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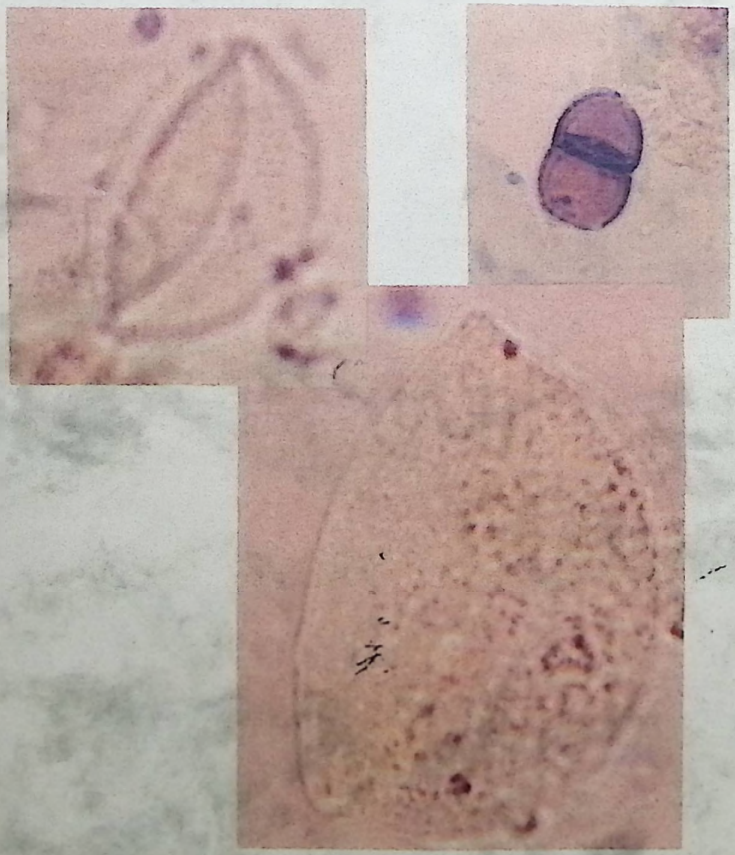
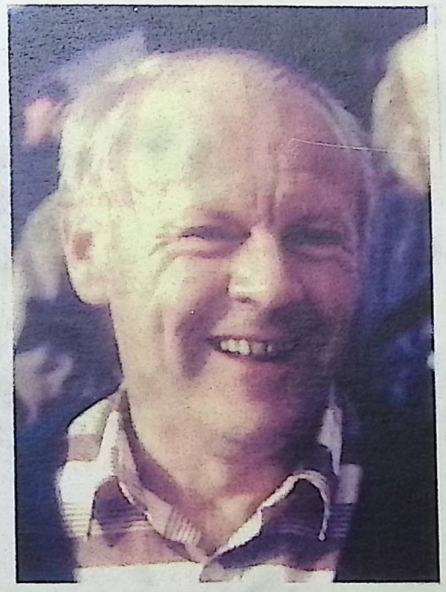
Part 5: Neogene Microflora of the Czech Republic

M. Konzalová: Upper Miocene palynomorphs from the South Moravian extension of the Vienna Basin





In memoriam

Erwin Knobloch †

1934-2004

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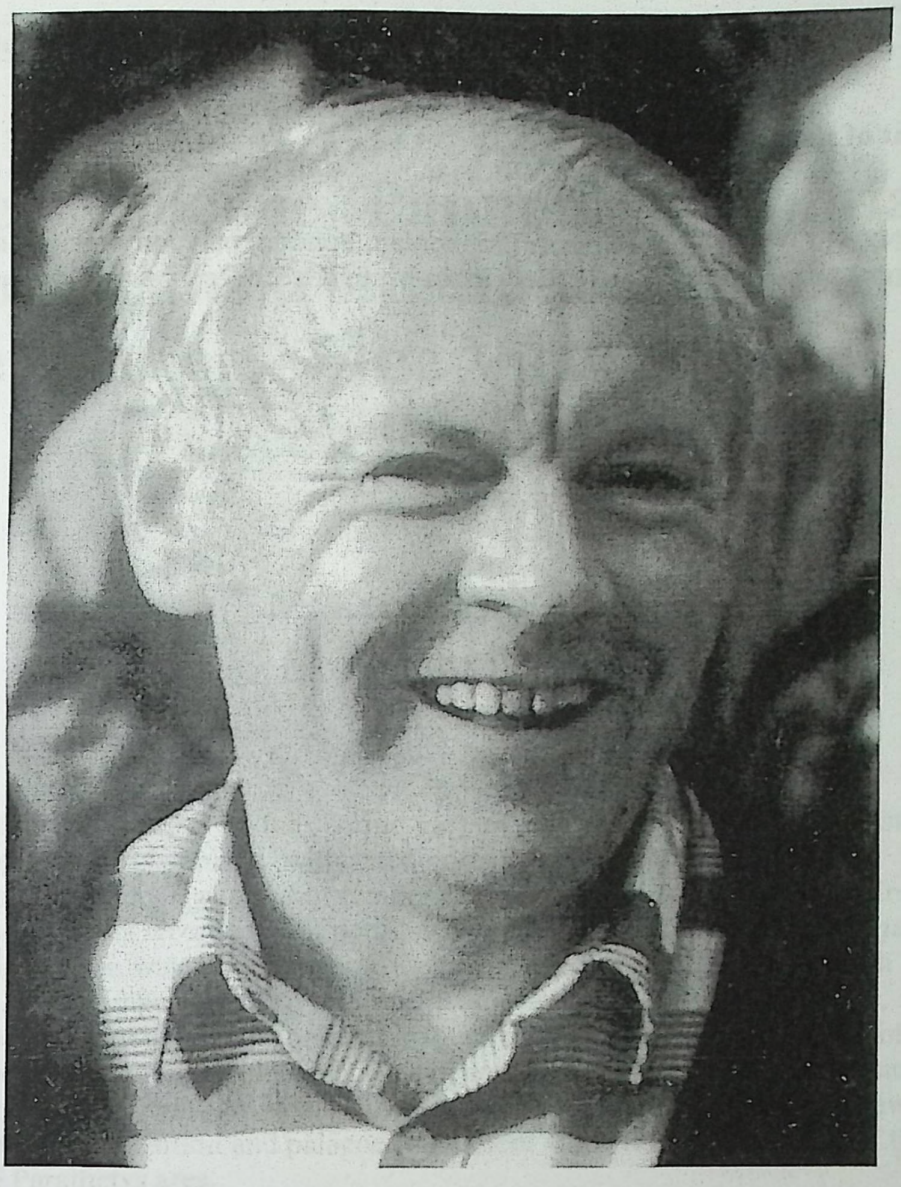

In memoriam Erwin Knobloch † 1934-2004

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Content of part 5

M. KONZALOVÁ: Upper Miocene (Pannonian, Pontian) palynomorphs from the South Moravian extention of the Vienna basin (Czech Republic).....1-51

Documenta naturae	155	5	p.1-51	3 tabs.	7 plates	München	2005

Upper Miocene (Pannonian, Pontian) palynomorphs from the south Moravian extention of the Vienna Basin (Czech Republic).

M. KONZALOVÁ

Abstract

Microscopic plant components of the lignitic clay of the former brickyard at Poštorná near Břeclav displayed an assemblage with predomination of algal remains and pollen of deciduous trees of temperate and warm temperatate zones with frequent *Celtis*. In addition, taxodiaceous swamp was recorded with peripheral surgum (*Nyssa*), sweetgum (*Liquidambar*) and sedges rimming the water body, laterally passing into aquatic vegetation with rich algal bloom remains. The comparison with microfloristic assemblages and fossil fruits, seeds and leaves of adjacent Pannonian and Pontian localities in Moravia and particularly in Hungary and Austria show many common elements. The depositional environment and the surrounding vegetation at the locality, not yet studied in plant microfossils, were defined. New data are added on the forest composition and palaeoenvironment at the time of cessation of the marine influence in the Parathetys area.

Key words. Paratethys, Vienna Basin, Upper Miocene, Pannonian, Pontian, Zone F (E-G), algal - pollen assemblage.

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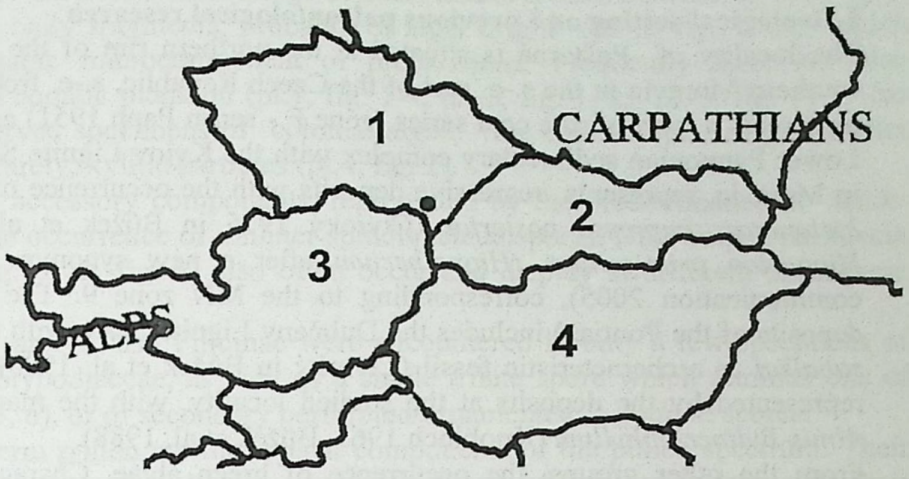
1 Introduction

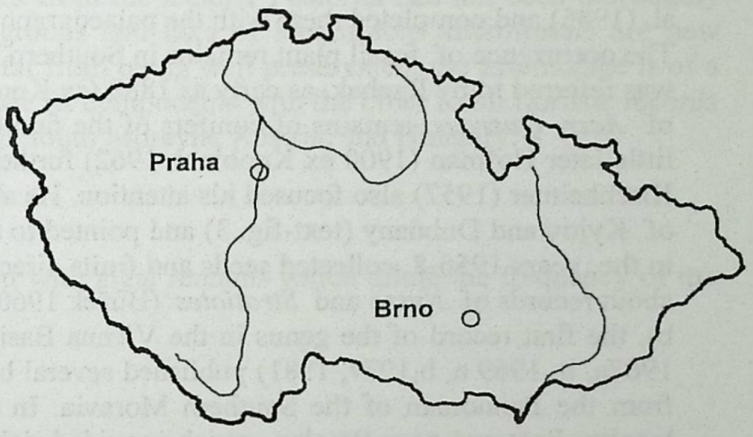
The sequence of clastic and clay deposits, involving carbonaceous clay with interbeds of two lignite seams at Poštorná near Břeclav (former brickyard) represents the northern extension of the Vienna Basin infringing into southern Moravia in the Bohemia, SE of the Bohemian Massif. Based on lithology and faunal remains these deposits are assigned to the Upper Pannonian, designated as Pontian, and represent its basal part. The plant leaves preserved in the clay and intercalating a seam, forming a leaf layer, were first studied by Bůžek (1960, 1962 a, b) and subsequently by Knobloch (1962, 1963 and l.c.) in the 1960s and 1970s, during the mapping of the former Central Geological Survey in Prague, simultaneously with the investigation of molluscs (Čtyroký 1975, Čtyroký et Knobloch 1976) and other fossils. The same locality and the same fossiliferous layer also provided material for palynological research, carried out initially for the possible confirmation of some abundant taxa in plant imprints. Due to the poor knowledge and scarcity of palynological spectra from the Pannonian sediments in the Bohemian territory, the coaly deposits of the respective locality were studied in more detail at present, with reference to all palynomorphs preserved. The plant microfossils, although not rich in specimens and far from being excellently preserved, were treated taxonomically, expressed in the numerical analysis and evaluated environmentally. The individual taxa were matched by proxy micro/macro remains and correlated with other coeval spectra in the broader area, in southern Moravia and adjacent territories outside (text-fig. 1, 2, 3), namely in Austria and Hungary.

Acknowledgement

My late colleagues, Dr. Č. Bůžek CSc. and Dr. E. Knobloch CSc. I am indebted for the fossil material (samples). Dr. H.-J. Gregor (München) I express my gratitude for the stimulating the work and its editing, Mr. J. Brozek (GI AS Prague) for the technical aid. The research is linked with the int. Project EEDEN (Environments a. Ecosystem Dynamics of the Eurasian Neogene) and the research topic of the Geological Institute of the Academy of Sciences AV OZ 301 305 16.

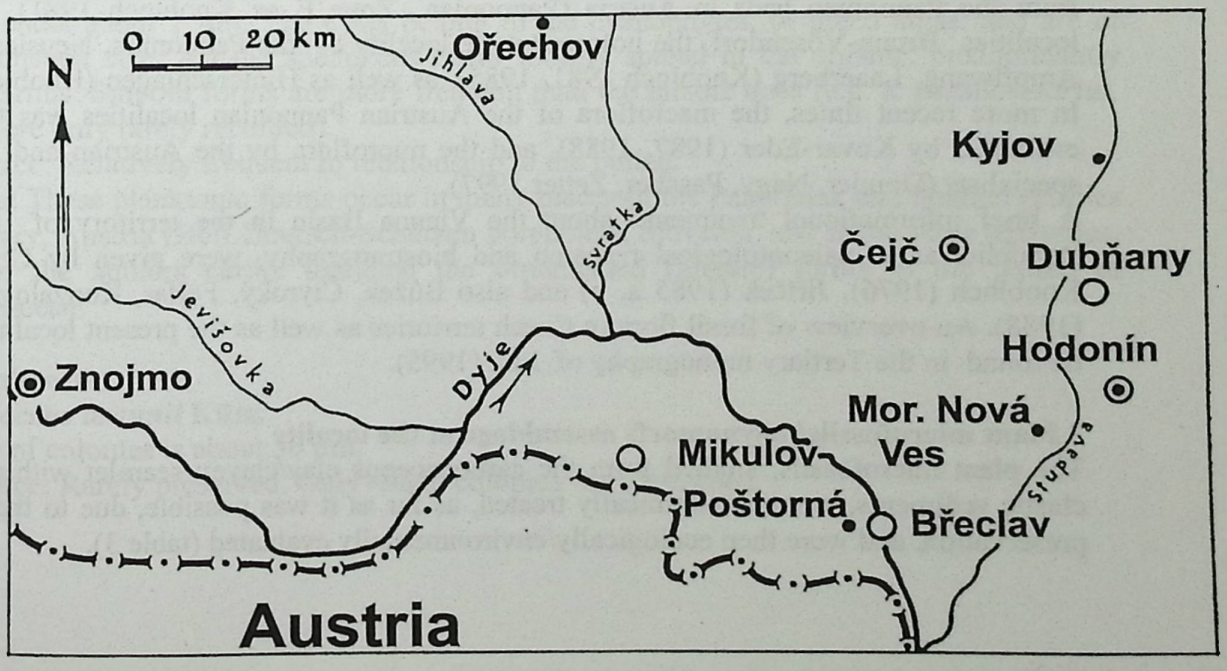


Text-fig. 1: Geographical Situation of South Moravia (1 Czech Republic) a part of the Vienna Basin (point), at the border to Slovakian Republic (2), Austria (3) and Hungary (4) – between The Alps and the Carpathians



Text-fig. 2: Czech Republic with the city of Brno (Southern Moravia)

Text-fig.3: Southern Moravia with fossil sites (below)



2 Geological setting and previous paleontological research

The locality of Poštorná is situated at the northern rim of the Vienna Basin, reaching to southern Moravia in the s.-e. part of the Czech Republic, s.-e. from Brno (text-fig. 2, 3), and represents a part of the coal series (zone F - sensu Papp 1951) assigned to the Pontian. The Lower Pannonian sedimentary complex with the Kyjov Lignite Seam (Pannonian zone B,C) in Moravia, represents regressive deposits with the occurrence of *Congeria ornithopsis* and *Melanopsis impressa posterior* (Čtyroký 1975 in Bůžek et al. 1988), and is dated by *Hipparion primigenium (Hippotherium* after a new synonym revision, Fejfar, personal communication 2005), corresponding to the MN zone 9. The Pannonian zone F (basal deposits of the Pontian) includes the Dubňany Lignite Seam with the occurrence of *Congeria zahalkai* as a characteristic fossil (Čtyroký in Bůžek et al. 1988), and its highest portion is represented by the deposits at the studied locality, with the macroflora of *Glyptostrobus-Alnus-Byttneriophyllum* (Knobloch 1963, Bůžek et al. 1988).

From the other groups, the occurrence of green algae, Characeae, in the *Congeria*-beds (Pokorný 1945) and ostracods (for example in the Pannonian beds, macrofaunistic zone E, at Moravská Nová Ves, Southern Moravia, Pokorný 1955) may be given as an example. Čtyroký (1975) and Jiříček (1985 a, b) referred to the many fauna groups (mollusks, ostracods, Sciaenids-otholithic fauna, mammals) occurring in the territory (zones A to F). Most of the fauna of the Vienna Basin and the Central Paratethys is evaluated and summarized in Papp et al. (1985) and completed there with the palaeography by Steininger and Rögel (1985).

The occurrence of fossil plant remains in Southern Moravia, in the Pannnonian/Pontian area, was referred to by Rzehak, as early as 1888 (ex Knobloch 1962). Rzehak recovered the leaves of *Acer*, *Quercus,* remains of conifers of the family Cupressaceae and some fossil fruits. A little later Hofman (1900 ex Knobloch 1962) further added to the finds of plants. In this area Kirchheimer (1957) also focused his attention. He also observed the fossil flora in the vicinity of Kyjov and Dubňany (text-fig. 3) and pointed to the occurrence of seeds and fruits. Bůžek, in the years 1956-8, collected seeds and fruits directly from the studied locality and reported about records of *Nyssa* and *Stratiotes* (Bůžek 1960, 1962 a), and later of *Rubus* (Bůžek 1962 b), the first record of the genus in the Vienna Basin recorded at all. Knobloch (1962, 1963, 1967a, b, 1969 a, b,1977, 1981) published several basic data on the leaf flora and seeds/fruits from the Pannonian of the Southern Moravia. In taxonomic study he concentrated on the locality Poštorná near Břeclav, which provided richly accumulated leaf materials (Knobloch 1963, Knobloch and Kvaček 1965). Also significant are the floristic studies of Knobloch from the Pannonian beds in Austria (Pannonian Zone E ex Knobloch 1981), from the localities Brunn-Vösendorf, the holostratotype locality of the Pannonian, Neusiedl am See, Ampflwang, Laaerberg (Knobloch 1981, 1985), as well as Hinterschlagen (Knobloch 1977). In more recent times, the macroflora of the Austrian Pannonian localities was thoroughly evaluated by Kovar-Eder (1987, 1988), and the microflora by the Austrian and Hungarian specialists (Draxler, Nagy, Pascher, Zetter 1997).

A brief informational treatment about the Vienna Basin in the territory of the Czech Republic, as to paleontological research and biostratigraphy, were given by Čtyroký and Knobloch (1976), Jiříček (1985 a, b) and also Bůžek, Čtyroký, Fejfar, Konzalová, Kvaček (1988). An overview of fossil flora in Czech terriories as well as the present locality can also be found in the Tertiary monography of Mai (1995).

3 Plant microfossils/palynomorfs assemblage at the locality

The plant microfossils, studied from the carbonaceous clay/clayey seamlet within clay and clastic sediments, were taxonomically treated, as far as it was possible, due to their state of preservation, and were then ecologically/environmentally evaluated (table 3).

A characteristic feature of the whole assemblage of microfossils is their embedding among an abundance of structural body fragments, probably of algal origin (pl. 2, fig. 1, 2), which compose the main organic microcomponent of preparations. Frequently there are also sphaerical algal cysts of aquatic plankton (pl.1, fig. 1-4; pl. 2, fig. 1, 2; pl. 3, fig. 1) . Also present are poorly preserved specimens of colonial algae, rare cuticles (pl. 3, fig. 3), hairs (pl. 4, fig. 1) and, very rarely, xylitic particles (pl.4, fig. 2).
Fungi remains occur as accessory components, represented by the predominance of thick-walled spores, and by the occurrence of thinner spindle teleutospores. Disc shaped perithecia of Microthyriaceae (e.g. pl. 2, fig. 3) also often occur and display at different onthogenic level.
Musci occur extremely rarely. Also Filicinae were encountered in only a few specimens of smooth spores of the Polypodiaceae, as well as a single trilete spore which reminds one of *Acrostichum* (pl. 3, fig. 5, 6), or of secondary perforated/ornamented *Lygodium* spores.
Coniferous and angiosperm pollen are the typical components of the pollen spectrum. Their exines are thin, often folded, not excellently preserved. (Some of them, with respect to their gross morphology, had to be placed in the category of unidentifiable pollen.) Gymnosperm inaperturate pollens comprise the common pollens of the swamp cypress and *Glyptostrobus*, but the pollens of flowering plants points to a more variegated pattern of trees, shrubs and herbacous plants, involving both, land and aquatic specimens.
The microscopic content of the samples from the locality Poštorná had not been thoroughly studied before now, so most of the groups and taxa of identifiable microfossils are new records. Even if the pollen exines are far from being well preservated, the assemblage is of a unique character and allow us to compare its components with the other fossil floristic records from the Pannonian/Pontian deposits in South Moravia, Austria, and Hungary.

4 Systematic part

4.1 Cyanobacteria and Algae

The preparations are often overcrowded with algal remains which dilute the frequency of the preserved sporomorphs.

Cyanophyceae

***Sigmopollis* sp. div.**

Unicellular plankton of a sphaerical shape and smooth surface, 12-16 μm or (more often) 14-16 μm in diameter, sometimes open by a short simple rupture with a straight rim. Mostly thin-walled, under/about 1 μm. The cysts belong to the cyanophytes, or green algae, and are of rather constant size. All the specimens occur loosely spread in the organic, predominantly algal, detritus. Smooth forms are more frequent than the hirsute ones (e.g. *S. pseudosetarius,* which were only rarely recorded).
Occurrence: Relatively frequent in relationship to the pollen.
Remarks: These planktonic forms occur in many places of the Pannonian and Pontian profiles in Hungary, Austria (Höll-Deutsch-Schützen boreholes), Slovenia, and in the other territories. Some of the authors earlier assigned the ornamented (hirsute) forms to the pollen of Nympheaceae.

Chlorophyceae

***Botryococcus braunii* Kütz.**

The size of colonies is about 30 μm.
Occurrence: Rarely preserved. Only single colonies were recorded.

Remarks: Nagy (1992) recorded abundant specimens in several Pontian profiles, for example Várkeszó 1, Gérce 1, and Pula 3. In the profile of Petőfibanya III the occurrence of colonies is only accessory, similar to the presently studied material.

***Pediastrum* sp. div.**
Several different types of *Pediastrum* can be distinguished. The delicate colonies, even though rarely preserved and mostly crumpled, resemble the specimens with a single outgrowth at the peripheral cells. Apart from these, a single quadrate form also occurs, 18 x 20 μm in size.
Occurrence: Single forms are more frequent than colonies. Both types occur among the previous specimens within the algal detritus.
Remarks: *Pediastrum* colonies also occur in the other Pontian sequences, for example, in the Pontian in Hungary (Pula 3), in low frequencies, more as single specimens (Nagy 1992), as at the locality under study.

Zygnemataceae
***Spirogyra* Link**
***Ovoidites* sp. div.**
Smooth aplanospores and/or zygospores of Zygnemataceae, common in the coaly clays, were recorded. Size 60-110 μm. The smooth forms occur more frequently than the rough ones that are assigned to the *Ovoidites ligneolus* (R. Pot.) W. Kr. The latter was recorded only exceptionally.
Occurrence: Along with the above planktonic forms.
Remarks: Specimens with a very wide range in time and space, particularly in the Tertiary. Listed from many Pannonian and Pontian localities in Hungary. Táta 11 (Pannonian), Megyaszó 1 (Pannonian/Pontian), Naszály 1 (Pontian), Alsóvadász 1 (Pontian) boreholes, Petőfibánya III, as well as other sites (Nagy 1992). Also, elsewhere in the territories of the Pannonian Basin (Slovenia, Serbia, Romania a.o.), including the Vienna part of the Basin (Upper Pannonian deposits, lignite sequence of the Torony-Höll-Deutsch-Schützen borehole profiles, at the Austria/Hungary border, Draxler et al. 1997). After summarizing occurrences of *Ovoidites* in the Pontian deposits in Hungary, Nagy (1992) referred them to the accessory elements in the sporo-pollen assemblages. Local occurrences may be slightly different.

Planktonic cysts incertae sedis
Pl. 3, fig. 1
Besides *Ovoidites,* large-sized (55-70 μm) smooth-walled sphaerical aplanospores/zygospores were recorded, isolated as the planktonic components, in rare case found close to the original envelope (pl. 3, fig. 1).

***Mecsekia* spp. – *Crassosphaera concinna* Cookson et Manum - *Pleurozonaria concinna* (in Nagy 1992) – group**
Pl. 1. fig. 1 - *Mecsekia* sp. – *M.* cf. *incrassata* Süto – Szentai
Pl. 1. figs. 2, 3, 4 - *Mecsekia* sp., thin form – *M.* cf. *orientalis* Süto – Szentai
Pl. 1. figs. 5, 6 - *Mecsekia* sp. – *M.* cf. *incrassata* Süto – Szentai
Planktonic cysts of the sphaerical or oval form, 13-16 μm in size diameter, with fine short prominences, granulate-like surface pattern. The cysts sometimes opened by a short simple rupture.
Occurrence: A rather frequent element, dispersed in the spongy-like algal fragments (pl. 2, fig. 1, 2).

Remarks: These plankton group is often listed from the localities of the Pannonian and Pontian in the Pannonian Basin, found in Hungary, as for example from the Alzóvadász 1 (Pannonian/Pontian), Naszály 1 (Pontian), Táta 11 (Pannonian) boreholes, and other places (Nagy 1992).

***Pleurozonaria* sp. – cf. *Pleurozonaria manumi* (Kriv.-Hutter) Rákosi sensu Nagy 1999**
Pl. 1, fig. 7
Fragment of the characteristic disc-shaped ornamented-algal body, displaying ornamentation similar to *P. manumi*, was found in the preparation, at the sealed edge of the cover glass (thus it was impossible to take a microphoto). The wall is 4-5 μm thick, the whole specimen cca 40 μm in diameter.
Another rather compressed specimen with a less distinct pattern on the surface was assigned to *Pleurozonaria* sp. (pl. 1, fig 7). Both specimens fall within the planktonic organisms.
Remarks: Nagy (1999) documented *Pleurozonaria manumi* from the Egerian of Hungary. From the Pannonian profile at the Hungary/Austria border (Torony 71, Nagy in Draxer et al. 1997), the frequency of the *Pleurozonaria* sp. is shown in the diagram.

***Thalassiphora* sp.**
Dinoflagellate cyst, hyaline, with rare, widely spaced granulae on the surface. The whole specimen 74 μm in size, rim 24 μm, central part 26.4 μm.
Occurrence: Two specimens found (one whole body and half of the second specimen), assembled with the above given algae.
Remarks: *Thalassiphora (T. balcanica)* occurs in the planktonic assemblages and horizons, with a predominance of dinoflagellates in the upper part of the Pannonian (as for example in Slovenia, Sütöné Szentai, 1989 ex Nagy 1999).

Dinophyceae - Dinoflagellates
Thin-walled, slightly elongated forms of the apical part, and a slightly developed equatorial ridge were encountered. They are smooth, delicate, with a wrinkled surface. No appendices are developed. Apical and antapical parts are widely narrowed at the poles. Size 25-30 μm.
Occurrence: Two specimens recorded.
Remarks: The specimens found at the locality resemble the dinoflagellates, also occurring in the peat. Dinophyceae equipped with processes occur (sporadically) in the Torony-Höll-Deutsch-Schützen boreholes at the Austria/Hungary border (Dinophyceae, *Spiniferites*, Draxler et al. 1997), at a small relative distance from the locality studied.

Plankton incertae sedis – form F
Slightly brown coloured, spherical vesicle with narrow and low neck at the pole, and two lateral hair-like appendices, pointed by tiny doubled globules. Body size of the 50 μm. The form seems (considering the type of preservation and surface pattern) like a re-deposited one, originally inorganic; but the appendices, which are evidently organic, make the specimen very special.
Occurrence: Only one specimen found.
Remarks: Not recorded/documented up to the present time in comparable palynological assemblages of the Pontian. Redeposition from earlier deposits certainly cannot be excluded.

4.2 Fungi
***Dictyosporites* sp.,**
Pl. 2, fig. 4
***Dyadosporites* sp.**

Pl. 2, Fig. 6
Several types of Fungi, mostly represented by fungal spores, were recorded. They appear as unicell or dyads, sphaerical, thick-walled persistent uniporate spores, up to 25 μm in size, provided with a wall about 3 μm thick, occurring along the thin-walled spores. Beside them, large-sized spindle forms (20 μm in size), and small sized (about 10 μm) spindle-shaped teleutospores occur. Fungous hyphae are rare, fruiting bodies are more frequent. Among them, Microthyriaceae display several types.

Microthyriaceae
Pl. 2. fig. 3, Pl. 2. figs. 7, 8
The fruiting bodies prevailingly of Microthyriaceae are predominantly preserved as fragments, rarely as the whole epithecia. Two types have been distinguished among them. Epithecia with very narrow (3 μm) radially arranged, densely packed cells (Pl. 2, fig. 7, 8); and bodies which display radial cells significantly broader (5-8 μm), and also broad septa, irregularly arranged within the disc (Pl. 2, fig. 3). The last type may be compared with *Paramicrothallites* sp. Different onthogenic stadia of fruiting bodies are preserved.
Occurrence. Rather frequent.

4.3 Musci
***Triletes* sp.**
Only one very small (12 μm), trilete spore with a stiff triangular amb has been recorded.
Remarks: The specimen differs from Sphagnaceae.

cf. *Sphagnum* – *Stereisporites buchenauensis* W. Kr.
Sphagnum -habitus spore with cca 5-6 μm wide rim; full size 28 μm.
Occurrence: One specimen.

4.4 Filicinae - Ferns
Polypodiaceae - *Laevigatosporites haardti* (R. Pot. et Ven.) Th. et Pf., *Laevigatosporites gracilis* Wilson et Webster, *Laevigatosporites discordatus* Pf.
Smooth spores (21-30 μm, 30-35 μm), without exospores, or only rarely with it. *L. haardti* is usually very common in the Neogene basins, but at the locality examined, only isolated specimens of the *haardti*-type and *L. gracilis* were recorded; more frequent are thin-walled spores of the *discordatus*-type, about 50 μm in size.
Remarks: Polypodiaceae are an edaphic controlled element and mostly mentioned as a group from different places and lithofacies of the Pannonian area; from the Pontian of the Pannonian Basin in Serbia, and many other places, including: the core profiles of the Pontian in Hungary (Pula 3, Naszály 1 in northern Hungary, Megyaszó 1 and elsewhere, Nagy 1992), and also the Torony-Höll-Deutsch-Schützen profiles (Draxler et al. 1997) at Austria/Hungary border.

?? *Acrostichum* vel cf. *Lygodium* - *Leiotriletes* sp.
Pl. 3, figs. 5, 6
Trilete spore, amb triangular with slightly convex sides, triradiate scar of divised arms at their ends, arms reaching up to 4/5 of the spore radius. Exospore corroded or perforated by tiny pores and foveolae. Spore wall 0.6 μm thick, diameter of spore 36 μm. Because of the thin wall and possibly corrosion of the spore surface, the assignment to the *Acrostichum* is ambiguous and the types of *Lygodium* may be the more probable. The exospore pattern can be a residue of the original ornamentation or a secondary feature.
Occurrence: One specimen only.

Remarks: In the Höll-Deutsch-Schützen boreholes in Austria, Vienna Basin, the *Leiotriletes* spores was recorded in the Upper Pannonian (lignite sequence) deposits and assigned to ?*Lygodium*. *Leiotriletes (L. wolffi)* was recorded in the Torony 71 (Torony-Ják area), in the analogical lignite sequence in Hungary (Nagy in Draxler et al. 1997). Further finds of *Leiotriletes* spores occur e.g. in the Pontian of the Naszály 1 borehole profile (*L. miocaenicus* Nagy, which differs by the absence of a division of the trilete scar).

Azollaceae - *Azolla* sp.
Remains of the massula with attached thin-walled, two-celled glochidium with a deformed (?) anchor-like tip. (The tip is damaged or primarily closed by an (?)asterisk-like disk which may be the result from an originally deformed anchored tip).
Occurrence: One specimen recorded. From the adjacent territories, *Azolla* has been recorded in the Torony 71 borehole profiles (Torony- Höll-Deutsch-Schützen in Austria, Draxler et al. 1997) at the Austria/Hungary border.

Azollaceae and Salviniaceae
Pl. 3, fig. 2
Fragments of microsporangial tissues, sometimes with well recognizable spaces (obviously after embedding microspores), were recorded. The diameter of the spaces (about 16 μm) points toward *Salvinia* microspores (pl. 3, fig. 2), rather than to the smaller ones of *Azolla*.
Occurrence: Any ferns at all, including hydrophytic specimens have been unknown from the studied locality. The remains of the *Salvinia reussi* Ett. were only recorded by Knobloch (1985) at Mistřín (Pannonian Zone C after mollusks) in South Moravia.

4.5 Gymnospermae - Conifers
Taxodiaceae and Cupressaceae
inclusive *Glyptostrobus* - *Inaperturopollenites concedipites* (Wodeh.)W. Kr., *I. dubius* (R. Pot. et Ven.) Th. et Pf., *I. hiatus* (R. Pot.) Th. et Pf., *Cupressacites sp. div.*
***Inaperturopollenites hiatus* (R. Pot.) Th. et Pf.**
Pl. 4, fig. 4
Conifers are represented by Taxodiaceae - Cupressaceae inaperturate pollen, comprising *Glyptostrobus,* swamp cypress and probably *Cephalotaxus* among *Cupressacites* pollen.
Occurrence: The group of the inaperturate pollen, including *Glyptostrobus* and swamp cypress occurs relatively often (compared to the other pollens).
Remarks: Pollen of the Taxodiaceae and Cupressaceae frequently occur in the Pannonian/Pontian coal-bearing sequences. In Hungary (Nagy 1985, 1992), they are: the second most frequent group within coniferous pollen in the Pontian profile at Pula 3, and Hidas 53; a constituent element of lignites (in coal-forming swamp association *Taxodiaceae-Nyssa, Coniferae*) in Petőfibanya (southern foreland of the Mátra Mts.); as well an occurrence in the Pontian of the Alsóvadász 1 borehole profile; and, they dominate in the Höll-Deutsch-Schützen-Bildein profiles in Austria, as well as in the lower portion of the Torony 71 profile in Hungary, in the Upper Pannonian at the Austrian/Hungary border (Draxler et al. 1997). *Taxodium*-pollen are mentioned by Pantić et Dulić (1993) from the Pontian of the Pannonian Basin in Serbia (north-eastern part) and inaperturate pollen of conifers have been recorded in many other sites in the Pannonian Basin. Also numerous, are *Glyptostrobus* macroremains (cones, twigs, seeds, outgrowths). They occur in the lignite complex at Dubňany (text-fig. 3; Knobloch 1963) and in the other lignitic seamlets and carbonaceous clays within the Pannonian and Pontian deposits in South Moravia (text-fig. 3). *Glyptostrobus* twigs at Ořechov 108 (Pannonian Zone B after mollusks), cones at Uherské Hradiště in the UH 16 borehole (Pannonian Zone B), and seeds in UH 18 (Pannonian Zone C after mollusks,

Čtyroký et Knobloch 1976). The presently studied locality is known for being rich in *Glyptostrobus europaeus* (Brongn.) Ung. remains (Bůžek 1960, 1962 a,b, Knobloch 1963). The twigs of *G. europaeus*, mentioned by Knobloch (1979) also occurred at Poštorná, and from the Pannonian deposits in Austria at Neusiedl am See (Burgerland). Another conifer, *Cephalotaxus* cf. *furtunei* Hook, which may be involved among *Cupressacites*-pollen, occur in macroremains at Brunn-Vösendorf (Berger 1952, 1955b in Knobloch 1985).

***Sequoiapollenites polyformosus* Thierg.**
Small-sized pollen, 22 μm in diameter with ligula 2.4-3.6 μm high. The formspecies, distinguished as early as in the thirties of the last century, has been recorded in many sites in Central Europe, in rich local occurrences (e.g. in the Subsudetic coal Formation in N. Moravia).
Occurrence: As an accessory, very rare element in the pollen assemblage studied.
Remarks: *Sequoiapollenites polyformosus* and *Sequoioxylon gypsaceum* (Goepp.) Greguss are documented in a co-occurrence from the Upper Pannonian lignite complex at Visonta in northern Hungary (Pálfalvy et Rákosi 1979), *Sequoia*-pollen in the coal-bearing beds in northern Croatia, in the southern part of the Pannonian Basin (Pantić 1989), and elsewhere. Macroremains of the (?)*Sequoia langsdorfii* (Bgt.) Heer were recorded by Berger (ex Knobloch 1985) in Brunn-Vösendorf (Pannonian zone E), and by Knobloch (1963) at Moravská Nová Ves (SW of Hodonín) in S. Moravia. The needle of *Sequoia abietina* (Brogn. in Cuv.) Knobloch was referred from Neusiedl am See (Knobloch 1979).

***Tsuga* – *Tsuga diversifolia* – type, *Zonalapollenites* cf. *igniculus* (R. Pot.) Th. et Pf.**
Pl. 4, fig. 7
Pollen with a collar about 6-7 μm wide. Diameter of the pollen 48 - 55 μm. Spinae (at magnification x 400) not well discernible, but as tiny low spines and cones are present.
Occurrence: One specimen. As an accessory component among the other conifers.
Remarks: Pollen of *Tsuga* occurs in the Pontian in Hungary, also as an accessory element among the other conifer pollen (e.g. Pula 3, Alsóvadás 1, Nagy 1992), and also at many other places in the Pannonian deposits in Hungary, Slovakia, former Yugoslavia, and Rumania (Nagy et Planderová 1985, Nagy 1999). From the Upper Pannonian at the Austria/Hungary border *Tsuga* is quoted from the Torony 71 profile (Torony-Höll-Deutsch-Schützen-Bildein boreholes, Nagy in Draxler et al. 1997), and documented from the Pontian of the Dacian Basin in Serbia by Pantić et Dulić (1993).

***Sciadopitys* - *Sciadopityspollenites verticillatiformis* (Zauer) W.Kr.**
Pollen with a narrow rim, coarse ornamentation composed of small-sized verrucae and baculae, densely packed, well visible, not coalescing. Pollen split into two halves. Diameter of pollen 30-45 μm.
Occurrence. One or two specimens.
Remarks. In the adjacent territories, *Sciadopitys* pollen occur in the Pannonian and Pontian deposits in Austria, Hungary (Pápa 2, Táta TVG 26), and Slovakia (Draxler et al 1997, Nagy and Planderová 1985, Nagy 1999) as an accessory element only.

Pinaceae
cf. *Cathaya* - *Pinus microalatus* – type
Pl. 4, fig. 3
Pinaceous pollen, most probably derived from *Cathaya*. They are 46.4 - 52.4 μm in diameter (whole grains), and display *haploxylon*-type bladders, 38 μm high at the central body, and tiny ?conical/granular sculpture on their surface, usually already observable in the LM. Size

of the sphaerical central body is cca 34 x 40 μm, sacci in the central part are 20 μm broad/deep. The pollen shows morphological features close to *Cathaya argyrophylla* Chun et Kuang and *Cathaya* type, from the Austrian deposits.
Occurrence: Several specimens of this type.
Remarks: *Cathaya* pollen described Nagy (1985 p. 40-41, p.134) from the Upper Pannonian silt (Pula 3 borehole, depth 13.5-14 m) from Hungary as *Cathaya pulaënsis* Nagy. Our specimens differ in the smaller size of the whole grains, and bigger central body of equal size to the hemisphaerical bladders. This type is more comparable with *Cathaya*-pollen of *C. argyrophylla*-type in both size and bladder attachments.
Further occurrences of *Cathaya* sp.- pollens are given from the Höll-Deutsch-Schützen 2 borehole profiles (relatively high frequency) in Austria and Torony 71 in Hungary (Torony-Höll-Deutsch-Schützen-Bildein boreholes, Draxler et al.1997). The genus is also mentioned in pollen from the Pontian of Serbia (Pantić et Dulić 1993).

***Pinus* – *Pityosporites* spp., *Pityosporites microinsignis* W. Kr., *Pinuspollenites minutus* (Zakl.) Nagy - small sized pollen group**
Pl. 5, figs. 1, 2 – Pinaceae, *Pinus*- small-sized pollen group
Small-sized bisaccate pollen with rounded bladders, in a different size relation to the central body; delicate exine and different infrastructure of the bladders were distinguished and differentiated within the other Pinaceae/*Pinus* pollen. They are 24-(36)-40 μm whole size and fall partly within the group of the smallest pinaceous pollen assigned here as *Pityosporites* spp., and partly to the *Pityosporites microinsignis* and *Pinuspolenites minutus.* The specimens which display circular or deltoidal central body (CB), with larger sacci overlapping CB, may be close to *Cathaya pulaënsis*-type sensu Nagy (1985), but display considerably lesser dimensions that make them only comparable to the specimen documented from the Miocene deposits of Jaroszów in Poland (Stuchlik 2002, p.18, Pl.18, 5 a,b; 40 μm in size). The exine of our comparable specimen is thin with tiny ?conical/granular ornamentation readily observable at a magnification of x 400 (LM), but the pattern is ambiguous, because it was not, (as it had been with *C. pulaënsis*), proven by SEM.
Occurrence: 3 specimens of the above types in one slide, of all the sporomorphs.

***Pinus* sp.div.- *Pinus silvestris* type - *Pinuspollenites labdacus* (R.Pot.) Raatz ex R. Pot., *Pinuspollenites* sp.**
Pl. 5, figs. 3, 4 - ***Pinus silvestris* type**
Besides small-sized pollen, predominantly of *Pinus*-type, the *Pinus* of the Subgenera *Haploxylon* and *Diploxylon* were recorded.
Occurrence: *Pinus*- and Pinaceae- pollen are frequent but not abundant and subordinated in occurrence to the *Taxodiaceae-Cupressaceae* pollen. Some of the *Pinus* exine display only characteristic gross morphology but the infrastructural features are no more discernible, probably due to unfavourable environment and fossilization process. Another exines display casts after pyrite framboids or "nests" of ferric hydroxides (Pl. 4, Fig. 5, 6).
Remarks: A continuous occurrence displays *Pinus labdacus*-type from the Pontian profiles (Pula 3 borehole) in Hungary, where the conifers with saccate pollen predominate in the assemblage (Nagy 1992). *Pinus*-pollen also occurs abundantly in the Torony 71 borehole in Hungary and Höll-Deutsch-Schützen 2 in Austria, at the border area with Hungary (Draxler et al. 1997); in the Pannonian in Hungary at Alsóvadász 1, Megyaszó 1, Naszály and other sites; very abundantly at Pápa 2 and Hidas 53; with further occurrences mentioned from Slovakia (Nagy and Planderová 1985) and elsewhere from the Pannonian Basin. Pantić and Dulić (1992) set *Pinus* among the frequently occurring conifers in the Pontian deposits from Serbia, there assemblaged with *Abies*, *Picea* and *Cedrus.* Macrofossils of pine (*Pinus sp.*) are known

from South Moravia and have been listed from the Pannonian at Dubňany, Moravská Nová Ves (Knobloch 1963), close to the presently studied locality (text.-fig. 3). *Pinus* needles (5.5 cm long, two in a bundle) were identified and documented by Knobloch (Čtyroký et Knobloch 1976) from the deposits at Ořechov 108 (Pannonian zone B after mollusks) in S. Moravia.

***Cedrus* - *Cedripites* sp. B "aff. *densireticulatus* Zauer" sensu Krutzsch, *Cedripites* cf. *miocaenicus* W. Kr.**

Cedripites sp. B belongs to large-sized bisaccate pollen, 65-85 µm long, with bladders shorter than the central body, and exine layer with densely spaced alveolar structure.

Occurrence: Single finds (sp.B), *C.* cf. *miocaenicus* recorded in several specimens.

Remarks. *Cedripites* sp.B (sensu Krutzsch 1971) is the closest morphotype to the large-sized pollen with densely arranged alveolar infrastructure and a typical cedroid outline. It is not a common form, whereas others *Cedripites* pollen, *Cedripites* sp.div. occur throughout the Pontian. The occurrences at Alsóvadász 1, Naszály 1, and Pula 3 in Hungary (Nagy 1992) may be mentioned. Low frequencies of pollen (*Cedrus* sp.) are demonstrated by Draxler at al. (1997) from the Upper Pannonian boreholes at the border area in Austria (Höll-Deutsch-Schützen 2), and Hungary (Torony 71). Pantić et Dulić (1993) and Nagy (1999) referred to *Cedrus*-pollen as an element frequently present in the southern territories of the Pannonian Basin.

cf. *Abies* – cf. *Abiespollenites* sp.

Pollen of the size of the whole grain 60 µm, sacci 36.5 µm wide, 21.6 µm deep. The absence of crest and the less size differs the specimen from the species *Abiespollenites microsaccoides* W. Kr. and *A. latisaccatus* (Trev.) W. Kr.

Occurence. Single occurrence.

Remarks. *Abies* sp. occurs in the Upper Pannonian sequences in Austria (boreholes Höll-Deutsch-Schützen 2) and analogical borehole Torony 71 in Hungary, in the Pontian at Pula (Nagy 1992), *Abiespollenites sivaki* Nagy, *Abiespollenites absolutus* Thierg. documented Nagy (1999) from the Pontian in Western Hungary.

***Keteleeria – dubius*- type**

Along with *Abies* occurs large-sized pollen of *Keteleeria.*

Occurrence. Two specimens

Remarks. Draxler et al. (1997) involve *Keteleeria* pollen in the diagrams from the Höll-Deutsch-Schützen 2 and Torony 71 boreholes, in the low frequencies which are corresponding to the occurrence at the studied locality.

4.6 Angiosperms - Flowering Plants

4.6.1 Dicotyledones

Juglandaceae –*Momipites punctatus* (R. Pot.) Nagy

Flexibile exines of triporate pollen 20-25 µm in size, were encountered in the assemblage of angiosperm pollen.

Occurrence: Two or three specimens, in one slide.

Remarks: Nagy (1992) recorded these pollen in the Pontian deposits of the Mecsek Mts., listed them from the Pannonian of the Megyaszó 1 borehole and the Pontian deposits overlying the Pannonian at Alsóvadász 1, Naszály 1 borehole profiles.

Carya
Recorded specimens lack solution area, and agree in size (about 28 μm) and morphology with the smaller type of *Carya* pollen.
Occurrence: Rare. Three specimens encountered.
Remarks: *Carya* pollen occurs in the Pannonian and Pontian profiles in Hungary (Nagy 1995,1992, Nagy in Draxler et al.1997), in Austria, at the Höll-Deutsch-Schützen 2 borehole profiles (Draxler et al.1997), Slovakia (Nagy et Planderová 1985), in the Pontian of the Dacian Basin in eastern Serbia, and elsewhere. Our specimens are comparable in morphology with the pollen grains of *Carya* from both the Pontian in Hungary (Nagy 1999) and Dacian Basin (Pantić et Dulić 1993), but display rather thinner exine in comparison with the last one. Leaves of *Carya serraefolia* and cf. *C. bilinica* were found at Laaerberg in Austria (Berg 1955a ex Knobloch 1985).

***Engelhardia – Engelhardtioidites microcoryphaeus* (R. Pot.) R. Pot.**
Engelhardia* vel *Platycarya
Pl. 7, fig. 3
Triporate pollen of triangular outline, size 14-16 μm, diameter of pores about 2 μm, exine about 1μm thick.
Occurrence: Rare. Only one or two specimens found in the assemblage.
Remarks: *Engelhardia* was recorded in pollen from many places of the Pannonian and Pontian deposits in Hungary: Pannonian, Pápa 2 borehole, Pontian, e.g. Petőfibanya III, Hidas 53 borehole (Nagy 1992); further in the Upper Pannonian in the Höll-Deutsch-Schützen 2 boreholes in Austria (Draxler et al.1997), in low or medium frequencies. More frequently occurs southward (Pantić et Dulić 1993, p. 182). Macroremains of the *Engelhardia* were identified by Knobloch (1978) from S. Moravia, at Moravská Nová Ves near Břeclav, close to the presently studied locality, and in the leaf impression, *E. detecta* Sap., from the Pannonian at Neusiedl am See in Burgenland, Austria (Knobloch 1978). Hably (2001) referred to *Engelhardia* from the Rudabánya in Hungary and pointed to its disappearing during the Pontian.

***Platycarya - Platycaryapollis* W. Kr.**
Pollen 15-16μm in size, with typical thickenings of exine.
Occurrence: Single find.
Remarks: *Platycarya* pollen is a significant and rare element in the Pannonian and Pontian floras in the area studied. It disappears in the Central Europe during the Pliocene (Mai 1995). Its occurrence at the locality studied is the only record of the genus.

Salicaceae
Salix
Small-sized oval pollen, 14.4-15 μm x 9.6-10 μm, with distinct reticulation. Muri/baculae 0.5 μm high.
Occurrence. Only two specimens recorded.
Remarks: Pollens occurred in the Upper Pannonian profiles Torony- Höll-Deutsch-Schützen-Bildein profiles (Draxler et al. 1997) and at many Pannonian/Pontian localities in Hungary. The remains of *Salix*, *S. moravica* described Knobloch (1969) from S. Moravia and leaves of *Salix* cf. *moravica* Knobloch (imprint of the leaf), from Neusiedl am See in Austria (Knobloch 1978).

Betulaceae

Betula

Pollen about 20μm in size.

Occurrence: Only one specimen recorded.

Remarks: *Betula* pollens occur in the Pannonian assemblages and locally are abundant in the Pontian (Hidas 53, Naszály 1 boreholes in Hungary). But they display mostly a scattered occurrences: Pula 3, Megyaszó 1, Alsóvadász 1 borehole profiles (Nagy 1992). Macroremains of *Betula* sp. occur in the Pannonian at Neusiedl am See (Knobloch 1978), Brunn-Vösendorf (Knobloch 1985), *Betula prisca* Ett., *B. macrophylla* (Göpp.) Heer and *Betula* sp. at Laaerberg (Berger 1955a ex Knobloch 1985) in Austria.

***Alnus* – *Alnipollenites verus* (R. Pot.) R. Pot.**

Pl. 3., fig. 7

Only pollen with four pores were recorded. They are small-sized, about 16-19 μm in diameter, with arci often weakly developed. Exine thin, pori not prominent.

Occurrence: In relation to the other pollen flora often, but not abundant.

Remarks: *Alnus* pollens range throughout the Pannonian, Pontian and are locally very abundant (for example Petőfibanya III, Pontian, lower portion of the Pontian, Pula 3 borehole, Nagy 1992; Torony 71, lignite sequence, Upper Pannonian, Nagy in Draxler et al. 1997), in the Höll-Deutsch-Schützen-Bildein boreholes at the Austria/Hungary border (Draxler et al. 1997) and occur in many, fast all profiles of these time sequences in Hungary, Slovakia, Croatia, Serbia and many other places, as a common element of the azonal/intrazonal vegetation. *Alnus cecropiifolia* (Knobloch 1963) is abundantly present at the studied locality Poštorná. Striking, is the co-occurrence of the four-porous types of pollen along with the macrofossils of Alnus. Further, the species, *A. ducalis* is known from the Pannonian at Moravská Nová Ves, in the vicinity of Břeclav, and also at Laaerberg in Austria (Knobloch 1985), Neusiedl am See (Knobloch 1978) and at other places. Both *Alnus* species taxonomy, of the *A. cecropiifolia* and *A. ducalis* is discussed by Kovar-Eder (1988).

cf. *Carpinus*

Size about 25 μm.

Occurrence: Only one badly preserved specimen was recorded.

Remarks: Pollens of the *Carpinus* range through the whole Pontian. They were recorded in many places in Hungary (e.g. Alsóvadász 1, Pula 3 – abundant), in the Torony 1 and in the Höll-Deutsch-Schützen 2 boreholes at the Hungary/Austria border (Draxler et al. 1997).

Leaves, involucres of *Carpinus* are referred by Knobloch (1978) from the Pannonian at Neusiedl am See in Burgenland, *Carpinus grandis* Ung. (Berger 1952, 1955 ex Knobloch 1985) from Brunn-Vösendorf (Austria).

Fagaceae

Quercus

Several different types of medium-sized *Quercus* pollen were distinguished. One group, morphologically well correlable, is analogical to the *Quercus* records from the borehole profiles Torony-Höll-Deutsch-Schützen-Bildein *(Quercus* sp.1, 2, 3, 5), documented by Zetter (in Draxler et al. 1997). The second group points to the rather granulate/verrucate forms (*Quercus* sp. 4, Zetter ibid.) and is +- related to the *Quercopollenites granulatus* Nagy (1969 ex 1985).

Occurrence: Mostly one specimen of one type.

Remarks: Nagy (1962) documented *Quercus*-pollen from the Pontian, borehole Hidas 53 (depth 147.5-148.5 m), another type, *Quercopollenites petrea* from the borehole Pula 3 in

Hungary. Leaves of *Quercus parlatorii* Gaud., *Q. neriifolia* A. Br., *Q. kubinyi* (Kov.) Berger and others are known from the Pannonian deposits (in Knobloch 1985).

cf. *Quercus* or *Eotrigonobalanus*
Pl. 6, fig. 2
Fagoide cingulate(?) pollen with fossulate/rugulate exine pattern. Pollen about 30 μm in size in polar axes, exine 1.5 μm thick.
Occurrence. One specimen recorded.
Remarks: After gross morphology and exine pattern, the relationship with the Fagoideae, Querceae - *Trigonobalanus* can be considered but should be necessary to prove it by the more detailed morphological study (SEM). At present, the *Eotrigonobalanus* (Walther and Zetter 1993) may be taken for preliminarily comparison.

Fagus
Pl. 6, figs. 7, 8
Spheroidal exine 45 x 40 μm in size, tectum displays low dense ornamentation (observed in LM).
Occurrence. Only one specimen recorded.
Remarks: The pollen is close to *Fagus* from the Polish Lowland (Middle Miocene), Oczkowice borehole (Ziembińska 1974, Pl. XXIII, 9a-c, *Faguspollenites verus* Raatz), from SW Poland, where the form occurs frequently also in the Upper Miocene (ibid.). *Fagus*-pollens were recorded by Nagy (1985, 1999) in the Pannonian and Pontian in Hungary and also in the borehole profiles Höll-Deutsch-Schützen 2 and Torony 71 (Draxler et al.1997). *Fagus* pollens are known also from the Dacian Basin in eastern Serbia (Pantić and Dulić 1993).
Leaves of *Fagus* were identified from many localities. Knobloch (1968,1985) mentioned *Fagus* from S. Moravia, *Fagus pliocaenica* Sap.- *Fagus haidingeri* Kov. from the Pannonian at Laaerberg in Austria (Knobloch 1985 ex Berger 1955a).

Castanea
Tricolporate pollen of oval shape, 12 μm in size.
Occurrence. 2 specimens.
Remarks. Nagy (1985,1992) recorded *Castanea* pollen (*oviformis* –type) and demonstated its single occurrences in the Pannonian/ Pontian deposits in Hungary (Nagy 1992). *Castanea* sp. occurs also in the Torony-Höll-Deutsch-Schützen profiles (Draxler et al. 1997). Leaves of *Castanea* were collected in S. Moravia: Dubňany-Ratíškovice area at Hodonín (Knobloch 1962), from the overlaying clays of the lignites at Ořechov and boreholes from the vicinity of Ořechov (UH 19, Pannonian, probably Zone B, in the cooccurrence with the leaves of *Byttneriophyllum tiliaefolium,* and UH 21, Pannonian Zone B, after Čtyroký et Knobloch 1976, Pannonian zones B and C). Further finds are given by Knobloch (1985) from Mistřín (*Castanea* cf. *atavia* Ung., Pannonian Zone C) and Austrian Pannonian localities, Brunn-Vösendorf (Berger 1952, 1955b in Knobloch 1985).

aff. *Trigonobalanopsis*
The tricolporate pollen, in gross morphology close to the specimen described as *Trigonobalanopsis* by Zetter (Walther et Zetter 1993, Zetter in Meller et al. 1999).
Occurrence. Two specimens.
Remarks. *Trigonobalanopsis* has been announced neither from the presently studied locality nor from the other Pannonian/ Pontian profiles in Moravia, studied earlier.

Ulmaceae

***Ulmipollenites undulosus* Wolff, *Ulmipollenites stillatus* Nagy**

Pl. 3, fig. 8, pl. 5, fig. 7 (*Ulmus, ?Planera*)

Mostly four-porous pollen encountered. Pollens with rugulate - corrugate ornamentation, irregular arranged, with low ridges are assignable to the *Ulmipollenites undulosus* Wolff, whereas pollen with very irregular low rugulate and tiny verrucate ornamentation are close to the *Ulmipollenites stillatus* Nagy, which may point to relation to *Ulmus carpinifolia*.

Occurrence: In relation to the other pollen frequent, about 3 specimens in one slide.

Remarks. Pollen of Ulmaceae occur in many boreholes of the Pannonian and Pontian in Hungary (Nagy 1969, 1985, 1992, 1999), Slovakia (Nagy et Planderová 1985), at the Austria/Hungary border profiles (Draxler et al. 1997) and many other places. *Ulmipollenites* is documented from the Pontian of the borehole Naszály 1 (Nagy 1985), high frequencies in the Pula 3 borehole. Macrofossils of the *Ulmus pyramidalis* Goepp. were identified in the Pannonian at Neusiedl am See (Knobloch 1978, /here also *Ulmus carpinoides* Goepp. is mentioned/), *Ulmus plurinervia* Ung., *U. longifolia* Ung. occur at Laaerberg (Berger 1955a in Knobloch 1985) in Austria, *Ulmus carpinoides* Goepp., *U. longifolia* Ung. occured in Moravská Nová Ves (in the vicinity of Hodonín,text-fig. 3; Pannonian Zone E, Knobloch 1963).

cf. *Zelkova – Zelkovaepollenites* sp.

Pl. 5, figs. 5, 6, 8

Four-, and rarely five-porous pollen regularly shaped, were encountered. Size 24-28 μm, exine rugulate (five-porous exemplar) to verrucate. Ornamentation about 1,5-2 μm high.

Occurrence: Along with *Ulmus* and of similar frequency.

Remarks: *Ulmus* and *Zelkova* are common in the Pannonian and Pontian pollen spectra. For example: Pula 3, Megyaszó 1, Torony 71 boreholes in Hungary (Nagy 1985, 1992, Nagy in Draxler et al. 1997), Höll-Deutsch-Schützen 2 borehole profiles in Austria (Draxler et al.1997), Pontian of the Pannonian Basin in Serbia (Pantić and Dulić 1993) and in many other territories. Knobloch (1985) mentioned *Zelkova* and *Glyptostrobus* as the two most frequent elements in the leaf assemblage of the holostratotype locality Brunn-Vösendorf (Pannonian Zone E) in Austria. *Zelkova zelkovaefolia* (Ung.) Bůžek et Kotlaba occurred at Neusiedl am See in Austria (Pannonian, Knobloch 1978) and at Mistřín (text-fig.3; Pannonian Zone C), in the Moravian part of the Vienna Basin; *Zelkova ungeri* (Ett.) Kov. occurs at Laaerberg (Pannonian Zone E) in Austria (Knobloch 1985).

***Celtis* - *Celtipollenites komloensis* Nagy**

Pl 6, fig. 1

Oval to sphaerical pollen of irregularly circular outline, smooth exine (LM observed at the magnification x 400), with oval pores, rarely spaced on the exine. Diameter of the observed pollen range between 32 - 36 μm, diameter of oval pores 4-7 μm. Along with the smooth pollen fine granulate occur.

Occurrence: In relation to the other pollen of foliated trees, *Celtis* is frequent element of deciduous trees.

Remarks: *Celtis* pollens are common in the Pannonian and Pontian of Hungary (Nagy 1985, 1992), from the Pontian respectively. Boreholes in the forelands of the Mecsek Mts., of the Bakony Mts., and in the northern Transdanubia can be mentioned (Hidas 53, Pápa 2, Naszály 1, Pula 3). In Hungary also, *Celtis* pollens locally display higher frequencies (Pula 3). They also occur in the borehole profiles at the Austria/Hungary border (Draxler et al 1997). Fossil macroremains, comparable with *Celtis occidentalis* were described as *Celtis occidentaloides* by Eder-Kovar (1988).

Polygonaceae

***Polygonum sp.- Persicarioipollis* sp.**

Reticulate pollen 29 μm in size, diameter of the reticulum meshes 3-4 μm. The recorded specimen is close to *Persicarioipollis. welzowense* W. Kr.

Occurrence: One and half of the second specimen encountered.

Remarks: *Persicarioipollis / Polygonum* is documented (LM, SEM) from the Upper Pannonian (lignite sequence) in Austria by Zetter (in Draxler et al.1997), from the Torony-Höll-Deutsch-Schützen-Bildein borehole profiles.To the *Persicarioipollis*-type are referred pollens from many localities in Hungary (Nagy 1985, 1992) e.g. Naszály 1 (Pontian, depth 60-66 m), Tata (mapping borehole 26), Köbánya brickyard; Petöfibanya III in N. Hungary (Pálfalvy et Rákosi 1979*)* and others. Worthy is the presence of the genus in the seeds. *Polygonum* aff. *reticulatum* Dorof. recorded Knobloch (ex 1985) at Mistřín (Pannonian Zone C) in S. Moravia.

Chenopodiaceae

***Chenopodipollis multiplex* (Weyl.et Pf.) W. Kr.**

Periporate pollen, medium-sized, 24 μm in diameter.

Occurrence: Only one specimen recorded.

Remarks: Chenopodiaceae-pollen are documented from the Upper Pannonian, Torony-Höll-Deutsch-Schützen-Bildein borehole profiles at the Austria/Hungary border (abundant in the lower portion of the profile Höll-Deutsch-Schützen 2), from the Pannonian and particularly Pontian in Hungary (e.g. Naszály 1 borehole, Nagy 1992), and from many other sites of the Pannonian area, as environmentaly controlled element.

Magnoliaceae

cf. *Magnolia* - cf. *Magnolipollis neogenicus* W. Kr. subsp. *minor* W. Kr.

Pollen about 38 x 20 μm, oval, smooth or slightly rugulate (LM).

Occurrence: Only two specimens recorded.

Remarks. Nagy points to the occurrence of *Magnolia*-pollen in the Upper Miocene in Hungary, but our specimens differ from the taxon assigned to *Magnoliaepollenites* sensu Nagy (1985). *Magnolipollis neogenicus* subsp. *minor* is close to the recorded specimens; it ranges in the Central European Tertiary from the Rupelian to the Pliocene. A seed of *Magnolia* sp. Knobloch identified (ex Knobloch 1985) from the Pannonian Zone C at Mistřín(text-fig. 3) in S. Moravia. (*Magnolia* leaves, assigned earlier to the *Papilionaceo-phyllum* were recognized in the Pannonian in Rumania, Kvaček 1979.)

cf. *Liriodendron* - *Liriodendroipollis semiverrucatus* W. Kr. subsp. *minor* W. Kr. vel *L. verrucatus* W. Kr.

Monosulcate pollen, 66 x 25 μm, with rarely dispersed broad verrucae 3 μm in size. Exine rather thin, only about 1μm. *L. semiverrucatus* subsp. *minor* or *L. verrucatus* may be considered as the closest morpho-species.

Occurrence: Only one specimen recorded.

Remarks: *Liriodendron procaccinii* Unger is known from the holostratotype locality of the Pannonian at Brunn-Vösendorf in Austria (Berger 1952, 1955 ex Knobloch 1985).

Hamamelidaceae – *Parrotia-type*

Pl. 6, figs. 5, 6

Tricolporate/tricolporoidate pollen of oval outline, polar axis 26.4-30 μm long, exine provided with distincly reticulate pattern.

Occurrence. More than two specimens in one preparation.

Remarks: *Parrotia* is often associated with *Ulmus, Zelkova, Salix, Liquidambar* in wetland and riparian forest (Brunn-Vösendorf, Knobloch 1985); *Parrotia* leaves (*P. persica* (D.C.) C.A. Meyer) occur in the Upper Miocene deposits most frequently (Mai 1995).

***Liquidambar – Periporopollenites stigmosus* (R. Pot.) Th. et Pf., *Liquidambarpollenites styraciflua* Nagy**
Pl. 3, fig. 4
Diameter of pollen grains about 36-45 µm, diameter of foramina about 8 µm, thickness of exine 0.6 µm.
Occurrence. Three specimens recorded, at different preservation.
Remarks. *Liquidambar*-pollen occurs as an accessory element of the Pannonian/Pontian at the most of the localities of the adjacent territories. For example in the Upper Pannonian at the Hungary/Austria border, in the Pontian of the Petöfibanya in Hungary, coal-bearing strata of the Pontian in northern Croatia (Pantić 1989) and many other places. Macroremains of the *Liquidambar europaeum* Al. Br.occur at Moravská Nová Ves near Břeclav, S. Moravia (Knobloch 1969), at Neusiedl am See, Burgenland (Knobloch 1978), at Brunn-Vösendorf (Pannonian Zone E) and Laaerberg in Austria (Berger 1955 ex Knobloch 1985, Kovar 1988), in the Pontian deposits in Hungary (Hably 2001) and elsewhere

cf. Rosaceae – *Rubus*? - type
Pl. 7, fig. 4
Oblate tricolporate pollen, cca 35 µm x 28 µm, colpi short, pori slightly protruding at the equator. Pattern of tectum granulate/ scabrate (observed in LM), the exine between 1.5-2 µm thick.
Occurrence: One specimen recorded. An accessoric element.
Remarks. This type of pollen was preliminarily compared with Fagoideae, Querceae, but on the basis of equatorially protruding germinalia (for example *Rosa microcarpa* Lindl., Fuhsiung Wang et al.1995), the Rosaceae family was taken into account. The thick exine, scabrate tectum (provided with parallel and +- tangled striate ornamentation in SEM, ibid. and Zetter 1998) and occasionally protruding pori, display some taxa of Rosaceae, as *Rubus*- and *Prunus*-types (*Rubus triphyllus* Thunb., Fuhsiung Wang et al.1995, *Prunus* sp., Zetter 1998) partly comparable with the fossil specimen, relatively good preserved; because of the single find and fixed specimen (not removable from the preparation), it was impossible to examine the pollen in SEM.
The leaves of *Prunus* are known from the Sarmatian of Hungary (Bükk-Hills area, Mai 1995), endocarps of *Rubus* occur abundantly at the locality but are most probably linked with the small or medium-sized tricolporate pollen.

cf. *Rosaceae*-type sensu Zetter
Tricolporate pollens, 16-18-20 µm x 12-14 µm in size, of oval shape with slightly protruding area around endoporus; exine surface smooth (observed in LM); pollens close to the Rosaceae specimen documented by Zetter in Draxler et al. (1997, Pl. 4, Fig. 7).
Occurrence: About 2-3 specimens.
Remarks:This type of pollen points to some relationship to the Rosaceae family but could not be proved by SEM. The pollen grains were small and without observable striate ornamentation in LM.

Saxifragaceae
***Itea* sp., *Iteapollis angustiporatus* (Schn.) Ziemb.-Tworz.**
Two-porous pollen. Size 16 µm.

Occurrence: One specimen recorded.
Remarks: The occurrence of *Itea*-pollen in the Pontian deposits is reported by Petrescu et Givulescu (1986) from Rumania. Bertholdi et al.(1994) recorded *Itea*-pollen in the assemblage from the late Neogene in Italy. Ivanov (2003) referred to the occurrence of *Itea* in Macedonia, from the deposits, for which suggested the age of the Late Pontian to Early Pliocene. *Itea*-pollen is listed also from the Upper Pannonian assemblage at the Austria/Hungary border (Draxler et al.1997). Any records of Saxifragaceae have been known from the Panonian-Pontian in J. Moravia.

Anacardiaceae
***Rhus* – *Rhoipites pseudocingulum* (P. Pot.) R. Pot. (pro parte)**
Occurrence. Rare but present in the studied material
Remarks: The pollen occurs in many places, in the close territory in the Upper Pannonian profiles Torony-Höll-Deutsch-Schützen-Bildein at the Austrian/Hungarian border. Several species of *Rhus* macroremains (Berger 1952, 1955 ex Knobloch 1985) are known from the holostratotype locality of the Pannonian, Brunn-Vösendorf in Austria. *Rhus bergeri* Knobl. is mentioned from S. Moravia (Knobloch 1968) but not repeated in Knobloch 1985.

Aquifoliaceae, cf. *Ilex* – *Ilexpollenites propinquus* (R. Pot.) R. Pot.
Occurrence. Two pollens recorded.
Remarks.This type ranges throughout the Neogene and is commonly spread in the Upper Pannonian deposits. For example, in the borehole profiles Hidas 53, Tihány 62 in Hungary, (Nagy 1985), although in single finds. Nagy (1969, 1992) compared the pollen with *Ilex quercifolia* Meerb. and *Ilex opaca* Ait.(p. 173, Nagy 1992).

Vitaceae
Ampelopsis
Occurrence. Only one specimen (of a bleached grain) was recorded.
Remarks. The pollen occurs in the Upper Pannonian in the borehole profiles Torony-Höll-Deutsch-Schützen-Bildein at the Austria/Hungary border (Draxler et al. 1997). The seeds *Ampelposis* cf. *tertiaria* Dorof. and *Ampelopsis* sp. are listed (*A.* cf. *tertiaria* documented in seed) in S. Moravia, e.g. from Mistřín (Pannonian Zone C) and Kunovice 1 (Pannonian Zone B, Knobloch 1985). Other finds of seeds (*Vitis* sp. vel *Ampelopsis* sp.) are referred by Knobloch (Čtyroký et Knobloch 1976) from the borehole profile near Ořechov (borehole UH 18, SW of Ořechov, Pannonian zone C, ibid.), S. Moravia.

Tiliaceae
***Intratriporopollenites* cf. *instructus* (R. Pot.) Th.et Pf.**
Tiliaceous pollen, 26-28.8 μm x 22- 24 μm provided with a prominent vestibulum/oculus and slightly heterobrochal reticulation of the tectum.
Occurrence: Two specimens recorded, in different states of preservation.
Remark: *Tilia* pollen documented in detail Zetter (in Draxler et al.1997, Pl. 6, Fig. 1-3) from the Upper Pannonian at the Austria/Hungary border. From macrofossils, *Tilia longebracteata* Andrae is mentioned by Knobloch (1969, p. 120) from Moravská Nová Ves in S. Moravia and from the Pannonian locality Neusiedl am See, SE from Wienna (Knobloch 1978). The finds from Neusiedl am See, are also linked with the occurrences of *Tilia* in the Pannonian/Pontian in Rumania (Knobloch ibid.). The occurrences of *Tilia expansa* Sap.- *T. engebracteata* Andrae cited Knobloch (1985 ex Berger 1955 a) from the Pannonian at Laaerberg. Kovar-Eder (1988) referred to *Tilia* (involucres) as to the only genus which seems to be restricted in distribution of macrofossils to the Pannonian/Pontian in the Pannonian area of Central

Europe (with the exception of finds from the Upper Badenian at Goldern in South Germany, Gregor 1982 ex Kovar-Eder 1988).
Inaperturopollenites instructus has been assigned by many authors to *Tilia* and the genus is documented in the Pannonian area in macrofossils. The pollen of *Intratriporopollenites cordataeformis* (Wolff) Mai are often recorded as Tiliaceae (Nagy 1985 and c.l.) in the Pannonian/Pontian spectra but mostly, both forms are designated only as *Tilia,* due to very different preservation of exines and scanty specimens, in analysis often hardly distinguishable at the level of the form-species.
Mai (1961) izolated pollen of the *instructus*-type from the fossil flower (*Burretia* Mai 1961), an extinct tilioid plant (Tiliaceae, Brownlowioideae). The Tiliaceae pollen from the locality Poštorná are comparable with the *I. instructus* and were recorded in the material from the layer with abundant *Byttneriophyllum* leaves (commonly considered as representatives of the Sterculiaceae). This fact could be in a good accordance with the view of Mai (ibid.).

***Intratriporopollenites* sp.**
Pl. 6, figs. 3, 4
Well preserved pollen of the *Tilia*-morphotype provided with a less prominent vestibulum and fine very slightly heterobrochate reticulation of tectum with +- equaly sized lumina (less than 1 μm in diameter). The whole size of the pollen is 30 μm, the thickness of vestibulum 3.6 - 4 μm. *I. cordataeformis* is comparable species in respect to the tectum pattern (pl. 13, fig. 11-14, Mai 1961), the coiled tips of the ornamented ektexine layer into exitus point to the features of the *instructus* type (Mai ibid). The specimen was assembled with the above pollen and can be linked with variability of *instructus – Burretia* type (Pl. 9, fig. 25, Mai 1961), from dispersed pollen with *Intratripor. instructus* subsp. *instructus* (pl.12, fig.10 ibid.) or with *I. cordataeformis* (Wolff) Mai sensu Nagy (1985, pl. CI, fig. 3, 4 only).
Remarks:*Tilia* pollen are mentioned as accessories of the Pannonian and the Pontian assemblages (Nagy 1969,1982,1992). *Intratriporopollenites cordataeformis* is referred to as an accessory element from the Petöfibanya III, Pontian (Nagy 1992), and in the Plate of occurrences (ibid., p. 265) Nagy gave the range of this *Tilia*-form through the whole Pontian. The *Intratriporopollenites* sp. from the presently studied locality points more to the *instructus* – type; apart from the family or subfamily assignment; the specimen could be a good type for the *Byttneriophyllum* layer (lacking *Byttneria* pollen; but Sterculiaceae-plants are eurypalynous and in other forms close to Tiliaceae; Erdtman 1952).
/Also worthy of mention in this respect, are other sites of *'Tilia* pollen records' (without morpho-species assignment), in co-occurrence with numerous *Byttneriophyllum* leaves. The lignite complex at Visonta (Upper Pannonian) in Northern Hungary (Pálfalvy et Rákosi 1979) may also be given as an another example.

Lythraceae - *Decodon*
Psilate tricolporate pollen, size to 30 μm, comparable with recent *Decodon globosa.*
Occurrence. Only rare single specimens.
Remark: *Decodon sibiricus* and *D. globosus* are listed among seed and fruit specimens from the locality Mistřín (Pontian C in south Moravia) by Knobloch (1985).

Nyssaceae
***Nyssa* - *Tricolporopollenites kruschi* (R.Pot.) Th. et Pf.**
cf. *Nyssa* – cf. *Nyssapollenites* sp.
Pl. 7, figs. 5, 6
Pollen grains *Nyssa – kruschi*-type display slightly spherical to ovoidal outline, size about 24-30 μm in long axis and faintly ornamented tectum.

Besides *kruschi*-type, the tricolporate pollen was recorded (cf. *Nyssa,)*, that reminds of *Nyssa* or Araliaceae (Pl. 7. fig. 5); the pollen was preliminarily designated to *Nyssa.* (Size: 33.6 μm long axis, 28,6 μm equatorial axis.)
Occurrence: 2 specimens recorded.
Remarks: Bůžek (1960) identified the seeds of *Nyssa disseminata* (Ludwig) Kirchh. at the studied locality, the pollen mentioned Gabrielová (1968, preliminary report).
Nyssa is listed among the pollen from the Pontian deposits in Hungary: the borehole Pula 3, as a constituent component of the coal-forming swamp – *Taxodiaceae – Nyssa, Coniferae* of the lignites in Petőfibanya (documented e.g. at the depth 0.1-1.9 m, the Pontian, Nagy 1992), and from the other Upper Pannonian (Torony 71) and Pontian localities. In Austria, *Nyssa*-pollen occurs in the profile Höll-Deutsch-Schützen 2, lignite sequences (Draxler et al. 1997). *Nyssa europea* Ung. (Berger 1952, 1955 ex Knobloch 1985) is known from the Upper Pannonian holotype locality Brunn-Vösendorf, Austria, mammalian Neogene zone MN 10, *Nyssa ornithobroma* Ung. occurred in the Pannonian macrofloras of the S. Moravia. /Two species, *Nyssa meriani* (Heer) Knobl. and *Nyssa ornithobroma* are given by Knobloch (1968) in the short overview of macroflora from the Pannonian of S. Moravia./

Cornaceae?
***Cornaceaepollenites* sp. vel *Tricolporopollenites* sp.**
Not fully preserved but very conspicuous pollen grain. Tricolporate pollen with the striking width of cavernae at the equator and narrow equatorially elongated pores 10-12 μm long. Cavernae cone-like, at the equator very broad, tapering toward the poles. The size of pollen 32.4 μm x 24 μm (laterally slightly compressed), exine not fully preserved, cca 2 μm thick, as far as could be observed; surface granulate/ fossulate to scabrate.
Occurrence: One specimen, not fully preserved but very striking.
Remarks: Planderová (in Nagy et Planderová 1985, Pl. 100, fig. 12) displayed the only related tricolporate pollen (with comparably broad cavernae) from the Pannonian in Slovakia, but the specimen differs in the very thick exine, which could not be observed in the incompletely preserved specimen from the presently studied locality. Nevertheless, the pollen is the only correlative type of tricolporate pollens from the surrounding regions of the Pannonian-Pontian deposits, palynologically documented. Cornaceae (Nagy et Planderová ibid.) seems to be the close related family to the fossil specimens. From macrofossils, the endocarps of *Swida* sp., probably *Swida gorbunovii* (Dorof.) Negru, are present within seeds and fruits collections from the four sites of the Pannonian in S. Moravia: Kunovice (1, 2), Mistřín, Uherské Hradiště (Pannonian Zones B, C) and Hodonín (Zone E); (Knobloch 1976 a, Knobloch 1985, Čtyroký et Knobloch 1976).

Araliaceae and Cornaceae
***Araliaceoipollenites cf. edmundi* (R. Pot.) R. Pot. - *Tricolporopollenites* cf. *edmundi* (R. Pot.) Th. et Pf.; ?*Tricolporopollenites euphori* (R. Pot.) Th. et Pf.**
Two representatives of these families were observed: 1.Tricolporate pollen of cf. *edmundi*-type, with massive colproate exitus, but slender than at typical *edmundi*-pollen, introduced by Potonié. Size: 30 μm (polar axis), exine of corroded surface, small surface areas with preserved granulate-like ornamentation (perforate tectum).
2. Tricolporate pollen of the *euphori*-type, 26 μm in size, distinguished by the higher baculate layer at the polar area, and by the less size from the *T. edmundi*-type.
Occurrence: Only one specimen of each type.
Remarks: Both pollen taxa occurred in the Pannonian /Pontian of Hungary. *A. edmundi* can be mentioned from the Pontian of the Alsóvadász 1 borehole (Nagy 1992).

Ericaceae
***Ericipites ericius* (R. Pot.) R. Pot.**
Large-sized terads 36 -38 μm. Exine surface of the single pollen of tetrads smooth.
Occurrence: One specimen.
Remarks: Nagy (1985, 1992) pointed to many Pannonian and Pontian localities with the occurrence of Ericaceae in the Hungary. *Ericipites* occurs also in the Torony-Höll-Deutsch-Schützen-Bildein profiles at the Austria/Hungary border (Draxler et al.1997).

Oleaceae, cf. *Fraxinus*
Size of tricolporate pollen 18- 26 μm. Fine granulate-reticulate ornamentation of exine, lumina between 0.6 μm and l μm.
Occurrence. As an accessory element in the pollen spectrum.
Remarks: 'Probably *Fraxinus'* pollen was recorded at the locality by Gabrielová (1968). The distribution of pollen in the Pannonian and Pontian is scattered without any significant frequency (Nagy 1992 and Draxler et al. 1997). *Fraxinus angusta* occurs among macro-remains at presently studied locality (Bůžek et al.1988).

Compositae
***Artemisia -Artemisiaepollenites sellularis* Nagy**
Pollen about 23 μm in size.
Occurrence: One specimen recorded.
Remarks: *Artemisia* pollen is scattered in the Pannonian and Pontian sediments in many sites. Pollen occurs in the Pannonian and Pontian deposits (mostly beyond the lower part) in Hungary (Megyaszó –1, Szerencs Hilly Region, Petöfibanya III, Hidas 53, Várkeszö 1, Köbánya brickyard; Nagy 1985, 1992), Slovakia (Nagy et Planderová 1985), in the Upper Pannonian borehole profiles at the Austrian/Hungarian border (Torony-Höll-Deutsch-Schützen-Bildein; Draxler et al.1997), predominantly as an accessory element in the assemblages.

4.6.2 Monocotyledones
Hydrocharitaceae
cf. *Stratiotes*
Pollen (fragment of exine) 26.4 μm, spinae cca 0.6 to 1μm.
Occurrence: Fragmentary preserved pollen.
Remarks: Pollens are noticed rarely; they were recorded e.g. in the assemblage from the Torony 72 in the Torony-Höll-Deutsch-Schützen-Bildein profiles (Draxler et al. 1997). The seeds are, in contrary to the pollen, very suitable for fossilization and frequently found. *Stratiotes* (*S. tuberculatus* E.M. Reid.) seeds occurred in the Pannonian strata in S. Moravia from the surroundings of Kyjov (text-fig.3) and are known since the time of Hofmann's finds (Kyjov, former Gaya, Hofmann 1900); they were identified at the presently studied locality by Bůžek (1960,1962 a). Bůžek also pointed to the earlier finds of *Stratiotes* at Čejč (Pontian), NW of Dubňany (text-fig.3). Knobloch (Čtyroký et Knobloch 1976) reported on the seeds from the Pannonian at Polešovice and Těmice in S. Moravia. All the finds point to the wide occurrence and distribution of the aquatic communities and presence of inland water habitats in S. Moravia.

Gramineae
***Graminidites* sp. div.**
Among monoporate pollen of Gramineae, several morphotypes were distinguished. They are scattered as single specimens.

Occurrence: Three pollen.
Remarks: Gramineae are commonly recorded in the Pannonian pollen spectra of the closest areas (Hungary, Austria), mostly in low percentages (except of the Pontian at Badersdorf in the Burgenland area, s.-e. Austria, Zetter 1988). Their occurrence is known also from the more distant parts of the Pannonian Basin (Pannonian of Serbia, Pantić et Dulić 1993).

***?Graminidites pseudogramineus* W. Kr.**
A large-sized (40 μm) gramineous pollen with distinct pore and annulus. By the size differs from the other recorded pollen of this group.
Remarks: Similar pollens were recognized and described as the morpho-species *pseudogramineus* from the Pliocene-Pleistocene deposits in Germany; to this species was also assigned (with question mark) the record of gramineous pollen from the Pannonian (the Mátra Mts. area) from Hungary (Nagy 1958 ex Krutzsch 1970), and other specimens recorded in the different territories (Krutzsch ibid).
Occurrence: One record.

***Graminidites laevigatus* W. Kr. – *Graminidites media* (Cookson) R. Pot. (ex Nagy 1985)**
Thin-walled pollen, the exine about 0.6 μm and less, distinct porus with annulus.
Occurrence: Two specimens.recorded.
Remarks. This type of gramineous pollen is common in the Neogene. Nagy (1985) pointed to its occurrence in the Miocene in Hungary.

Arecaceae (Palmae)
***Arecipites* sp.**
Monosulcate pollen, 27.6 - 29 μm in size, exine surface displays fine granulate-reticulate pattern with densely arranged luminae.
Occurrence. Two specimens.
Remarks: Nagy (1992) referred to the palm pollen *(Sabalpollenites)* the specimens from the Pannonian assemblage obtained from the Mecsek Mts., the Pontian deposits W. of the Gerecse Mts. and from the Szerencs Hilly Region (Megyaszó 1 borehole, Pannonian), as the component of the *Taxodium - Nyssa* swamp. *Arecipites* occurred also in the Höll-Deutsch-Schützen 2 borehole profile in Austria (Upper Pannonian, lignite sequence) and southward, in the Pontian of the Pannonian Basin in Serbia (Pantić et Dulić 1993).

cf. Araceae, Aroideae
Boat-shaped monosulcate pollen, small-sized, 16-18 μm, surface reticulate, reticulum distinctly heterobrochate. Brochi large, 0.6.-0.8 μm on the non sulcus side, along sulcus exine smooth or pitted with tiny pores.
Occurrence: Two pollens.
Remarks: The distinct surface reticulation with relatively large meshes distinguish the specimens from the pollen of *Acorus calamus* and *Calla palustris* (observed in SEM) but the relationship with Aroideae as well as Calloideae and ?Monsteroideae can be considered as more probable, based on gross morphology of the pollen, than the relation to the other members of the family. The pollen match well with the whole swampy association at the locality: algae, Sparganiaceae, Gramineae pollen, *Spirematospermum* (Bůžek 1962 a), *Byttneriophyllum* (Knobloch et Kvaček 1965 a,b) and other plant remains of this facies.
Acorus brachystachys Heer occurs among macrofossils from the Upper Miocene in Poland (Poznań clays, ex Němejc 1975), many fossil fruits and seeds have been assigned to the family Araceae. They were critically examined by Gregor and Bogner (1984) and evaluated in relationship to the living representatives. According their study, Monsteroideae were well

represented among tertiary plants. Mai (1995) pointed to almost laurasian distribution of the Subfamily Monsteroideae in the Tertiary floras.

Sparganiaceae

***Sparganiaceaepollenites polygonalis* Thierg.**

***Sparganiaceaepollenites* cf. *neogenicus* W. Kr.**

Besides *S. polygonalis*, large-sized pollen was encountered, 30 μm in diameter, with regular reticulation of exine and elongated (oval) rimmed pore (4.6 μm x 6 μm in diameter, rim 0.5 μm), assigned to *S.* cf. *neogenicus*. In relation to the modern *Sparganium racemosa,* the fossil specimen displays the thinner-wall and distinct, more regularly arranged pattern of the reticulum. (Lumina 0.5 μm, muri/baculae 0.6 μm wide, exine under 1.2 μm). The pollen differs also from the fossil species *S. neogenicus* in the less dimension of the pore diameter.

Occurrence: Three specimens of *Sparganiaceaepollenites* recorded.

Remarks: Some of the *Sparganium* - types may be derived from *Typha.* The tetrads of *Typha* were not recorded in the material presently studied but were mentioned by Gabrielová (1968). Nevertheless, *Sparganium* pollens are in the Pannonian assemblages commonly found (Nagy 1985, Pálfalvy et Rákosi 1979, Pantić et Dulić 1993 and others) and display (after Nagy) the higher frequencies. It is probable that *Sparganium* was represented by more fossil species (*Sparganium neglectum, S. nanum* – localities Mistřín, Kunovice, Ořechov, Knobloch 1985) or displayed a greater variability of pollen grains in one plant inflorescences (or both eventualities existed). The seeds/fruits of Sparg*anium neglectum* and ?*Sparganium* (an endocarp) documented Knobloch from the Pannonian of the Ořechov area (UH 19 borehole; Čtyroký et Knobloch 1976, Pl.II, fig.12, Pl. I, fig. 29), *S. nanum* Dorof. in Kolak. and *S. neglectum* Beeby foss. from the Pannonian at Kunovice (Knobloch 1985, Pl. 101, figs 8, 14). From these species, *Sparganium neglectum* Beeby foss. was thoroughly investigated by Knobloch and Mai (1975). Worthy of mentioning are also the finds of fruiting heads of ?*Sparganium* sp. recorded in the Pannonian in Austria (Kovar-Eder et Wójcicki 2001, Kovar-Eder, Schwarz, Wójcicki 2002).

Table 1
(Caprifoliaceae, *Lonicera* – type, Berberidaceae – *Mahonia* and cf. *Juglans* were recorded only in very poor preservation.)

Remarks: Most of the pollens occur as single specimens or in low frequencies in the assemblage studied. The spectrum displays a rather greater differences of taxa, presented in low frequencies, rather than an abundance of single specimens.
Symbols: * designates more than presence, ** frequent, *** abundant; o – designates presence (single occurrence)

RECORDED TAXA AND NUMBER OF SPECIMENS	*
FUNGI	*
Microthyriaceae	**
ALGAE REMAINS	***
MUSCI	
Triletes sp.	1
cf. *Sphagnum* –*Stereisporites buchenauensis*	1
Filicinae	
Polypodiaceae – *L. haardti, L. gracilis, L. discordatus*	5
?? *Acrostichum* vel cf. *Lygodium*	1
Azollaceae – *Azolla sp.*	1
Azollaceae - Salviniaceae	1
Gymnospermae - Coniferae	
Taxodiaceae – Cupressaceae incl. *Glyptostrobus*	15
Sequoiapollenites polyformosus	1
Tsuga – T. diversifolia - type	1
Sciadopitys	2
cf. *Cathaya*	4
Pinus – small-sized group, P. microinsignis, P. minutus, P. sp.	9
Pinus sp., *P. silvestris – type*	2
Cedrus – Cedripites sp. B ;C. cf. *miocaenicus*	4
cf. *Abies – Abiespollenites* sp.	1
Keteleeria – dubius - type	2
Angiospermae – Dicotyledones	
cf. *Magnolia* – cf. *M. neogenicus minor*	2
cf. *Liriodendron – L. semiverrucatus minor* vel *verrucatus*	*1*
Betula	1
Alnus	5
cf. *Carpinus*	1
Ulmus, Ulmaceae, *U. undulosus, U. stillatus*	8
cf. *Zelkova*	6
Celtis – C. komloensis	10
Carya	3
Juglandaceae – *M. punctatus*	8
Engelhardia – E. microcoryphaeus	1
Engelhardia vel *Platycarya*	1
Platycarya	1
Tiliaceae – *I. instructus, Intratriporopoll.* sp.	3
Oleaceae – cf. *Fraxinus*	1
Hamamelidaceae – *Parrotia* - type	11

Liquidambar – *L. styraciflua* - type	3
Salix	2
Saxifragaceae – *Itea* sp., *I. angustiporatus*	1
Lythraceae - *Decodon*	2
Quercus	5
cf. *Quercus* vel *Eotrigonobalanus*	1
Fagus	1
Castanea	2
aff. *Trigonobalanopsis*	2
Rhus – *R.. pseudocingulum*	1
Aquifoliaceae, cf. *Ilex* - *Ilexpollenites propinquus*	1
Ampelopsis	1
Nyssa – *T. kruschi*, cf. *Nyssapollenites* sp.	2
cf. Rosaceae – *Rubus*? - type	1
cf. Rosaceae – type sensu Zetter	3
Araliaceae-Cornaceae – *A.* cf. *edmundi*	1
Araliaceae-Cornaceae - ?*Tricolporopoll. euphori*	1
Cornaceae? *Cornaceaepoll.* sp. vel *Tricolporopoll.* sp	1
Artemisia - *A. sellularis*	1
Polygonum sp. – *Persicarioipoll.* sp.	2
Ericaceae – *Ericipites ericius*	1
Chenopodiaceae – *Ch. multiplex*	1
Angiospermae – Monocotyledones	
cf. Araceae, Aroideae	2
Arecaceae (Palmae) – *Arecipites* sp.	2
Sparganiaceae – *S. polygonalis, S.* cf. *neogenicus*	3
Gramineae – *Graminidites* sp. div.	3
? *Graminidites pseudogramineus*	1
Graminidites laevigatus	2
Hydrocharitaceae – cf. *Stratiotes*	1
Freshwater Cyanobacteria, Algae	***
Sigmopollis	**
Botryococcus	o
Pediastrum - colony	1
Pediastrum – single cells	**
Ovoidites ligneolus	o
Spirogyra	**
Incertae sedis	**
Brackish/marine plankton	**
Mecsekia	19
Pleurozonaria	2
Thalassiphora	2
Dinophyceae	2
Incertae sedis	1
Other Components	
cuticles	*
hairs	o
xylitic splinters	o

Table 2.
The proxy/simultaneous occurrences of micro- and macro-plant remains at the studied locality.
Symbols: *Fragmentary preserved; **probably preserved within compressed porate pollen.
Footnotes to the macroremains: l -leaves, s- seeds, ed – endocarps.

Common plant taxa micro- and macro- proxy, and selected shrubs/herbs or trees recorded in pollen. Locality Poštorná near Břeclav, Moravian part of the Vienna Basin.				
Present study	After Bůžek 1960, 1962 a,b, Bůžek et al. 1988, Knobloch 1962, 1963, Knobloch et Kvaček 1965 a,b			
Pollen, spores, plankton	Leaves, cones, seeds, fruits			
Filicinae; Polypodiaceae	Fern leaf	l		
SALVINIA - AZOLLA	-			
Taxodiaceae-Cupressaceae	GLYPTOSTROBUS EUROPAEUS	l		
TSUGA	-			
PINUS - CATHAYA	-			
SEQUOIA - S. POLYFORMOSUS	-			
PINUS SP. DIV.	-			
CEDRUS	-			
cf. Abies, Keteleeria	-			
cf.*Magnolia-M. neogenicus*	-			
cf. *Liriodendron -L. semiverrucatus*	-			
ALNUS	ALNUS CECROPIAEFOLIA	l		
ULMUS	-			
ZELKOVA	-			
ENGELHARDIA	-			
PLATYCARYA	-			
CARYA	-			
*Juglans (??)***	*Juglans* cf. *acuminatus*	l		
CELTIS – C. KOMLOENSIS	-			
-	ACER TRICUSPIDATUM , ACER SP.	l		
cf. *Fraxinus*	FRAXINUS ANGUSTA	l		
HAMAMELIDACEAE, PARROTIA-TYPE	-			
LIQUIDAMBAR	-			
SALIX	SALIX VARIANS	l		
NYSSA – T. KRUSCHI	*Nyssa ornithobroma*		s	

	NYSSA DISSEMINATA			
CASTANEA-T. OVIFORMIS	-			
FAGUS	-			
QUERCUS	-			
Quercoideae, cf. *Trigonobalanus* - types	-			
INTRATRIPOROPOLLENITES SP. - TYPE	BYTTNERIOPHYLLUM TILIAEFOLIUM	l		
cf. Rosaceae , cf. *Rubus*	RUBUS SP.			ed
Cornaceae	-?			
AMPELOPSIS	-			
ERICACEAE – E. ERICIUS	-			
SAXIFRAGACEAE - ITEA	-			
POLYGONUM - PERSICARIOIPOLL. SP.	-			
AROIDEAE	-			
ARECIPITES, ARECACEAE	-			
STRATIOTES*	STRATIOTES TUBERCULATUS		s	
-	SPIREMATOSPERMUM WETZLERI		s	
SPARGANIUM	-			
Gramineae	PHRAGMITES OENINGENSIS	l?		
ARTEMISIA	-			
CHENOPODIUM	-			
Plankton	-			

Table 3

Selected taxa recorded in spores/pollens, their extant analogies or related plants; their autoecology and climatic demands/geographic distribution. The overview display predomination of warm teperate and temperate elements with less presentation of thermophilous and subtropical taxa at the locality but these elements are still present (*Arecipites, Engelhardia* a.o.)

Remark: *Ilex opaca* Aiton and *Celtis occidentalis* L. are the extant plants suggested by Nagy (1992) for the the pollen of *Ilexpoll. propinquus* and *Celtipollis komloensis*, based on comparison with macrofossils. Pollen of *Fagus* from the presently studied locality, shows

paralel occurrence (in broader area) with *Fagus haidingeri* Kov. emend. Knobl.compared with chinese *Fagus hayatae* Palib. ex Hayata.

Taxa recorded at the locality (spores, pollens)	**Extant analogue**	**Aquatic plants, Herbs, Lianas Shrubs, Conifers, Deciduous trees Evergreen trees**	**Ecology/ habitat**	**Elements/ phytogeography/ climatic claim**
ALGAE			Telmat.	
FUNGI				
Fungi – diferent types of spores			Ubiqui.	Cosmop.
Microthyriaceae.		epiphytes		Trop, subtrop
FERNS – FILICINAE				
Polypodiaceae		h	Underst.	Cosmop.
??*Acrostichum* vel LYGODIUM		h liana	Freshw to saltwater. marshes; Mesoph a. mixed, gallery forest	Trop, subtrop Subtrop, trop
Azolla		Aqu. plant	Floating aqu. pl.	Temperate to tropic
Azollaceae – Salvinia		Aqu. plants	Floating aqu. pl.	Trop. to warm temp.
Conifers				
Taxodiaceae - Cupressaceae		Conif tree	Swamp trees	Atlant Am.
Taxodiaceae	*Glyptostrobus pensilis*	Conif tree	Swamp tree; river banks, deltas, flooded, waterlogged soil	SE China-subtrop, N Vietn
Sequoia	*S. sempervirens*	Conif tree	Coast tree	Pacif Am.-subtrop
SCIADOPITYS		Conif tree	Mount tree	Asia, Japan
TSUGA	*T.* cf. *diversifolia*	Conif.tree		N. Am., Canada
CATHAYA		Conif. tree		China –warm temper/ subtr
Pinus sp.		Conif. tree		Temper, on Mts in N trop belt
Abies sp.		Conif. tree		Temp, warm temper (C Am)
Keteleeria sp.		Conif. tree		E. Asia, SE Asia (Indochina) - subtrop
Cedrus		Conif. tree		Warm temper

FLOWERING PLANTS DICOYLEDONEAE				
cf. *Magnolia*		Deciduous/ evergreen tree		Himal to Japan, Malays, Borneo to Java. N Am, Asia; warm temp to trop
cf. *Liriodendron*		Deciduous tree	Decid forest; mount forest	N. Am; temp Asia –China, Vietn.;
ENGELHARDIA		Evergreen tree		E Asia (incl Formosa), Malaysia; Mex, C. Am - subtrop
PLATYCARYA		Deciduous tree	Mixed forest – mtn slopes	SW Asia (S Caspian region), China
ALNUS		Decid. tree/shrubs	River bank, .. riparian forest	North temper hemisph to subtrop; Andes
ULMUS – *stillatus, undulosus*		Decid. tree	Mix forest	North temper hemisph
ZELKOVA		Decid. Tree	Mix forest	Mediterr, W Asia; warm temper; subtrop
CARYA		Decid. tree	Mix forest	N. Am., Asia-China; warm temp, subtr
CELTIS SP.; C. KOMLOENSIS	*Celtis occidentalis*	Decid. tree	Rich forest, hill slopes	Endemic, Mediterranean, Asia Minor – warm temper; N Amer, temper
SAXIFRAGA-CEAE – ITEA		Shrub, small tree	Wet stream banks;mtns slopes	N. Amer; Himal to Japan, W Malaysia; subtrop
TILIA		Decid tree		N hemisph temper, (S to E. Asia –Indoch) a. Mex
cf. *Fraxinus*		Decid. tree	Riparian forest	N hemisph
SALIX		Decid. tree/shrub	Riparian forest	N hemisph, temper– chiefly
Hamamelidaceae, cf. *Parrotia*		Decid. tree	Mntn. forest	East N Amer, E Europe, SW Asia (N Iran, Caucasus), China; temper
LIQUIDAMBAR	L.STYRACI-FLUA	Decid. tree	River banks, swamps	N. Am., temper
Rhus		Decid. tree/shrub	Forest edge	N. Am., Canada, temper
Rubus		Decid. shrub	Forest edge, peat	Cosmop, chiefly N hemisph.- temp
Rosaceae		Decid. shrub		Cosmop
Cornaceae		Trees a shrubs		Temper N a S hemisph., trop mts.
Araliaceae		Trees, shrubs, twiners tree		Chiefly trop/subtr

FAGUS	FAGUS HAYATAE	Decid/Evergr tree	Mtn ridges, decid forest	China, warm temper
QUERCUS		Decid/evergr tree		N Am, trop S Am, temp/ subtrop Eurasia
TRIGONOBALA-NUS		Evergr tree		SE Asia, Malaysia, Mex
CASTANEA		Decid tree		S. Europe – warm temper (endem.), extratrop zone
NYSSA		Decid tree	humid forest, wet soil	N Am, Asia
Ampelopsis		Decid tree/lianas		Temper, subtr
Ilex - Ilexpoll. propinquus	ILEX .OPACA	Everg (even decid) shrub/tree	Sandy soil, humid forest	E N Am - temper
DECODON		h	wet soil	Atl N Amer
Ericaceae		Dec/evergr shrub; h		Cosmop
ARTEMISIA		h		Temper/warm temper (to N Africa, S Amer)
MONOCOTYLE-DONEAE				
Aroideae		h/lianas	telmatic/rim/aquatic	Subtrop./trop, temp (less)
ARECACEAE - ARECIPITES sp.	palms	evergreen		Warm temper, subtrop., trop
Caryophyllaceae - *Polygonum persic.*	h/undershrubs			Cosmop (nearly); north-temperate region
Sparganiaceae - *Sparganium*	h	Telmatic/rim		Cosmop
Gramineae - *Graminidites sp div.*	h	Telmatic/rim/steppe		Cosmop
STRATIOTES	h-floating	Aquatic/rim		Temper -Europe, NW Asia
Plankton	Aqu	Aquatic		Cosmop

5 Environment

Palynomorphs indicate several different environments at the locality and surrounding areas, with response of the water level and topography, in a well predisposited area in the eastern edge of the Bohemian Massif.

The aquatic environment is striking and well documented by planktonic algal aplanospores/zygospores, cysts, algal epibionts, and aquatic and rim macrophytes. Rim herbaceous vegetation of *Sparganium* and *Gramineae* is present, but the imprint of the *Glyptostrobus* swamp with *Byttneriophyllum, Alnus* and wetland populations with *Liquidambar,* and probably *Nyssa,* seems to have been even more significant. Noticebly reflected in the pollen are the components of both mixed mesophytic and riparian forest; with thriving *Carya, Celtis, Parrotia, Zelkova, Ulmus, Alnus, Salix, cf. Fraxinus,* shrubs of Oleaceae a.o. Trees and shrubs growing on the slopes and elevations, represented by hardwoods with some types of *Quercus* (including Quercoideae), *Fagus, Castanea,*

Araliaceae, *Magnolia* and *Liriodendron* as accessories within it. For the *Pinus, Picea, Tsuga, Cathaya,* higher elevations and slopes with coniferous woods on top of the hills are probable. Special attention was payed to the planktonic organisms revealed in the assemblage. The revelation of unicellular algal cysts (*P. manumi, M. concinna),* some dinophytes and green algae testify to an environment with slightly higer salinity; otherwise they are absent in the purely freshwater environments. They proliferated there along with Zygnemataceae, *Spirogyra, Pediastrum* and other microphytes, in mixed algal assemblages of the freshwater and brackish types. The environment responds to the partially salty soil (Chenopodiaceae) and hyposaline water which is often found after regression and in estuaries.

6 Conclusions

The observed organic remains and the composition of palynomorphs testify to: a telmato-limnic environment with richly proliferating cyanophytes and algae:water plants: gramineous rim vegetation and coniferous swamps with *Glyptostrobus:* and accompanying foliated trees, partly preserved in macroflora, partly in the co-occurrence of both other types, partly preserved in macroflora, partly in the co-occurrence of both macroflora and pollen, or in the pollen records alone.

The woody plants represent *Ulmus, Ulmaceae* (sensu lato), *Zelkova, Carya, Celtis,* Hamamelidaceae, *Tilia* (Tiliaceae), *Magnolia, Liriodendron* and Pinaceae including *Tsuga, Cedrus*, cf. *Cathaya*, which point to zonal vegetation of the wider area.

The absence of *Myrica* swamp in the pollen spectra and some other forms from the level of shrubs are compensated by the frequencies of water plants, showing higher innundation of the locality under study.

The microphytes and their detritic particles complement the meso- and macroscopic plant remains, giving data about components so far unknown from the locality, which point to the character of the water environment. The mix of freshwater and brackish planktons points to the slightly brackish water influence and salty soil environment, what was not presumed/ documented for the studied locality up to now.

The pollen spectrum of conifers and flowering plants has many taxa in common with the spectra known from the forelands of the Mecsek Mts., Szerencs Hilly region, the Mátra Mts. in Hungary, and at the Austria-Hungary border. The pollen taxa proved many of assignments of the macrofossils: *Alnus, Zelkova, Ulmus, Liquidambar, Carya,* Juglandaceae (among others), and contribute to the knowledge of the new ones: *Tsuga, Pinus, Parrotia, Fagus,* among others. Only a few plants in macrofossils are known from the studied locality, *Glyptostrobus, Byttneriophyllum, Nyssa, Alnus, Rubus* were the best known and most abundant. For the *Byttneriophyllum* leaves, the absence of *Byttneria*-pollen was newly confirmed, and the relationship with tilioid pollen suggested and supported. *Glyptostrobus - Byttneriophyllum - (Nyssa)*-swamp represents the typical association for the Pontian swampy environment in the extention of the Vienna Basin in S. Moravia presently studied.

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Plate 1

Fig. 1: Plankton, *Mecsekia* sp. – *M.* cf. *incrassata* Sütö – Szentai. x 2100

Fig. 2: Plankton, *Mecsekia* sp. – thin form, another focus level (of the specimen 1)

Fig. 3: Plankton, *Mecsekia* sp. – thin form, *M.* cf. *orientalis* Sütö – Szentai. x 2050

Fig. 4: Plankton, *Mecsekia* sp. – thin form, another focus level (of the specimen 3).

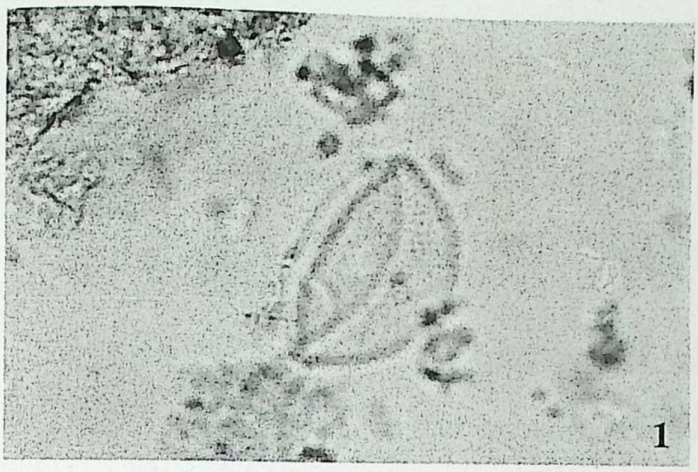
Fig. 5: Plankton, *Mecsekia* sp. – *M.* cf. *incrassata* Sütö – Szentai. x 2300

Fig. 6: Plankton, *Mecsekia* sp. – another focus level. (x 2500)

Fig. 7: Plankton, cf. *Pleurozonaria manumi* (Kriv. – Hutter) Rákosi sensu Nagy 1999. x 1750

Fig. 8: Plankton, cf. *Pleurozonaria manumi,* another focus level.

Plate 1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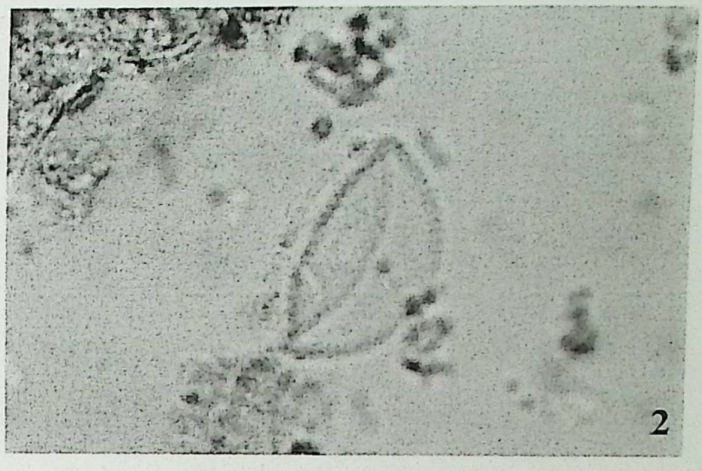
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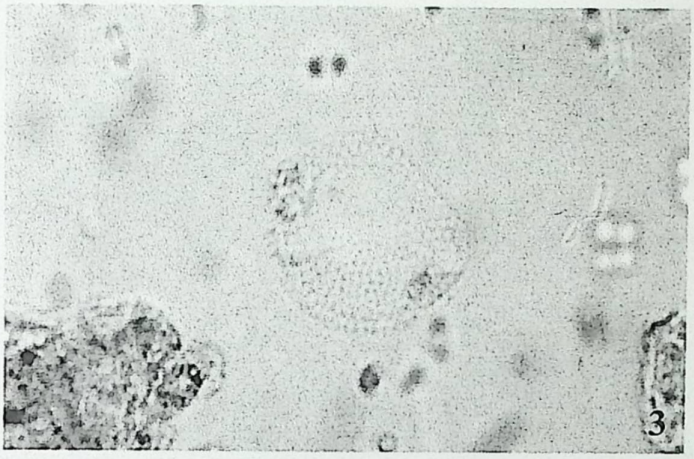
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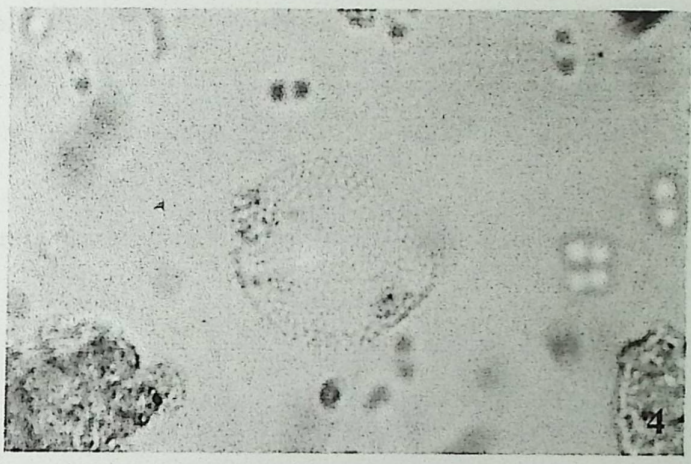
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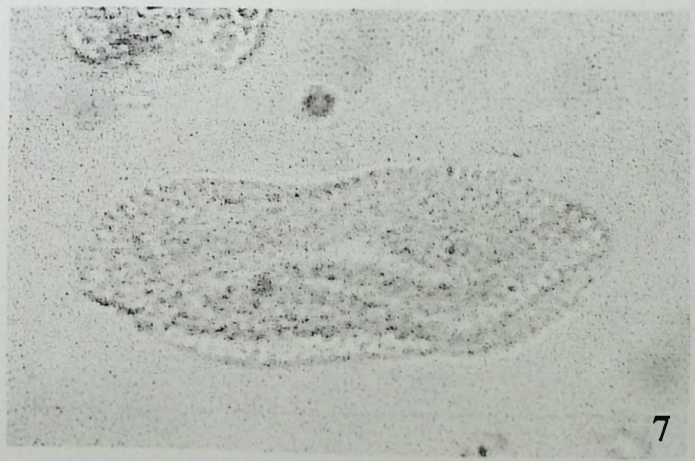
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Plate 2

Fig. 1: Algae – remain of algal thallus. x 880

Fig. 2: Algae – remain of algal thallus, another focus level.

Fig. 3: Fungi, Microthyriaceae – part of epithecium with straight radial cells. x 830

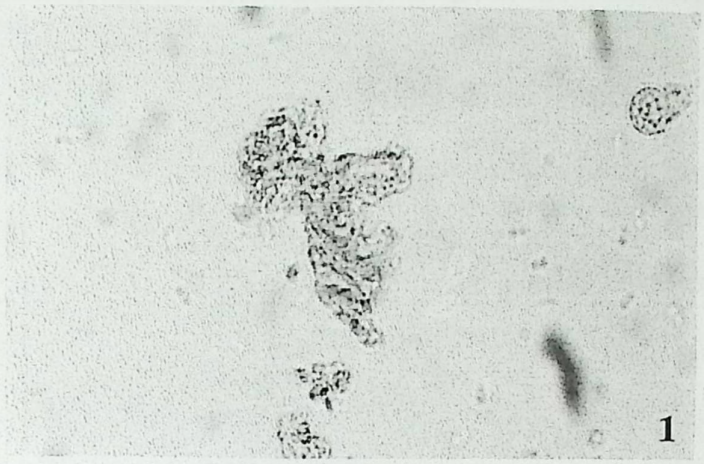
Fig. 4: Fungi – *Dictyosporites* sp., multiple cells arranged in series. x 830

Fig. 5: Character of preparations - highly condensed detritus and rare pollen. x 510

Fig. 6: Fungi – *Dyadosporites* sp., dyade (along with degradated pollen). x 900

Fig. 7: Fungi –fragment of probable large-sized perithecium with nodular cells. x 830

Fig. 8: Fungi – large fragment of perithecium with regularly arranged cells. x 830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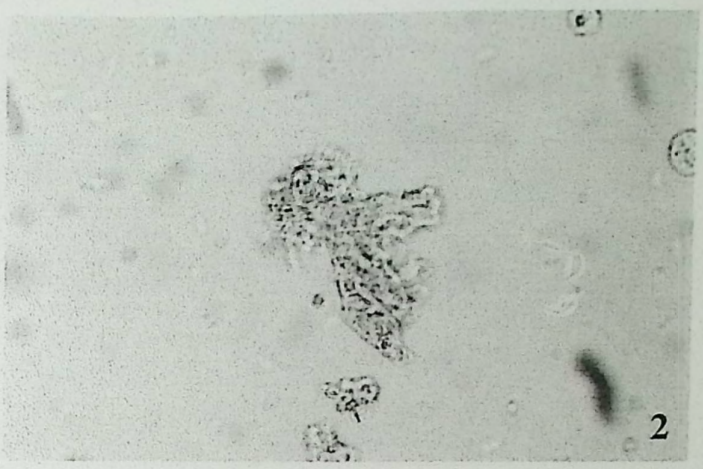
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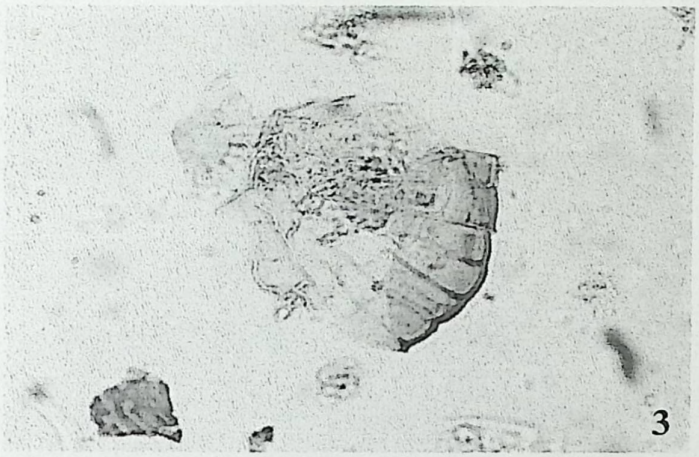
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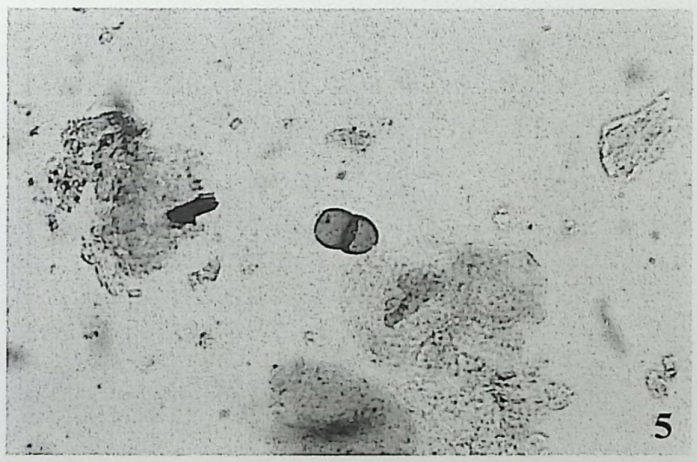
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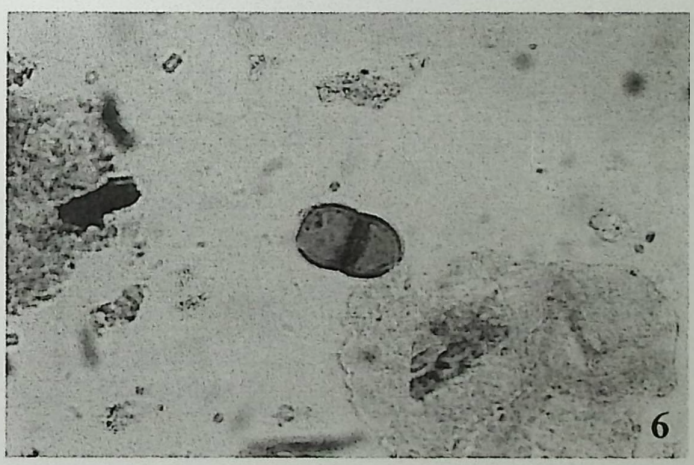
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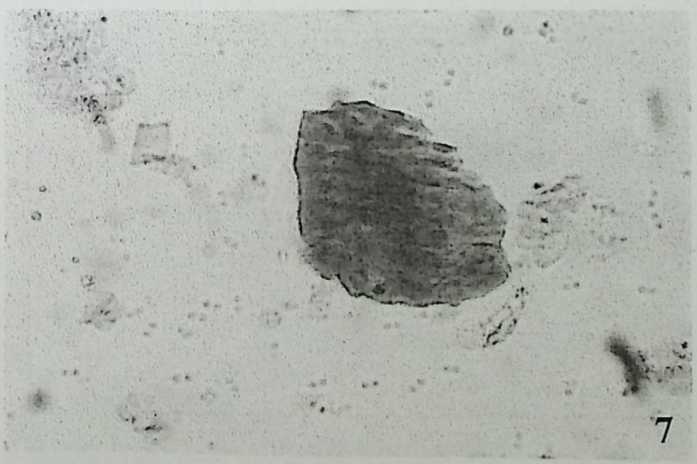
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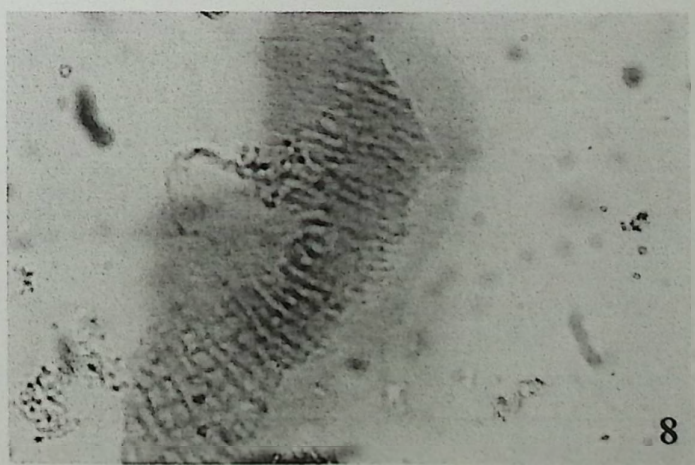
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Plate 3

Fig. 1: Planktonic cyst and its envelope. x 1150

Fig. 2: cf. *Salvinia* – fragment of microsporangial tissue ecompassing the oval spaces (at the rim of fragment) after embedding microspore. x 640

Fig. 3: Remain of epidermal tissue with well preserved cells. x 600

Fig. 4: *Liquidambar*. x 830

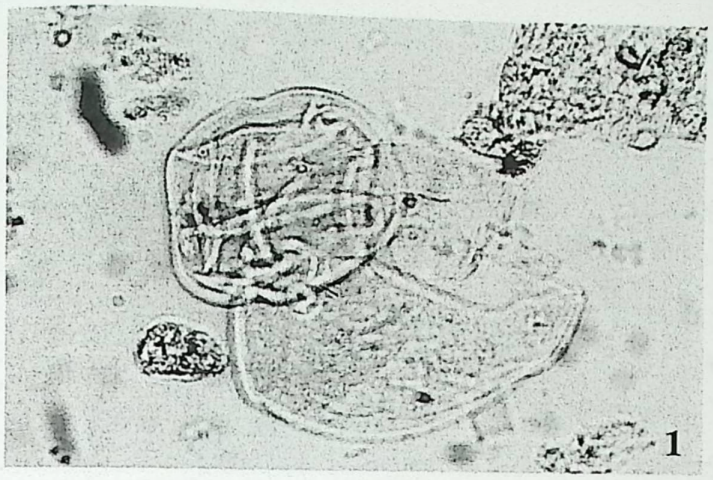
Fig. 5: cf. *Lygodium* – or ?? *Acrostichum*. x 900

Fig. 6: The same specimen at higher magnification and another focus level. x 1100

Fig. 7: Four-porate *Alnus*. x 1500

Fig. 8: Ulmaceae, *Ulmus*. x 1300

Plate 3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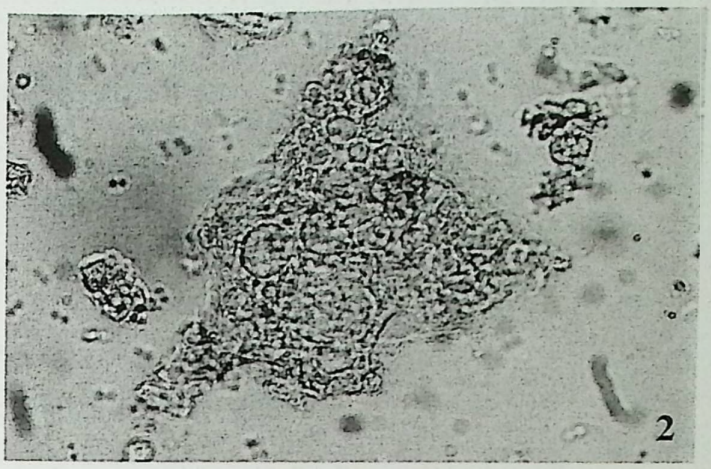
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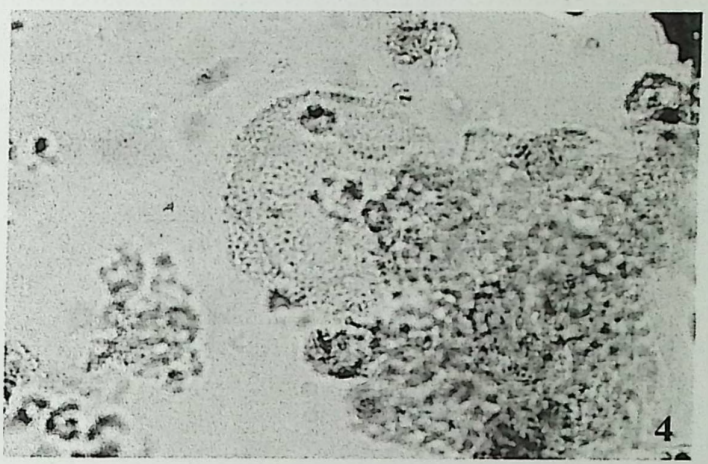
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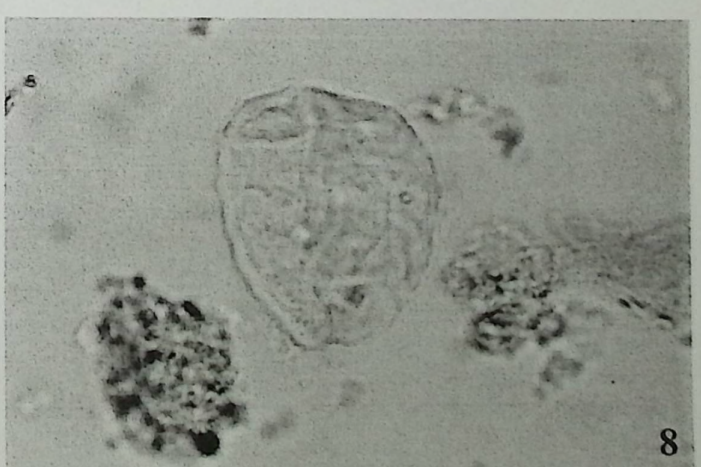
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Plate 4

Fig. 1: An isolated hair from the bundle-hair of the *Byttneriophyllum tiliaefolium* (Al.Braun) Knobl. et Kvač. x 900

Fig. 2: Xylitic splinter preserved as fusinite. x 900

Fig. 3: cf. *Cathaya – Pityosporites microalatus* – type. x 1000

Fig. 4: Taxodiaceae – cf. *Glyptostrobus* - *Inaperturopollenites hiatus* (R. Pot.) Th. et Pf. x 1000

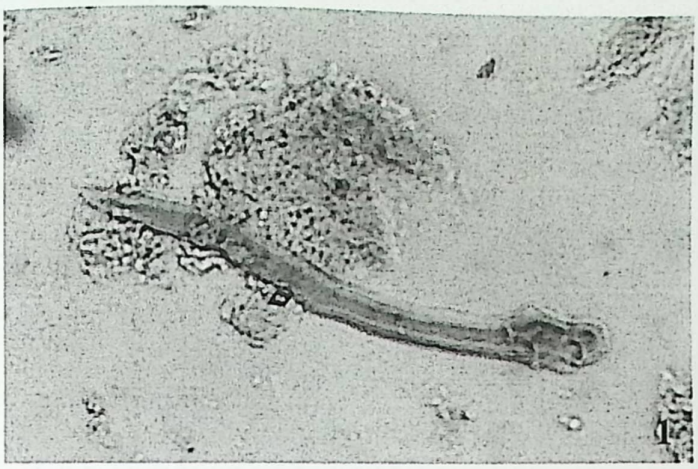
Fig. 5: *Pinus – Pityosporites labdacus* with Fe hydroxyde flakes after pyrite. x 830

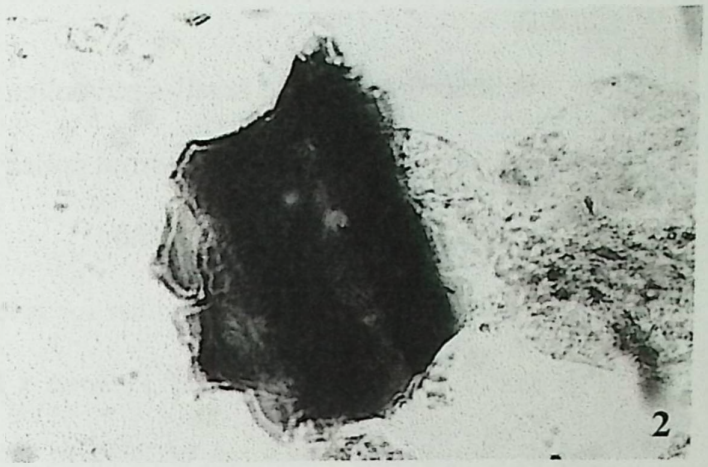
Fig. 6: *Pinus* - *Pityosporites labdacus* with cubic pyrite microcrystals (dark spots). x 910

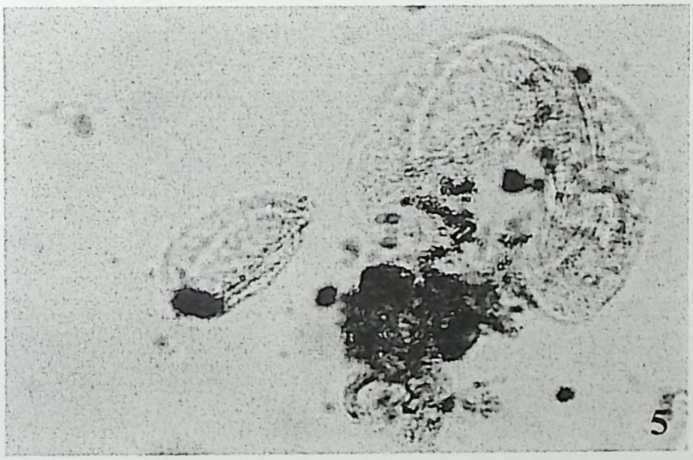
Fig. 7: *Tsuga – Tsuga diversifolia*-type, *Zonalapollenites* cf. *igniculus* (R.Pot.)Th. et Pf. x 830

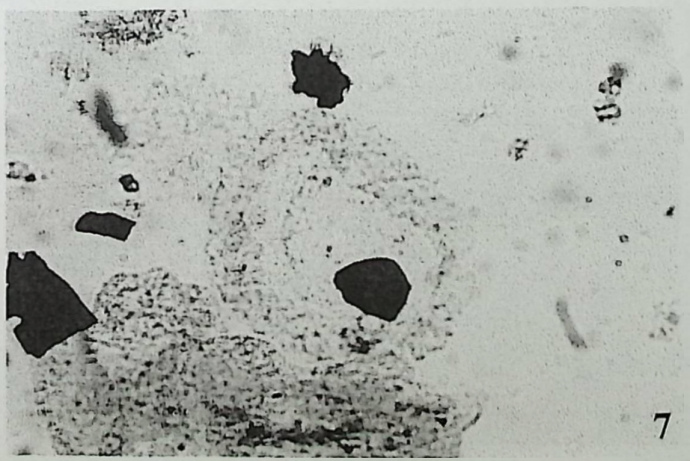
Fig. 8: *Cedrus* vel *Picea – Pityosporites* sp. x 850

Plate 4









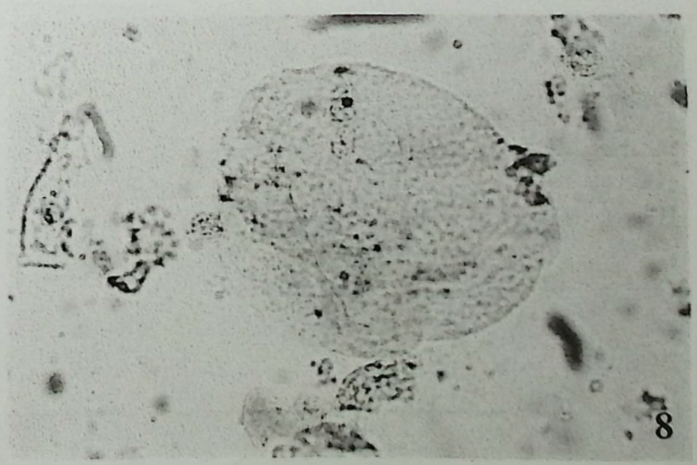


Plate 5

Fig. 1: Pinaceae – *Pinus* – small-sized pollen group. x 880

Fig. 2: Pinaceae – *Pinus* – small-sized pollen group, another focus level. (x 950)

Fig. 3: *Pinus silvestris* –type. x 1100

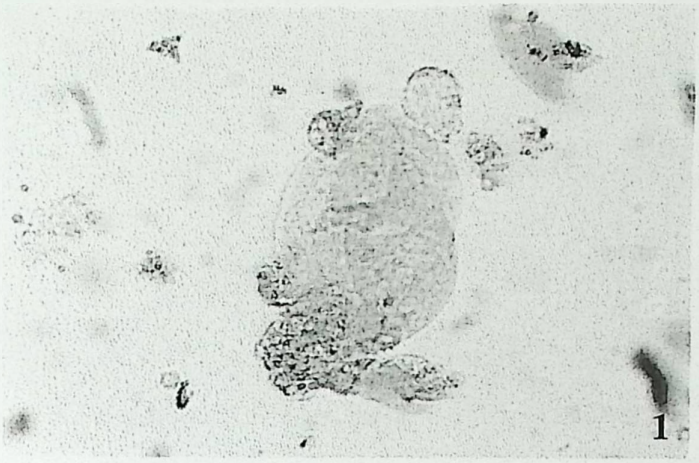
Fig. 4: *Pinus silvestris* –type, another focus level

Fig. 5: Five-porate Ulmaceae, cf. *Zelkova*. x 1100

Fig. 6: Five-porate Ulmaceae, cf. *Zelkova,* another focus level.

Fig. 7: Ulmaceae, *Ulmus*, ?*Planera*. x 1100

Fig. 8: Four-porate Ulmaceae, cf. *Zelkova*. x 960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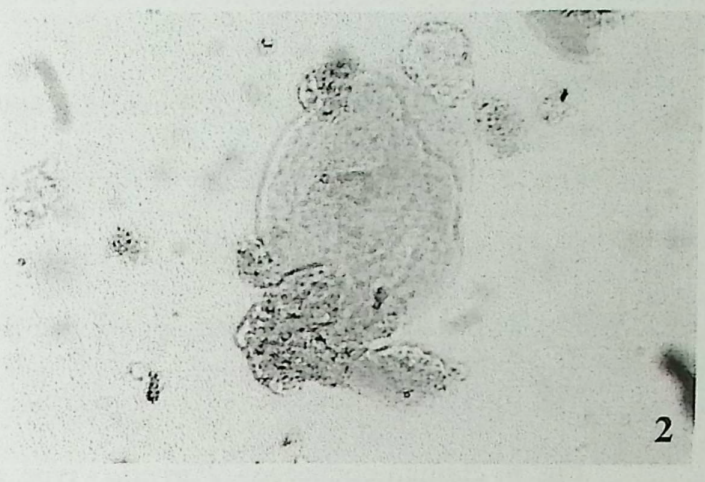
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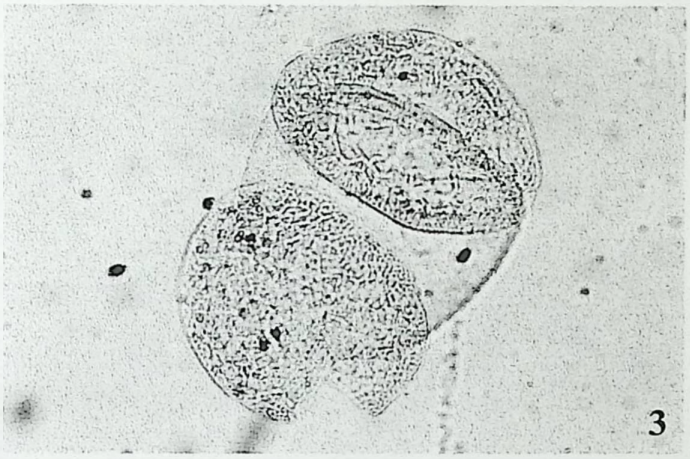
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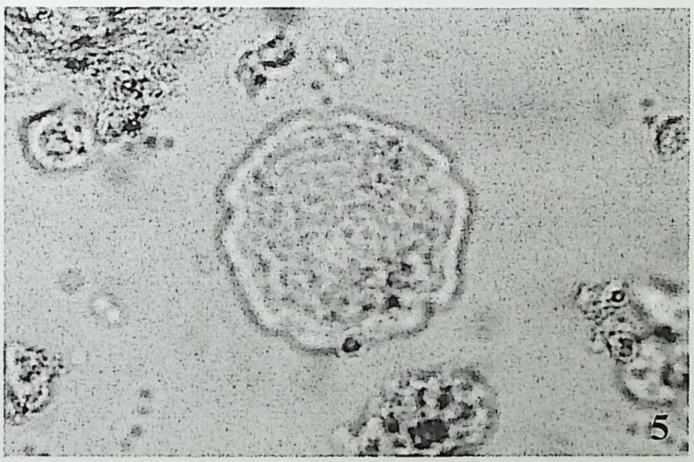
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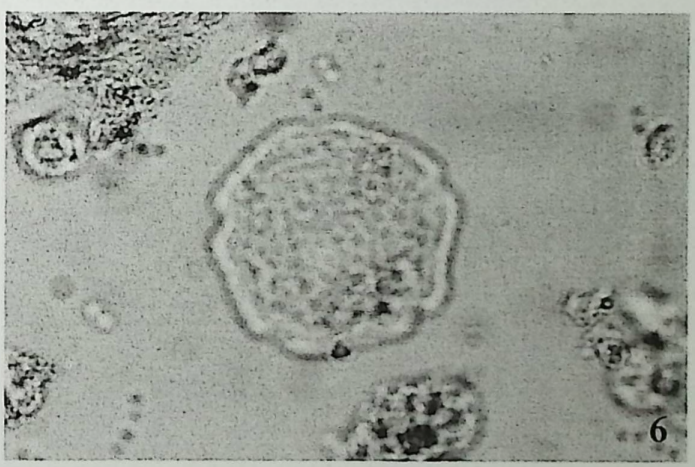
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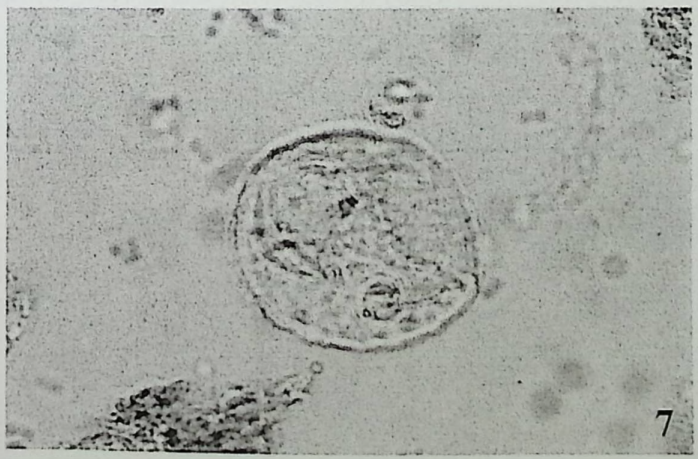
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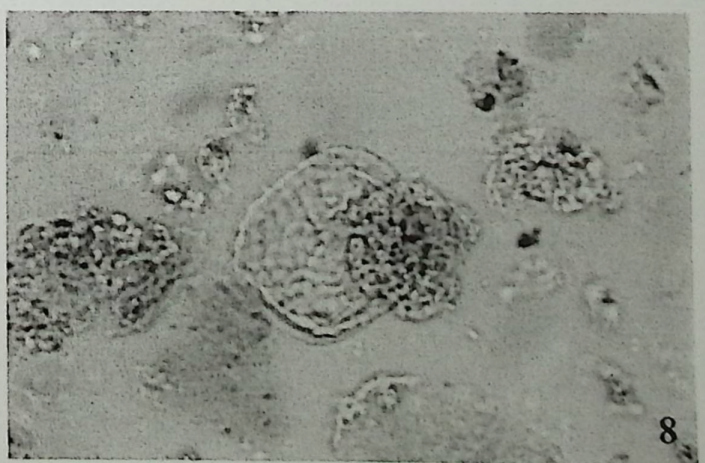
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Plate 6

Fig. 1: *Celtis – Celtipollis komloensis* Nagy. x 1000

Fig. 2: Fagaceae, cf. *Quercus* or *Eotrigonobalanus* – type. x 1200

Fig. 3: *Intratriporopollenites* sp. x 1300

Fig. 4: *Intratriporopollenites* sp., another focus level.

Fig. 5: Hamamelidaceae – *Parrotia* – type. x 1200

Fig. 6: Hamamelidaceae – *Parrotia* - type, another focus level.

Fig. 7: *Fagus.* x 1200

Fig. 8: *Fagus*; another focus level.

Plate 6


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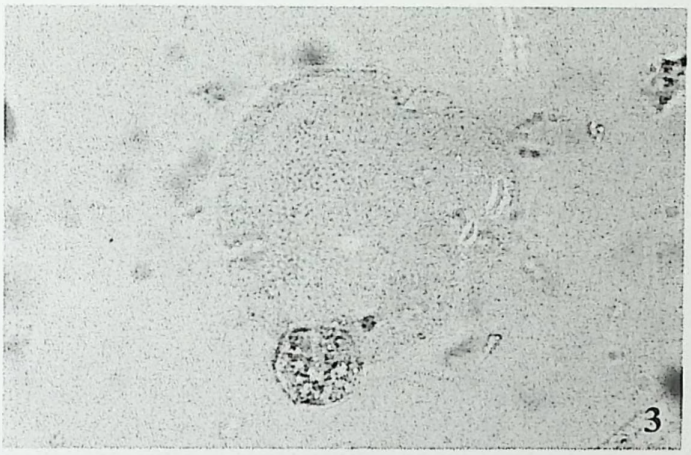
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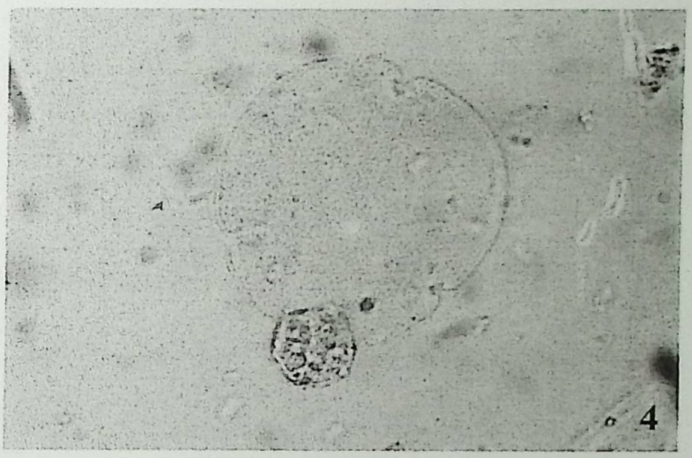
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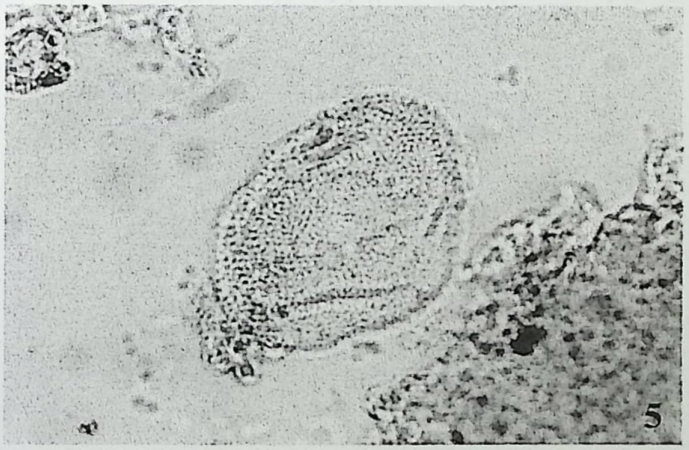
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Plate 7

Fig. 1: Incertae sedis; probably animal remains. x 1000

Fig. 2: Incertae sedis; probably animal remains, another focus level

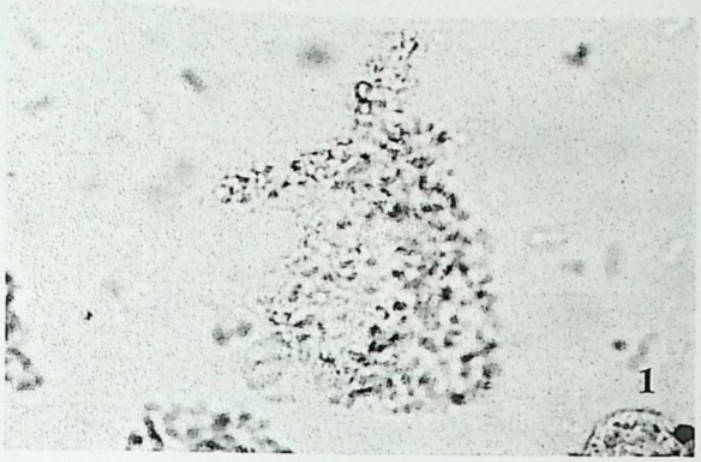
Fig. 3: Juglandaceae; *Engelhardia* vel *Platycarya.* x 1000

Fig. 4: cf. Rosaceae - *Rubus* – type. x 890

Fig. 5: cf. *Nyssa* – cf. *Nyssapollenites* sp. x 1300

Fig. 6: cf. *Nyssa*; cf. *Nyssapollenites* sp., lower magnification and another focus level

Plate 7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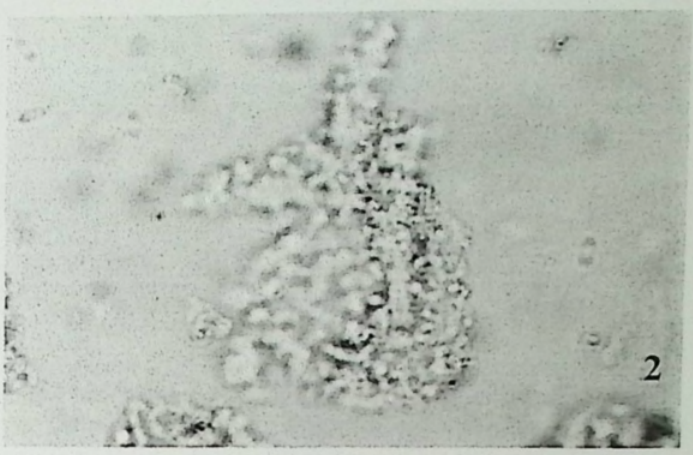
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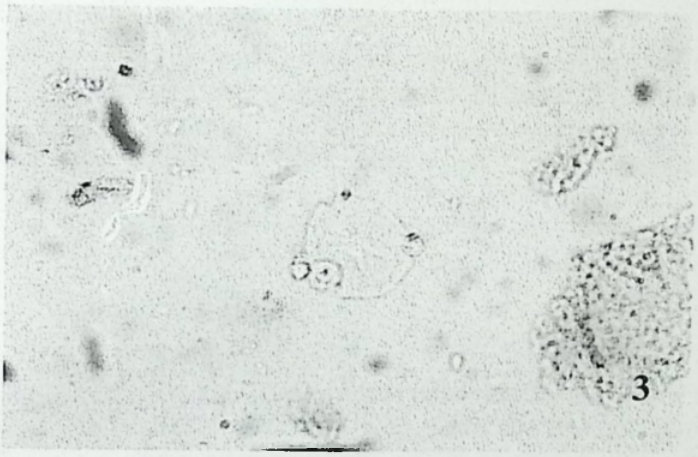
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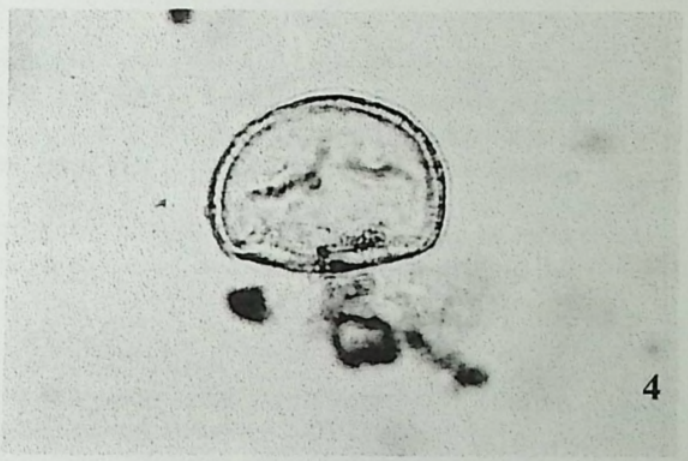
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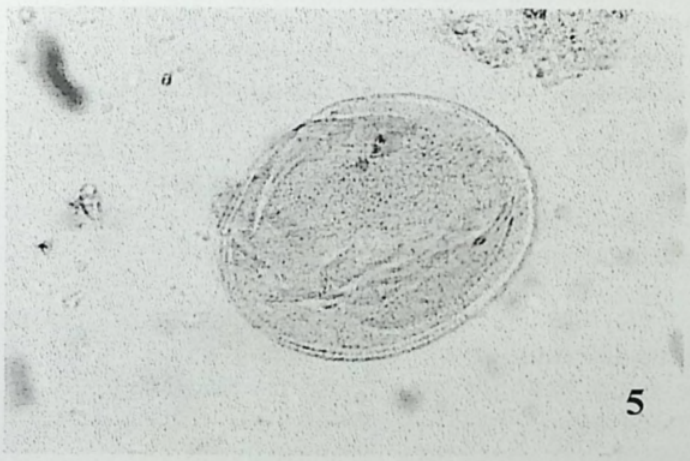
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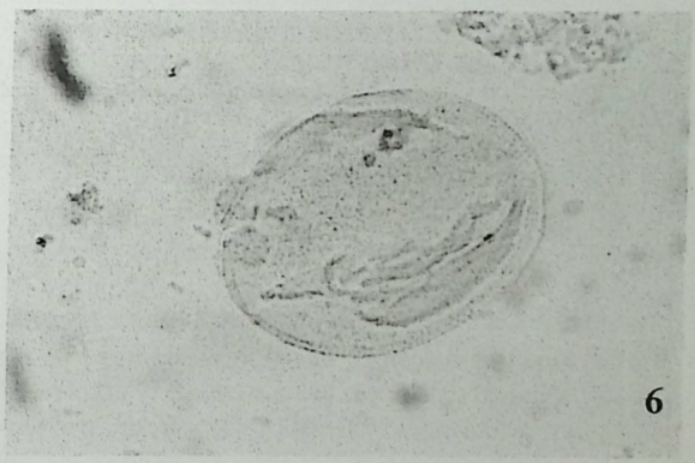
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