III — warm-temperate and temperate vegetation. This comprises the whole upper part of the profile beginning from sample 66 and may be divided into several subperiods (zones) differing one from the other not so much in the floristic list as in the quantitative proportion of their individual components.

Zone „a" (samples 66—53). — At this time a great part was played in dry areas by forests of pine, oak, and, possibly, of birch. On wet ground swamp forests developed, differently formed than in the preceding periods. The position of dominance previously held by trees of the genera *Taxodium* and *Glyptostrobus* was taken by *Nyssa* but the share of *Aralia* did not change. The group of thermophilous shrubs became very reduced and, like the herbaceous plants, of which the most numerous were still the *Cyperaceae* and *Polypodiaceae,* no longer played any significant role.

Zone „b" (samples 52—45). — The vegetation of this subperiod differed only slightly from the preceding one. The pine share decreased and the pollen of the *Araliaceae,* as well as that of the families *Cyrillaceae* and *Leguminosae,* vanished altogether. The share of the genera *Quercus, Nyssa* and *Alnus* continued to be large and at the same time there was an increase in the beech and the herbaceous plants, chiefly the *Gramineae,* and plants of the family *Compositae,* especially the *Centaurea* of the *cyanus* type. The convergence of the top values of these two last components is striking. The *Gramineae* with large pollen grains include, besides the rare types „1" and „2", also the type *„Bambusa"* and other genera distinguished by large pollen grains (*Oryza, Cidonia, Dendrocalamus,* and others). The share of the *Cyperaceae* increased only slightly in comparison with the preceding subperiod.

Zone „c" (samples 43—27). — At this time, in the immediate vicinity of the investigated spot the water and shore vegetation became richly developed. The dominant role was played by *Nymphaeaceae, Trapa, Potamogeton, Sparganium* (153·7%), *Carex, Cladium* and the *Gramineae.* In the pollen rain, beside the sporomorphs from the immediate vicinity of the water basin, there also appeared pollen grains and spores of swamp-forest plants with *Taxodium* and *Nyssa* to the fore. In these forests or on the shores of the sedimentary basins alder forests *(Alnus)* also appeared in abundance. Dry places were overgrown with pine forest, with a large participation of *Sciadopitys, Sequoia,* and *Cryptomeria,* and by a fairly considerable admixture of oak trees.

Zone „d" (samples 27—14). — As the water basin became overgrown, the ferns, *Gramineae,* and *Cyperaceae* increased. The significance of swamp forests diminished, this being reflected in the pollen diagram by a fall in the *Taxodiaceae* curve and a complete disappearance of the genus *Nyssa*. The role of the alder continued to be an important one. *Sequoia* forests became reduced to the minimum or perished altogether. However, pine with oak forests remained with even a tendency to spread further. The pine, at the outset of this subperiod, attained its maximum values in the whole profile.

Zone „e" (samples 14—1) — is characterized by a further domination of pine with oak forests and slight development of swamp forests. The pine-oak forests became reduced to a larger degree only at the top of the profile, a renewed growth of swamp forests occurring at the same time at first with the ascendancy of *Nyssa* and later on of the *Taxodiaceae,* especially of the genus *Glyptostrobus*. At this time the *Taxodiaceae* and *Betula* attained their maximum spread, the latter being the most important component of mixed forests.

Period III of the vegetation development was characterized by a temperate warm or temperate climate, periodically fairly damp (zones „b" and „e") and even very damp (zone „c") and periodically dry (zones „a" and „d").

On the territory of the Mazovian Trough there existed at this time numerous small lakes with a richly developed shore and water vegetation, the neighbourhood of water basins being occupied by swamp forests composed mainly of *Taxodium* and *Nyssa* and by alder forests. At the same time, on the so-called Kujawy Ridge, the topographic conditions did not favour a formation of water basins and swamps so that here there probably grew pine forests with oaks, *Sequoia,* and other components.

8. COMPARISON OF RESULTS OF PALYNOLOGICAL RESEARCHES AND OF DETERMINATIONS OF MACROSCOPIC REMAINS

The macroscopic remains of the flora from Rypin were elaborated by Łańcucka-Środoniowa (1957). She determined 37 species or genera that represent in 77·5% an exotic element. 73% of the described forms are Miocene plants, 22·5% Pliocene ones and barely 4·5% „Quaternary". Additional investigations of the profile III have enriched this list mainly in historically younger plants i.e. Quaternary ones (Łańcucka-Środoniowa, oral information).

Among the plants recognized on the basis of macroscopic remains a great share falls to the water and marsh plants which are found in large quantities in almost all samples. This provides evidence of the existence of a sedimentary water basin throughout the time when the sediment was forming in Rypin. The presence of such a basin has been palynologically determined only in the top part of the profile where in the pollen spectra *Sparganium, Decodon, Potamogeton,* and the *Nymphaeaceae* prevail. In the remaining parts of the profile Rypin II only *Sparganium* occurs regularly in small quantities.

The results of palynological researches are on the whole consistent with those obtained by Łańcucka-Środoniowa (l.c.). Almost all taxonomic units that had been determined macroscopically were also determined in the pollen material with the exception of the genera: *Rubus, Arctostaphyloides, Sambucus, Diclidocarya, Carpolithes Rosenkjaeri* Hartz, *Stratiotes, Brasenia,* and *Ceratophyllum.* As far as *Diclidocarya* and the *Arctostaphyloides* are concerned, the pollen grains of these genera are probably among the sporomorphs included in the families *Lythraceae* and *Ericaceae.*

The detailed description of the macroscopic flora from Rypin facilitated the establishing of some sporomorphs among certain determined species.

On the basis of an analysis of the macroscopic remains of plants Łańcucka-Środoniowa (1957) determined the age of the flora from Rypin as Upper Miocene. Old Tertiary elements (*Myrica Suppani* Kirch., *Symplocos Gothani* Kirch., *Arctostaphyloides* Menzelii Kirch.) have been determined from the profile III only, while in profile II no macroscopic remains were found of plants that might be considered as old Tertiary ones. At the bottom of this profile, where in the pollen flora the old Tertiary element was abundantly represented, no macroscopic remains were found at all. Consequently, there are certain divergences between the results obtained by applying two different methods of investigation; this leads to the conclusion that, from the palynological point of view, the bottom part of the profile II is accepted as being much older than the top part of this profile. As a result of macroscopic investigations only, the whole profile II was considered as Upper Miocene.

9. SPOROMORPHS HAVING STRATIGRAPHIC SIGNIFICANCE

All determined sporomorphs have been divided into three groups, each with a different stratigraphic significance.

Group No I — is formed by an old Tertiary element which plays the greatest part in the Paleogene to the Upper Oligocene inclusively, but is found only sporadically in the Neogene. Numbered here are also sporomorphs that have been described for the first time and are connected with the subtropical and tropical plants.

Group No II — is formed by sporomorphs occurring most frequently in the Miocene though still found in the Pliocene; they appear already in the Oligocene where they do not, however, play any great part.

Group No III — is represented by sporomorphs that have no great stratigraphic significance as they are to be found in the Tertiary as well as in the Quaternary.

In Table 1 and 2 with each denomination of the sporomorph the stratigraphic group is given among which the mentioned sporomorph has been numbered.

10. STRATIGRAPHY

a) Stratigraphic base

The classification of the sporomorphs into three stratigraphic groups has clearly located the old Tertiary elements at the bottom of the profile and the younger one in its upper parts. Some of the sporomorphs, though occurring in great quantities, have no stratigraphic significance. As an example may serve here abundantly represented coniferous trees. Although it is fairly generally accepted that the proportion *Taxodiaceae* — *Cupressaceae* to *Pinaceae* changes from the Eocene till the Miocene in favour of the *Taxodiaceae* — *Cupressaceae* (Potonié 1951) it appears in our profile that this proportion is a different one and independent of the age of the sediment. Also the occurrence of pines (*Pinus silvestris* type and *P. haploxylon* type) is dependent in the profile from Rypin rather on local conditions and has no stratigraphic significance. An exception in this respect are the genera *Cupressus* and *Callitris,* which occur only at the bottom of the profile together with old Tertiary elements, and the genus *Sciadopitys.* Thiergart (1949) called attention to the existence of a leading level with *Sciadopitys* („*Sciadopitys*-Vorstoss") at the transition from the Oligocene to the Miocene. In the profile Rypin II *Sciadopitys* also attains its maximum (although low) percentage values at the transition from the Oligocene to the Miocene.

On the basis of the quantitative occurrence of the individual sporomorphs as well as of their three groups of stratigraphic significance, the following age estimate of the sediments constituting the profile Rypin II may be assumed:

Period I of the development of the vegetation falls within the decline of the Upper Oligocene (Chattian). In all this part the sediment is uniform, muddy sandy with a small contribution of peaty loam at the bottom. Here dominates an old Tertiary element representing mostly genera growing nowadays in subtropical and tropical areas. An important part is played here by *Ptelea,* considered by German palynologists (Krutzsch 1957) as the leading element for the Eocene until the Middle Oligocene. This genus still occurs in the Upper Oligocene and sporadically in the Miocene. Macroscopic remains of *Ptelea* are known — according to Kirchheimer (1957) — only from the Oligocene but Andreánszky (1959) found leaves of *Ptelea* as early as in the Hungarian Sarmatian.

In the bottom part *Gunnera* played an equally important role as that of *Ptelea.*

According to Potonié (1951) the *Castaneoideae* and especially *Castanopsis* and *Pasania* played the greatest part at the turn of the Chatt-Aquitanian. The sporomorphs of these genera attain their maximum percentage values (10·83%) at the bottom of our profile.

The *Sapotaceae*, generally considered to be an old Tertiary element (Thomson 1949), occur in the profile Rypin II also only in the bottom part.

In the opinion of many palynologists sporomorphs numbered among the *Cyrillaceae* are known, above all, from the older Tertiary although they are still found sporadically in the Upper Miocene. At Rypin these sporomorphs occur regularly in the periods I and II whereas in the III-rd one they are encountered only sporadically.

In the discussed part of the profile sporomorphs were found from the family *Elaeagnaceae* belonging to two different organ species considered to be a characteristic element for the Upper Oligocene marine sediments (Krutzsch 1962a).

In period I there also occur old Tertiary spores belonging to the genera *Lygodium, Mohria, Cyathea, Lycopodium cernuum* type, to the family *Gleicheniaceae,* and not exactly determined spores named *Foveotriletes* and *Toroisporis.* The last two forms, not hitherto known from the younger Tertiary, occur in abundance in the Eocene brown coal from Geiseltal (Krutzsch 1959).

Also found here are single pollen grains of the *Proteaceae, Restionaceae,* and *Aglaoreidia* cyclops described by Erdtman (1960b) from the English Oligocene. Besides plankton forms giving evidence of the salinity of the water were encountered. These are *Centricae, Rhombodinium, Wetzeliella,* and the *Hystrichosphaeridae,* particularly frequent in Tertiary marine sediments. According to Brelie (1958) these organisms do not always show a marine origin of the sediment as they may also occur in inland freshwater reservoirs that had periodical contact with the sea. This has been observed in the Rhineland brown coal deposits, where, in various layers of that undoubtedly continental sediment, the *Hystrix* occur abundantly. Thus it may be supposed that in the Chatt the sedimentary basin at Rypin was periodically connected with an Upper Oligocene sea. In the opinion of Pożaryski (1953) the sea in the Upper Oligocene reached as far as Kujawy whence it withdrew only at the end of that period. Traces of the Oligocene in the Rypin area have been pointed out by Rühle (1955).

In period I of the profile Rypin II Miocene elements and representatives of genera that exist in Europe till the present-day did not play any important part, especially as far as quantity was concerned.

The floristic composition of this part of our profile resembles the fossil floras of Berzdorf and Obersdorf in the southern part of Upper Lusatia. These floras have been palynologically elaborated by Hunger (1953) and considered as lying within the confines of the Upper Oligocene and the Miocene. In the pollen diagram from Berzdorf, however, the hornbeam (25%) occurs in considerably greater quantities than at Rypin. As to the quantity of the *Leguminosae* and the „group *Rhus*" the flora from Berzdorf comes rather closer to the period II of our profile. At the same time, from the point of view of the quantity of these two components, the flora from Obersdorf corresponds to our period I. Besides this, in the discussed floras from Lusatia as well as in period I from Rypin, the *Symplocaceae, Myrica, Engelhardtia,* and *Sapotaceae* as well as spores of *Lygodium* are encountered in similar quantities. A common feature of these floras is also the occurrence of the *Hystrichosphaeridae.*

There is a great similarity between the floristic composition of period I and the floras considered as belonging to the border of the Chatt-Aquitanian from the area of Zebrzydowa in Lower Silesia (Romanowicz 1961). The old Tertiary element is as richly represented in these floras as at Rypin. Forms described by Romanowicz (l.c.) as *Rhooidites pseudocingulum* and *Rh. dolium* probably correspond to the sporomorphs determined in our profile as *Ptelea*. Potonié (1951) called attention to the fact that in the group „*fusus*" — here belongs our *Ptelea* — there are also the forms described as *Rhooidites.*

Rhooidites occurs in the Upper Oligocene floras from the area of Zebrzydowa in slightly larger quantities than in period I of our profile; other old Tertiary elements, however, such as the *Sapotaceae, Cyrillaceae,* and *Quercoidites henrici,* appear in these profiles in similar quantities.

Also similar are pollen spectra of the Upper Oligocene brown coals from the layers III, IV, and V from the locality Wola Rogozińska 5, near Łódź (Doktorowicz-Hrebnicka 1961). Analogous percentage values are attained in the profiles from Wola Rogozińska by the majority of old Tertiary elements such as: *Lygodium, Sapotaceae, Cyrillaceae,* old forms of the *Myricaceae, Castaneoideae,* and others. The occurrence of the *Hystrichosphaeridae* is another common feature of these profiles.

Sporomorphs of genera that compose the present-day flora of Europe are encountered in small quantities both in the discussed period of the profile from Rypin and in the mentioned Upper Oligocene profiles. The considerable share of *Carpinus* (25%) in the profile from Berzdorf is an exception.

Period II of the profile Rypin II included only the beginning of the Lower Miocene i.e. Aquitanian. Here there is a distinct decrease in the number of forms belonging to the old Tertiary element. Neither the *Ptelea* nor the *Gunnera* occur any longer and the share of the *Castaneoideae, Araliaceae, Sapotaceae,* and the old Tertiary spores pronouncedly lose its significance. An important part in this period is played by the *Leguminosae* which are distinguished by a great abundance of forms. According to Thiergart (1940) and Thomson (1949) the *Leguminosae* belon to the old Tertiary element and played their greatest part in the Lower Miocene though they are still found in the Upper Miocene. In our period II *Engelhardtia* and *Myrica*, numbered also with the old Tertiary element (Thomson 1949), attain their maximum values. Both these genera occurred as early as in period I of our profile but they reached their optimum occurrence only in period II. Just as important a part as the *Engelhardtia* and *Myrica* was played, in this period, by the *Ilex* while others, the so-called „younger" elements, had not as yet a significant role.

By a comparison of the diagram from Rypin with other pollen diagrams, period II of our profile may be placed in the younger part of the border of the Chatt-Aquitanian. A characteristic feature of this transition is the order of succesion of forms that play the most important part. That is to say, both in the pollen diagram from Rypin and in the analogous profiles representing the Chatt-Aquitanian from the Zebrzydowa area in Lower Silesia (Romanowicz 1961), there prevails in the older parts the „group *Rhus*" (*Ptelea* and the *Rhooidites*) giving place later to the family *Leguminosae*. In both profiles the occurrence of *Quercoidites henrici*, a form considered by Potonié (1951) as a characteristic element of the border of the Chatt-Aquitanian, is likewise similarly presented. In our profile as well as in those from the Zebrzydowa area *Quercoidites henrici* is most common in the bottom parts. The occurrence of *Alnus* and *Betula* is also similar in the two profiles while *Engelhardtia* behaves slightly differently, reaching its maximum values in the pollen diagram from Rypin in period II and in the profiles from Zebrzydowa in the oldest parts. The Lower Silesian Chatt-Aquitanian has also slightly larger quantities of the genera *Nyssa* and *Symplocos*.

There exists, too, a similarity between the periods I and II of the profile from Rypin and the Chatt-Aquitanian flora from the Babina mine in Lower Silesia (pit No 5, profile 2), (Doktorowicz-Hrebnicka 1957c). Our profile is richer, however, as regards flora than the analogous part from Babina.

It is difficult in the profile from Rypin to draw a distinct line between the Chattian and the Aquitanian. It appears to run more or less at the level of sample 88 since it is here that a change of the sediment takes place with a simultaneous decline of the sporomorphs belonging to the genera *Gunnera* and *Symplocos* (older forms) and a lack of marine plankton.

Period III, including the whole top part of the profile Rypin II, belongs to the Upper Miocene. This estimate is in agreement with the results of macroscopic investigations of this flora (Łańcucka-Środoniowa 1957). The sediment in that part of the profile is more loamy than at the bottom, old Tertiary forms playing here an already insignificant part, their place being taken by sporomorphs characteristic for the Miocene.

Sporomorphs representing genera that grow in Europe nowadays appear in great quantities. A striking feature is the great homogeneity of the pollen diagram of this period the main changes being of a quantitative and not a qualitative nature.

When comparing the top part of the profile Rypin II with the Upper Miocene profile from Rogóźno near Łódź (Mamczar 1961) it is easy to see their great resemblance. Old Tertiary elements (*Myrica, Rhus, Araliaceae,* and others) are to be found in both profiles only sporadically, the curves of the coniferous trees are similar, and the proportion of saccate coniferous to inaperturate varies in the different parts of our profile as well as in those from Rogóźno. The occurrence of the genus *Nyssa* is also very similar. *Betula* and the *Juglandaceae, Corylus, Carpinus,* and also the *Castaneoideae,* which appear sporadically here and there, behave likewise. In the profile from Rypin *Alnus, Fagus,* and *Ulmus* occur in slightly larger quantities than at Rogóźno, while from the herbaceous plants the *Polypodiaceae* and *Sparganium* appear. At Rogóźno, on the other hand, *Ilex* occurs in greater quantities. In spite of some local differences the two floras may be considered as equal in age, with the reservation that the level III from Rogóźno includes only the upper half of period III of the profile from Rypin (probably zones „c", „d", and „e").

The palynological character of period III of the profile Rypin II is consistent with the character of the Upper Miocene as given by Thiergart (1940).

b) Problem of the lack of the Middle Miocene

It results from the stratigraphy described in the preceding part of this paper that, since the periods I and II include the Chatt-Aquitanian and period III the Upper Miocene, there was a sedimentary interval between the periods II and III. If there were no such interval, then period III would include not only the Upper Miocene but also the whole Middle Miocene as well as a part of the Lower one.

Period III of the profile from Rypin possesses the character of the youngest Miocene, which seems beyond dispute in comparison with the Middle Miocene profiles. Even the two bottom parts of period III, „a" and „b", cannot be the Middle Miocene or, even less, the Lower Miocene. If these two parts are compared with the typical profiles of the Middle Miocene of Central Poland from Gosławice (Mamczar 1960) and Morzysław near Konin (Kremp 1949) quite substantial differences may be observed. The profile from Rypin is more deficient in old Tertiary elements. Sporomorphs numbered among the *Castaneoideae, Cyrillaceae,* and particularly the whole „group *Rhus*", are in the profiles from Gosławice and Morzysław fairly richly represented but in the discussed period of our profile they occur only sporadically or are completely lacking. *Ilex,* which at Gosławice and Morzysław occurs in quantities exceeding 5%, attains in period III of Rypin values of about 1% and only once 3%. In the parts of our profile discussed here *Quercoidites henrici* occurs no longer while it is regularly found in the Middle Miocene from Gosławice and Morzysław where, besides, the *Oleaceae* occur in considerably larger quantities. A further difference is that sporomorphs of plants existing today in Europe are found in period III of our profile in greater quantities than in the profiles from Gosławice and Morzysław. *Fagus,* which reaches in the profile from Rypin 7·36% does not occur at all at Morzysław and at Gosławice attains not more than 2%. In our profile *Alnus,* in the period under discussion, usually exceeds 10% and attains its maximum 41·04% ,while at Gosławice it does not exceed the 8% and at Morzysław 5%. Pollen of trees from such genera as *Ulmus, Tilia,* and *Betula* also attains greater values in the profile from Rypin than at Gosławice and at Morzysław.

Sporomorphs with no special stratigraphic significance occur both here and there in similar quantities. At Morzysław *Pinus haploxylon* type and *Cedrus* occur abundantly, while at Rypin the *Polypodiaceae* are considerably more numerous.

Still greater differences exist between period III of the profile from Rypin and a Miocene pollen diagram from Stare Gliwice (Oszast 1960). The pollen flora from Stare Gliwice is richer in old Tertiary elements (*Rhus, Engelhardtia, Castaneoideae, Pistacia*) and, moreover, includes several forms that are completely absent at Rypin (*Buxus, Punica*). The diagram from Stare Gliwice differs also from the Middle Miocene diagrams from Gosławice and Morzysław. These differences are probably the result of different climates in the south of Poland and in the lowland of North Poland. In the Tortonian the territory of South Poland lay under the climatic influence of the Paratetys and had, according to Szafer (1961) — a Mediterranean climate. Hence the forelands of the Carpathian and Sudetic Mountains belonged at that time to a vegetational province other than the Middle Miocene vegetation of the Polish lowland.

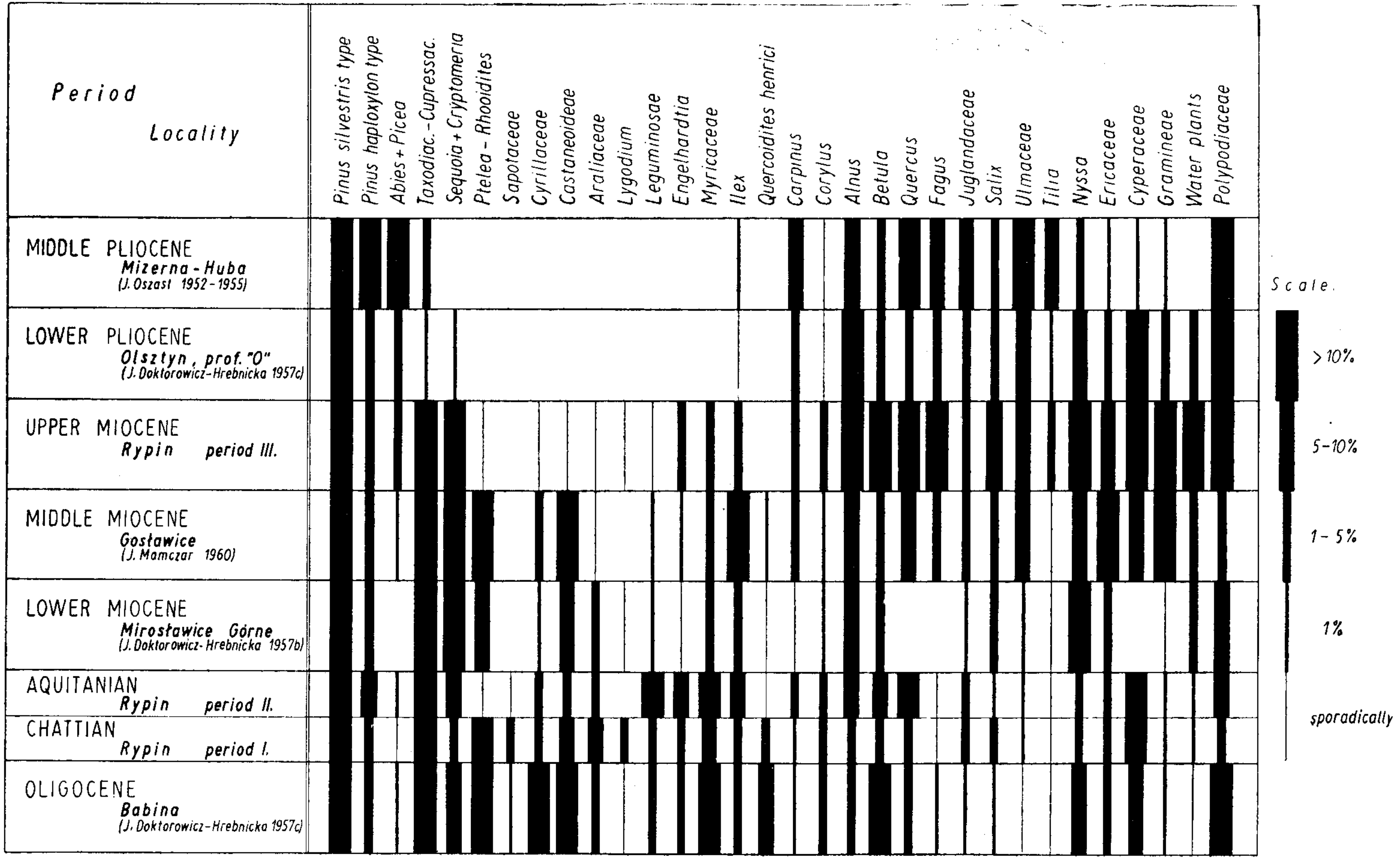
With a view to better documentation of the lack of a Middle Miocene part in the profile from Rypin, a stratigraphic table (see p. 95) was drawn covering the period of time from the Oligocene to the Middle Pliocene.

This table illustrates the gradual extinction of the old Tertiary elements with the simultaneous appearance and increase of elements important in the younger Tertiary and the Quaternary.

It is not easy to explain why there developed a sedimentary gap (samples 72—76) more than two metres thick. In the geological profile a sedimentary change occurs in this part represented by an insert of clay with small gravel, the largest grain being 1 cm in diameter. The frequency of sporomorphs in these samples was very low as in 1 cm^3 of the

Stratigraphic table

Tabela stratygraficzna



sediment it was possible to determine only 97 sporomorphs in sample 66 and 100 sporomorphs in sample 70. They were, moreover, very corroded, this fact, together with the low frequency, indicating serious disturbances of the sedimentation and probable processes of intense erosion.

The genesis of the sedimentary gap is perhaps associated with the Savish phase of orogenic movements, during which, at the turn of the Oligocene/Miocene, the territory of northern Poland arose (Łyczewska 1958).

On the territory of northern Poland, at the bottom of the Miocene brown coal formation, there occur quartzites and quartzy sands, white or grey in colour, about which — according to Łyczewska (l.c.) — it is as yet not known whether they are incident to brown coal formations or else divided by the sedimentary gap. The existence of such a sedimentary gap would be indicated by the destruction of the sandstone surface and the forming of depressions in which later formations of brown coal became embedded.

Gołąb (1951), investigating Miocene sandstones from the vicinity of Ostrzeszów, writes about the existence in that area of a sedimentary gap that lasted from the Lower to the Upper Tortonian. For the existence of such a gap in the Rypin area there is — to the present author's knowledge — no geological evidence.

In Tertiary profiles of West Germany a sedimentary gap is also encountered but at a different time, however, than from the one at Rypin. Numerous geological borings from the southern Limburg, the northern ridge of the Ardennes, and from the territory of the Rhineland showed a lack of Lower Miocene sediments (Teichmüller 1958). Immediately on marine Oligocene layers lie here Middle Miocene ones. The genesis of a sedimentary gap lasting throughout the whole Lower Miocene is explained by the above-named author as being the result of orogenic movements that, from the Upper Oligocene on, raised the northern part of the Rhineland while lowering at the same time its southern part.

11. ACKNOWLEDGEMENTS

I should like to express my heartfelt thanks to Dr M. Środoniowa, who placed the material for palynological research work at my disposal. I am especially indebted to Professors W. Szafer and A. Środoń who devoted much of their time to discussions relative to the botanical interpretation of the profile as well as to problems incident to stratigraphy. I thank Dr W. Krutzsch from the Paleobotanical Laboratory of the Central Geological Institute in Berlin for conferring with me about stratigraphic problems and for his valuable comments on nomenclature.

I wish also to thank Docent J. Bobrowska and Professor M. Kostyniuk for their critical revision of the manuscript, Dr J. Oszast for introducing me to the methodology of Tertiary palynologic investigations.

LITERATURE

1. Altehenger A., 1959. Floristisch belegte Klimaschwankungen im Mitteleuropäischen Pliozän der Reuver Stufe. Palaeontographica. **106**, 1—3:11—70. Stuttgart.
2. Andersen S. Th., 1961. Vegetation and its Environment in Denmark in the Early Weichselian Glacial (Last Glacial). Danmarks Geologiske Undersøgelse II. **75**: 1—175. København.
3. Andreánszky G., 1959. Sarmatische Flora von Ungarn. Akadémiai Kiado Budapest. 360.
4. Bobrowska J., 1957. Rodzaj *Decodon* J. F. Gmel. z polskiego neogenu. Inst. Geol. Prace. **15**:77—82. Warszawa.
5. Bolchovitina N. A., 1953. Sporowo-pylcewaja charakteristika melowych otloženii centralnych oblastiej SSSR. Trudy Inst. Geol. Nauk Ak. SSSR. Wyp. 145. Geol. ser. 61:184, 16 Tabl.
6. Brelie v. der G., 1958. Sporen und Pollen im marinen Tertiär der Niederrheinischen Bucht. Fortschr. Geol. Rheinl. u. Westf. 1:185—204.
7. Cookson I. C. and Eisenack A., 1962. Additional microplankton from Australian Cretaceous sediments. Micropaleontology. **8**, 4:485—507.
8. Couper R. A., 1960. New Zealand Mesozoic and Cainozoic Plant Microfossils. Betaafse Internationale Petroleum Mij. N. V. The Hague Palaeontological Bulletin 32:5—87.
9. Čigurjaeva A. A., 1956. Atlas mikrospor tretičnych otloženii SSSR. Izd. Univ. Charkow—Saratow. 118, Tabl. 128.
10. Doktorowicz-Hrebnicka J., 1954. Analiza pyłkowa węgla brunatnego z okolic Żar na Dolnym Śląsku. Inst. Geol. Biul. 71:41—92. Warszawa.
11. Doktorowicz-Hrebnicka J., 1957a. Wzorcowe spektra pyłkowe plioceńskich osadów węglonośnych. Inst. Geol. Prace 15:87—137. Warszawa.
12. Doktorowicz-Hrebnicka J., 1957b. Z badań mikroflorystycznych węgla brunatnego w Mirosławicach Górnych na Dolnym Śląsku. Inst. Geol. Prace 15:167—183. Warszawa.
13. Doktorowicz-Hrebnicka J., 1957c. Wiek węgla brunatnego z terenu Babiny na Dolnym Śląsku w świetle analizy pyłkowej. Inst. Geol. Prace 15:187—197. Warszawa.
14. Doktorowicz-Hrebnicka J., 1960. Paralelizacja pokładów węgla brunatnego województwa bydgoskiego i poznańskiego. Inst. Geol. Biul. 157:69—133. Warszawa.
15. Doktorowicz-Hrebnicka J., 1961. Paleobotaniczne podstawy paralelizacji pokładów węgla brunatnego ze złoża Rogóźno pod Łodzią. Inst. Geol. Biul. 158: Cz. I: 113—172, Cz. II: 173—303. Warszawa.
16. Dyakowska J., 1959. Podręcznik Palynologii. Metody i Problemy. Wydawnictwa Geologiczne, Warszawa. 325 pp.
17. Engler A. and Prantl K., 1896. Die natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten. III. T. 4. Abt. Verl. W. Engelmann. Leipzig 1—362 s.

18. Erdtman G., 1943. An Introduction to Pollen Analysis. Waltham, Mass. USA. 239 pp.
19. Erdtman G., 1947. Suggestions for the classification of fossil and recent pollen grains and spores. Svensk Bot. Tidskr. **41**, 1:104—114.
20. Erdtman G., 1952. Pollen morphology and plant taxonomy. Angiosperms. Stockholm. 539 pp.
21. Erdtman G., 1957. Pollen and Spore Morphology Plant Taxonomy. *Gymnospermae, Pteridophyta, Bryophyta.* Stockholm—New York. 124 pp.
22. Erdtman G., 1960a. The acetolysis method. Svensk Botan Tidskr. **54**, 4:561—564.
23. Erdtman G., 1960b. On three new Genera from the Lower Headon Beds, Berkshire. Botaniska Notiser **113**, 1:46—48. Lund.
24. Florin R., 1931. Untersuchungen zur Stammesgeschichte der *Coniferales* und *Corditales*. I. Kungl. Svenska Vetenskapsakademiens Handlingar. **10**, 1:1—588. Stockholm.
25. Florin R., 1963. The Distribution of Conifer and Taxad Genera in Time and Space. Almqvist et Wiksells Boktryckeri AB. Acta Horti Bergiani. **20**, 4:121—312.
26. Gołąb J., 1951. Geologia wzgórz Ostrzeszowskich. Inst. Geol. Prace 7:115—144. Warszawa.
27. Guinet Ph., 1962. Pollens d'Asie tropicale. Institut Français de Pondichéry, Trav. de la Sec. Sc. et Tech. **5**. **F.** I:1—2,52 fiches hors-texte.
28. Hedberg O., 1947. Pollen morphology in the genus *Polygonum* L. s. l. and its taxonomical significance. Svensk Bot. Tidskr. 40:371—404.
29. Hunger R., 1953. Mikrobotanisch-Stratigraphische Untersuchungen der Braunkohlen der südlichen Oberlausitz und die Pollen analyse als Mittel zur Deutung der Flözgenese. Freiberger Forschungshefte. Beih. der Zeitschr. „Bergakademie", R. „C." 8:5—38. Berlin.
30. Iversen J. & Troels-Smith J., 1950. Pollenmorphologische Definitionen und Typen. Danmarks Geol. Unders., R. IV, **3**, 8:31—52.
31. Kedves M., 1961a. Zur palynologischen Kenntnis des unteren Eozäns von Halimba. Acta Biol. Univ. Szege. Pars. Bot. Nova Ser. **7**, 3—4:25—41.
32. Kedves M., 1961b. Études palynologiques dans le bassin de Dorog II. Pollen et Spores **3**, 1:101—153.
33. Kirchheimer F., 1950a. Das Vorkommen von *Sciadopitys* im mitteleuropäischen Tertiär und die Bedeutung ihres Pollens für die Stratigraphie der Braunkohlenschichten. Neu Jahrb. für Geol. u. Pal. Monatsh. 1950:59—64.
34. Kirchheimer F., 1950b. Mikrofossilien aus Salzablagerungen des Tetiärs. Palaeontographica B. 90, Abt. B.:127—160. Stuttgart.
35. Kirchheimer F., 1957. Die Laubgewächse der Braunkohlenzeit. Veb. W. Knapp Verlag-Halle (Saale). 783 pp.
36. Kostyniuk M., 1938. Trzeciorzędowe drewna i pyłki z Mazowsza i Wołynia. Kosmos Ser. A., 63:1—53. Lwów.
37. Knox A. S., 1942. The use of bromoform in the separation of noncalcareous microfossils. Science, 95. No. 2464.
38. Kremp G., 1949. Pollenanalitische Untersuchungen des miozänen Braunkohlenlagers von Konin an der Warthe. Palaeontographica B. 90, Abt. B:53—93. Stuttgart.
39. Krutzsch W., 1954. Bemerkungen zur Benennung und Klassifikation fossiler (insbesondere tertiärer) Pollen und Sporen. Geologie, Jahrg. **3**, 3:258—311. Berlin.
40. Krutzsch W., 1957. Sporen und Pollengruppen aus der Oberkreide und dem Tertiär Mitteleuropas und ihre stratigraphische Verteilung. Zeitschr. f. angew. Geol. 3, 11/12:509—548. Berlin.

41. Krutzsch W., 1959. Mikropaläontologische (sporenpaläontologische) Untersuchungen in der Braunkohle des Geiseltales I. Geologie **8**, 21/22:1—426. Berlin.

42. Krutzsch W., 1961. Über Funde von „ephedroiden" Pollen im deutschen Tertiär. Geologie **10**, 32:15—53. Berlin.

43. Krutzsch W., 1962. Stratigraphisch bezw. botanisch wichtige Sporen- und Pollenformen aus dem deutschen Tertiär. Geologie **11**, 3:265—307. Berlin.

44. Krutzsch W., 1962b. Atlas der mittel- und jungtertiären dispersen Sporen- und Pollen—sowie der Mikroplanktonformen des nördlichen Mitteleurops. Veb. Deutscher Verlag der Wissenschaften. B. **I**:108. Berlin.

45. Krutzsch W., 1963. Atlas der mittel- und jungtertiären dispersen Sporen- und Pollen—sowie der Mikroplanktonformen des nördlichen Mitteleuropas. Verb. Deutscher Verlag der Wissenschaften. B. II. Berlin W. 8.

46. Kuprianova L. A., 1960. Palynological data contributing to the history of *Liquidambar*. Pollen et Spores, **2**, 1:71—88.

47. Kuptzowa I. A., 1962. Novyj vid roda *Stephanodiscus* Ehr. iz pliocenovych otłoženii nižnej Kamy. Botaničeskie Materiały otdela sporovych rastienii. Bot. Inst. im. Kom. Akad. Nauk SSSR. **15**:37—38. Moskwa—Leningrad.

48. Leschik G., 1951. Mikrobotanisch-stratigraphische Untersuchungen der jungpliozänen Braunkohle von Buchenau. Palaeontographica B. 92, Abt. B:1—51. Stuttgart.

49. Leschik G., 1956. Die Entstehung der Braunkohle der Wetterau und ihre Mikro- und Makroflora. Palaeontographica B. 100, Abt. B, Lief. 1—3:26—64. Stuttgart.

50. Łańcucka-Środoniowa M., 1957. Mioceńska flora z Rypina na Pojezierzu Dobrzyńskim. Inst. Geol. Prace 15:5—76. Warszawa.

51. Łańcucka-Środoniowa M., 1963. Stan badań paleobotanicznych nad miocenem Polski południowej. Roczn. Pol. Tow. Geol. **23**, 2:129—158.

52. Łyczewska J., 1958. Stratygrafia paleogenu i neogenu Polski północnej. Kwartalnik Geologiczny **2**:127—160.

53. Macko S., 1957. Lower miocene pollen flora from the valley Kłodnica near Gliwice (Upper Silesia). Prace Wrocł. Tow Nauk. S. B. 88:1—313 Wrocław.

54. Macko S., 1959. Pollen Grains and Spores from Miocene Brown Coals in Lower Silesia I. Prace Wrocł. Tow. Nauk. S. B. 96:1—177. Wrocław.

55. Mai D. H., 1961. Über eine fossile Tiliaceen-Blüte und Tilioiden Pollen aus dem deutschen Tertiär. Geologie **10**, 32:54—93. Berlin.

56. Mamczar J., 1960. Wzorcowy profil środkowego miocenu Polski środkowej. Inst. Geol. Biul. 157:13—68. Warszawa.

57. Mamczar J., 1961. Wzorcowy profil sporowo-pyłkowy z górno-mioceńskiego węgla brunatnego z Polski środkowej (złoże Rogóźno). Inst. Geol. Biul. 158:305—323. Warszawa.

58. Manten A. A., 1958. Palynology of the Miocene browncoal mined at Haanrade (Limburg, Netherlands). Acta Bot. Neederl. 7:445—488.

59. Matthes W., 1956. Einführung in die Mikropaläontologie. S. Hirzel Verlag, Leipzig. 348 S.

60. Nagy E., 1958. Palynologische Untersuchung der am Fusse des Matra-Gebirges gelagerten Oberpannonischen Braunkohle. Ann. Inst. Geol. Publ. Hung. **47**, 1:1—353. Budapest.

61. Nagy E., 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.

62. 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. u. Westf. **2**:503—525.

63. Oszast J., 1952—1955. Pollen diagrams from Huba and Mizerna (unpublished).

64. Oszast J., 1960. Analiza pyłkowa iłów tortońskich ze Starych Gliwic. Monographiae Botanicae **9**, 1:1—47. Warszawa.

65. Pacltova B., 1960. Rostlinné mikrofosilie (hlavne sporomorphy) z Ceskobudejovickié pánvi. Sbornik Ústředniho Ústavu Geologického Sr. 25:109—176. Nakl. Cesk. Ak. Ved. Praha.

66. Planderova E., 1961. Prispevok k palynologickému vyzkum niektorych oblasti juzného Slovenska. Biologické Práce Sect. Biol. a Lek. Ved. Slov. Akad. Ved. **7**, 1:77—109.

67. Pokrovskaja I. V., 1956. Atlas miocenovych sporovo-pylcevych kompleksov rozličnych rejonov SSSR. Mat. Geol. Inst. nov. ser. Izd. 13:1—459. Moskwa.

68. Pokrovskaja I. V., 1957. Stratigrafija Mezozoja i Kainozoja Zapadnosibirskoj nizmennosti. Gosudarstvennyj Sojuznyj Zapadno Sibirskij Nefterazvedočnyj Trest. 148 str., 141 tab. Moskwa.

69. Popov P. A., 1956. Pylca *Trapa* L. w tretičnych otloženijach Jenisejskogo krjaža. Dokl. Akad. Nauk. SSSR. **110**, 3:453—456.

70. Potonié R., 1931. Zur Mikroskopie der Braunkohlen Tertiäre Blütenstaubformen. Zeitschr. Braunkohle, **30**, 16:325—333. Halle.

71. Potonié R., 1951. Revision stratigraphisch wichtiger Sporomorphen des mitteleuropäischen Tertiärs. Palaeontographica B. 91, Abt. B. Lief. 5—6:131—151. Stuttgart.

72. Potonié R., 1956. Sinopsis der Gattungen der Sporae dispersae, I. Sporites. Beih. zum Geol. Jahrb. H. 23, 103 S. Hannover.

73. Potonié R. & Kremp G., 1955—1956. Die Sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie mit Ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Palaeontographica, Abt. B, T. I, **98**, 1—3:1—136. T. II, **99**, 4—6:85—191. T. III, **100**, 4—6:65—121. Stuttgart.

74. Potonié R., Thomson P. W. & Thiergart F., 1950. Zur Nomenklatur und Klassifikation der neogenen Sporomorphae (Pollen und Sporen). Geol. Jahrb. 1949, **65**:35—69. Hannover.

75. Potonié R. & Venitz H., 1934. Zur Mikrobotanik des miozänen Humodils der niederrheinischen Bucht. Preussisches Geol. Landesanstalt **5**:5—54. Berlin.

76. Pożaryski W., 1953. Osady morskie oligocenu młodszego na Kujawach. Inst. Geol. Biul. 87. Warszawa.

77. Raukopf K., 1959. Pollenanalytische Untersuchungen zur Feinstratigraphie der Tertiärkohlen von Mecklenburg, Berlin und der Lausitz. Abh. der Deutsch. Akad. der Wiss. zu Berlin, Jahrg. 1959, 8:3—24.

78. Rein U., 1961. Die Möglichkeiten einer pollenstratigraphischen Gliederung des Miozäns in Nordwestdeutschland. Meyniana **10**:160—166. Kiel.

79. Reissinger A., 1950. Die Pollenanalyse ausgedehnt auf alle Sedimentgesteine der geologischen Vergangenheit. Palaeontographica Bd. 90, Abt. B:99—126. Stuttgart.

80. Reymanówna M. & Stuchlik L., 1959. Próby stosowania polimerów w pracowni paleobotanicznej. Wiadomości Botaniczne **3**, 2:95—100. Kraków.

81. Rogalska M., 1954. Analiza sporowo-pyłkowa liasowego węgla blanowickiego z Górnego Śląska. Inst. Geol. Biul. 89:1—46. Warszawa.

82. Rogalska M., 1956. Analiza sporowo-pyłkowa liasowych osadów obszaru Mroczków—Rozwady w powiecie opoczyńskim. Inst. Geol. Biul. 104:1—89. Warszawa.

83. Romanowicz I., 1961. Analiza sporowo-pyłkowa osadów trzeciorzędowych z okolic Bolesławca i Zebrzydowej. Inst. Geol. Biul. 158:325—409. Warszawa.

84. Rossignol M., 1962. Analyse pollénique de sédiments marins quaternaires en Israël. II Sédiments pleistocènes. Pollen et Spores **4**, 101:121—148.

85. Rudolph K., 1935. Mikrofloristische Untersuchungen tertiärer Ablagerungen im nördlichen Böhmen. Beih. z. Bot. Centralbl. 54, B:244—328.

86. Rühle E., 1955. Przegląd wiadomości o podłożu czwartorzędowym w północnowschodniej części Niżu polskiego. Inst. Geol. Biul. 70:159—172. Warszawa.

87. Selling O. H., 1946. Studies im Hawaiian pollen statistics part. II. Bishop Museum Honolulu, Hawai, Special Publication 37:87 pp.

88. Simoncsics P., 1959. Palynologische Untersuchungen an der Miozänen Braunkohle des Solgotarianer Kohlenreviers. Acta Biol. Univ. Szeged. Pars Bot. 5:181—199.

89. Sladkov A. N., 1951. Opredelenie vidov *Lycopodium* L. i *Selaginella* Spring po sporam i mikrosporam. Materialy po Geomorfologii i Paleogeografii SSSR 5. Trudy Instituta Geografii Akademii Nauk SSSR 50:167—199. Moskwa.

90. Sobolewska M., 1956. Roślinność plejstoceńska z Syrnik nad Wieprzem. Inst. Geol. Biul. 100:143—192. Warszawa.

91. Szafer W., 1950. Przewodnik do wycieczki na Podhale XXII Zjazdu Pol. Tow. Geol. w r. 1949. XIX Rocznik Pol. Tow. Geol. 505—508.

92. Szafer W., 1953. Stratygrafia plejstocenu w Polsce na podstawie florystycznej. Pol. Tow. Geol. **22**, 1:1—99.

93. Szafer W., 1954. Plioceńska flora z okolic Czorsztyna. Inst. Geol. Prace 11:1—133. Warszawa.

94. Szafer W., 1961. Mioceńska flora ze Starych Gliwic na Śląsku. Inst. Geol. Prace 33:5—205. Warszawa.

95. Teichmüller R., 1958. Die niederrheinische Braunkohlenformation. Stand der Untersuchungen und offene Fragen. Fortschr. Geol. Rheinl. u. Westf. 2:721—750.

96. Thiergart F., 1940. Die Mikropaläontologie als Pollenanalyse im Dienst der Braunkohlenforschung. Brennstoff Geologie 13:1—40. Stuttgart.

97. Thiergart F., 1949. Die *Sciadopitys*-Zone und der *Sciadopitys* Vorstoss in der rheinischen Braunkohle. Zeitschr. Braunkohle, Jahrg. 1949:152—156. Düsseldorf.

98. Thomson P. W., 1949. Alttertiäre Elemente in der Pollenflora der rheinischen Braunkohle und einige stratigraphisch wichtige Pollenformen derselben. Palaeontographica B. 90, Abt. B:94—98. Stuttgart.

99. Thomson P. W. & Pflug H., 1953. Pollen und Sporen des Mitteleuropäischen Tertiärs. Palaeontographica, **94**, Abt. B, 1—4:1—138. Stuttgart.

100. Traverse A., 1955. Pollenanalysis of the Brandon lignite of Vermont. Bureau of Mines, Report of Investigations. U. S. Departm. of the Interior 5151.107 pp.

101. Ueno J., 1960. Palynological notes of *Podocarpaceae*. Acta Phytotax. Geobot. **18**, 7:198—207. Osaka City University.

102. Wagenitz G., 1955. Pollenmorphologie und Systematik in der Gattung *Centaurea* L. s. l. Flora **142**, 2:213—279. Jena.

103. Wang Fu-Hsung, Chien, Nau-Feng, etc., 1960. Morphology of Pollen of Chinese Plants. Bot. Inst. of Ac. of Sc. of China. 376 pp.

104. Wettstein R., 1935. Handbuch der Systematischen Botanik. Leipzig und Wien, 1152 S.

105. Weyland H. & Pflug H. D., 1957. Die Pflanzenreste der Pliozänen Braunkohle von Ptolemais in Nordgriechenland. I. Palaeontographica **102**, 4—6:96—109. Stuttgart.

106. Weyland H., Pflug H. D. & Mueller H., 1960. Die Pflanzenreste der Pliozänen Braunkohle von Ptolemais in Nordgriechenland. II. Palaeontographica **106**, Abt. B. 4—6:71—98. Stuttgart.

107. Weyland H., Pflug H. D. & Pantic N., 1958. Untersuchungen über die

Sporen- und Pollen Flora einiger jugoslawischer und griechischer Braunkohlen. Palaeontographica **105**, Abt. B, 1—4:75—99. Stuttgart.

108. Zagwijn W. H., 1960. Aspects of the pliocene and early pleistocene vegetation in the Netherlands. Uitgevers-Mij. „Emest van Aelest". Maastrich. 1—78.
109. Zaklinskaja E. D., 1953. Opisanie nekotorych vidov pylcy i spor, vydelennych iz tretičnych otloženij pasekowskogo karera Voronežskoj oblasti. Trudy Inst. Geol. Nauk 142, geol. ser. 59:60—102. Moskwa.
110. Zaklinskaja E. D., 1963. Pylca pokrytosiemiennych i ee značenie dla obosnozanija stratigrafii verchnego Mela i paleogena. Trudy Geologiczeskogo Instituta. **74**:1—256. Moskwa.

STRESZCZENIE

ANALIZA PYŁKOWA OSADU MIOCEŃSKIEGO Z RYPINA

Praca zawiera wyniki badań palynologicznych nad neogeńskim osadem z Rypina (profil II), położonego na północny zachód od Warszawy. Materiał do badań był przygotowany przy pomocy metody acetolizy (Erdtman 1943, 1960) po uprzednim poddaniu go działaniu płynów ciężkich metodą Knoxa (1942). Część systematyczna zawiera opis wyróżnionych sporomorf, ułożonych według systemu Wettsteina (1935) i Florina (1931). Nomenklatura oparta jest na systemie naturalnym przy równoczesnym uwzględnieniu nazewnictwa morfograficznego.

Wszystkie oznaczone rośliny podzielono na 3 grupy geograficzne:

1. rośliny klimatu subtropikalnego i tropikalnego;
2. rośliny klimatu umiarkowanie ciepłego i przejściowego do umiarkowanego;
3. rośliny klimatu umiarkowanego i przejściowego do umiarkowanie chłodnego.

Z punktu widzenia edaficznego wyróżniono:

1. rośliny wodne, przybrzeżne i torfowiskowe;
2. rośliny lasu bagiennego (*Taxodium-Nyssa* Swamps);
3. rośliny wilgotnych zarośli typu *Myricaceae-Cyrillaceae;*
4. rośliny lasów i zarośli stanowisk suchszych.

Na podstawie diagramu pyłkowego wyróżniono następujące trzy okresy rozwoju roślinności.

Okres I roślinności subtropikalnej i tropikalnej. W tym jedynie okresie występują *Ptelea* i *Gunnera* w stosunkowo wysokich procentach, a niektóre inne formy osiągnęły tu swoje maksymalne wartości (*Castaneoideae, Araliaceae, Sapotaceae, Cyrillaceae*). W młodszych okresach rośliny te występują już tylko sporadycznie. Z okresem I związane są również paprocie z rodzajów *Cyathea, Lygodium* oraz *Gleicheniaceae*.

W okresie tym wyróżnić można trzy grupy roślinności w zależności od podłoża, na jakim występują. Na miejscach zabagnionych rosły lasy cyprysnikowe, na wilgotnych zarośla z *Ptelea, Cyrillaceae, Myrica, Engelhardtia, Sapotaceae* i in. z licznymi paprociami, miejsca bardziej otwarte zajmowały *Hippophaë, Cyperaceae, Ericaceae* i prawdopodobnie *Gunnera*, a najsuchsze stanowiska porastały lasy sosnowe z *Cryptomeria, Sequoia, Sciadopitys, Quercus, Castanea, Castanopsis, Pasania, Ilex* i in. Klimat tego okresu był wilgotny o charakterze subtropikalnym.

Okres II panowania roślinności subtropikalnej i klimatu suchszego i prawdopodobnie chłodniejszego niż klimat okresu poprzedniego. Panującą grupą roślin były nie lasy bagienne, ale wilgotne zarośla krzewów z *Leguminosae* (zwłaszcza *Caragana*), *Symplocos, Engelhardtia, Myrica Ilex* i in. Zanika *Ptelea* i *Gunnera*, a udział paproci subtropikalnych zmalał do minimum.

Okres III panowania roślinności umiarkowanie ciepłej i umiarkowanej. Okres ten obejmuje całą stropową część profilu. Wyróżnić w nim można parę faz, w których skład roślinności był odmienny w zależności od zmieniających się czynników edaficznych.

W fazie „a" na suchszych miejscach dużą rolę odgrywały lasy sosnowe, dębowe oraz być może brzozowe, a na miejscach podmokłych lasy bagienne, głównie z *Nyssa, Taxodium* i *Glyptostrobus*.

Roślinność fazy „b" różniła się od poprzedniej mniejszym udziałem sosny, zanikiem *Araliaceae, Cyrillaceae* i *Leguminosae* oraz wzrostem udziału buka i roślin zielnych, a zwłaszcza *Compositae, Centaurea* typ *cyanus* i traw o dużych ziarnach pyłku.

Cechą znamienną fazy „c" jest obfity rozwój roślinności wodnej i przybrzeżnej (*Sparganium* 153·7%, *Decodon* 61·9% i in.).

W fazie „d" w miarę zarastania zbiorników sedymentacyjnych rozprzestrzeniały się *Cyperaceae, Gramineae* i paprocie.

W fazie „e" ponownie panują lasy sosnowe z dębem z mniejszym udziałem składników budujących lasy bagienne. Dopiero w samym stropie profilu nastąpił ponowny rozwój lasów bagiennych kosztem lasów przywiązanych do stanowisk suchszych.

Okres III charakteryzował klimat umiarkowanie ciepły lub umiarkowany o różnym stopniu wilgotności w różnych jego odcinkach. Na terenie Niecki Mazowieckiej znajdowały się wówczas liczne, ale prawdopodobnie niewielkie jeziorka z bogatą roślinnością wodną i przybrzeżną, a w ich sąsiedztwie rosły lasy bagienne. Na znacznie suchszym tzw. Wale Kujawskim rosły lasy sosnowe z *Quercus, Sequoia* i in.

Wyniki uzyskane przy badaniu szczątków makroskopowych z profilu Rypin II (Łańcucka-Środoniowa 1957) są na ogół zgodne z wynikami badań palynologicznych. Tylko nielicznych roślin oznaczonych makroskopowo nie znaleziono w materiale pyłkowym.

Na podstawie analizy makroskopowej flory Łańcucka-Środoniowa (1957) określiła wiek osadu z Rypin na górny miocen. Autorka ta nie znalazła żadnych oznaczalnych szczątków roślinnych ze spągowej części profilu.

Wszystkie wyróżnione sporomorfy podzielono pod względem znaczenia stratygraficznego na trzy grupy.

Sporomorfy grupy I reprezentują element starotrzeciorzędowy odgrywający największą rolę w paleogenie po oligocen górny włącznie, a w neogenie spotykany tylko sporadycznie.

Sporomorfy grupy II występują najczęściej w miocenie, aczkolwiek zjawiają się już w oligocenie, gdzie jednak nie odgrywają większej roli, i spotykane są jeszcze w pliocenie.

Grupa III obejmuje sporomorfy nie mające większego znaczenia stratygraficznego, gdyż spotykane są zarówno w trzeciorzędzie, jak i czwartorzędzie.

Podział powyższy wyraźnie zlokalizował elementy starotrzeciorzędowe w spągu profilu, a elementy tzw. „młodsze" w jego górnych partiach. Wydzielony w diagramie pyłkowym okres I zaliczono do schyłku oligocenu górnego. Największą rolę odgrywały tu *Ptelea, Gunnera, Castaneoideae, Sapotaceae* i in. Tu też spotykano pojedyncze ziarna pyłku znane tylko z trzeciorzędu starszego *(Restionaceae, Proteaceae, Aglaoreidia cyclops)* oraz plankton morski. Flora tego okresu jest podobna do flor z Obersdorf i Berzdorf, zaliczonych przez Hungera (1953) do pogranicza oligo-miocenu, oraz do flor tego samego wieku z Zebrzydowej na Dolnym Śląsku (Romanowicz 1961) i Rogóźna koło Łodzi (Doktorowicz-Hrebnicka 1961).

Okres II obejmuje młodszą część pogranicza szat-akwitanu. Maleje udział elementów, które panowały w okresie poprzednim, a zasadniczą rolę odgrywają inne, również starotrzeciorzędowe elementy, takie jak *Engelhardtia, Myrica, Cyrillaceae* oraz *Leguminosae*. Te ostatnie, zdaniem Thiergarta (1940) i Thomsona (1949), odegrały największą rolę właśnie na pograniczu szatu i akwitanu. Pod względem składu florystycznego okres II naszego profilu podobny jest do analogicznego okresu znanego z Zebrzydowej na Dolnym Śląsku (Romanowicz 1961) i z kopalni Babina (otwór nr 5 profilu 2), (Doktorowicz-Hrebnicka 1957c).

Okres III, obejmujący całą stropową część profilu Rypin II, należy do miocenu górnego, co zgodne jest z wynikami badań makroskopowych tej flory. Sporomorfy starotrzeciorzędowe odgrywały tu już tylko minimalną rolę, a na ich miejsce zjawiły się i narastały elementy charakterystyczne dla miocenu. Skład florystyczny tej części profilu jest uderzająco podobny do flor górnomioceńskich Polski środkowej.

Z przedstawionej tu stratygrafii wynika, że pomiędzy okresem II a III istnieje w profilu z Rypina przerwa sedymentacyjna, obejmująca cały miocen środkowy i część miocenu dolnego. Gdyby takiej przerwy nie było, wówczas okres III musiałby w dolnej części obejmować miocen środkowy. Zaprzecza temu jednak porównanie tego odcinka z profilami miocenu środkowego Polski centralnej. W profilach środkowomioceńskich z Gosławic (Mamczar 1960) i Morzysławia (Kremp 1949) w większych ilościach aniżeli w Rypinie występują elementy starotrzeciorzędowe, inne zaś, tzw. „młodsze", mają przewagę w naszym profilu.

W celu lepszego udokumentowania braku miocenu środkowego w naszym profilu zestawiono tabelę stratygraficzną (str. 95), ilustrującą wygasanie elementów starotrzeciorzędowych z równoczesnym pojawianiem się i narastaniem elementów mających znaczenie w trzeciorzędzie młodszym i w czwartorzędzie.

Wytłumaczenie przerwy sedymentacyjnej pomiędzy okresami II a III zachodzącą wówczas zmianą osadu (glina ze żwirkiem) nie jest rzeczą łatwą, niemniej w literaturze znane są takie przerwy, aczkowiek obejmujące inne okresy trzeciorzędu (Gołąb 1951, Teichmüller 1958).

INDEX OF LATIN NAMES OF SPOROMORPHS

Pages with descriptions of sporomorphs are distinguished from other references to plants by numbers in bold type

PLATES

Plate I

× 900

		pp.
1, 2.	*Sphagnum* sp. 1	9
3.	*Sphagnum* sp. 2	10
4, 5.	*Sphagnum* sp.; *Stereisporites megastereoides* (Pf.) Th. & Pf.	9
6.	*Sphagnum* sp.; *Stereisporites psilatus* (Ross) Th. & Pf.	9
7.	*Sphagnum* sp.; *Stereisporites stereoides* (R. Pot. & Ven.) Th. & Pf.	9
8—10.	*Anthoceros* sp. *Rudolphisporis rudolphi* Krutzsch ssp. *major* n. spm.	10
11, 12.	cf. *Psilotum* sp.	11

Plate I

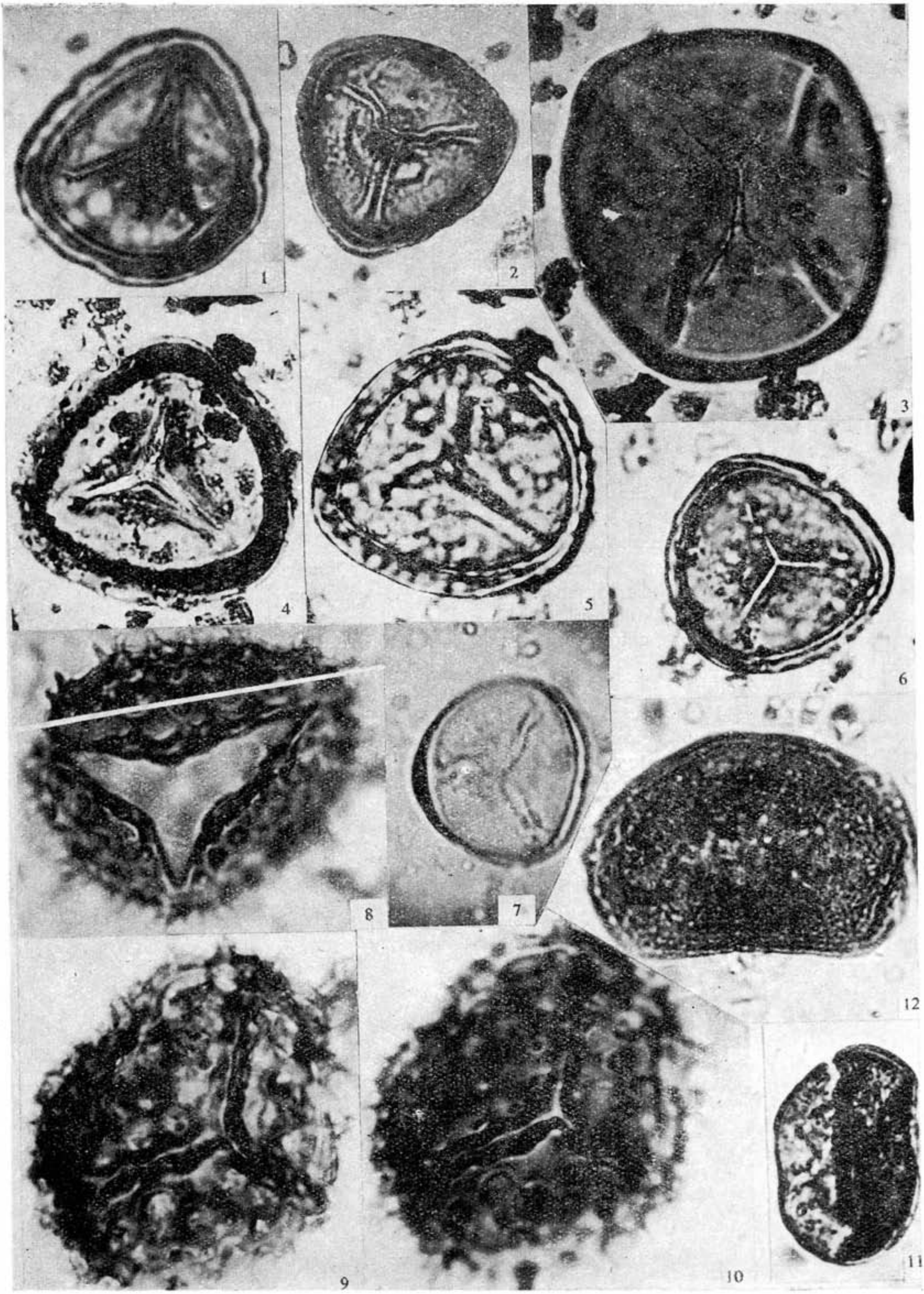
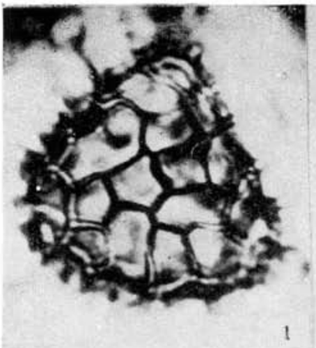


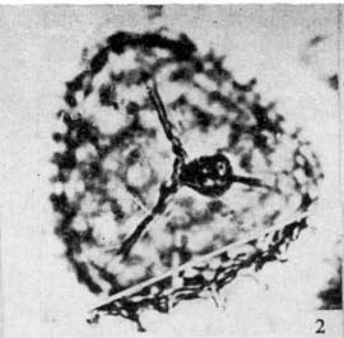
Plate II

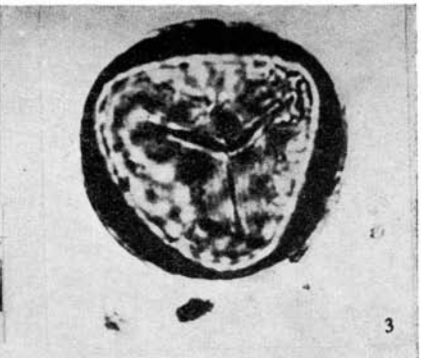
× 900

		pp.
1, 2.	*Lycopodium annotinum* L. type; *Retitriletes frankfurtensis* Krutzsch	11
3.	*Lycopodium cernuum* L. type	12
4, 5.	*Lycopodium* sp. 1 cf.; *Camarozonosporites (Camarozonosporites) decorus* (Wolf) Krutzsch	13
6.	*Lycopodium clavatum* L. type	12
7, 8.	*Lycopodium annotinum* L. type; *Retitriletes annotinoides* Krutzsch	11
9.	*Lycopodium* sp. 2; *Camarozonosporites (Hamulatisporis) helenensis* Krutzsch	13
10. 11.	*Lycopodium inundatum* L. type	12
12, 13.	*Lycopodium selago* L. type	13

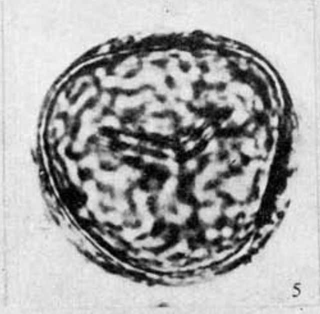
Plate II

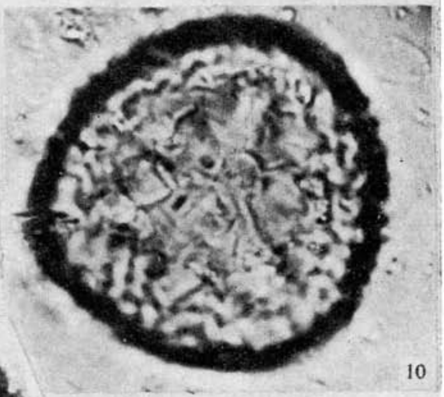

1


2

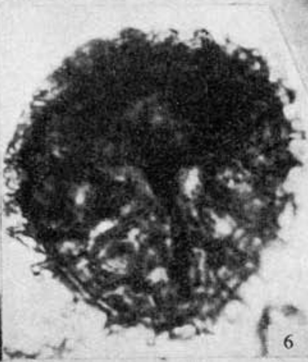

3

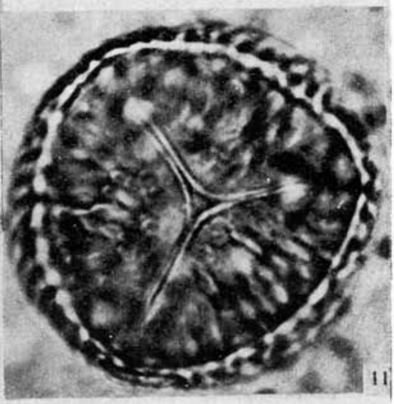

4

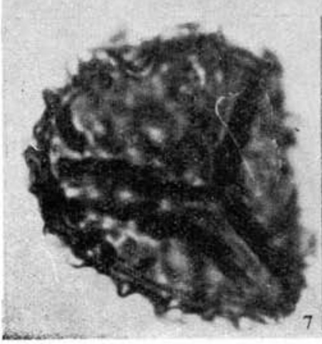

5


10


9


6


11


7


8


12


13

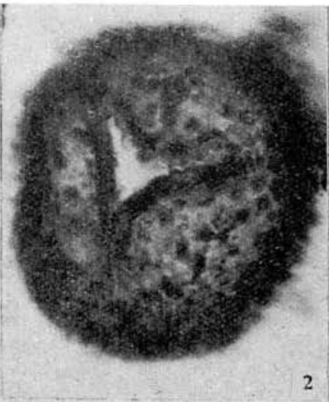
Plate III

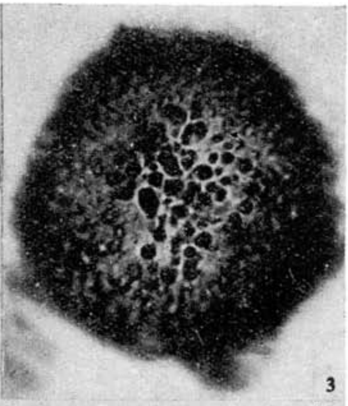
× 900

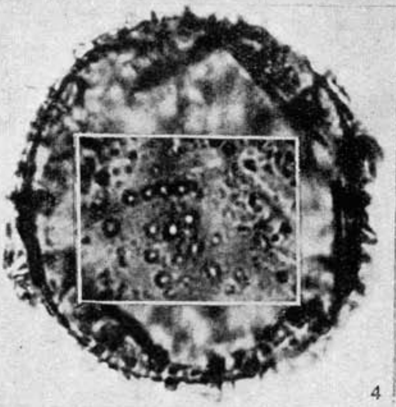
		pp.
1, 2.	*Equisetum* sp.	14
2—6.	*Osmunda claytoniana* L. type	15
7.	*Osmunda regalis* L. type	15
8.	*Osmunda* cf. *bromeliifolia* Copel	15
9, 10.	cf. *Mohria* sp.	16
11, 12.	*Lygodium* sp. 2	16

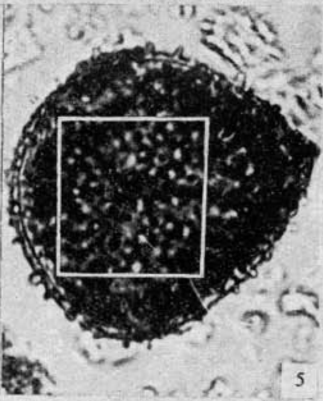
Plate III


1

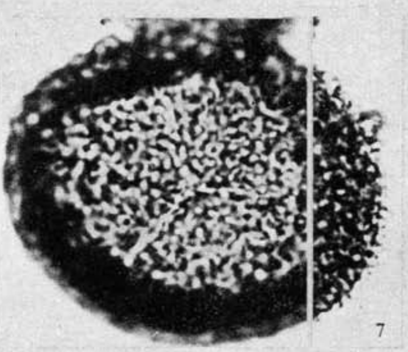

2


3


4

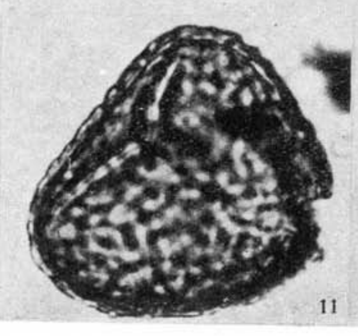

5


6


7


8


9


11


12

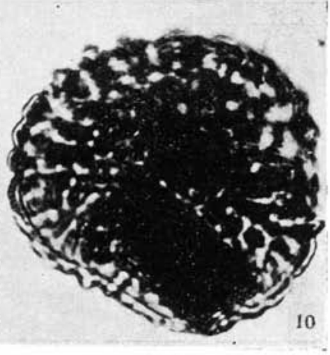
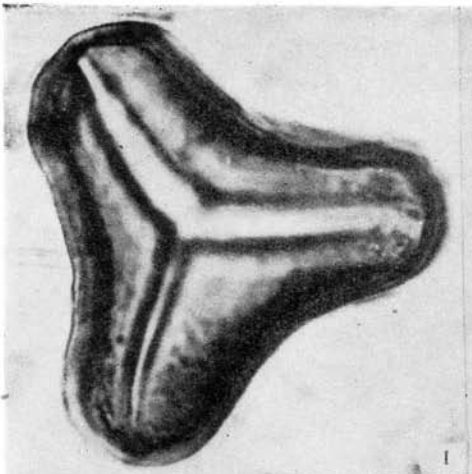

10

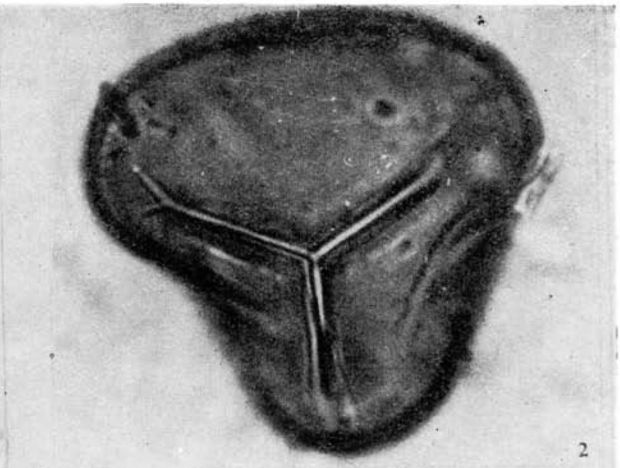
Plate IV

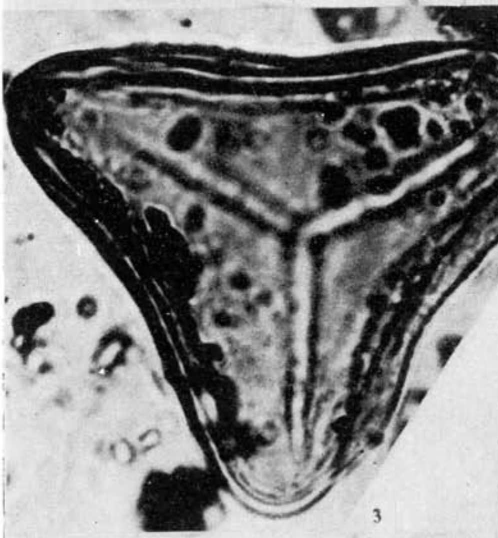
× 900

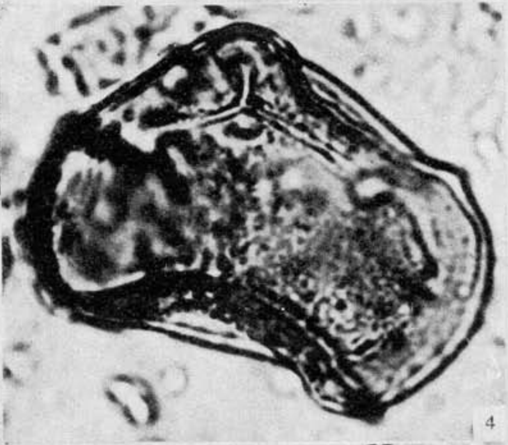
		pp.
1, 3.	*Gleicheniaceae*	17
2.	*Lygodium* sp. 1	16
4.	*Dicksonia* cf. *thyrsopteroides* Moore	19
5, 6.	*Gleicheniaceae?;* cf. *Concavisporites rugulatus* Th. & Pf.	18
7.	*Gleicheniaceae?; Undulatisporites* cf. *pseudobrasiliensis* Krutzsch	17
8, 9.	*Hymenophyllaceae?*	19
10, 11.	cf. *Alsophila* sp.	19

Plate IV


1

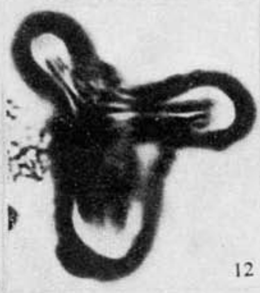

2

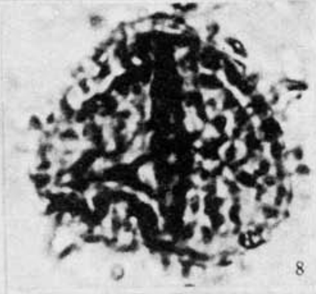

3


4


5

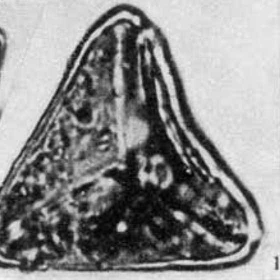

7


12


8


6


10


11

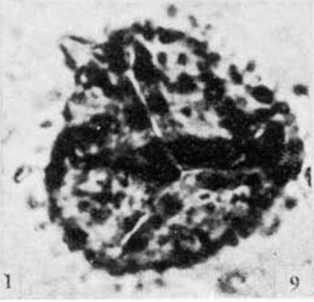
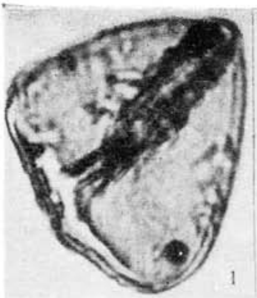

9

Plate V

× 900

		pp.
1—3.	*Cyathea* cf. *propinqua* Molt.	20
4—7.	*Cyathea* cf. *vestita* Mart.	20
8.	cf. *Hemitelia maxonii* Ros.	21
9.	*Toroisporis* sp.	22
10—12.	*Cyatheaceae-Schizaeaceae*	21
13.	*Polypodium* sp.	21
14—16.	*Polypodiaceae; Laevigatisporites hardtii* (R. Pot. & Ven.) Th. & Pf.	22

Plate V


1


2

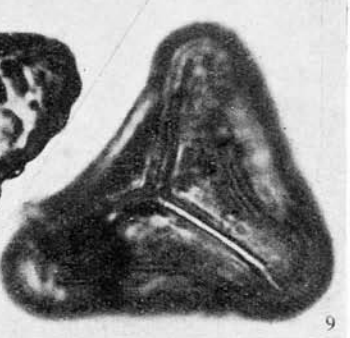

3

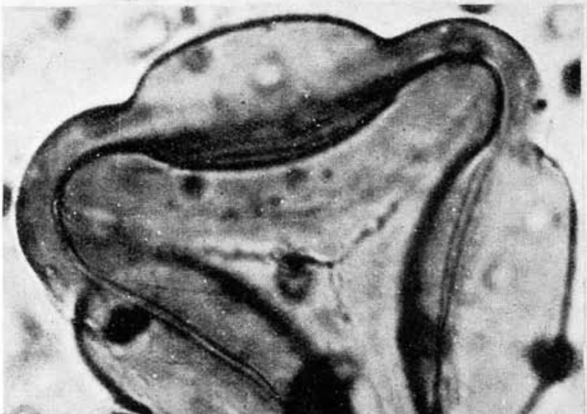

4

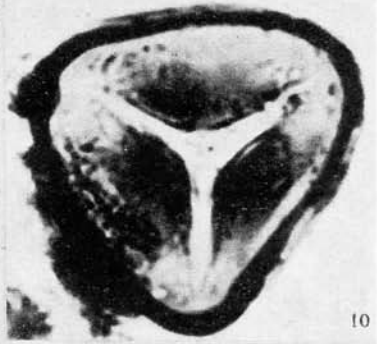

6


7

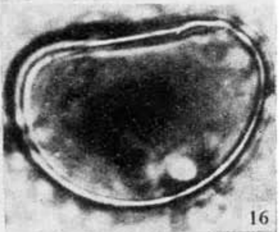

5


9

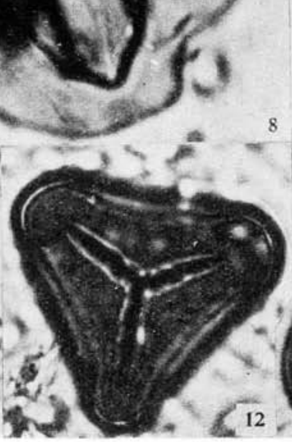

8


10


13


16


11


12


14


15

Plate VI

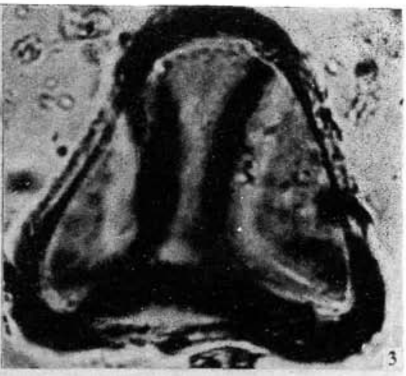
× 900

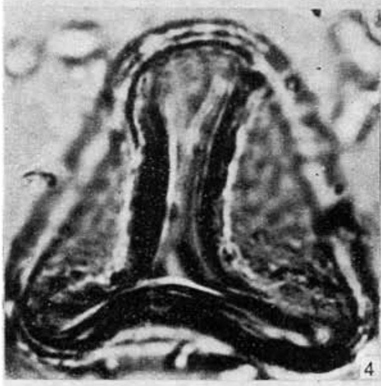
		pp.
1, 2.	*Selaginellaceae; Lusatisporis* sp.	14
3, 4.	*Toroisporis (Toroisporis) aneddeni* Krutzsch	22
5—7.	*Foveotriletes* sp.	22
8, 9.	*Triletes* (strongly corroded)	22
10, 11.	*Camarozonosporites (Hamulatisporis)* sp.	13
12.	*Concavisporites complicatus* Th. & Pf.	18
13.	cf. *Concavisporites* sp.	18

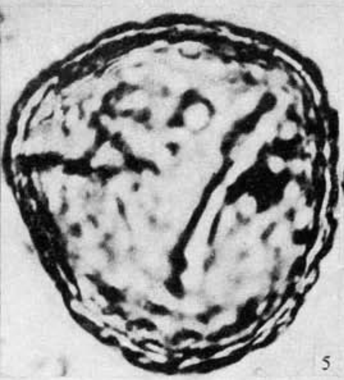
Plate VI

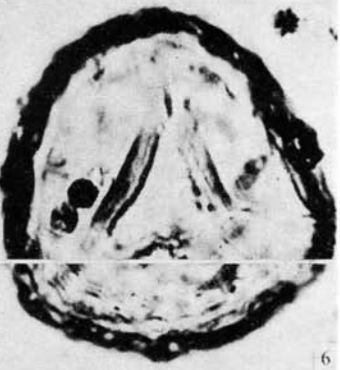

1


2

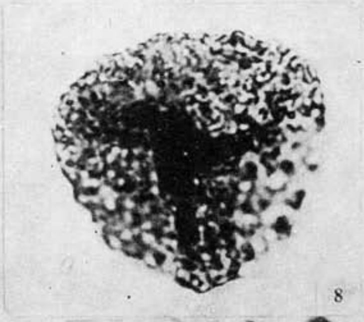

3

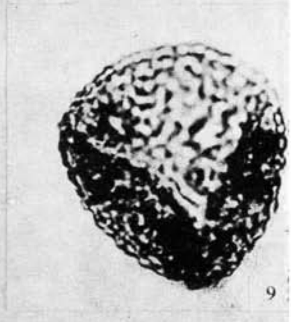

4

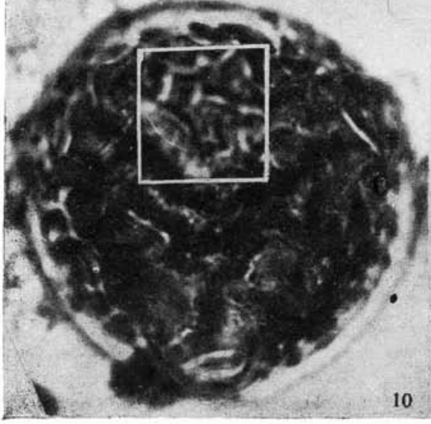

5

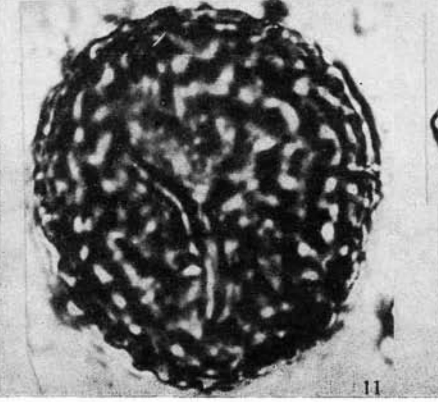

6


7


8


9


10


11


12


13

Plate VII

× 450 and × 900

	pp.
1. cf. *Dacrydium* sp. × 900	23
2. cf. *Dacrydium* sp. × 450	23
3. *Podocarpus* sp. 1 × 900	23
4. *Podocarpus* sp. 1 × 450	23
5. *Podocarpus* cf. *dacrydioides* A. Rich. × 450	24
6—8. *Abies* sp. × 450	24

Plate VII

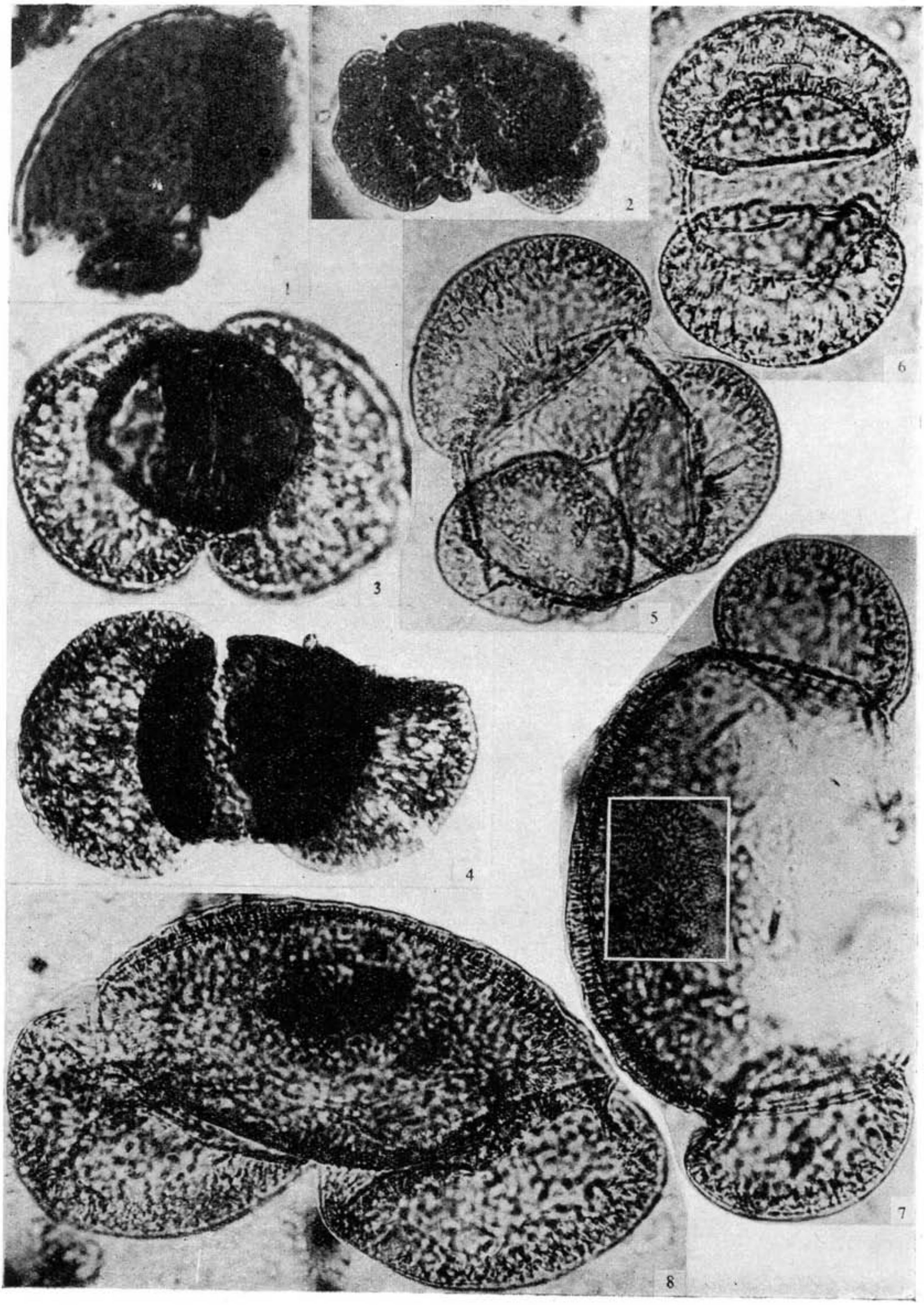
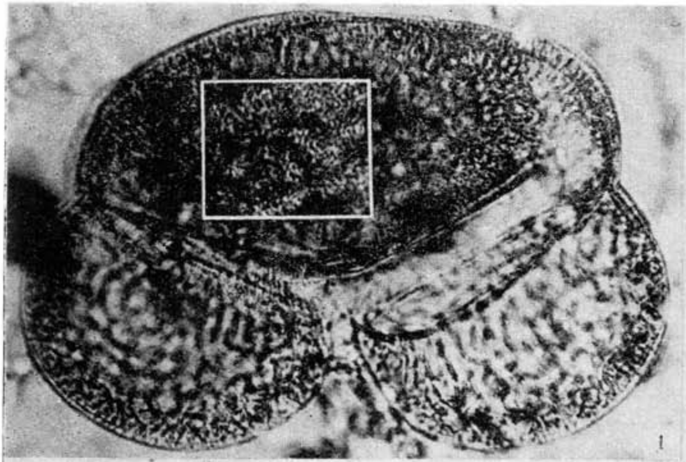
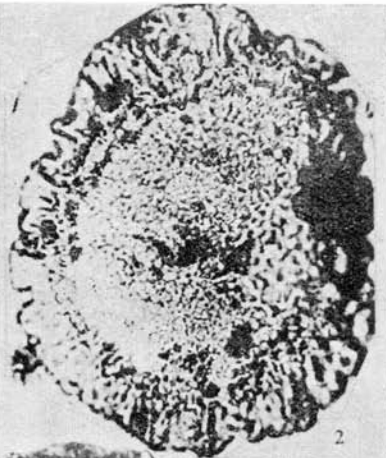


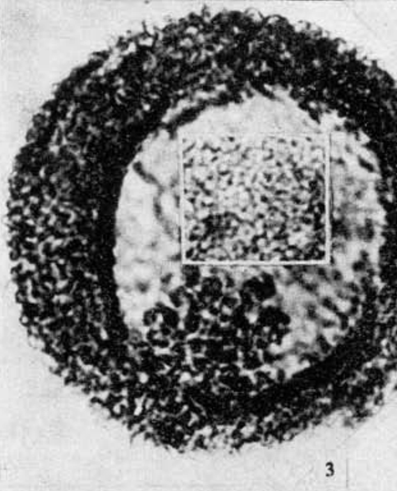
Plate VIII

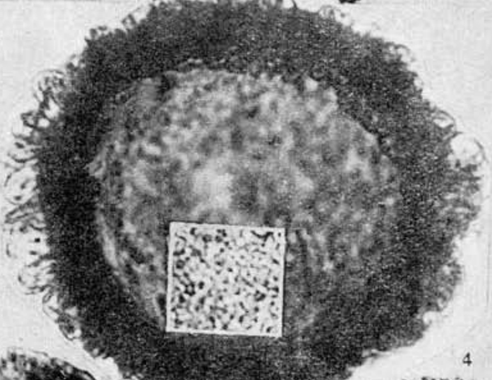
× 450 and × 900

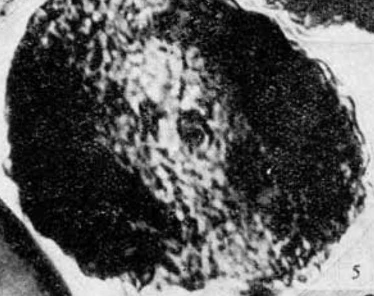
	pp.
1. *Abies* sp. × 450	24
2. *Tsuga diversifolia* (Maxim.) Mast. type × 450	24
3. *Tsuga canadensis* Carr. type × 450	25
4. *Tsuga diversifolia* (Maxim.) Mast. type × 900	24
5. *Tsuga pattoniana* Engelm. type × 450	25
6. *Tsuga canadensis* Carr. type × 450	25
7. *Tsuga diversifolia* (Maxim.) Mast. type × 450	24
8. *Larix* sp. × 900	26


1

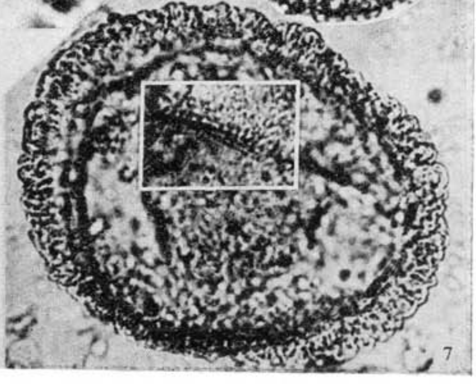

2


3


4


5


6


7

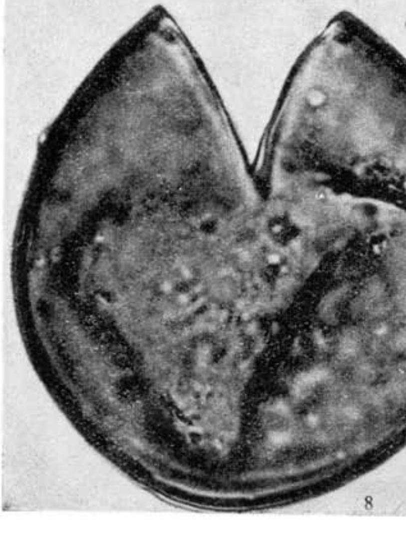
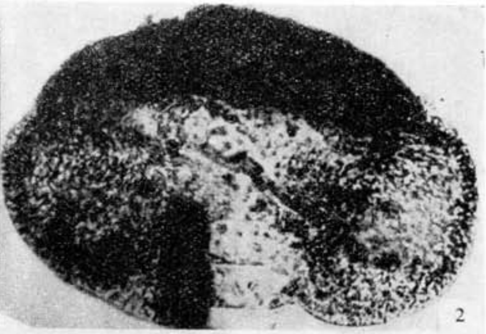

8

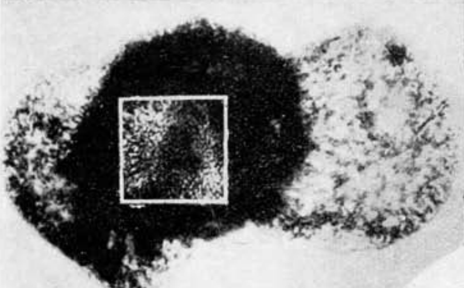
Plate IX

× 450

		pp.
1, 2.	*Picea* sp.	25
3.	*Cedrus* sp.	26
4—9.	*Pinus silvestris* L. type	26
10, 11.	*Pinus haploxylon (minor)* Rudolph type	27
12—14.	*Pinus haploxylon (major)* Rudolph type	27


1


2


3


4


5


6


7

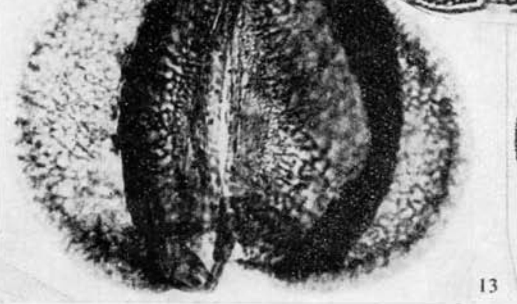

12


8


11


9


10


13

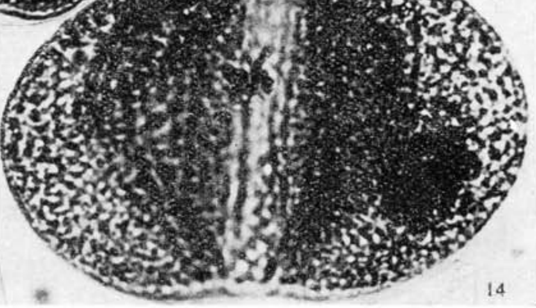
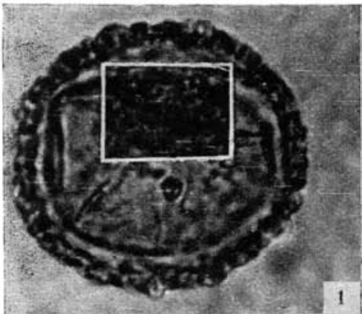
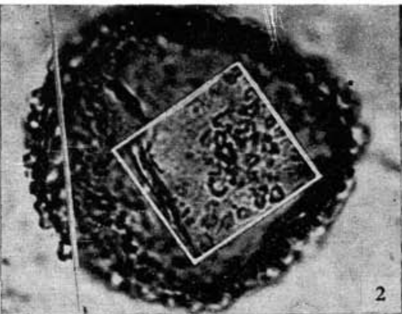

14

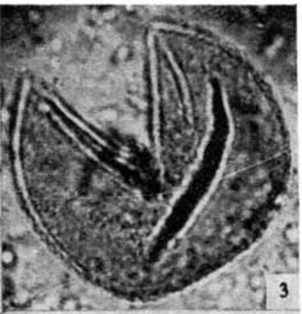
Plate X

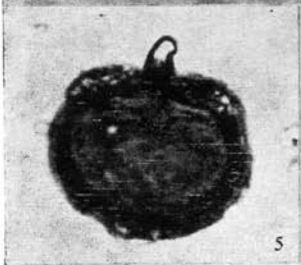
× 900

		pp.
1, 2.	*Sciadopitys verticillata* Sieb. & Zucc.	27
3, 4.	*Taxodium* sp.	28
5, 6.	*Sequoia* sp.	28
7.	*Glyptostrobus* cf. *europaeus* (Brongn.) Heer	28
8—11.	*Cryptomeria* sp.	29
12.	cf. *Taiwania* sp.	29
13.	cf. *Cunninghamia* sp.	29
14.	cf. *Callitris* sp.; *Inaperturopollenites emmaensis* (Mürr. & Pf.) Th. & Pf.	30
15.	*Cupressus* sp.	30
16.	*Taxodiaceae-Cupressaceae; Inaperturopollenites dubius* (R. Pot. & Ven.) Th. & Pf.	30
17, 18.	*Ephedra distachya* L. type	31
19.	*Ephedra* sp. 1; *Ephedripites (Distachyapites) frankfurtensis* Krutzsch	31


1

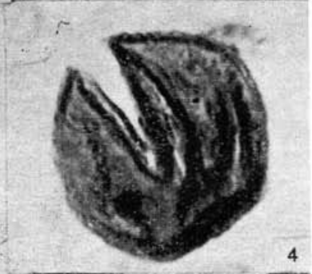

2

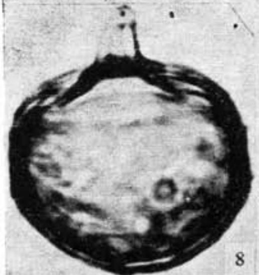

3


5

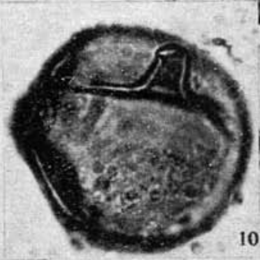

6

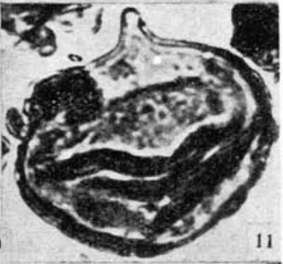

7


4

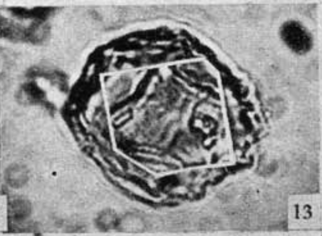

8

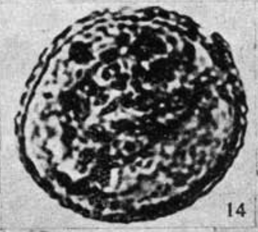

9


10


11

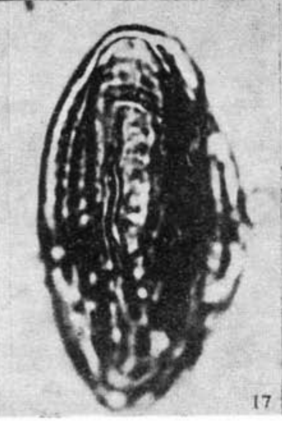

12


13


14


15


16


17


18


19

Plate XI

× 900

		pp.
1, 2.	*Betula* sp.	31
3.	*Alnus glutinosa* (L.) Gaertn. type	32
4.	*Alnus Kefersteinii* Goepp. type	32
5.	*Carpinus* sp.	33
6.	*Ostrya* sp.	32
7, 8.	*Corylus americana* Walt. type	33
9, 10.	*Corylus avellana* L. type	33
11.	cf. *Castanopsis* sp.	34
12, 13.	*Castanea* sp.	34
14, 15.	cf. *Pasania* sp.	35
16—19.	*Fagus* sp.	35
20—22.	*Quercus* sp.	35
23—25.	cf. *Quercus* sp.	36
26.	*Quercoidites henrici* R. Pot.	36
27.	*Myrica* sp.	36

Plate XI

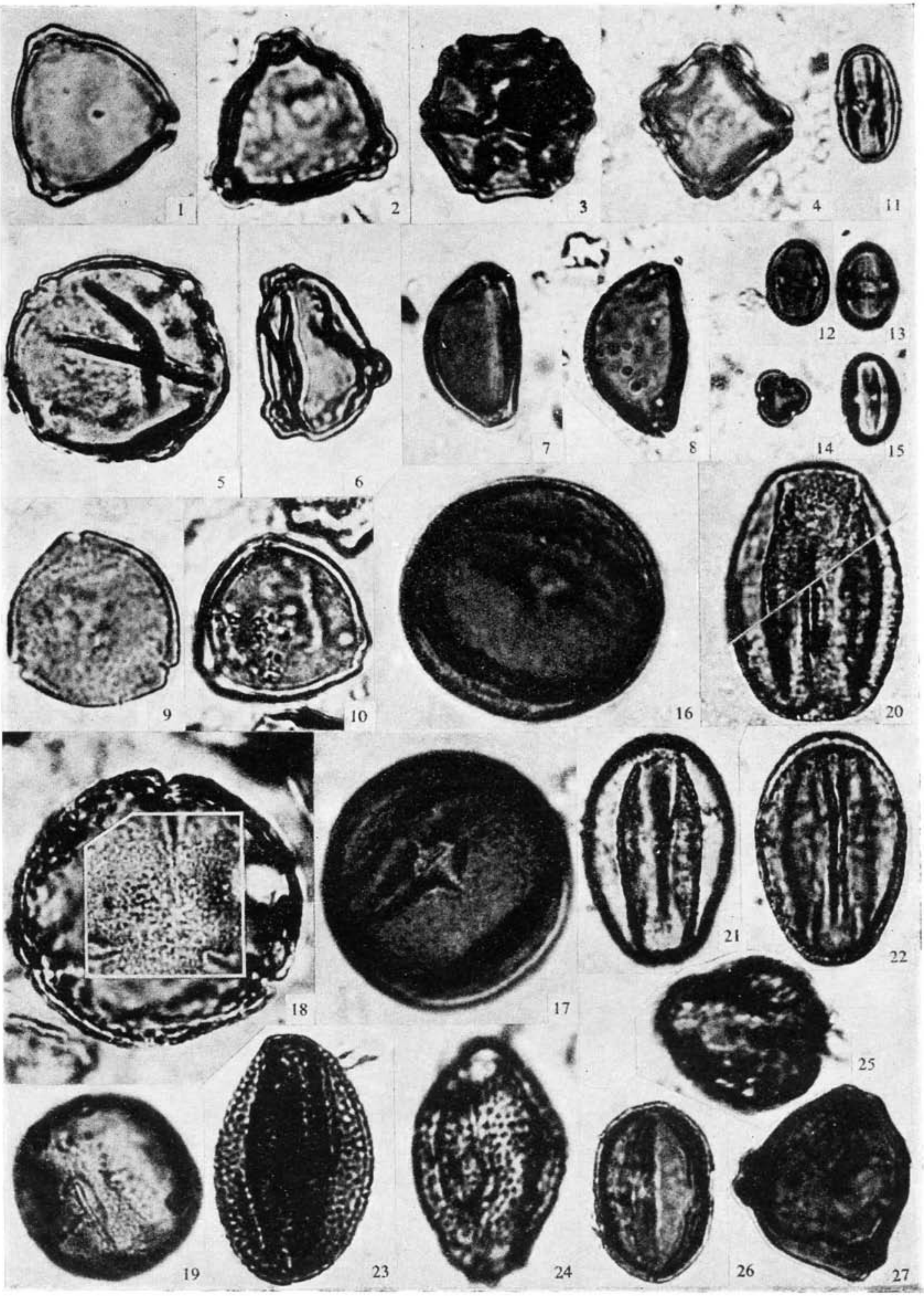


Plate XII

× 900

		pp.
1, 2.	*Juglans* sp.	37
3, 4.	*Pterocarya* sp.	37
5.	*Carya* sp.	37
6, 7.	*Engelhardtia* sp.; *Triatriopollenites coryphaeus* ssp. *punctatus* (R. Pot.) Th. & Pf.	38
8, 9.	*Engelhardtia* sp.; *Triatriopollenites coryphaeus* ssp. *microcoryphaeus* (R. Pot.) Th. & Pf.	38
10, 11.	*Salix aurita-caprea* n. comb. type	38
12, 13.	*Salix* sp.	39
14, 15.	*Ulmus* sp.	39
16, 17.	*Celtis* sp.	39
18—21.	*Eucommia ulmoides* Oliv.	40
22.	*Proteaceae?*	40
23—25.	cf. *Loranthus* sp.	41

Plate XII

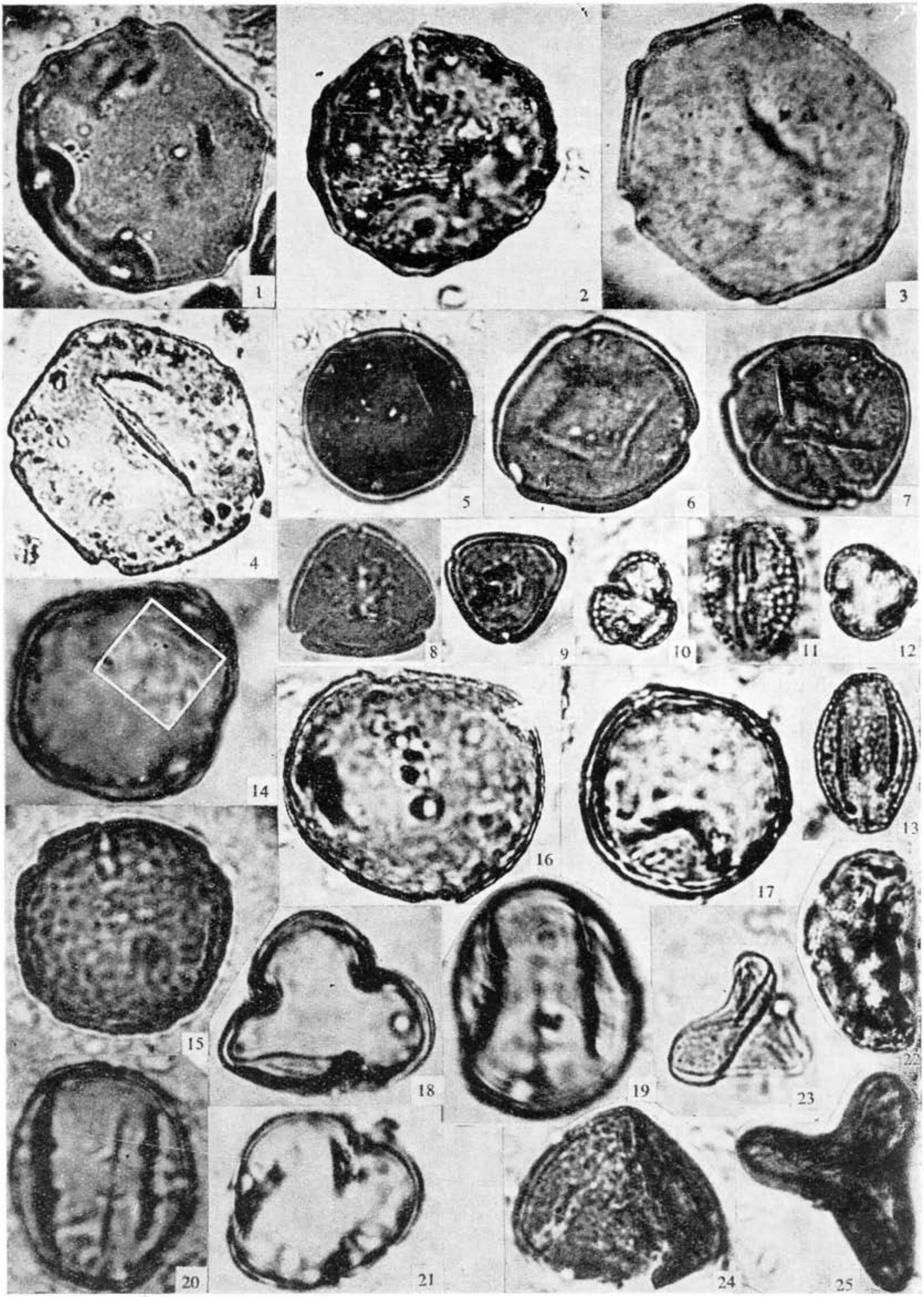


Plate XIII

× 900

		pp.
1.	*Olacaceae* cf. *Chaunochiton* sp.	40
2—4.	*Arceuthobium* cf. *oxycedri* M. B.; *Spinulaepollis arceuthobioides* Krutzsch	41
5—8.	*Arceuthobium* sp.; *Spinulaepollis arceuthobioides* ssp. *major* n. spm.	42
9, 10.	*Rumex* sp.	43
11—13.	*Polygonum „avicularia”* Hedberg type	42
14.	*Polygonum persicaria* L. type	42
15, 16.	*Caryophyllaceae*	43
17, 18.	*Euphorbiaceae?* cf. *Discoglypsemma* sp.	44
19, 20.	*Chenopodiaceae*	43
21—23.	*Liquidambar* sp.	44
24, 25.	*Corylopsis* sp.	44
26.	*Magnoliaceae*	45
27.	*Lauraceae*	45

Plate XIII

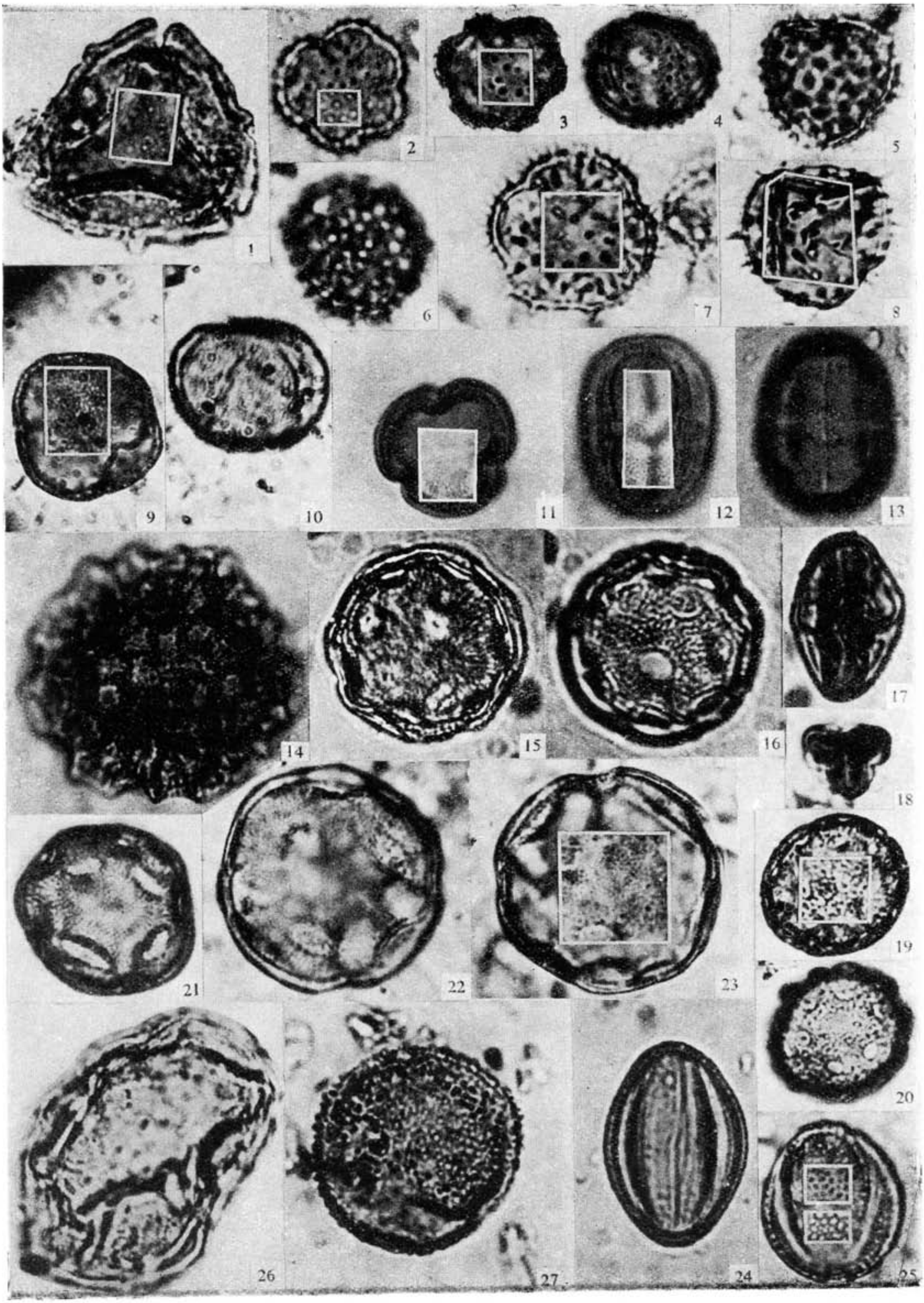


Plate XIV

× **900**

		pp.
1—3.	*Ranunculaceae*	45
4, 5.	*Thalictrum* sp.	46
6, 7.	*Guttiferae?* cf. *Garcinia Mannii* Oliv.	46
8.	*Nymphaeaceae*	46
9.	*Cruciferae*	46
10—12.	*Rosaceae*	47
13—15.	cf. *Caragana* sp.	47
16—21.	*Leguminosae* gen. div.	47
22—24.	cf. *Gynometria* sp.	48
25, 26.	cf. *Cassia* sp.	48
27, 28.	*Hippophaë* sp.	48
29.	cf. *Elaeagnus* sp.; *Boehlensipollis hohli* Krutzsch	48

Plate XIV

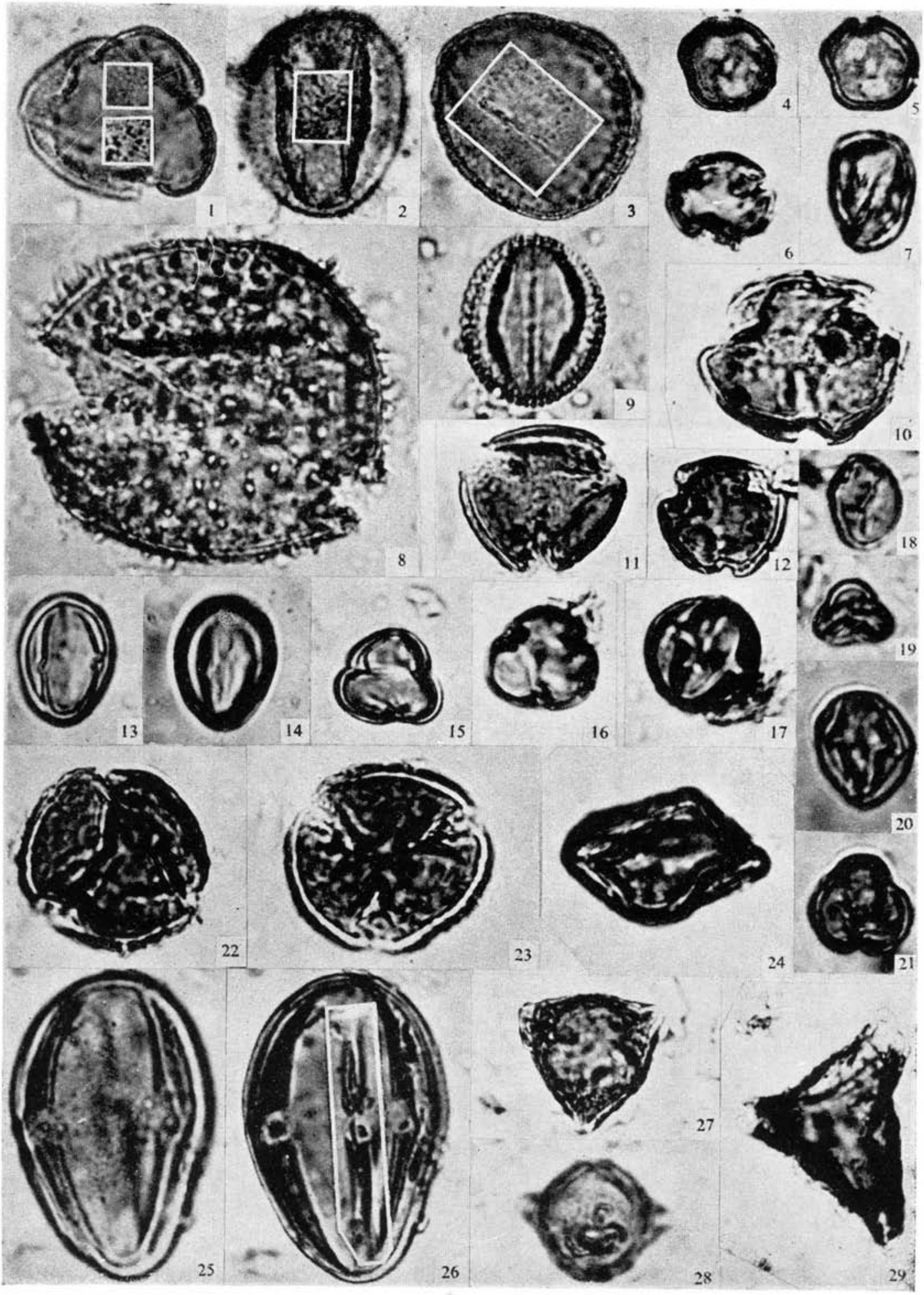


Plate XV

× 900

		pp.
1—5.	cf. *Lythrum* sp.	49
6, 7.	*Decodon cf. globosus* (Reid) Nikit.	49
8—11.	*Nysa* sp.; *Tricolporopollenites kruschi* ssp. *analepticus* (R. Pot.) Th. & Pf.	50
12, 13.	*Nyssa* sp.; *Tricolporopollenites kruschi* ssp. *rodderensis* (Thierg.) Th. & Pf.	50
14, 15.	*Nyssa* sp.; *Tricolporopollenites kruschi* ssp. *accessorius* (R. Pot.) Th. & Pf.	50
16, 17.	*Myrtaceae?*	51
18.	*Myrtus* sp.	50
19.	cf. *Eucalyptus* sp.	51
20—22.	*Oenotheraceae*	51


1


2


3


4


5


6


7


8


9


10


11

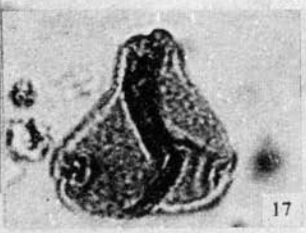

12


13


14

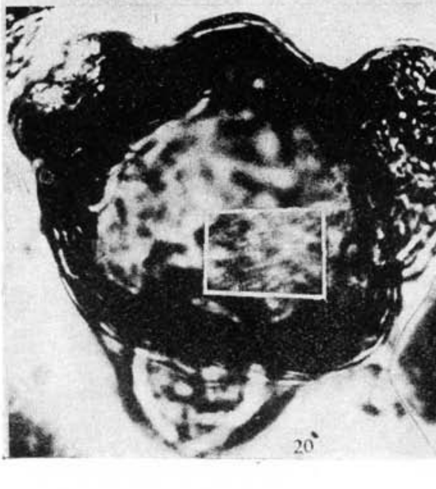

15

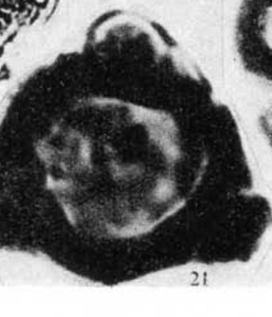

16


17


18


19


20


21


22

Plate XVI

× 900

		pp.
1—3.	*Trapa* sp.	51
4.	cf. *Myriophyllum* sp.	52
5.	*Myriophyllum* sp.	52
6.	*Halorrhagis* sp.; *Halorrhagoidites triporatus* n. spm.	52
7, 8.	*Halorrhagis* sp.; *Halorrhagoidites stephanoporatus* n. spm.	52
9—12.	cf. *Gunnera* sp.	53
13.	*Tilia* sp.	53
14.	*Linum* sp.	54
15—18.	cf. *Palea* sp.	54
19.	cf. *Aegle* sp.	54
20.	cf. *Evodia* sp.	54
21, 22.	*Rutaceae?*	55
23—25.	*Fagara* sp.	55
26—30.	cf. *Ptelea* sp.	55

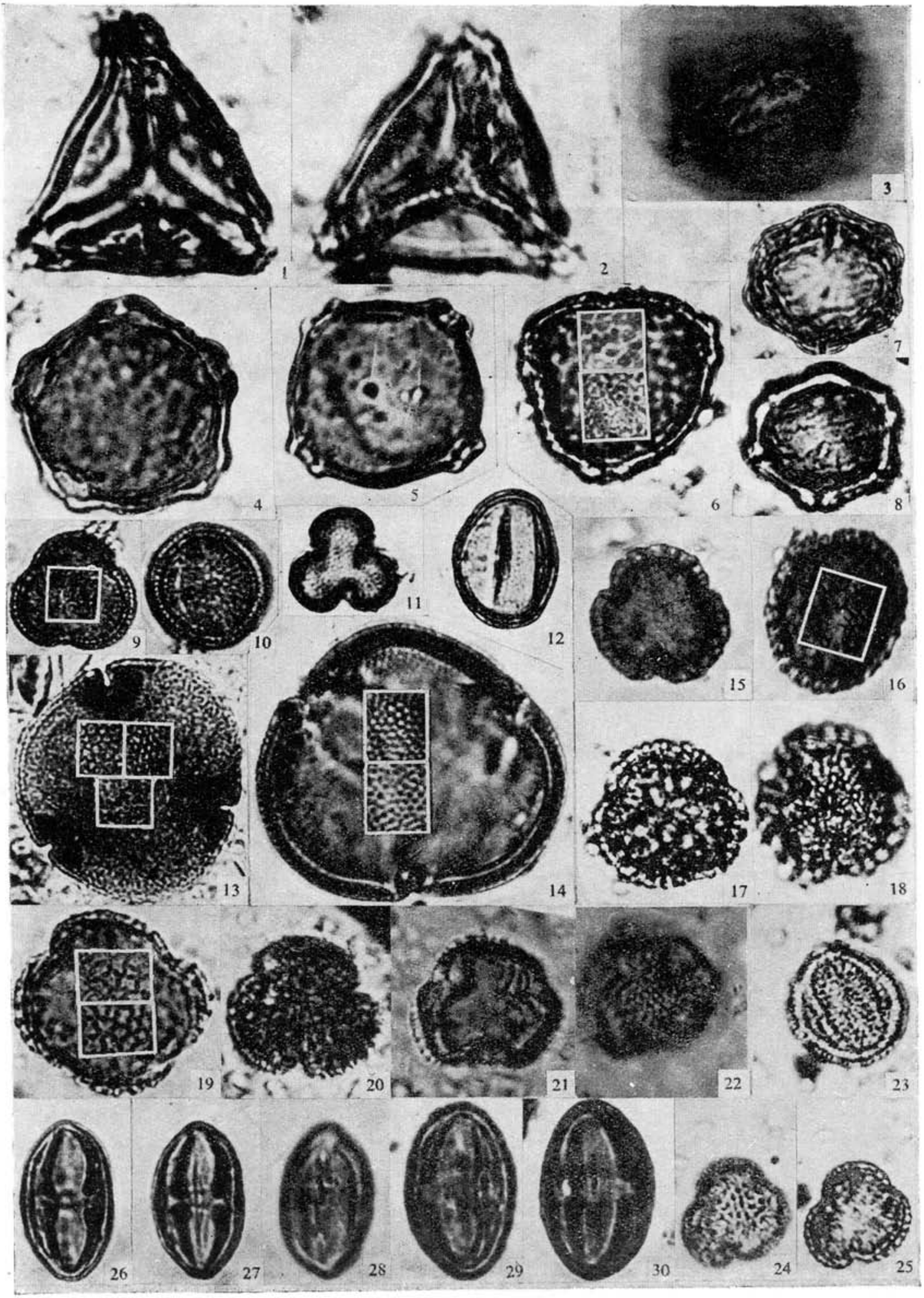

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
26
27
28
29
30
24
25

Plate XVII

× 900

		pp.
1, 2.	cf. *Toona ciliata* M. Roem.	56
3, 4.	cf. *Melia* sp.	56
5.	*Pistacia* sp.	56
6, 7.	cf. *Sapindus* sp.	57
8—10.	*Rhus* sp. div.	57
11—14.	*Rhus* cf. typhina L.	57
15, 16.	*Acer* sp.	58
17.	*Ilex; Tricolporopollenites iliacus* f. *medius* Th. & Pf.	58
18—20.	*Ilex; Tricolporopollenites iliacus* f. *major* Th. & Pf.	58
21, 22.	*Ilex; Tricolporopollenites margaritatus* (R. Pot.) Th. & Pf.	59
23—25.	cf. *Cliftonia* sp.	60
26.	*Cyrilla* cf. *racemiflora* L.	59


1

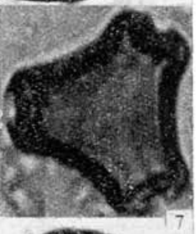

2


3


4


5


6

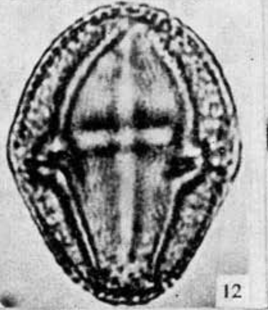

7


8


9

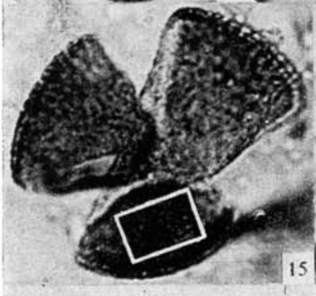

10


11


12


13

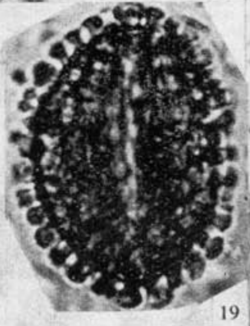

14

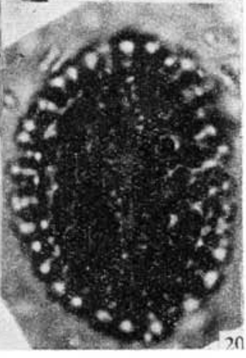

15


16

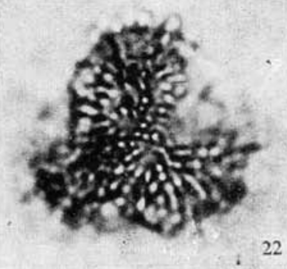

17


18

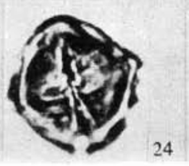

19


20


21


22


23


24


25

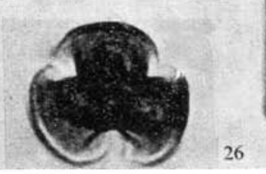

26

Plate XVIII

× 900

		pp.
1, 2.	*Cyrillaceae?; Tricolporopollenites cingulum brühlensis* Th. & Pf.	60
3—5.	*Cyrillaceae-Clethraceae*	61
6.	*Cyrilla* sp. 1	60
7—10.	*Staphylea* sp.	59
11—13.	*Rhamnaceae*	61
14—17.	*Vitis* sp.	61
18, 19.	*Parthenocissus* sp.	62
20—24.	*Polyscias* sp.	63
25—29.	cf. *Aralia* sp.	63

Plate XVIII

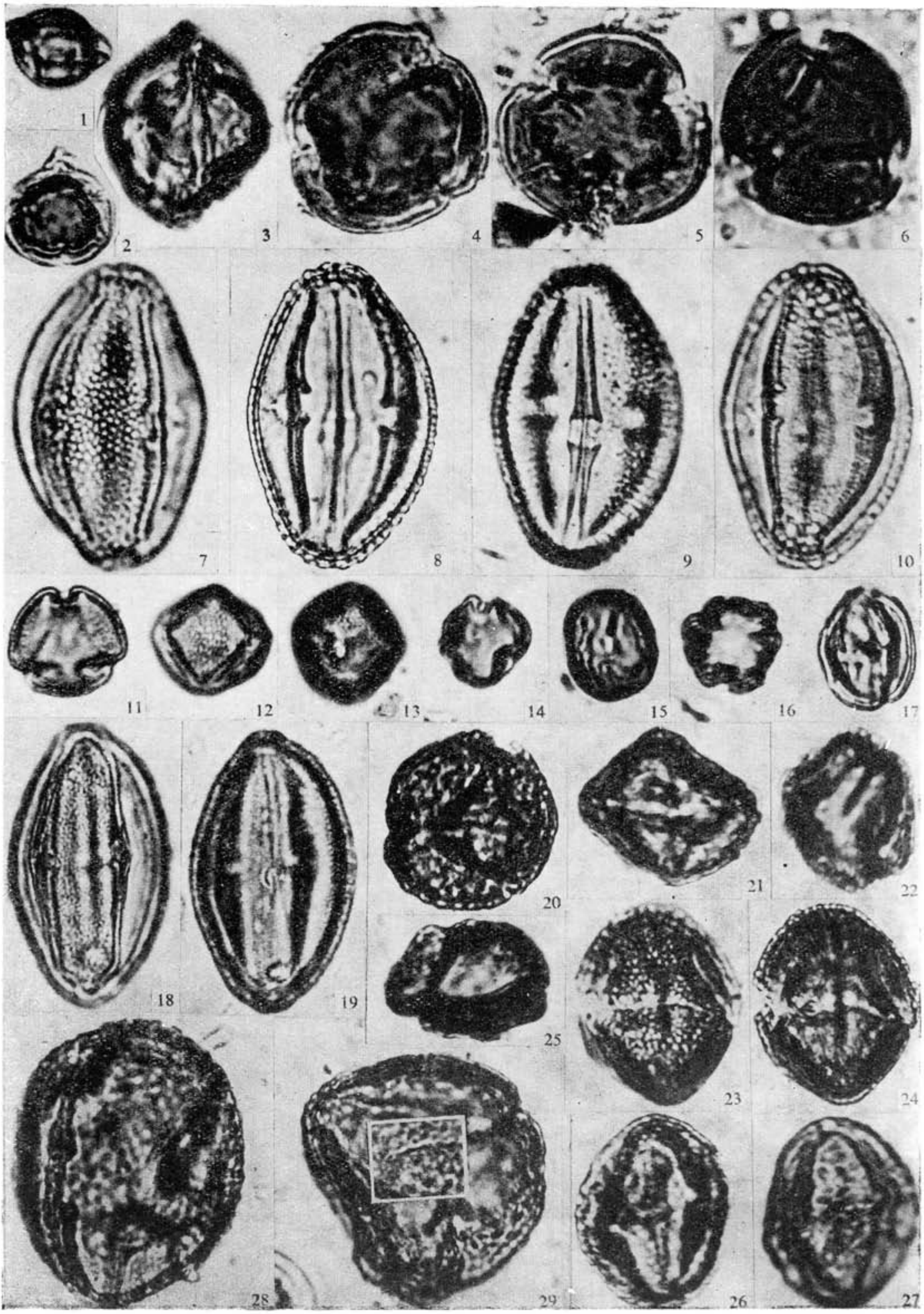
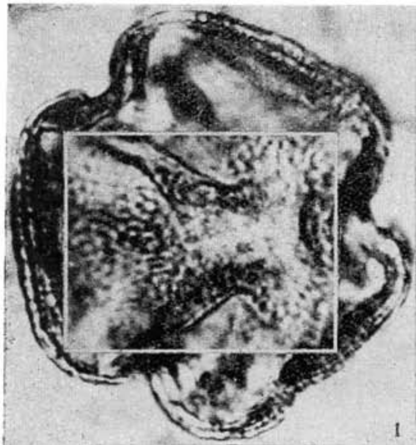
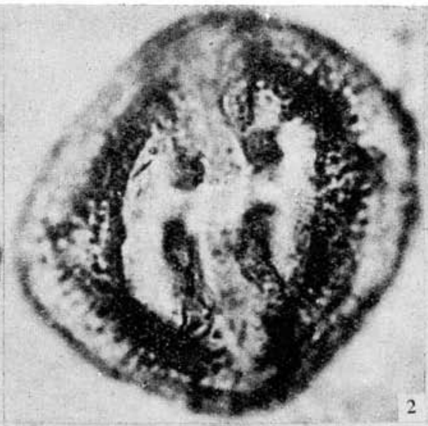


Plate XIX

× 900

		pp.
1—4.	*Cornus* sp.; *Cornoidites major* n. spm.	62
5—7.	*Cornus* sp.; *Cornoidites minor* n. spm.	63
8.	*Araliaceae-Cornaceae; Tricolporopollenites edmundi* (R. Pot.) Th. & Pf.	64
9.	*Umbelliferae*	64
10, 11.	*Pirolaceae*	64
12, 13.	*Rhododendron sp.*	65
14, 15.	*Ericaceae*	65

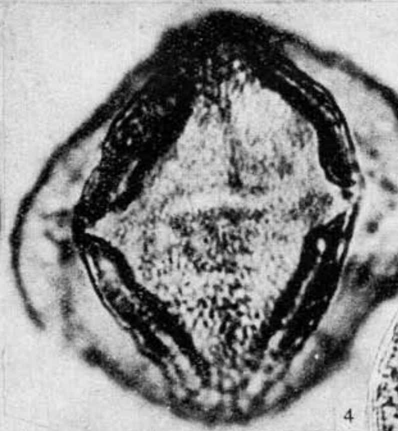

1


2


5


6

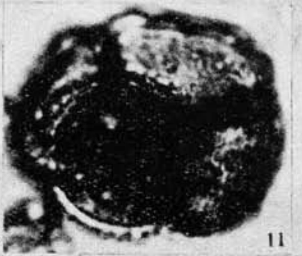

3


4


7

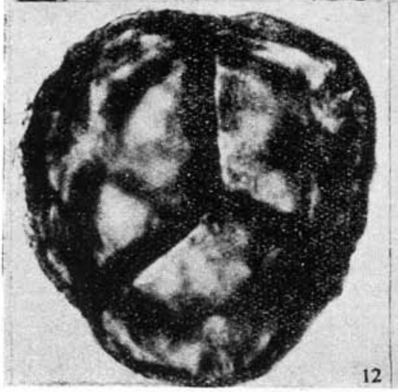

8

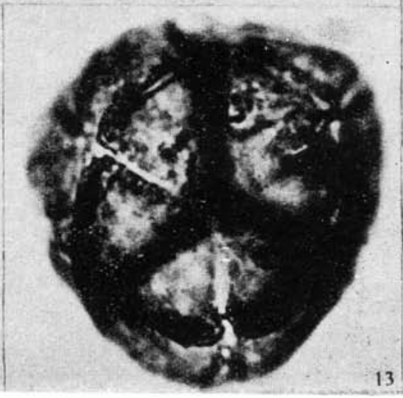

10


11


9


1


12


13

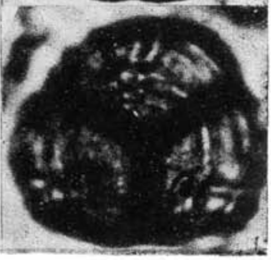
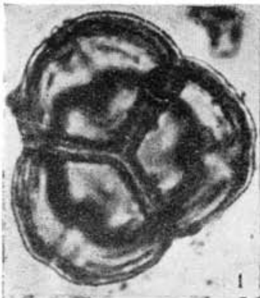

1

Plate XX

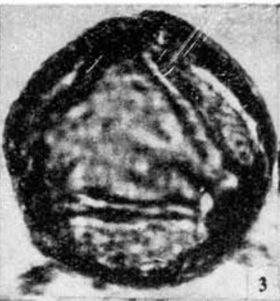
× 900

		pp.
1, 2.	*Ericaceae*	65
3, 4.	cf. *Styrax philadelphoides* Perkins	65
5.	*Symplocos* sp. 1	66
6, 7.	*Symplocos* sp. 2	66
8, 9.	*Symplocos* sp. 3	66
10—15.	*Sapotaceae; Sapotaceoidae-pollenites manifestus* R. Pot.	67
16, 17.	*Sapotaceae; Sapotaceoidae-pollenites micromanifestus* Thomson	67
18—20.	*Solanaceae*	67
21, 22.	cf. *Markhamia* sp.	67
23.	cf. *Barleria* sp.	68

Plate XX

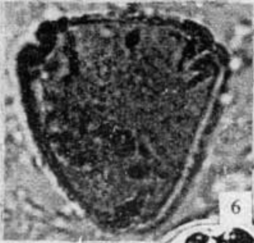

1


2


3


4


5


6


7


8


9


10


11


12


13


14

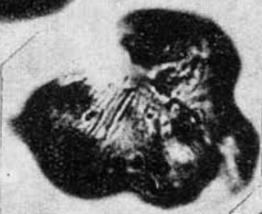

15

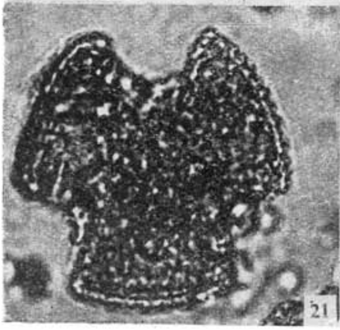

16


17


18


19


20


21


22

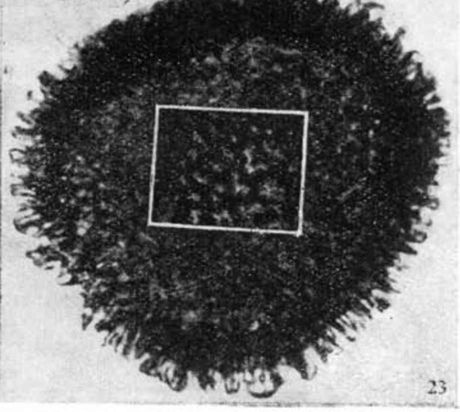
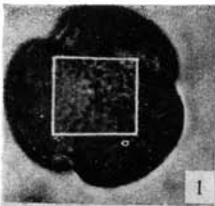

23

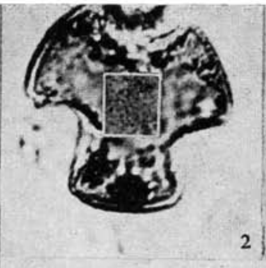
Plate XXI

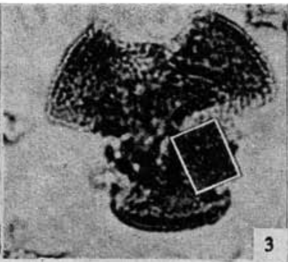
× 900

		pp.
1.	cf. *Vitex* sp.	68
2—4.	*Labiatae*	68
5, 6.	*Plantago major* L. type	69
7.	*Apocynum* sp.	69
8—11.	*Forsythia* sp.	69
12, 13.	*Oleaceae; Porocolpopollenites rotundus* (R. Pot.) forma *reticulata* n. spm.	70
14—17.	cf. *Fraxinus* sp.	70
18, 19.	*Rubiaceae*	70
20—22.	*Viburnum* sp.	71
23.	*Diervillea* sp.	22
24.	*Lonicera* sp.	71

Plate XXI


1


2


3


4


5

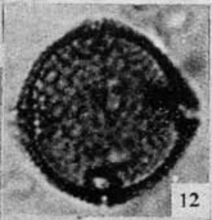

6

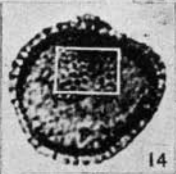

8

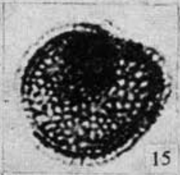

9

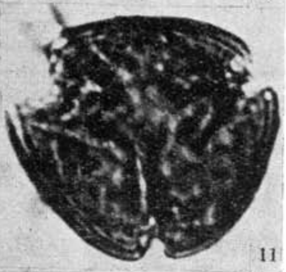

10


7

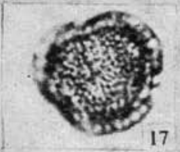

12


14


15


11


16


17


13

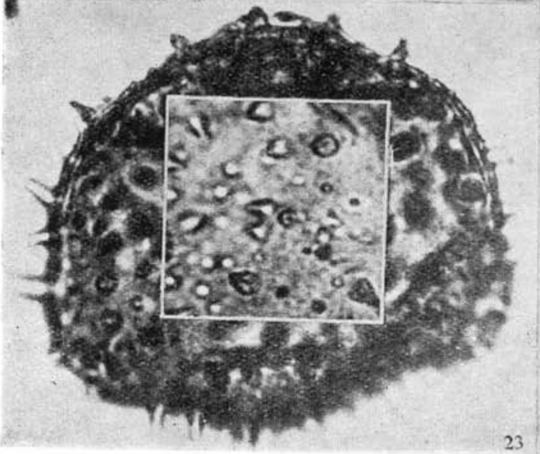

18


19


20


21


22


23

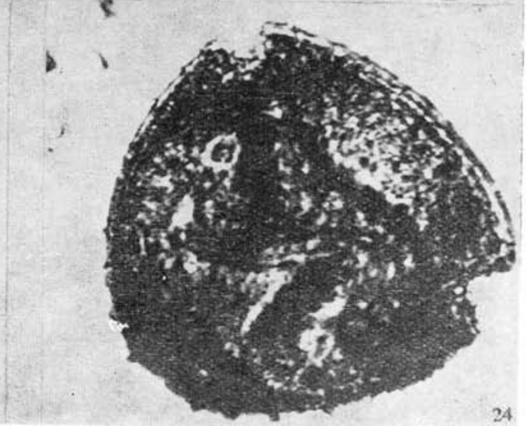
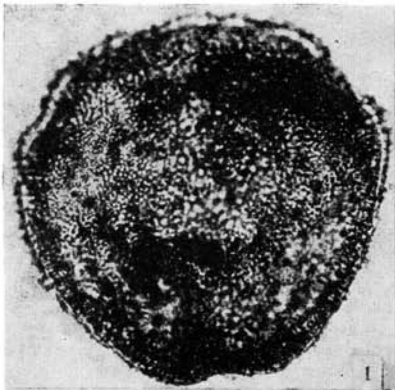

24

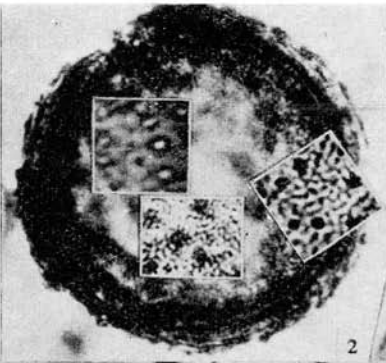
Plate XXII

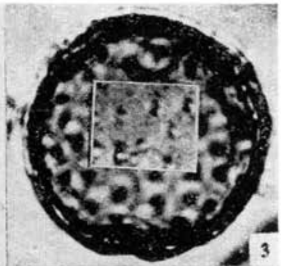
× 450 and × 900

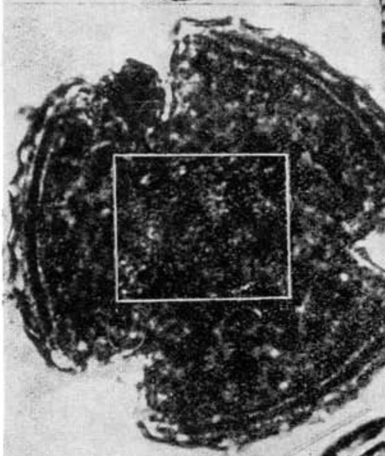
		pp.
1.	cf. *Lonicera sp.* × 450	71
2.	*Lonicera* sp. × 900	71
3.	cf. *Phyteuma* sp. × 900	72
4.	*Valerianaceae* × 900	72
5.	*Artemisia* sp. × 900	73
6.	*Compositae* subfam. *tubuliflorae* × 900	73
7, 8.	*Compositae* subfam. *liguliflorae* × 900	74
9—11.	*Centaurea cyanus* L. type × 900	73
12, 13.	*Butomus* sp. × 900	74
14, 15.	*Potamogeton* sp. × 900	74
16, 17.	cf. *Tulipa* sp. × 900	74

Plate XXII


1


2

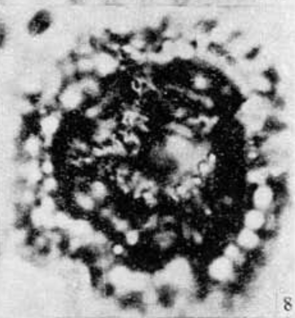

3


4


5


6

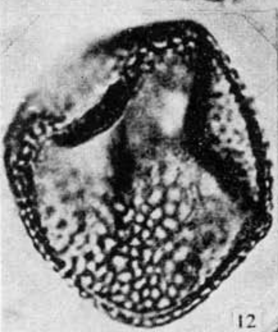

7

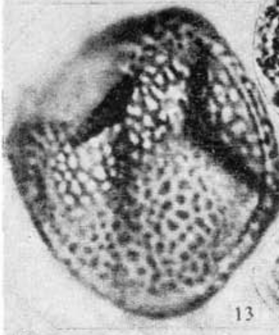

8

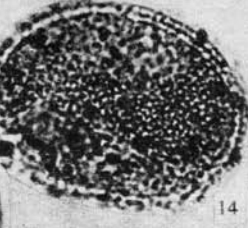

9


10


11


12


13


14


15


16

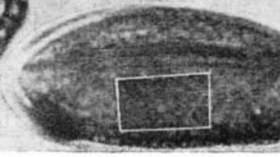

17

Plate XXIII

× 900

		pp.
1.	cf. *Tulipa* sp.	74
2, 3.	*Restionaceae*	75
4.	*Cladium* sp.	75
5—8.	*Cyperaceae* sp. div.	76
9, 10.	cf. *Dulichium* sp.	75
11, 12.	*Gramineae* type „2"	77
13.	*Gramineae* type „1"	77
14—18.	*Gramineae; Monoporopollenites graminaeus* Weyl. & Pf.	76

Plate XXIII

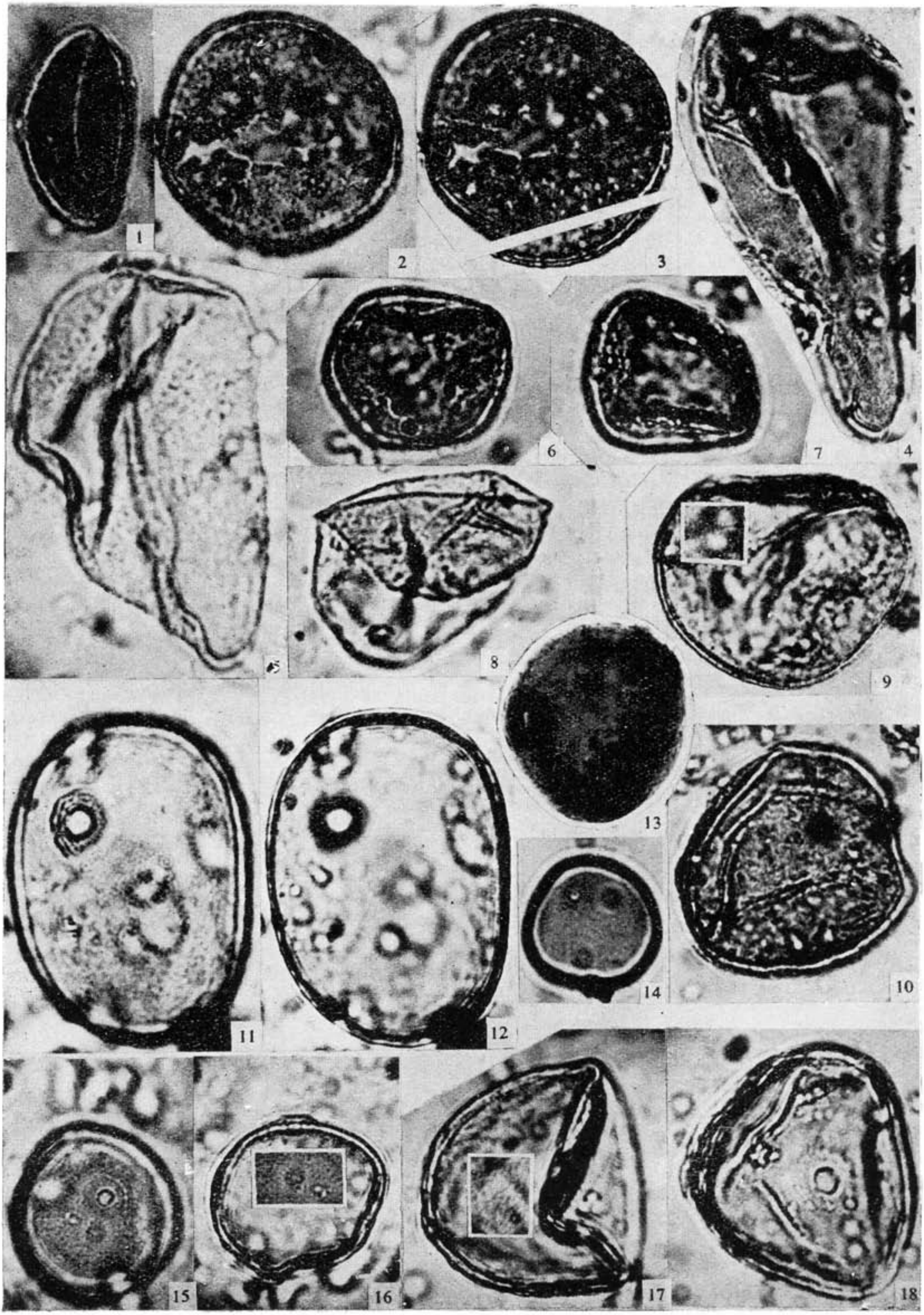
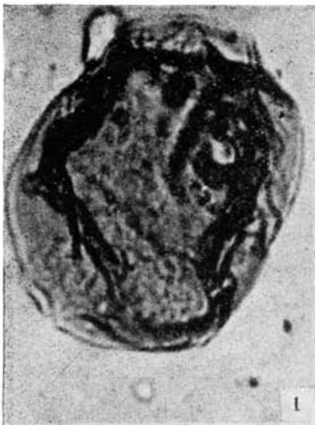


Plate XXIV

× 900

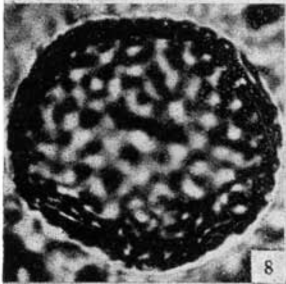
		pp.
1, 2.	*Gramineae „Bambusa”* type	76
3—7.	cf. *Corypha* sp.	77
8, 9.	*Sparganium minimum* Fr. type	78
10, 11.	*Sparganium ramosum* Huds. type	78
12.	*Typha latifolia* L. type	78
13, 14.	*Typha angustifolia* L. type	79
15, 16.	*Aglaoreidia cyclops* Erdtm.	79
17.	*Trudopollis pertrudens* Pf.	79
18, 19.	*Pollenites microlaesus* R. Pot.	80
20.	*Pollenites laesus* R. Pot.	80


1


2

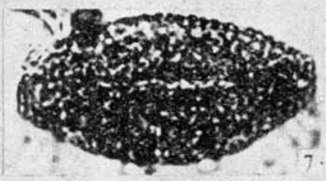

3

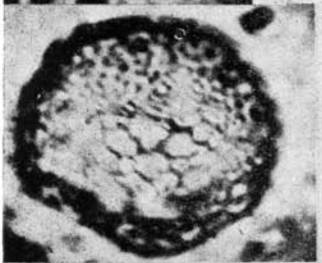

4


8


5


6

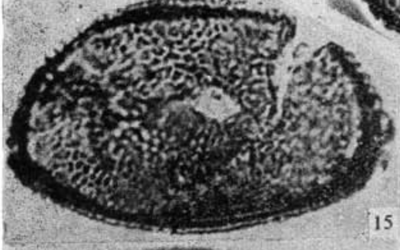

7


9


10


11


12


15


17


13


14


16


18


19

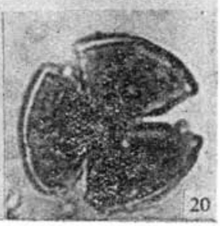
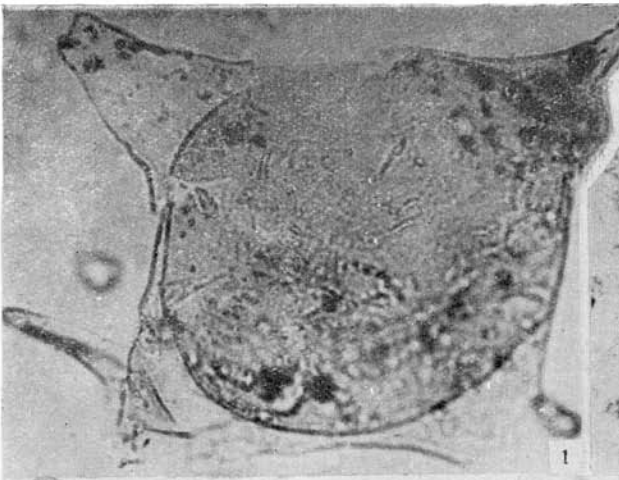
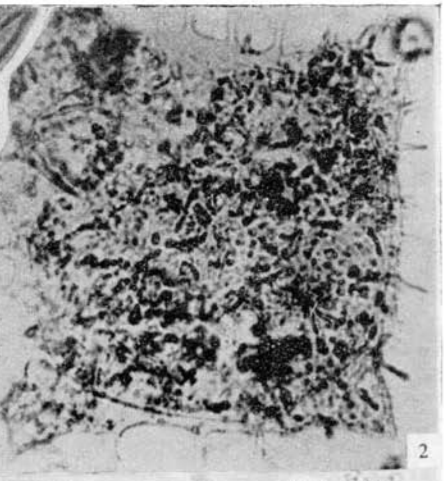

20

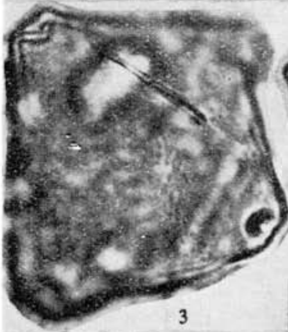
Plate XXV

× 450 and × 900

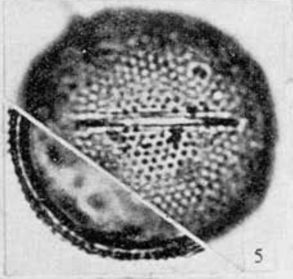
		pp.
1.	*Rhombodinium* sp. × 450	80
2.	*Wetzeliella* sp. × 450	80
3, 4.	*Triceratium* sp. × 900	81
5.	*Centricae (Discaceae)* × 900	81
6.	*Foraminifera* × 900	82
7—13.	Marine plankton × 900	82
14.	*Ovoidites ligneolus* R. Pot. × 900	81
15.	*Fungi* × 900	81
16, 17.	*Hystrichosphaera* sp. × 900	82

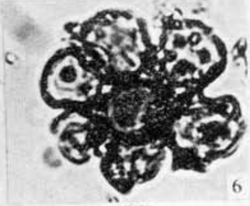

1


2


3


4

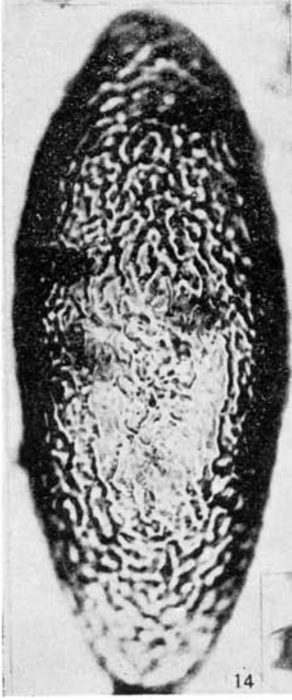

5

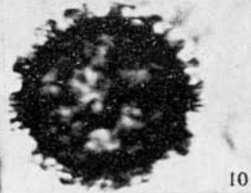

6

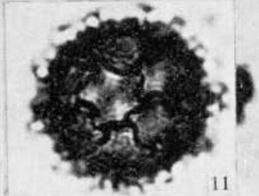

7


8

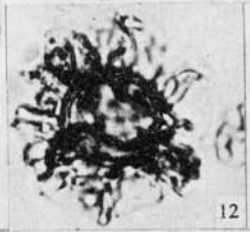

9


14


10


11


16


12


13


15

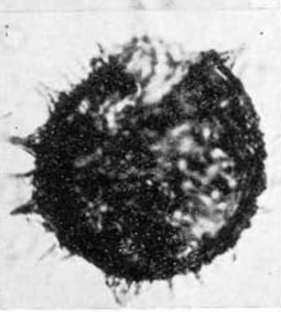


Table 1

Quantitative occurrence of sporomorphs in the profile of Rypin II (Sporomorphs found sporadically — less than in 15 samples — are enumerated in the table 2)

No sample		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Depth in metres		14.00–14.20	14.20–14.60	14.60–14.80	14.80–15.60	15.60–16.70	16.70–17.00	17.00–17.40	17.40–17.60	17.60–17.90	17.90–18.30	18.30–18.50	18.50–19.00	19.00–20.00	20.00–20.70
Σ of counted sporomorphs		1088	1056	1394	1072	503	300	399	499	399	219	230	235	197	97
Σ of distinguished forms		48	51	61	51	39	38	37	40	36	17	21	26	20	20
number of sporomorphs - group I		5	8	11	10	2	1	0	1	0	1	1	1	0	0
number of sporomorphs - group II		25	22	30	19	22	19	20	24	17	4	7	12	11	10
number of sporomorphs - group III		18	21	20	22	15	18	17	15	19	12	13	13	9	10
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Sphagnum sp.	III	2	7	10	7	5	–	2	4	–	–	1	–	–	–
13. Lygodium sp. 1	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16. Gleicheniaceae	II	–	–	–	–	–	–	–	–	–	–	–	–	3	–
27. Polypodiaceae	III	1	5	2	32	23	11	6	11	7	2	1	3	4	22
34. Abies sp.	III	3	4	3	–	–	2	–	–	–	–	1	–	–	–
35. Tsuga canadensis type	II	2	–	–	–	–	1	2	1	–	–	–	1	–	–
38. Picea sp.	III	–	–	–	2	–	1	1	1	1	2	6	4	–	–
41. Pinus silvestris type	III	47	50	40	88	73	69	118	52	41	64	93	78	87	30
42. Pinus haploxylon type	II	2	3	8	2	6	13	10	4	1	11	12	11	6	1
43. Sciadopitys verticillata	II	1	3	2	2	5	3	7	10	3	–	1	–	1	1
44. Sequoia sp.	II	12	10	5	4	8	2	1	4	–	–	–	2	–	1
45. Taxodium sp.	II	2	34	19	19	18	4	4	2	1	–	–	1	3	5
46. Glyptostrobus cf. europaeus	II	40	50	18	27	40	1	9	10	7	–	–	1	1	–
47. Cryptomeria	II	9	14	6	4	3	–	1	–	–	–	–	–	–	–
52. Taxodiaceae - Cupressaceae	II	426	466	682	365	78	18	20	49	14	–	–	–	–	–
54. Betula	III	299	140	200	152	40	43	41	97	26	17	14	22	8	2
55. Alnus glutinosa type	III	21	19	48	52	46	20	30	68	29	41	20	21	21	8
57. Ostrya	II	–	–	–	1	1	1	1	–	–	1	–	–	–	–
58. Carpinus	III	1	1	3	4	–	1	1	–	1	–	–	1	–	–
59. Corylus avellana type	III	3	7	23	8	–	–	–	–	–	–	–	–	–	–
61. Castanea	II	–	1	2	–	–	–	–	–	–	–	–	–	–	–
62. cf. Castanopsis	I	1	4	–	–	–	–	–	–	–	–	–	1	–	–
63. cf. Pasania	I	2	2	11	5	–	–	–	–	–	–	–	–	–	–
64. Fagus	III	12	9	8	7	3	4	12	3	7	1	–	1	–	–
65. Quercus	III	14	8	13	8	25	5	25	23	10	17	13	17	3	1
68. Myrica	II	12	3	6	–	3	4	1	10	9	–	1	–	–	2
70. Carya	II	1	–	2	–	1	1	1	1	1	–	–	–	–	–
71. Pterocarya	II	–	1	1	–	–	1	5	4	1	–	–	5	10	–
72. Engelhardtioidites f. minor	II	–	–	2	4	–	3	1	1	1	–	2	4	1	–
73. Engelhardtioidites f. magna	I	–	2	2	–	4	3	–	–	–	6	4	–	–	–
74. Salix	III	31	15	13	13	4	3	3	6	4	–	–	–	–	–
75. Ulmus	III	2	8	11	22	11	4	13	9	10	5	9	3	2	2
76. Celtis	II	–	–	1	1	3	2	5	9	4	–	–	–	4	–
88. cf. Discoglypsemna	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–
89. Liquidambar	II	1	1	3	–	2	1	3	4	3	4	2	3	–	–
90. Corylopsis	II	1	–	2	–	1	–	–	5	7	–	–	–	–	–
98. Rosaceae	III	–	–	–	–	–	–	–	1	1	–	–	–	–	–
99. Leguminosae gen. div.	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100. cf. Caragana	I	–	–	2	3	–	–	–	–	–	–	–	–	–	–
105. cf. Lythrum	III	–	–	–	1	1	1	–	–	–	–	–	–	–	–
107. Nyssa f. minor	II	2	13	133	145	11	1	15	24	7	27	20	21	17	6
109. Nyssa f. magna	II	3	85	12	9	6	6	6	11	9	–	–	–	–	–
112. Myrtaceae genera indeterminata	II	–	–	2	1	–	–	–	1	–	–	–	–	–	–
113. Oenotheraceae	II	–	–	1	–	–	–	–	–	–	–	–	1	–	2
118. Tilia	III	1	–	–	–	2	3	3	–	–	2	–	–	–	–
123. Rutaceae genera indeterminata	II	–	–	–	–	1	–	–	1	–	–	–	–	–	–
130. Ilex; Tricolporopol. iliacus	II	14	17	7	5	3	2	2	6	1	–	–	–	–	3
131. Ilex; Tricolporopol. margaritatus	II	1	–	–	1	–	–	–	–	–	–	–	1	–	–
133. Cyrilla cf. racemifolia	I	–	1	3	3	–	–	–	–	–	–	–	–	–	–
136. Cyrillaceae - Clethraceae	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–
138. Rhamnaceae	III	–	–	–	1	–	–	–	–	–	–	–	–	2	–
139. Vitis	I	1	–	1	2	–	–	–	–	–	–	–	–	–	–
142. Araliaceae	II	1	–	1	–	–	4	2	4	5	–	2	2	–	–
147. Ericaceae	III	2	3	13	18	14	7	14	9	8	6	8	8	3	1
150. Symplocos	II	–	–	–	–	1	–	1	1	–	–	–	–	–	–
161. cf. Fraxinus	II	–	–	–	–	1	–	–	2	–	–	–	–	–	–
174. Potamogeton	III	–	–	1	1	–	–	1	–	–	–	–	–	–	–
178. Cyperaceae sp. div.	III	53	20	27	9	24	25	2	19	14	–	1	–	1	1
180. Gramineae type "1", type "2"	II	–	–	–	–	1	–	–	–	–	–	–	–	7	1
181. Gramineae - Monoporopol. graminaeus	III	8	2	2	2	7	2	4	4	12	2	1	3	–	1
183. Sparganium ramosum type	III	16	1	1	6	1	1	–	–	136	–	2	2	–	–
189. Pollenites laesus	II	2	3	–	–	–	–	–	–	–	–	–	–	–	–
Varia		19	4	4	14	22	25	25	17	11	9	16	17	12	6
Triceratium		1	–	2	–	–	–	–	–	–	–	–	–	–	–

No sample		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Depth in metres		20.70–21.00	21.00–21.10	21.10–21.70	21.70–22.00	22.00–23.00	23.00–24.20	24.20–24.30	24.30–24.50	24.50–25.00	25.00–25.50	25.50–26.00	26.00–26.50	26.50–26.80	26.80–27.40	27.40–27.90
Σ of counted sporomorphs		423	519	654	428	444	319	336	316	364	310	95	321	321	401	718
Σ of distinguished forms		35	29	39	29	28	30	33	27	29	29	23	33	41	25	38
number of sporomorphs - group I		2	1	2	2	0	0	3	0	2	1	0	2	1	2	2
number of sporomorphs - group II		13	13	20	13	11	15	12	14	11	9	13	14	17	9	18
number of sporomorphs - group III		20	15	17	14	17	15	18	13	16	19	10	17	23	14	18
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1. Sphagnum sp.	III	1	2	1	1	–	–	3	–	1	–	–	–	1	–	1
13. Lygodium sp. 1	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16. Gleicheniaceae	II	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
27. Polypodiaceae	III	36	59	139	150	146	53	58	31	83	32	6	85	22	2	5
34. Abies sp.	III	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–
35. Tsuga canadensis type	II	–	–	3	1	2	1	1	1	–	–	–	–	–	–	–
38. Picea sp.	III	1	–	1	–	2	5	–	–	–	–	–	–	–	–	–
41. Pinus silvestris type	III	42	30	182	30	53	69	63	8	13	55	22	27	52	29	42
42. Pinus haploxylon type	II	4	8	2	2	7	7	7	–	3	1	1	1	1	–	10
43. Sciadopitys verticillata	II	2	–	1	2	2	3	1	1	1	2	1	–	2	1	3
44. Sequoia sp.	II	–	–	–	–	–	–	–	–	–	1	3	–	3	–	2
45. Taxodium sp.	II	4	11	–	–	–	–	1	–	4	–	–	1	–	–	3
46. Glyptostrobus cf. europaeus	II	–	3	1	3	1	–	1	2	6	2	1	1	–	–	–
47. Cryptomeria	II	1	–	–	–	–	–	–	–	2	–	–	–	–	–	3
52. Taxodiaceae - Cupressaceae	II	–	37	12	81	50	17	51	96	65	55	7	66	19	16	18
54. Betula	III	4	4	16	2	3	4	2	–	2	2	3	5	15	1	14
55. Alnus glutinosa type	III	45	73	64	33	31	46	27	45	43	43	6	34	24	55	25
57. Ostrya	II	1	–	1	–	–	2	–	–	–	–	–	2	–	–	8
58. Carpinus	III	1	–	2	–	1	–	–	–	–	–	–	–	1	–	–
59. Corylus avellana type	III	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
61. Castanea	II	–	–	–	–	–	–	1	3	–	–	–	–	–	–	1
62. cf. Castanopsis	I	–	–	–	4	–	–	–	–	–	–	–	1	–	1	2
63. cf. Pasania	I	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
64. Fagus	III	1	–	8	2	11	11	8	2	6	4	–	4	9	1	4
65. Quercus	III	12	22	40	9	13	14	2	5	20	10	3	9	16	2	14
68. Myrica	II	–	2	9	9	2	4	8	2	3	3	1	7	13	–	–
70. Carya	II	1	–	–	1	–	1	–	–	–	–	1	–	1	–	2
71. Pterocarya	II	8	3	1	–	–	1	–	2	2	2	–	1	1	1	5
72. Engelhardtioidites f. minor	II	–	2	1	–	–	–	–	–	–	9	1	8	4	–	–
73. Engelhardtioidites f. magna	I	3	1	–	1	–	–	–	–	–	–	–	–	–	–	–
74. Salix	III	50	7	–	2	4	2	1	7	3	5	1	6	–	1	3
75. Ulmus	III	12	28	24	9	9	7	9	23	25	15	2	9	2	4	14
76. Celtis	II	2	3	4	6	3	–	3	3	–	2	3	1	2	2	5
88. cf. Discoglypsemna	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
89. Liquidambar	II	3	9	9	4	1	1	2	3	2	–	–	1	–	–	6
90. Corylopsis	II	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–
98. Rosaceae	III	5	–	–	–	–	–	–	1	–	1	–	–	–	–	–
99. Leguminosae gen. div.	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100. cf. Caragana	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
105. cf. Lythrum	III	6	2	3	–	4	–	1	4	2	2	–	2	–	2	2
107. Nyssa f. minor	II	–	–	10	–	–	2	1	–	–	–	–	4	20	1	9
109. Nyssa f. magna	II	–	–	–	–	–	–	–	–	–	–	–	–	–	1	4
112. Myrtaceae genera indeterminata	II	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
113. Oenotheraceae	II	1	–	1	–	–	1	–	–	–	–	–	1	1	5	1
118. Tilia	III	–	–	–	–	2	–	–	–	–	2	–	1	3	–	1
123. Rutaceae genera indeterminata	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
130. Ilex; Tricolporopol. iliacus	II	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–
131. Ilex; Tricolporopol. margaritatus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
133. Cyrilla cf. racemifolia	I	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
136. Cyrillaceae - Clethraceae	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
138. Rhamnaceae	III	–	–	–	–	–	–	3	–	2	1	–	–	–	–	–
139. Vitis	I	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–
142. Araliaceae	II	2	2	5	2	–	1	–	–	–	–	–	1	1	1	–
147. Ericaceae	III	10	7	35	10	9	7	9	–	3	8	–	6	7	3	5
150. Symplocos	II	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
161. cf. Fraxinus	II	–	–	1	1	–	–	1	–	–	4	2	–	4	–	–
174. Potamogeton	III	3	1	5	–	–	4	7	9	7	2	–	–	1	18	39
178. Cyperaceae sp. div.	III	101	128	2	14	22	12	3	15	21	5	–	1	7	–	15
180. Gramineae type "1", type "2"	II	–	–	–	–	–	–	–	–	–	–	–	–	20	–	3
181. Gramineae - Monoporopol. graminaeus	III	31	27	22	27	42	13	18	16	13	8	6	13	10	4	14
183. Sparganium ramosum type	III	9	7	18	6	6	2	4	4	3	4	1	2	8	144	392
189. Pollenites laesus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Varia		15	34	22	13	22	24	27	26	21	27	10	14	27	21	27
Triceratium		–	10	1	1	1	2	6	9	–	9	–	11	7	1	–

No sample		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Depth in metres		27.90–27.95	27.95–28.00	28.00–28.50	28.50–28.60	28.60–29.00	29.00–29.50	29.50–29.80	29.80–30.00	30.00–30.50	30.50–31.00	31.00–31.40	31.40–31.90	31.90–32.00	32.00–33.00	33.00–34.00	34.00–34.10	34.10–34.50
Σ of counted sporomorphs		336	588	300	291	300	302	599	701	602	604	598	300	218	300	–	295	297
Σ of distinguished forms		36	42	36	29	27	3	37	37	37	42	40	35	30	33	–	39	39
number of sporomorphs - group I		4	2	1	0	1	2	1	1	4	3	2	0	0	0	0	0	3
number of sporomorphs - group II		13	21	19	16	13	18	18	21	17	22	18	17	18	17	0	19	19
number of sporomorphs - group III		19	19	16	13	13	14	18	15	16	17	20	18	12	16	0	20	19
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1. Sphagnum sp.	III	1	1	3	–	10	2	1	3	–	7	10	–	1	–	–	1	–
13. Lygodium sp. 1	II	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
16. Gleicheniaceae	II	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
27. Polypodiaceae	III	7	44	8	16	–	4	7	15	17	16	14	5	16	34	–	15	15
34. Abies sp.	III	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
35. Tsuga canadensis type	II	–	–	1	1	1	–	1	1	–	–	–	1	–	–	–	–	–
38. Picea sp.	III	3	1	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–
41. Pinus silvestris type	III	57	79	62	87	25	29	38	57	48	80	64	44	36	28	–	36	24
42. Pinus haploxylon type	II	3	11	6	5	2	2	1	1	4	8	2	2	3	1	–	–	2
43. Sciadopitys verticillata	II	3	8	4	3	–	2	7	4	4	7	5	5	1	–	–	2	–
44. Sequoia sp.	II	–	7	5	1	5	14	19	19	7	9	23	–	9	2	–	3	–
45. Taxodium sp.	II	13	2	14	5	1	19	36	23	7	15	21	3	2	1	–	–	3
46. Glyptostrobus cf. europaeus	II	–	6	15	6	15	27	56	67	29	50	48	7	3	18	–	11	1
47. Cryptomeria	II	2	13	3	–	12	12	24	22	6	9	10	–	1	–	–	3	1
52. Taxodiaceae - Cupressaceae	II	54	127	51	74	75	55	156	163	120	129	111	18	13	70	–	56	21
54. Betula	III	20	32	7	10	14	5	2	5	10	24	40	20	24	13	–	25	20
55. Alnus glutinosa type	III	14	45	16	10	5	8	20	15	88	27	54	44	16	34	–	13	16
57. Ostrya	II	2	7	–	–	–	–	1	1	–	4	–	–	–	–	–	–	–
58. Carpinus	III	3	3	–	–	–	–	3	1	–	–	1	1	–	–	–	–	1
59. Corylus avellana type	III	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
61. Castanea	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
62. cf. Castanopsis	I	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–
63. cf. Pasania	I	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
64. Fagus	III	6	9	3	2	3	3	1	4	9	9	6	11	1	1	–	2	1
65. Quercus	III	8	27	9	14	9	5	10	13	13	10	4	13	10	6	–	7	2
68. Myrica	II	–	5	4	5	14	4	5	6	14	11	1	1	3	3	–	7	2
70. Carya	II	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
71. Pterocarya	II	4	1	2	–	–	1	2	1	3	1	4	3	–	1	–	2	1
72. Engelhardtioidites f. minor	II	2	5	1	3	–	–	2	5	3	2	3	2	–	2	–	1	2
73. Engelhardtioidites f. magna	I	2	–	–	–	–	1	–	2	6	–	–	–	–	–	–	–	–
74. Salix	III	3	8	8	4	45	1	5	4	4	12	10	2	–	5	–	1	10
75. Ulmus	III	17	7	3	5	3	4	1	1	5	1	6	9	7	5	–	8	1
76. Celtis	II	1	–	–	–	–	1	1	1	2	2	3	2	2	5	–	1	–
88. cf. Discoglypsemna	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
89. Liquidambar	II	–	1	1	1	–	1	3	2	–	3	4	4	1	–	–	4	–
90. Corylopsis	II	–	1	1	–	–	1	–	1	2	1	1	1	1	2	–	–	1
98. Rosaceae	III	–	1	–	–	–	–	–	–	3	–	1	–	–	–	–	–	–
99. Leguminosae gen. div.	III	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–
100. cf. Caragana	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
105. cf. Lythrum	III	–	–	–	–	–	–	1	–	1	–	–	–	–	1	–	–	–
107. Nyssa f. minor	II	–	27	6	3	8	3	9	7	8	22	23	10	14	8	–	12	14
109. Nyssa f. magna	II	8	6	7	2	1	–	–	3	3	5	8	10	7	3	–	5	9
112. Myrtaceae genera indeterminata	II	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–
113. Oenotheraceae	II	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1
118. Tilia	III	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	1	–
123. Rutaceae genera indeterminata	II	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–
130. Ilex; Tricolporopol. iliacus	II	1	5	1	1	1	–	2	4	6	2	4	4	2	2	–	1	2
131. Ilex; Tricolporopol. margaritatus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
133. Cyrilla cf. racemifolia	I	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
136. Cyrillaceae - Clethraceae	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
138. Rhamnaceae	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
139. Vitis	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
142. Araliaceae	II	–	1	1	1	–	2	1	2	1	–	1	3	4	3	–	–	–
147. Ericaceae	III	8	24	11	1	7	1	4	7	4	13	12	9	7	5	–	4	8
150. Symplocos	II	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	1	–
161. cf. Fraxinus	II	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
174. Potamogeton	III	1	3	1	–	–	5	1	3	2	4	2	–	–	1	–	2	–
178. Cyperaceae sp. div.	III	12	17	11	10	24	9	22	41	39	20	20	21	1	14	–	11	15
180. Gramineae type "1", type "2"	II	–	–	–	1	–	6	–	1	–	–	–	–	3	1	–	11	27
181. Gramineae - Monoporopol. graminaeus	III	3	7	3	3	3	–	17	25	39	18	5	3	8	10	–	2	6
183. Sparganium ramosum type	III	5	4	4	1	3	55	100	136	70	57	37	3	3	4	–	6	1
189. Pollenites laesus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Varia		20	33	22	13	8	16	24	33	22	13	33	30	27	12	–	29	43
Triceratium		–	2	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–

No sample		47	48	49	50	51	52	53	54	55	56	57	58	59	60
Depth in metres		34.50–34.90	34.90–36.00	36.00–38.00	38.00–40.20	40.20–40.50	40.50–40.60	40.60–41.00	41.00–41.50	41.50–41.90	41.90–42.00	42.00–43.00	43.00–44.00	44.00–44.10	44.10–44.20
Σ of counted sporomorphs		297	306	297	500	294	299	201	306	305	302	300	303	304	300
Σ of distinguished forms		32	39	37	39	40	33	32	41	42	40	44	45	36	37
number of sporomorphs - group I		3	3	3	2	4	3	4	3	4	5	4	5	8	3
number of sporomorphs - group II		17	19	17	18	19	15	13	21	20	19	20	23	19	18
number of sporomorphs - group III		15	17	17	20	20	16	15	17	21	18	20	17	15	16
		47	48	49	50	51	52	53	54	55	56	57	58	59	60
1. Sphagnum sp.	III	1	1	5	3	3	3	1	1	5	1	5	3	4	11
13. Lygodium sp. 1	II	1	2	–	–	–	–	–	–	1	1	–	1	–	–
16. Gleicheniaceae	II	1	–	–	–	–	–	2	1	–	–	–	–	1	–
27. Polypodiaceae	III	9	6	9	11	12	9	4	9	8	14	6	11	13	22
34. Abies sp.	III	–	–	–	3	–	–	–	–	–	1	–	–	–	1
35. Tsuga canadensis type	II	–	3	1	1	–	–	–	1	–	3	–	2	1	1
38. Picea sp.	III	1	–	–	1	–	1	–	–	–	–	–	–	–	–
41. Pinus silvestris type	III	47	53	35	70	37	58	42	38	41	45	70	74	66	80
42. Pinus haploxylon type	II	3	4	2	3	8	2	1	4	3	3	2	2	5	3
43. Sciadopitys verticillata	II	–	3	1	4	3	4	2	1	5	3	1	1	1	1
44. Sequoia sp.	II	–	2	2	7	7	1	–	–	–	3	1	2	–	2
45. Taxodium sp.	II	–	–	–	5	1	–	–	–	–	–	3	–	–	–
46. Glyptostrobus cf. europaeus	II	3	1	7	16	7	8	2	8	10	9	2	2	11	7
47. Cryptomeria	II	–	–	1	–	1	2	–	–	2	1	1	2	3	1
52. Taxodiaceae - Cupressaceae	II	25	23	8	26	15	38	9	9	22	38	23	14	22	14
54. Betula	III	25	20	18	52	25	26	18	33	24	16	14	26	33	17
55. Alnus glutinosa type	III	36	23	43	38	38	26	45	34	33	28	42	37	45	29
57. Ostrya	II	1	–	–	–	1	–	1	1	–	–	–	2	1	–
58. Carpinus	III	–	–	–	1	–	–	–	–	1	–	2	3	–	–
59. Corylus avellana type	III	–	–	–	–	2	1	2	1	–	–	–	1	–	–
61. Castanea	II	–	–	–	–	–	–	–	–	–	1	–	–	–	–
62. cf. Castanopsis	I	–	–	3	1	–	–	–	2	–	–	–	–	–	–
63. cf. Pasania	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–
64. Fagus	III	6	10	19	27	13	4	2	6	6	8	5	1	–	5
65. Quercus	III	4	23	15	23	22	9	1	27	21	29	21	19	18	14
68. Myrica	II	6	1	2	2	–	1	3	1	6	2	5	5	–	1
70. Carya	II	–	–	1	1	–	–	–	1	–	–	–	–	1	2
71. Pterocarya	II	–	–	–	2	4	2	–	3	–	–	1	4	1	2
72. Engelhardtioidites f. minor	II	4	2	2	9	1	2	18	1	2	3	2	2	3	2
73. Engelhardtioidites f. magna	I	–	4	2	–	–	4	2	–	–	–	–	–	–	–
74. Salix	III	1	–	–	–	–	–	–	3	1	1	–	–	2	–
75. Ulmus	III	2	3	9	10	5	6	–	3	7	10	4	1	5	7
76. Celtis	II	1	4	6	4	1	5	1	1	4	2	2	1	1	2
88. cf. Discoglypsemna	III	–	–	–	–	–	–	–	–	–	–	1	–	1	–
89. Liquidambar	II	1	6	1	5	1	5	1	–	3	1	1	5	–	2
90. Corylopsis	II	–	–	–	–	–	–	1	–	–	–	–	–	–	–
98. Rosaceae	III	–	1	–	–	–	–	–	–	1	1	1	–	–	–
99. Leguminosae gen. div.	III	–	–	–	–	–	–	–	1	1	–	–	–	–	–
100. cf. Caragana	I	–	–	–	–	–	–	–	–	–	–	1	6	1	–
105. cf. Lythrum	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–
107. Nyssa f. minor	II	11	12	11	11	10	14	5	17	20	16	11	10	9	8
109. Nyssa f. magna	II	11	8	4	12	4	4	–	–	–	–	6	5	7	7
112. Myrtaceae genera indeterminata	II	–	–	–	–	–	–	–	1	–	–	2	–	–	–
113. Oenotheraceae	II	1	1	–	–	–	–	–	1	–	–	–	–	–	1
118. Tilia	III	–	3	1	2	2	1	–	3	1	2	–	5	1	1
123. Rutaceae genera indeterminata	II	1	1	–	–	–	–	–	1	–	–	1	–	–	–
130. Ilex; Tricolporopol. iliacus	II	–	2	3	3	5	2	–	3	2	2	–	2	2	2
131. Ilex; Tricolporopol. margaritatus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–
133. Cyrilla cf. racemifolia	I	–	–	–	–	–	–	1	–	–	3	1	–	–	–
136. Cyrillaceae - Clethraceae	I	–	–	–	–	–	–	–	–	–	–	–	–	1	–
138. Rhamnaceae	III	–	–	1	–	1	–	–	–	–	–	–	–	1	2
139. Vitis	I	1	–	–	–	–	–	1	–	–	–	1	–	–	–
142. Araliaceae	II	–	–	–	–	–	–	–	12	6	8	4	1	4	1
147. Ericaceae	III	23	19	12	10	20	11	6	21	6	9	13	11	11	13
150. Symplocos	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–
161. cf. Fraxinus	II	–	1	–	–	–	–	–	–	–	–	–	–	–	–
174. Potamogeton	III	–	–	–	–	–	–	–	1	–	–	1	2	–	1
178. Cyperaceae sp. div.	III	17	5	21	14	–	3	1	10	7	2	10	6	3	9
180. Gramineae type "1", type "2"	II	1	–	–	11	3	–	7	–	9	6	–	–	1	–
181. Gramineae - Monoporopol. graminaeus	III	4	6	11	40	13	8	1	4	13	3	1	5	1	6
183. Sparganium ramosum type	III	–	–	4	4	1	2	2	1	1	1	4	2	–	6
189. Pollenites laesus	II	2	2	1	–	–	–	–	–	3	–	1	1	1	–
Varia		45	40	30	52	16	21	13	28	16	18	17	16	19	14
Triceratium		–	–	–	–	1	–	–	–	–	–	–	–	–	–

No sample		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Depth in metres		44.20–44.30	44.30–44.40	44.40–45.10	45.10–46.00	46.00–46.40	46.40–46.60	46.60–47.50	47.50–47.90	47.90–48.20	48.20–48.50	48.50–48.60	48.60–49.50	49.50–49.60	49.60–50.70	50.70–51.00
Σ of counted sporomorphs		507	404	301	299	300	97	0	300	302	103	–	289	299	303	329
Σ of distinguished forms		53	41	37	38	37	21	–	29	34	23	–	39	41	43	38
number of sporomorphs - group I		6	5	4	1	3	1	–	4	7	1	0	5	6	3	3
number of sporomorphs - group II		25	17	14	18	16	7	0	12	15	9	0	18	17	20	18
number of sporomorphs - group III		22	19	19	19	18	12	0	13	12	13	0	16	18	20	17
		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1. Sphagnum sp.	III	12	17	7	2	5	1	–	–	–	1	–	2	5	1	2
13. Lygodium sp. 1	II	1	4	–	1	–	–	–	–	–	–	–	–	–	–	–
16. Gleicheniaceae	II	2	2	–	4	3	–	–	2	2	–	–	–	1	–	–
27. Polypodiaceae	III	14	16	7	17	24	7	–	2	3	3	–	26	25	17	6
34. Abies sp.	III	13	13	9	1	–	1	–	–	–	1	–	–	1	3	2
35. Tsuga canadensis type	II	2	2	1	–	–	–	–	–	–	–	–	1	–	–	1
38. Picea sp.	III	1	–	–	–	1	–	–	–	–	–	–	–	–	–	1
41. Pinus silvestris type	III	178	114	53	92	86	35	–	69	64	39	–	84	84	78	54
42. Pinus haploxylon type	II	9	5	4	6	5	4	–	7	4	4	–	8	10	6	9
43. Sciadopitys verticillata	II	12	8	1	6	6	1	–	–	2	1	–	1	1	1	–
44. Sequoia sp.	II	2	4	–	–	–	–	–	–	–	–	–	1	–	1	1
45. Taxodium sp.	II	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
46. Glyptostrobus cf. europaeus	II	10	10	7	2	–	–	–	–	–	–	–	–	–	–	1
47. Cryptomeria	II	1	4	–	–	1	–	–	–	–	–	–	1	3	–	7
52. Taxodiaceae - Cupressaceae	II	26	37	19	13	11	6	–	5	–	7	–	3	20	33	32
54. Betula	III	6	7	39	18	15	5	–	21	23	3	–	9	23	16	4
55. Alnus glutinosa type	III	19	13	22	21	31	11	–	58	49	7	–	20	20	25	3
57. Ostrya	II	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1
58. Carpinus	III	3	–	1	2	1	–	–	–	1	–	–	1	3	1	2
59. Corylus avellana type	III	–	2	3	2	–	–	–	–	–	–	–	–	1	–	–
61. Castanea	II	–	–	–	–	–	–	–	–	–	–	–	2	2	–	–
62. cf. Castanopsis	I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
63. cf. Pasania	I	–	1	–	–	–	–	–	–	–	–	–	–	–	1	5
64. Fagus	III	3	–	4	1	2	–	–	1	3	–	–	4	3	1	–
65. Quercus	III	6	7	15	9	9	3	–	2	11	2	–	22	11	22	49
68. Myrica	II	7	4	–	1	2	–	–	1	–	–	–	1	1	1	13
70. Carya	II	3	–	–	–	–	–	–	–	–	–	–	–	–	1	2
71. Pterocarya	II	3	1	–	1	–	–	–	3	1	–	–	4	1	1	–
72. Engelhardtioidites f. minor	II	2	1	–	1	–	–	–	21	22	4	–	15	3	10	19
73. Engelhardtioidites f. magna	I	–	–	1	–	–	–	–	27	1	–	–	3	3	3	–
74. Salix	III	2	3	1	–	3	–	–	–	–	–	–	1	3	1	–
75. Ulmus	III	6	3	2	1	1	–	–	5	9	–	–	5	3	2	1
76. Celtis	II	1	–	6	1	1	–	–	1	1	–	–	–	2	1	–
88. cf. Discoglypsemna	III	–	–	–	–	–	–	–	–	6	–	–	1	–	–	1
89. Liquidambar	II	1	–	–	3	1	1	–	2	6	1	–	1	2	11	2
90. Corylopsis	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
98. Rosaceae	III	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–
99. Leguminosae gen. div.	III	1	–	–	–	–	–	–	–	–	–	–	–	–	1	7
100. cf. Caragana	I	–	1	1	–	1	–	–	–	2	–	–	–	1	–	5
105. cf. Lythrum	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
107. Nyssa f. minor	II	4	5	5	11	7	3	–	6	11	6	–	13	7	–	2
109. Nyssa f. magna	II	3	5	12	2	6	2	–	18	10	–	–	–	2	6	–
112. Myrtaceae genera indeterminata	II	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
113. Oenotheraceae	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
118. Tilia	III	–	–	–	–	2	–	–	–	–	1	–	–	1	1	1
123. Rutaceae genera indeterminata	II	1	–	–	1	2	–	–	–	–	–	–	2	–	2	–
130. Ilex; Tricolporopol. iliacus	II	1	–	2	1	1	–	–	–	–	1	–	5	2	–	16
131. Ilex; Tricolporopol. margaritatus	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
133. Cyrilla cf. racemifolia	I	–	–	–	–	–	–	–	2	3	–	–	4	3	–	5
136. Cyrillaceae - Clethraceae	I	–	–	–	–	–	–	–	–	3	1	–	–	–	–	–
138. Rhamnaceae	III	–	1	1	1	1	–	–	–	–	–	–	–	1	1	–
139. Vitis	I	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
142. Araliaceae	II	3	2	5	6	3	2	–	1	2	–	–	3	1	1	–
147. Ericaceae	III	38	–	15	23	18	3	–	14	19	5	–	6	4	9	22
150. Symplocos	II	–	–	1	–	–	–	–	–	2	–	–	–	–	1	3
161. cf. Fraxinus	II	–	–	5	–	–	–	–	–	6	–	–	1	–	–	–
174. Potamogeton	III	4	4	–	–	–	–	–	–	–	–	–	–	–	–	–
178. Cyperaceae sp. div.	III	10	30	20	9	19	4	–	6	9	1	–	4	16	8	15
180. Gramineae type "1", type "2"	II	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
181. Gramineae - Monoporopol. graminaeus	III	7	16	4	4	1	2	–	1	–	2	–	7	7	3	1
183. Sparganium ramosum type	III	50	24	1	11	9	1	–	1	1	2	–	–	–	–	3
189. Pollenites laesus	II	2	–	2	2	1	–	–	2	4	1	–	2	–	7	9
Varia		20	15	21	17	15	3	–	14	15	7	–	17	14	16	24
Triceratium		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

No sample		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Depth in metres		51.00–51.50	51.50–52.00	52.00–52.40	52.40–53.00	53.00–53.50	53.50–54.00	54.00–54.70	54.70–55.00	55.00–56.00	56.00–57.00	57.00–58.40	58.40–59.60	59.60–60.00	60.00–60.30	60.30–60.60
Σ of counted sporomorphs		500	394	300	399	301	201	300	200	300	–	98	302	293	303	290
Σ of distinguished forms		49	40	36	51	51	27	44	35	46	–	31	45	51	49	52
number of sporomorphs - group I		6	5	5	8	7	4	3	1	5	0	3	9	9	11	8
number of sporomorphs - group II		24	18	18	24	24	11	22	17	24	0	15	19	26	21	27
number of sporomorphs - group III		19	17	13	19	20	12	19	17	17	0	13	17	16	17	17
		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
1. Sphagnum sp.	III	1	1	–	2	2	–	2	1	–	–	–	2	1	–	5
13. Lygodium sp. 1	II	–	–	–	–	–	–	–	–	–	–	–	–	6	3	6
16. Gleicheniaceae	II	1	1	–	1	–	–	–	1	–	–	1	–	5	1	1
27. Polypodiaceae	III	3	1	–	2	1	3	3	1	4	–	–	7	16	1	5
34. Abies sp.	III	8	4	2	3	4	–	4	2	3	–	–	–	2	–	–
35. Tsuga canadensis type	II	–	–	–	1	2	–	2	–	1	–	–	1	3	4	–
38. Picea sp.	III	1	–	–	1	2	–	–	–	–	–	–	–	1	3	–
41. Pinus silvestris type	III	76	56	35	127	68	75	94	63	126	–	31	117	82	64	75
42. Pinus haploxylon type	II	10	4	4	20	4	8	11	8	7	–	4	13	13	8	11
43. Sciadopitys verticillata	II	1	1	–	2	7	1	1	–	1	–	–	–	10	10	6
44. Sequoia sp.	II	9	1	3	3	–	–	2	9	5	–	1	2	4	6	2
45. Taxodium sp.	II	–	–	–	20	3	–	–	–	2	–	–	3	4	–	–
46. Glyptostrobus cf. europaeus	II	11	1	7	15	13	4	3	3	3	–	–	2	5	7	6
47. Cryptomeria	II	25	3	6	17	9	1	4	5	–	–	2	7	2	1	2
52. Taxodiaceae - Cupressaceae	II	84	50	62	45	41	18	32	26	39	–	12	29	30	65	49
54. Betula	III	5	11	6	6	16	11	10	2	8	–	4	13	5	2	2
55. Alnus glutinosa type	III	4	20	21	3	4	1	3	7	6	–	2	5	6	2	3
57. Ostrya	II	1	–	–	–	1	–	–	–	1	–	–	–	–	–	–
58. Carpinus	III	2	1	2	2	2	2	5	2	–	–	1	3	–	–	2
59. Corylus avellana type	III	11	10	12	7	7	6	6	8	2	–	1	4	–	1	1
61. Castanea	II	1	–	–	–	–	–	–	–	1	–	1	–	6	10	14
62. cf. Castanopsis	I	–	–	1	1	2	2	–	–	–	–	–	–	4	2	4
63. cf. Pasania	I	1	2	1	–	–	1	–	–	–	–	–	–	–	–	–
64. Fagus	III	–	–	–	–	–	–	–	–	–	–	–	3	–	1	–
65. Quercus	III	7	8	6	2	2	1	4	1	4	–	1	1	3	7	9
68. Myrica	II	39	13	13	5	12	3	16	3	8	–	1	4	6	6	3
70. Carya	II	–	–	–	–	1	–	–	–	–	–	–	1	–	–	1
71. Pterocarya	II	4	–	–	–	3	–	–	1	2	–	1	–	1	–	5
72. Engelhardtioidites f. minor	II	20	40	11	19	9	9	2	6	3	–	2	12	5	3	5
73. Engelhardtioidites f. magna	I	1	–	–	–	–	–	–	–	5	–	–	5	8	5	4
74. Salix	III	1	1	3	1	1	–	2	2	1	–	–	–	1	3	7
75. Ulmus	III	5	–	2	–	–	–	1	4	–	–	1	1	1	2	–
76. Celtis	II	2	1	–	–	1	–	–	–	–	–	–	–	–	1	1
88. cf. Discoglypsemna	III	2	2	2	–	1	–	2	1	–	–	–	2	1	–	1
89. Liquidambar	II	1	1	2	3	1	2	2	1	–	–	–	–	3	–	–
90. Corylopsis	II	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
98. Rosaceae	III	–	–	–	1	2	2	2	1	1	–	–	–	–	–	–
99. Leguminosae gen. div.	III	3	13	6	6	2	–	1	–	–	–	1	–	–	–	1
100. cf. Caragana	I	52	52	22	9	4	3	8	3	4	–	2	3	–	3	4
105. cf. Lythrum	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
107. Nyssa f. minor	II	3	–	–	1	1	–	1	3	2	–	2	–	–	1	3
109. Nyssa f. magna	II	–	1	–	–	1	–	2	–	–	–	–	1	1	–	–
112. Myrtaceae genera indeterminata	II	–	–	–	–	–	–	–	1	3	–	–	–	–	–	1
113. Oenotheraceae	II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
118. Tilia	III	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
123. Rutaceae genera indeterminata	II	–	–	–	–	–	–	1	3	–	–	–	–	–	–	1
130. Ilex; Tricolporopol. iliacus	II	11	17	5	1	3	1	2	5	4	–	–	3	–	2	3
131. Ilex; Tricolporopol. margaritatus	II	8	9	3	–	1	–	3	–	3	–	1	3	2	–	–
133. Cyrilla cf. racemifolia	I	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–
136. Cyrillaceae - Clethraceae	I	4	6	7	5	5	2	5	–	5	–	–	1	–	–	1
138. Rhamnaceae	III	1	–	–	1	–	–	1	–	–	–	–	–	–	–	–
139. Vitis	I	–	–	–	2	–	–	–	–	–	–	–	1	1	4	–
142. Araliaceae	II	10	2	1	1	4	–	3	2	1	–	4	4	1	2	5
147. Ericaceae	III	13	20	10	14	4	10	22	6	8	–	1	10	8	4	4
150. Symplocos	II	5	3	2	1	2	2	1	1	4	–	–	1	–	–	–
161. cf. Fraxinus	II	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–
174. Potamogeton	III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
178. Cyperaceae sp. div.	III	13	2	20	7	20	17	14	3	4	–	2	8	1	11	6
180. Gramineae type "1", type "2"	II	–	–	–	–	–	2	–	–	2	–	2	–	–	–	–
181. Gramineae - Monoporopol. graminaeus	III	–	1	–	–	2	1	5	1	2	–	1	1	1	1	–
183. Sparganium ramosum type	III	–	1	–	–	–	–	–	1	–	–	3	1	1	–	–
189. Pollenites laesus	II	9	–	2	7	1	–	1	4	2	–	2	1	1	1	2
Varia		20	7	12	18	11	10	13	9	14	–	4	9	10	12	10
Triceratium		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

No sample		91	92	93	94	95	96	97	98	99	100	101	102
Depth in metres		60.60–61.00	61.00–62.00	62.00–62.70	62.70–63.00	63.00–63.50	63.50–63.80	63.80–64.00	64.00–64.30	64.30–64.35	64.35–64.40	64.40–64.45	64.45–64.50
Σ of counted sporomorphs		386	305	304	300	298	298	1079	704	383	565	730	552
Σ of distinguished forms		58	54	41	52	48	50	64	57	49	50	53	54
number of sporomorphs - group I		10	10	11	14	11	13	19	15	13	15	12	13
number of sporomorphs - group II		25	27	16	22	25	21	23	23	19	16	22	23
number of sporomorphs - group III		15	17	14	16	12	16	22	19	17	19	19	18
		91	92	93	94	95	96	97	98	99	100	101	102
1. Sphagnum sp.	III	–	–	–	12	2	–	–	1	–	1	–	–
13. Lygodium sp. 1	II	3	1	2	–	1	4	–	3	1	2	2	1
16. Gleicheniaceae	II	1	1	–	2	2	–	–	–	1	–	3	1
27. Polypodiaceae	III	10	8	3	4	7	4	4	14	6	10	11	17
34. Abies sp.	III	–	1	–	–	–	–	2	2	–	–	2	1
35. Tsuga canadensis type	II	–	3	–	2	1	–	1	–	2	–	–	1
38. Picea sp.	III	–	–	–	2	–	2	1	–	4	2	2	3
41. Pinus silvestris type	III	104	79	91	57	78	102	403	157	63	66	135	93
42. Pinus haploxylon type	II	9	7	9	13	9	12	20	12	3	3	20	17
43. Sciadopitys verticillata	II	7	2	5	1	5	2	10	10	–	1	7	3
44. Sequoia sp.	II	6	2	5	1	1	3	2	–	–	9	2	1
45. Taxodium sp.	II	–	–	–	–	–	–	–	–	–	–	–	–
46. Glyptostrobus cf. europaeus	II	23	22	4	9	11	6	35	16	7	77	9	5
47. Cryptomeria	II	3	5	2	3	5	2	7	4	3	4	12	14
52. Taxodiaceae - Cupressaceae	II	62	38	44	23	27	30	167	107	42	50	82	72
54. Betula	III	4	3	5	3	4	6	8	6	1	8	8	9
55. Alnus glutinosa type	III	6	3	8	1	5	1	7	15	4	4	15	22
57. Ostrya	II	–	–	–	–	2	–	–	–	–	–	1	–
58. Carpinus	III	3	2	–	–	–	1	2	1	1	–	2	–
59. Corylus avellana type	III	–	2	2	5	7	1	9	13	12	3	6	8
61. Castanea	II	13	12	11	13	6	10	41	28	5	11	17	7
62. cf. Castanopsis	I	1	1	1	11	5	–	20	11	14	16	23	4
63. cf. Pasania	I	4	2	6	6	4	1	–	3	–	–	17	–
64. Fagus	III	–	–	–	1	–	–	–	–	–	8	4	9
65. Quercus	III	7	10	3	12	8	6	25	18	17	23	32	12
68. Myrica	II	–	3	8	–	6	3	17	30	9	16	22	13
70. Carya	II	2	–	–	–	3	2	11	3	2	–	–	2
71. Pterocarya	II	1	–	–	–	1	2	7	1	–	–	1	1
72. Engelhardtioidites f. minor	II	8	3	2	5	6	5	12	11	6	6	9	8
73. Engelhardtioidites f. magna	I	4	4	5	4	4	–	15	8	4	7	11	–
74. Salix	III	5	5	5	2	6	6	21	7	5	3	10	6
75. Ulmus	III	1	–	–	–	–	–	4	5	–	1	2	2
76. Celtis	II	5	–	–	1	–	–	–	–	–	–	–	–
88. cf. Discoglypsemna	III	3	1	1	2	2	2	2	6	–	2	2	1
89. Liquidambar	II	–	1	–	1	–	1	4	–	–	–	–	3
90. Corylopsis	II	–	1	–	3	–	–	–	–	–	–	–	–
98. Rosaceae	III	–	1	–	–	–	–	–	1	4	5	3	3
99. Leguminosae gen. div.	III	1	–	–	–	–	1	2	3	2	–	3	–
100. cf. Caragana	I	4	–	4	1	2	–	2	2	1	–	–	–
105. cf. Lythrum	III	–	–	–	–	–	–	–	–	–	–	–	–
107. Nyssa f. minor	II	2	3	1	4	2	4	8	8	4	7	5	9
109. Nyssa f. magna	II	–	–	–	–	–	–	–	–	–	–	–	–
112. Myrtaceae genera indeterminata	II	2	2	–	2	–	–	–	–	–	–	1	2
113. Oenotheraceae	II	–	–	–	–	–	–	–	–	–	–	–	–
118. Tilia	III	–	–	–	–	–	–	1	–	–	–	–	–
123. Rutaceae genera indeterminata	II	1	1	–	–	2	–	–	–	–	1	–	1
130. Ilex; Tricolporopol. iliacus	II	–	3	3	3	3	3	2	2	1	1	2	4
131. Ilex; Tricolporopol. margaritatus	II	–	–	–	–	–	–	–	–	–	–	–	–
133. Cyrilla cf. racemifolia	I	–	–	–	–	–	–	–	–	–	4	3	4
136. Cyrillaceae - Clethraceae	I	2	1	–	–	–	1	–	–	–	–	–	–
138. Rhamnaceae	III	–	–	–	–	–	–	–	–	–	1	–	–
139. Vitis	I	–	1	1	6	2	3	14	3	4	6	7	4
142. Araliaceae	II	2	4	2	5	4	2	6	33	16	6	5	10
147. Ericaceae	III	3	2	2	2	3	4	3	1	1	6	9	2
150. Symplocos	II	–	1	–	–	–	–	–	–	1	–	–	–
161. cf. Fraxinus	II	–	–	–	–	1	–	1	–	–	–	–	–
174. Potamogeton	III	–	–	–	–	–	–	–	–	–	–	–	–
178. Cyperaceae sp. div.	III	11	12	20	32	18	12	23	9	11	25	39	15
180. Gramineae type "1", type "2"	II	–	–	–	–	–	–	–	–	–	–	–	–
181. Gramineae - Monoporopol. graminaeus	III	2	1	–	1	1	4	2	2	–	–	–	–
183. Sparganium ramosum type	III	–	–	2	1	–	1	1	2	–	–	–	1
189. Pollenites laesus	II	3	2	1	1	2	–	1	1	2	3	2	–
Varia		11	11	12	12	6	6	19	16	17	17	15	11
Triceratium		–	–	–	–	–	–	–	–	–	–	–	–

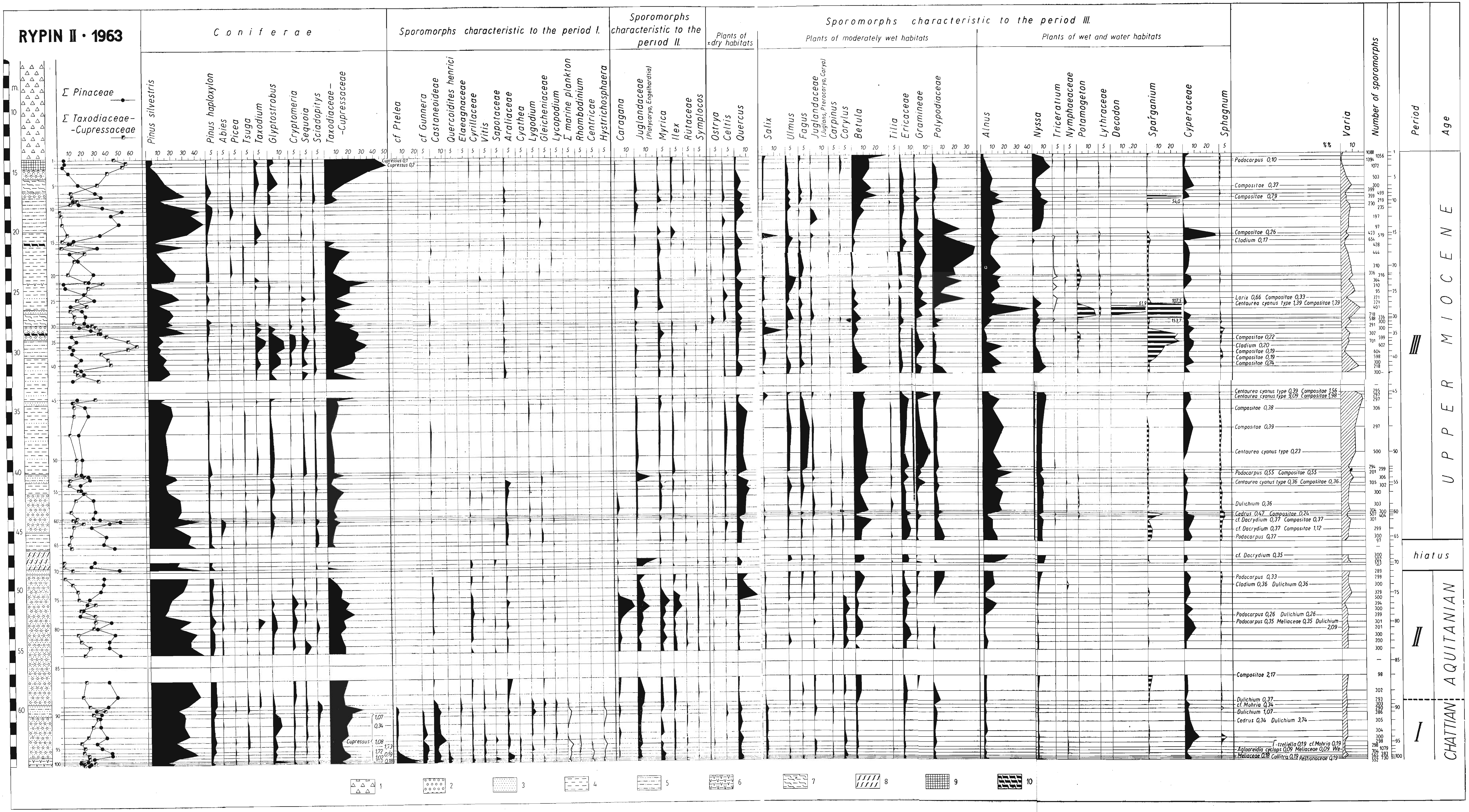
Sporomorphs found sporadically in the profile of Rypin II in less than 15 samples.

(Roman numerals indicate plant groups, Arabic – Nos. of samples, Arabic in brackets – quantity of sporomorphs in the sample.)

2.	Anthoceros	II	13 (sample) (1): 14 (1): 27 (1); 41 (1); 55 (1);
3.	cf.Psilotum	I	87 (1); 94 (1);
4.	Lycopodium annotinum type	III	66 (1); 91 (2); 97 (1);
5.	L.cernuum type	I	88 (1); 92 (1); 93 (4);
6.	L.clavatum type	III	19 (1); 27 (1); 48 (1); 51 (1); 62 (1); 79 (1); 84 (1); 88 (3); 89 (3); 90 (1); 94 (3); 96 (2);
7	L.inundatum	I	61 (2); 72 (1); 88 (1); 101 (1);
8.	L.selago type	III	51 (1); 89 (2);
9.	Equisetum	III	84 (2);
10.	Osmunda cf.bromeliifolia	II	75 (1);
11.	O.claytoniana type	II	8 (1); 17 (1); 25 (2); 54 (1); 60 (2); 61 (1);
12.	O.regalis type	II	63 (1); 88 (1);
14	Lygodium sp. 2	I	89 (2); 90 (4); 91 (1); 96 (1); 98 (1);
15.	Mohria	I	4 (1); 49 (1); 89 (1): 97 (1):
17.	Undulatisporites cf. pseudobraziliensis	I	21 (1); 23 (2); 79 (1);
18.	cf.Concavisporites rugulatus	I	54 (1); 56 (1); 58 (1);
19.	Hymenophyllaceae ?	I	21 (1); 23 (3); 30 (1); 51 (1); 52 (1); 60 (1); 65 (1); 66 (1); 87 (1); 89 (1);102 (1);
20.	Dicksonia cf.thyrsopteroides	I	88 (1); 94 (1); ?
21.	cf.Alsophila	I	82 (1); 96 (1);100 (1);
22.	Cyathea cf.propinqua	I	94 (3); 96 (1); 97 (1); 98 (1);102 (1);
23.	Cyathea cf.vestita	I	88 (1); 95 (1); 96 (2); 97 (1); 98 (5); 99 (2); 100 (1);101 (1);102 (1);
24.	cf.Hemitelia maxonii	I	62 (1);
25.	Cyatheaceae-Schizeaceae	II	5 (1); 98 (1);
26.	Polypodium	III	91 (1);
28.	Foveotriletes	I	62 (1); 89 (1): 96 (1); 100 (1);
29	Toroisporis aneddeni	I	24 (1); 46 (1); 69 (1);
30.	Camarozonosporites /Hamulatisporis/ sp.	I	36 (1);
31	Lusatisporis	I	58 (1);
32.	cf.Dacrydium	I	63 (1); 64 (1); 68 (1);
33	Podocarpus	I	3 (1); 53 (1); 65 (1); 73 (1); 79 (1); 80 (1);
36.	Tsuga diversifolia type	II	17 (3); 18 (1); 19 (1); 39 (1); 62 (1); 74 (1); 82 (1);
37	T.pattoniana type	II	61 (1); 65 (1); 89 (1); 90 (1);
39.	Larix	III	26 (2);
40.	Cedrus	II	61 (2); 92 (2);
48.	cf.Taiwania	II	2 (1);
49	cf.Cunninghamia	II	2 (2); 87 (3); 88 (3); 89(12); 90 (1); 91 (1); 92 (1);
50.	cf.Callitris	I	101 (4);
51.	Cupressus	I	1 (1); 2 (2); 86 (2); 91 (4); 92 (1); 94 (3); 95 (5); 96 (5); 97 (2); 98 (7);100 (1);
53.	Ephedra	I	15 (1); 97 (2);
56.	Alnus Kefersteinii	II	2 (1); 8 (6); 33 (2); 37 (2); 49 (3); 51 (2); 52 (3); 54 (2); 57 (4); 73 (2);
60.	Corylus americana type	I	2 (1); 3 (2); 4 (5);
66.	cf.Quercus	II	79 (2); 88 (1); 90 (1); 94 (1); 97 (1); 98 (1); 99 (1);
67.	Quercoidites henrici	I	89 (1); 95 (2); 96 (1); 97(14); 98(10); 99(15); 100 (6);101(20);102(11);
69.	Juglans	II	3 (1); 17 (1); 49 (2); 89 (1); 95 (1);
77.	Eucommia ulmoides	II	3 (1); 4(14); 19 (1); 20 (1); 22 (1); 26 (1); 35 (1); 39 (1); 48 (1); 51 (1); 73 (1); 76 (2); 77 (1); 84 (1);
78.	Proteaceae ?	I	94 (1);
79.	cf.Chaunochiton	II	54 (1);
80.	cf.Loranthus	II	3 (1); 16 (2); 18 (1); 19 (1); 76 (1); 88 (2); 91 (1); 94 (2); 96 (2);
81.	Arceuthobium cf.oxycedri	II	1 (2); 4 (1); 61 (1); 76 (1); 78 (1); 91 (1);
82.	Spinulaepollis arceuthobioides ssp. major	II	1 (1); 2 (3); 3 (2); 35 (1); 80 (1);
83.	Polygonum "avicularia" type	III	9 (2); 14 (1); 46 (1); 55 (1);
84.	P."persicaria" type	III	8 (1); 41 (3); 43 (1); 48 (5); 56 (1);
85.	Rumex	III	27 (1);
86.	Chenopodiaceae	III	6 (1); 9 (1); 25 (1); 25 (1); 27 (2); 45 (1); 46 (3); 50 (2); 58 (1); 87 (1); 99 (1);
87.	Caryophyllaceae	III	29 (1); 46 (1); 65 (1);
91.	Magnoliaceae	II	1 (1); 31 (1);
92.	Lauraceae	II	27 (1); 55 (1);
93.	Ranunculaceae	III	1 (3); 2 (3); 3 (2); 21 (4); 22 (1); 27 (4); 29 (2); 31 (1); 36 (2); 40 (1); 41 (1); 47 (1); 51 (1); 74 (1);
94.	Thalictrum	III	92 (2); 97 (2);
95.	Nymphaeaceae	II	1 (1); 3 (1); 4 (1); 9 (1); 23 (1); 34 (1); 45 (2); 55 (1); 58 (2); 59 (2); 74 (4); 95 (1); 96 (2); 97 (1); 98 (1);
96.	Cruciferae	III	4 (1); 27 (2);
97.	cf.Garcinia Mannii	I	90 (1);
101.	cf.Cassia	I	57 (1); 77 (3);
102.	cf.Cynometris	I	87 (4); 88 (2);
103.	Hippophaë	I	88 (1);
104.	cf.Elaeagnus	II	88 (1); 89 (4); 90 (2); 91 (1); 92 (1); 94 (2); 96 (1); 99 (1);101 (1);
106.	Decodon cf.globosus	II	2 (1); 4 (1); 25 (1); 28(83); 29 (2);
108.	Nyssa f.media	II	22 (1); 56 (1); 69 (1);
110.	cf.Eucalyptus	II	79 (1); 97 (1);
111.	Myrtus	II	82 (1),101 (1);
114.	Trapa	III	39 (1);
115.	Myriophyllum	III	2 (1); 3 (2); 4 (1); 59 (1); 61 (1); 74 (1); 93 (1);
116.	Halorrhagis	I	4 (1); 61 (1);
117.	cf.Gunnera	I	61 (1); 90 (4); 91 (8); 92 (6); 93(13); 94 (1); 95(15); 96(18); 97(50); 98(26); 99(17);100(18); 101(23);102(19);
119.	Linum	III	63 (1); 84 (1); 98 (1);
120.	cf.Aegle	I	39 (1);
121.	cf.Ptelea	I	89 (5); 90 (5); 91 (3); 92 (4); 93 (4); 94 (2); 95 (2); 96 (2); 97(32); 98(49); 99(48);100(106); 101(103);102(98);
122.	Fagara	I	3 (2); 4 (1); 5 (3); 17 (1); 38 (1); 60 (1); 61 (2); 73 (1); 76 (2); 77 (1); 84 (1);
124.	cf.Melia	I	97 (1);
125.	cf.Toona ciliata	I	80 (1); 98 (1);100 (1);
126.	Pistacia	II	1 (1); 2 (3); 3 (2); 55 (2); 57 (1); 78 (1); 84 (1);
127.	Rhus	I	3 (1); 4 (1); 8 (1); 26 (2); 30 (1); 34 (3); 48 (1); 58 (1); 78 (1); 79 (1); 80 (1); 91 (4); 98 (4);
128.	cf.Sapindus	I	40 (1); 61 (1);100 (1); 102 (1);
129.	Acer	III	2 (3); 10 (2); 27 (1); 40 (1); 47 (1); 49 (1); 50 (7); 51 (1); 53 (1); 57 (2);101 (1);
132.	Staphyllea	II	3 (1); 17 (1); 58 (1);
134.	Cyrilla sp.1	II	36 (1); 76 (6); 78 (1); 79 (1); 84 (1); 86 (1); 90 (1); 91 (2); 93 (2); 94 (2); 95 (2); 96 (2); 97 (6); 98 (8); 99 (3);
135.	cf.Cliftonia	I	99 (1);100 (6);101 (9); 102 (3);
137.	Pollenites cingulum brühlensis	I	39 (1); 93 (1);
140.	Parthenocissus	I	2 (1); 3 (1); 28 (1); 29 (1); 48 (1); 55 (1); 58 (1); 69 (1); 72 (1); 73 (1); 74 (1); 86 (2); 97 (2);
141.	Cornus	II	1 (1); 98 (1);100 (1); 101 (1);
143.	Polyscias	II	98 (1);102 (4);
144.	Tricolporopollenites edmundii	I	1 (5); 2 (2); 3 (1); 4 (2); 31 (1); 76 (1); 97 (1); 98 (4);
145.	Umbelliferae	III	7 (1); 9 (1); 30 (8); 32 (1); 34 (1); 48 (1); 51 (1); 52(11); 64 (1); 70 (1); 72 (1); 89 (1); 92 (1); 93 (1);
146.	Pirolaceae	III	30 (2); 61 (1); 62 (1); 76 (1); 79 (1); 80 (1);
148.	Rhododendron	III	40 (1); 49 (4); 50 (6); 51 (1); 62(17); 84 (1); 90 (1); 97 (1); 98 (3); 100 (2);101 (2):102 (4);
149.	cf.Styrax philadelphoides	II	80 (1);
151.	Sapotaceoidae-pollenites manifestus	I	56 (1); 69 (1); 79 (1); 80 (1); 84 (1); 94 (2); 97 (1); 99(12);100 (2); 102 (2);
152.	S.-pollenites micromanifestus	I	63 (1); 68 (6); 87 (1); 94 (3); 97 (2); 99 (1);
153.	Solanaceae	III	2 (1); 97 (1);
154.	cf.Markhamia	I	87 (1); 93 (1); 95 (1); 96 (1); 99 (1);
155.	cf.Barleria	I	38 (1); 39 (1);
156.	cf.Vitex	II	1 (1); 29 (2); 48 (1);
157.	Labiatae	III	24 (2); 57 (2); 76 (1); 79 (1); 80 (1); 81 (2); 90 (1); 93 (1); 97 (4); 99 (1);100 (1);102 (1);
158.	Plantago "major" type	III	28 (1); 89 (2); 92 (1);
159.	Apocynum	II	2 (1);
160.	Forsythia	I	92 (3);
162.	Porocolpopollenites rotundus f.reticulata	II	25 (9); 42 (1); 48 (1); 63 (5); 69 (6); 72 (1); 74 (7); 77 (1);
163.	Rubiaceae	II	16 (3); 31 (1); 35 (1); 40 (1); 46 (4); 51 (2); 65 (1); 79 (1); 87 (1);
164.	Viburnum	III	56 (1); 57 (1); 99 (1);
165.	Lonicera	II	5 (1); 15 (1); 16 (1); 31 (1); 38 (1); 43 (1); 45 (1); 46 (1); 61 (1); 72 (1); 79 (1); 82 (1);
166.	Diervillea	II	3 (1);
167.	Valerianaceae	III	39 (1); 61 (1); 62 (1);
168.	cf.Phyteuma	III	64 (1);
169.	Centaurea cyanus	III	27 (4); 45 (1); 46(23); 50 (1); 55 (1);
170.	Artemisia	III	46 (2);102 (1);
171.	Compositae tubuliflorae	III	6 (1); 27 (4); 40 (1); 41 (1); 45 (2); 46 (5); 48 (1); 49 (1); 53 (1); 64 (3); 86 (2);
172.	Compositae liguliflorae	III	9 (2); 15 (1); 26 (1); 36 (1); 39 (1); 41 (1); 45 (1); 55 (1); 61 (1); 63 (1); 87 (1); 99 (1);
173.	Butomus	III	2 (4); 3 (3);
175.	cf.Tulipa	II	3 (2); 46 (1); 55 (1); 56 (1); 75 (1); 87 (1); 90 (1); 91 (1); 92 (2); 95 (1); 96 (1);
176.	Restionaceae	I	102 (1);
177.	cf.Dulichium	II	58 (1); 74 (1); 79 (1); 80 (6); 88 (1); 91 (4); 92(11);
179.	Cladium	III	17 (1); 38 (1); 74 (1);
182.	cf.Corypha	I	32 (2); 93 (1);102 (2);
184.	Sparganium minimum type	III	4 (1); 12 (1); 15 (1); 26 (1); 57 (1); 82 (1); 100 (1);
185.	Typha	III	20 (1); 21 (1); 53 (5); 55 (1); 57 (1);
186.	Aglaoreidia cyclops	I	97 (1);
187.	Trudopollis petrudens	I	54 (1); 97 (1);
188.	Pollenites microlesus	II	90 (1); 98 (1);
	Other microfossils.		
	Rhombodinium		94 (1); 95 (2); 96 (1);
	Wetzeliella		97 (1);
	Centricae		90(19); 94 (1); 95 (2); 96(22); 97(11); 98 (3); 99 (3);100(18);101(12);
	Hystrichosphaera		88 (1); 89 (1); 90 (6); 91 (9); 92 (1); 94 (1); 95 (8); 96 (3); 97 (5); 98 (5); 99 (2);101 (1); 102 (2);
	Ovoidites ligneolus marine plankton		1 (1); 2 (2); 3 (1); 4 (3); 62 (1); 63 (1); 95 (2); 96 (1); 97 (1); 98 (1); 99 (1);

Pollen diagram of the profile Rypin II

Diagram pyłkowy profilu Rypin II



1. boulder clay glina zwałowa
2. sand piasek
3. dust pył
4. compact loam ił zwięzły
5. dustlike loam ił pylasty
6. peaty loam ił torfiasty
7. black coaly loam czarny ił węglisty
8. clay glina
9. peat strongly mineralized torf silnie zmineralizowany
10. lignits lignity