Neogene macro-and palynoflora from Hungary and their relationship

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The macrofloral remains recorded from the Egerian, Eggenburgian, Ottnangian, Karpatian, Badenian, Sarmatian, Pannonian and Pontian of the Hungarian Neogene have been reviewed. The macroflora has been compared with the palynoflora wherever recorded from the above stages, and their relationship has been evalutated.

Key-words—Macroflora, palynoflora, Neogene, Hungary.

INTRODUCTION

THE microfossils of plant origin in many cases could be identified only to a phylum level, and rarely up to the generic and species levels. In our studies macrofossils along with microfossils (palynofossils) were instrumental for proper interpretations, primarily when the one and the same locality was to be evalutaed. It is of great importance to compare palynological data with those of the macrofloras.

In recent years attempts have been made to perform an integrated study of macrofossils and palynological data (Nagy & Pálfalvy 1960, 1961, 1963).

The major studies on the Neogene macroflora of Hungary are linked with G. Andreánszky and his co-workers. Andreánszky (1966) studied the Egerian flora, the Middle and Upper Miocene and Pliocene floras, and the Sarmatian floras (Andreánszky, 1949, 1959). Pálfalvy (1964, 1967) studied the flora of different periods, ranging from Egerian to Lower Pliocene but was mainly involved in the Middle Miocene of Hungary. Hably (1982, 1985) studied many floral assemblages of the Egerian and the Lower Miocene flora of Ipolytarnóc. A summary on Neogene gymnospermous and angiospermous fossil woods can be seen in Greguss's work (1967, 1969). From these studies attempts have been made to compare the data with that of the Neogene palynoflora of Hungary. For this only those macrofossils have been selected which are referred along with the palynological data, without attempting to identify them upto species level. The taxa not included in both the lists have not been used.

MACRO AND PALYNOFLORAL RELATIONSHIPS

Andreánszky (1966, p.23) mentions the exposure of the Eger Brickyard as containing the richest Upper Oligocene-Lower Miocene flora, listing 123 species. Included in the palynological data, 304 taxa are from the Egerian Formation. In addition to the holostratotype, borehole sections of other Egerian formations were also dealt with. Data on macroflora represent 40.4% of the palynological data. From the macrofloral fossils of the Egerian, 49 species are turned out to be correlatable with palynological data, without attempting to identify them beyond generic level. This means that the 54 spore-pollen species representing 17.8% of the total amount of spore-pollen species were encountered in the Egerian formations. The number of comparable species of fern and gymnosperms is very small (see Egerian Table 1), whereas the angiosperms are fairly good in number. Despite this, the macrofloral data yielded more information on floral relationships than those of microflora (Table 1).

Table 1. Egerian

Macroflora	Extant taxa	Microflora
Osmunda lignitum Gieb.	*Osmunda javanica* B.	*Osmundacidites nanus*
O. parschlungiana/Ung./Andreánszky	*O. regalis* L.	*O. primarius*
		O. primarius crassiprimarius
Blechnum braunii Ett.	*Blechnum brasiliense* Desv.	*Laevigatosporites discordatus discordatus*
		L. peseudodiscordatus
Asplenium egedense Andr.	Asplenium marinum	*L. nitidus*
		Punctatisporites crassieximus
Pinus taedaeformis/Ung./Heer	*Pinus taeda* L.	*P. crassimaximus*
		Pinuspollenites latisaccatus
P. palaeostrobus Ett.	*P. strobus* L.	*P. labdacus*
Sequoia langsdorffi/Brgt/Heer	*Metasequoia*	*Taxodiaceaepollenites* sp.
S. couttsiae Heer	*Glyptostrobus*	*Taxodiaceaepollenites* sp.
Callitrites brongniarti Endl.	*Callitris*	*Cupressacites* sp.
Magnolia cf. *M. grandiflora* L.	*Magnolia*	*Magnoliaepollenites simplex*
Arbutus praeunedo Andr.	*Arbutus unedo* L.	*Ericipites callidus*
		E. discretus
		E. ericius
Lomatites aquensis Sap.	*Lomatia longifolia*	*Proteacidites egerensis*
	A. Br./Proteaceae	
Alnus cf. *A. nepalensis* Don	*Alnus nepalensis* Don	*Alnipollenites verus*
Carpinus grandis Ung.	*Carpinus japonica* Bl.	*Carpinipites carpinoides*
Castanopsis ? furcinervis Rossm./Kr. *et* Wld.	*Castanopsis* sp.	*Tricolporopollenites cingulum fusus*
Lithocarpus colchica Kolak.	*Lithocarpus*/*Pasania*/	*T. cing. pusillus*
	pseudomolucca Rehd.	
Quercus tenerrima Web.	*Quercus chrysolepis* Liebm.	*T. cing. oviformis*
Q. gigantum Ett.	*Q. pagodaefolia*/Aske/Elliott	*Quercopollenites granulatus*
Q. crassipetiolata Andr. *et* Kov.		*Tricolporopollenites henrici*
		T. microhenrici
		T. porasper
		T. villensis
		T. minimus
Engelhardtia brongniarti Sap.	*Engelhardtia* sp.	*Engelhardtioides microcoryphaeus*
Pterocarya denticulata /O.Web./Heer	*Pterocarya fraxinifolia*/	*Pterocaryapollenites stellatus*
	Lam/Spach.	
Juglans cf. *J. regia* L.	*Juglans regia* L.	*Juglanspollenites verus*
Juglans cf. *J. cinerea* L.	*J. cinerea* L.	*J. maculosus*
Carya felcata And.	*Carya olivaeformis* Nutt.	*Caryapollenites simplex simplex*
Myrica/*Comptonia*/*acutiloba* Btg.	*Comptonia asplenifolia*/L./Spreng.	
Myrica cf. *M. javanica* Bl.	*Myrica javanica* Bl.	*Myricipites bituitus*
Myrica cf. *M. longifolia* Teysm. *et* Binn.	*M. longifolia* Teysm. *et* Binn.	*M. rurensis*
M. lignitum/Ung./Saporta	?	*M. myricoides*
Salix levateri Heer	*Salix. russeliana* Sm.	
S. arcinervia O. Web.	*Salix* sp.	*Salixipollenites densibaculatus*
S. varians Goepp.	*S. fragilis* L.	*S. helveticus*
Ulmus sp. I.	*Ulmus americana* L.	*Ulmipollenites miocaenicus*
Ulmus sp. II.	?	*U. polyangulus*
Ulmus sp. III.	?	*U. stillatus*
Ulmus IV.	?	*U. undulosus*
Ulmus V.	*Ulmus levis* Pall.	
Rhus succedanoides Andr.	*Rhus succedanea* Sieb. *et.* Zucc.	*Rhoipites* sp.
Rhus. cf. *R. glabra* L.	*R. glabra* L.	*Rhoipites pseudocingulum*
Acer hungaricum Andr.	*A. pennsylvanicum* L.	
A. trilobatum/Sternbg/ A. Br.	*A. rubrum* L.	*Aceripollenites reticulatus*
A. agriense Andr.	?	
Rhamnus cf. *R. purshiana* DC.	*R. purshiana* DC.	*Rhamnaceaepollenites triquetrus*
R. deletus Heer	*R. confluens* Boiss.	
Symplocos cf. *S. phanerophlebia* Meer.	*S. phanerophlebia* Meer.	*Porocolpopollenites stereoformis*

Symplocos cf. *S. rubiginosa* Wall.	*S. rubiginosa* Wall.	*P. triangulus*
Cornus büchii Heer	*C. paniculata* L' Hérit.	*Tricolporopollenites hedwigae*
Tuzsonia hungarica Andr.	?	*Dicolpopollenites calamoides*
Phoenicites leganyii Andr.	?	*Sabalpollenites papillosus*
Phoenicites sp.	?	*S. retareolatus*
		Monocolpopollenites tranquillus

The macrofloral data of the Eggenburgian Stage are rather scarce. A few finds are mentioned by Jablonszky (1914), Rásky (1959) and Pálfalvy (1976) from the Ipolytarnóc Sandstone Slab with footprint records. Sandstone is less suitable for preserving pollen grains as well as macrofossils. Comparing the floral list compiled by Jablonszky and Pálfalvy with of borehole sections Püspökhatvan 4, (rich in pollen); it can be stated that all the taxa that can be botanically identified are included therein, except for species of Lauraceae and Cyperaceae families and the *Araceites hungaricus* species described by Rásky (1959).

Hably (1985) repeatedly studied the flora of the sandstone and mentions that *Ulmus pyramidalis* Göepp occurs only in the sandstone. It is also noted that the flora cannot be separated from that of the overlying tuffs. The Eggenburgian flora of the sandstone was largely preserved by tuff beds corresponding to the Ottnangian, substage (Rásky, 1959 & Hably, 1985).

The Ottnangian flora of Ipolytarnóc was published by Hably (1985) which includes 64 species. It is recommended not to compare the macroflora on a quantitative basis, which is indicative of the lower part of the Ottnangian, with the palynological data having 209 species recorded from a number of boreholes from all over the country. However, the macrofloral list was compared with the palynological data in the following manner (Table 2).

Table 2. Ottnangian

Macroflora	Microflora
Dryopteris sp.	*Leiotriletes* sp.
Asplenium sp.	*Laevigatosporites* sp.
Pinus saturni Ung.	
Pinuxylon tarnocziense/Tuzson/Greguss	*Pinuspollenites labdacus*
Magnolia (5 species)	*Magnoliaepollenites simplex*
Quercus apocynophyllum Ettings.	*Tricolporopollenites henrici*
"*Quercus*" *cruciata* A. Braun	*T. microhenrici*
Engelhardtia orsbergensis	*Engelhardtioidites microcoryphaeus*
Cyclocarya cyclocarpa/Schlech./Knobl.	*Caryapollenites* sp.
	Pterocaryapollenites sp.
Myrica hakeafolia/Ung./Sap.	*Myricipites* sp.
Ebenaceae	*Sapotaceoidaepollenites* sp. Ebenales
Caesalpiniaceae : *Podogonium*	*Tricolporopollenites*
oehningensis/koening/kirchh.	*caesalpiniaceaeformis*
Myrtophyllum sp.	*Myrtaceidites myrtiformis*
Acer tricuspidatum Bronn	*Aceripollenites rotundus*
Oreopanax protomulticaulis Rásky/Hably	*Araliaceoipollenites edmundi*
Schefflera gaudini/Sap./Rásky	*A. edmundi* f. *reticulatus*
S. protolucescens Rásky	*A. euphorii*
Tricalsya protojavanica Rásky	Rubiaceae sp.
aff. *Andromeda* sp.	*Ericipites baculatus*
	E. ericius
	E. discretus
Sabal major/Ung./Heer	*Sabalpollenites retareolatus*

The representative of *Dryopteris* and *Asplenium* species mentioned by Hably as belonging to the Polypodiaceae are likely to be encountered in our material in great number with small *Leiotriletes* and *Laevigatosporites* species. The *Pinus saturni* Ung., *Pinus* sp., detrital fossils of conifers and the world wide-known *Pinuxylon tarnocziense* (Tuzson) Greguss can also be correlated with *Pinuspollenites labdacus*. Hably has described 5 species of *Magnolia* species. As for *Magnolia dianae* Unger, Hably reported it from the Egerian flora and also from the Ottnangian, Karpatian and Sarmatian beds. The pollen *Magnoliaepollenites*

simplex has so far been found in Egerian, Ottnagian, Middle and Upper Badenian sediments.

Two species, namely *Quercus apocynophyllum* and *Q. cruciata* assigned to the genus *Quercus* are partly of uncertain botanical relationship and can be correlated with *Tricolporollenites henrici* and *T. microhenrici*. *Engelhardtia orsbergensis* can be compared with *Engelhardtioidites microcoryphaeus*. *Cyclocarya cyclocarpa* is regarded as *Carya* or *Pterocarya* species, and thus it can represent, on palynological basis, the genera *Caryapollenites* and *Pterocaryapollenites*.

According to Hably 1985 the *"Myrica" hakeafolia* is assigned to the Myricaceae but is said to be of uncertain taxonomic position. Its comparison with *Myricipites* species, which occur in significant amount throughout the Neogene and particularly in the Ottnangian, is uncertain.

Podogonium oehningense (Koenig) Kirchheimer assigned to the Caesalpiniaceae family is present in the Lower Miocene. A species described as *Tricolporopollenites caesalpiniaceaeformis* assigned to the Caesalpiniaceae has been identified from the Ottnangian in borehole Zengővarkony 45.

Leaf fossils of *Myrtophyllum* sp. assigned to Myrtaceae can be correlated with the pollen of *Myrtaceidites myrtiformis* Sim., described by Simoncsics from the Salgóterján Brown Coal Formation. This pollen has been found in the Egerian (borehole Fót 1) and Ottnangian part (911.0 m) of borehole section Nagygörbo 1.

Acer tricuspidatum can be correlated with *Aceripollenites routundus*. Of the Araliaceae family, 3 macrofossils, viz., *Oreopanax protomulticaulis* and 2 species of *Schefflera* (*S. gaudini* and *S. protolucescens*, are included. In the Ottnangian Formation of Hungary, 3 pollen species assigned to the Araliaceae family are included, viz., *Araliaceoipollenits edmundi*, *A. edmundi cf. raticulatus* and *A. euphorii*. However, I do not mean that they actually correspond to the aforesaid macrospecies. Hably (1982) also mentions the occurrence of the genus *Oreopanax* in the Oilgocene of South France. The *Araliaceoipollenites* species are of Paleogene origin.

Rásky (1955) described *Tricalsya protojavanica*, a macrofossil belonging to the Rubiaceae family, which also includes pollen from the Ottnangian of borehole section Várpalota 133.

A fossil leaf, *Andromeda* sp. of uncertain affinity of the Ericaceae family was compared with the genus *Vaccinium* by Hably (1985). Three species of *Ericipites* are included in the Ottnangian flora, namely, *E. baculatus*, *E. ericius* and *E. discretus*. Of Palmae, *Calamus noszky* and *Sabal major* are found at Ipolytarnóc. *Calamus* is not included in the palynoflora but two other palm species, namely *Monocolpopollenites tranqullus* and *Sabalpollenites retareolatus* are included therein.

A comprehensive study of the Karpatian-Badenian flora in the Mecsek Mountains (Pálfalvy, 1964) has provided a basis for the correlation of the Karpatian-Badenian macroflora with the palynoflora. Pálfalvy does not differentiate the species belonging to the Karpatian (Helvetion) from those of the Badenian (Tortonian) beds. However, no other comprehensive study on this aspect is available. Pálfalvy's work has been used in the present study (Table 3).

Table 3

Karpatian-Badenian	Karpatian	Badenian
Osmunda heeri Gaud.	*Osmundacidites primarius crassiprimar.*	*O.primariumcrassiprimarius* + 4 species
Lygodium gaudini Heer	*Leiotriletes* species	*Leiotriletes* species
Gleichenites hungaricus Pálf.	*Gleicheniidites rimosus*	*Gleicheniidites rimosus*
Ginkgo adiantoides Ung.	*Ginkgoretectina neogenica*	*G. neogenica*
Pinus palaeoistrobus Ett.	*Pinuspollenites labdacus*	*P. labdacus*
P. preasilvestris Ett.	*P. labdacus*	*P. labdacus*
P. teadaeformis/Ung./Heer	*P. latisaccatus latisaccatus*	*P. latisaccatus latisaccatus*
Keteleeria rhenana Kr.	*Keteleeriaepollenites komloënsis*	*Keteleeriaepollenites komloënsis*
Cedrus miocaenica Lauby	*Cedripites hidasensis*	*Cedripites hidasensis*
Taxodium dubium/Stembg/Heer	*Taxodiaceaepollenites* sp.	*Taxodiaceaepollenites* sp.
Sequoia langsdorfii /Brgt./Heer	*Sequoiapollenites polyformosus*	*Sequoiapollenites polyformosus*
Glyptostrobus europaeus/Brgt./Heer	*Taxodiaceaepollenites* sp.	*Taxodiaceaepollenites* sp.
Ephedrites sotzkianus Ung.	8 *Ephedripites* species	12 *Ephedripites* species
Magnolia diannae Ung.		*Magnoliaepollenites simplex*
Liquidambar europaea A. Br.	*Liquidambarpollenites styracifluaeformis*	*L. styracifluaeformis*
Acacia parschlugiana Ung.	*Acaciapollenites varpalotaënsis*	
Nyssa disseminata /Ludw./Kirchh.	*Nyssapollenites contortus*	*N. contortus*
Myrtus sp.	*Myrtaceidites myrtiformis*	*M. mesoneus*

Pteleaecarpum bronnii/Ung./Wld.		
Rhus heufleri Heer	*Rutacearumpollenites komloënsis*	*R. komloënsis*
R. pyrrhae Ung.	*Rhoipites pseudocingulum*	*R. pseudocingulum*
Acer decipiens A. Br.		
A. inaequilobum Kov.	*Aceripollenites reticulatus*	*A. reticulatus*
A. mecsekense Andr.	*A. rotundus*	*A. rotundus*
Ilex berberidifolia Heer	*Ilexpollenites iliacus*	*I. iliacus*
Cyrilla hungarica Pálf.	*Cyrillaceaepollenites exactus*	*C. exactus*
	C. megaexactus	*C. megaexactus*
Tetrastigmophyllum hungaricum Andr.		Rubiaceae sp.
Cornus graeffi/Heer/Hantk.	*Tricolporopollenites edmundi*	*T. edmundi* f. *major*
	f. *major*	
Tilia milleri Ett.	6 *Intratriporopollenites* spp.	6 *Intratriporopollenites* species
Leucothoe protogaea Ung.	5 *Ericipites* species	4 *Ericipites* species
Vaccinium rottense Ung.		
Achras pitecobroma Ung.	11 *Sapotaceoidaepollenites* species	12 *Sapotaceoidaepollenites* species
Mimusops hungarica Andr.		
Symplocos lignitarum/Quenstedt/Kirchh.	3 *Porocolpollenites* species	7 *Porocolpopollenites* species
Polygonum cardiocarpum Heer	3 *Persicarioipollenites* species	2 *Persicarioipollenites* species
Ficus giebeli Heer		Moraceae sp.
Ulmus carpinoides Goepp.	3 *Ulmipollenites* species	4 *Ulmipollenites* species
U. longifolia Ung.		
Celtis hungarica Pálf.	*Celtipollenites komloënsis*	*C. komloënsis*
Zelkova ungeri /Ett./Kov.	*Zelkovaepollenites potoniei*	*Z. potoniei*
Zelkova praelonga Ung.	*Z. thiergarti*	*Z. thiergarti*
Carpinus grandis Ung.	*Carpinipites carpinoides*	*C. carpinoides*
C. kisseri Berger /fruct./		
Corylus insignis Heer		*Triporopollenites coryloides*
Betula prisca Ett.	*Betulaepollenites betuloides*	*B. betuloides*
B. subpubescens Goepp.		
Alnus feroniae/Ung./Cz.	*Alnipollenites verus*	*A. verus*
A. gracilis Ung.		
A. attenuata Goepp.		
Fagus deucalionis Ung.	5 *Faguspollenites* species	6 *Faguspollenites* species
Castanea cf. *C. alavia* Ung.	*Tricolporopollenites cingulum oviformis*	*T. cingulum oviformis*
Castanopsis decheni/Web./Kr. et Wld.	*T. cingulum pusillus*	*T. cingulum pusillus*
Quercus böckhi Staub		
Q. kubinyi /Kov./Cz.	*Quercopollenites granulatus*	*Q. granulatus*
Q. mediterranea Ung.	*Q. robur typus*	*Q. robur typus*
Q. neriifolia A. Br.	*Q. petrea typus*	*Q. petrea typus*
Juglans acuminata A. Br.	*Juglanspollenites verus*	*J. maculosus*
J. sieboldiana Max.		*J. verus*
Pterocarya denticulata /Web/Heer	*Pterocaryapollenites stellatus*	*P. mecsekensis*
P. castaneaefolia /Goepp./Schlecht		*P. rotiundiformis*
Carya bilinica Ung.	*Caryapollenites simplex simplex*	*C. simplex simplex*
Engelhardtia marcoptera/Brongt./Ett.	*Engelhartioidites microcoryphnaeus*	*E. microcoryphaeus*
Myrica acuminata/Ung./Sap.	*Myricipites myricoides*	*M. myricoides*
M. integerrima Kr. et Weyl.	*M. rurensis*	*M. rurensis*
M. lignitum/Ung./Sap.		
Salix angusta A. Br.	*Salixipollenites densibaculatus*	*S. densibaculatus*
S. media A. Br.	*S. helveticus*	*S. helveticus*
Cyperites sp.	*Cyperaceaepollenites neogenicus*	*C. neogenicus*
Phragmites oeningensis A. Br.	*Graminidites media*	*G. crassiglobosus ?*
Typha latissima A. Br	*Tetradomonoporites typhoides*	
Trachycarpus rhapifolia/Sternbg./Takht.	*Arecipites trachycarpoides*	*A. trachycarpoides*
Phoenicites daemonorops/Ung./Heer	*Monocolpopollenites tranquillus*	
Sabal major Ung.	*Sabalpollenites retareolatus*	*S. retareolatus*

A total of 78 macroflora species can be compared with 109 taxa of the Karpatian-Badenian palynoflora. This quantitative difference itself points to the fact that the taxa have usually been correlated to the generic level.

In his study on the Sarmatian macroflora Andreánszky (1959) gives summary of comprehensive studies and also presents a number of data from Greguss's work. Of marcofossils, those that can be correlated with the palynological data are listed in Table 4. one hundred one species of macroflora could be correlated with 85 palynological species.

Table 4. Sarmatian

Macroflora	Microflora
Riccia cf. *R. frostii* Aust.	*Ricciaesporites hungaricus*
Osmunda parschlugiana /Ung./Andreánszky	*Osmundacidites nanus*
	O. primarius primarius
Pteris paleoaurita É. Kovács	*Polypodiaceoisporites spiniverrucatus/Pteris pellucida*
Ginkgo adiantoides /Ung./Heer	*Ginkgoretectina neogenica*
Cedroxylon sp. Andreánszky	4 *Cedripites* species
Abies sp.	*Abiespollenites absolutus*
Picea /vel *Tsuga*/	5 *Tsugaepollenites* species
Picea sp.	*Piceapollenites neogenicus*
Pinus/Taeda/rigios Ung.	*Pinuspollenites latisaccatus media*
Pinus kotschyana Ung.	*P. labdacus*
Pinus cf. *P. halepensis* Mill.	
Taxodium distichum miocaenicum Heer	*Taxodiaceaepollenites* sp.
Taxodioxylon taxodii Gothan	*Taxodiaceaepollenites* sp.
Sequoia langsdorfii /Brgt./ Heer	*Taxodiaceaepollenites* sp.
Taxodioxylon sequiadendri Andreánszky	*Sequiapollenites polyformosus*
Tetracentron hungaricum Andreánszky	
Tetracentronites hungaricus Greguss	*Tetracentracearumpollenites minimus*
Liquidambar europaea A. Br.	*Liquidambarpollenites styracifluaeformis*
Nyssa hungarica Andr.	*Nyssapollenites contortus*
	N. pseudocruciatus
Elaeaganus acuminata Web.	*Slovakipollis elaeagnoides*
Rhus cf. *R. glabra* L.	*Rhoipites pseudocingulum*
Acer 87 species	*Aceripollenites rotundus*
	A. reticulatus
Ilex parschlugiana Ung.	*Ilexpollenites iliacus*
Ilex oreadum Ett.	*I. margaritatus*
I. cf. *I. mexopaca* Ait.	*I. propinquus*
Vitis cf. *V. aestivalis* Mchx.	*Vitipites sarmaticus*
V. tokayensis Stur	
V. teutonica A. Br.	
Viburnum hungaricum Andr.	*Caprifoliipites andreanszkyi*
Viburnum cf. *V. dentatum* L.	*Viburnum rhytidophyllum* Hemsl.
Viburnum cf. *V. tinus* L.	*Caprifoliipites gracilis*
Cornus cf. *C. sanguinea* L.	*Tricolporopollenites edmundi major*
Cornus cf. *C. ralba*	*T. hedvigae*
C. praeamomum É. Kovács	
Lonicera cf. *L. chrysantha* Turcz.	*Lonicerapollis gallwitzi*
L. lipthayana Andr.	
Tilia vindobonensis Stur	5 *Intratriporopollenites* species
T. sarmatica Andreánszky	
Sterculiaceae 2 species	*Reevesiapollis triangulus*
Ligustrum sp.	*Oleoidearumpollenites chinense*
Ericaceae species 3	5 *Ericipites* species
	S. rotundus
Sapotacites minor Ett.	*S. sapotoides*
Ulmus 12 species	*Ulmipollenites stillatus*
	U. undulosus
Zelkova 6 species	*Zelkovaepollenites potoniei*

Celtis occidentaloides É. Kov.	*Celtipollenites komloënsis*
Carpinus 7 species	*Carpinipites carpinoides*
Carpinoxylon hungaricum Greguss	
Ostrya 4 species	*Ostryapollenites rhenanus*
Corylus 4 species	*Triporopollenites coryloides*
Betula 14 species	*Betulaepollenites betuloides*
Alnus 23 species	*Alnipollenites verus*
Fagus cf. *F. orientalis* Lipsky	*Faguspollenites gemmatus*
Fagus cf. *F. grandifolia* Ehrh.	*F. minor*
Fagus 6 species	*Faguspollenites* 4 species
Castanea 5 species	*Tricolporopollenites cingulum oviformis*
Quercus 41 species	*Quercopollenites* 3 species
	Tricolporopollenites microhenrici
Juglans 5 species	*Juglanspollenites maculosus*
	J. verus
Carya 5 species	*Caryapollenites simplex*
Pterocarya denticulata /O. Web//Heer	*Pterocaryapollenites mecseknsis*
P. castaneifolia /Gepp./ Schlecht.	*P. rotundiformis*
Pterocaryoxylon sp.	*P. stellatus*
Engelhartia brogniarti Sap.	*Engelhardioidites microcoryhaeus*
Myrica longifolia Ung.	
Myrica. cf. *M. microcarpa* Benth.	*Myricipites myricoides*
M. deperdita Ung.	*M. rurensis*
M. integrifolia Ung.	
Salix angusta A. Br.	
S. cf. *S. fragilis* L.	*Salixipollensites densibaculatus*
S. arcinervia O. Web.	*S. helveticus*
S. pentandra miocaenica Kubát	
Phoenicites sp. I.	*Arceipites chamaedoriformis*
Phoenicites sp. II.	
Eucaryoxylon crystallophorum Müller-Stoll *et* Mädel.	

The Pannonian macrofloras are poorly studied. The macroflora of Rudabanya localities assigned to the Pontian from the Vilmos opencast by Nagy and Pálfalvy (1961) is the older one, whereas the opencast mine Andrássy III is the younger probably (*pers. comm.* L. Kardos). The beds of the Vilmos opencast mine have a poor macro - and microfloral assemblages. Nevertheless, this is the only one to be reckoned since the other one is uncertain. Fossilized tree-trunk described by Horváth (1954) from Megyaszó contributes to the knowledge of the macroflora (Table 5).

Table 5. Pannonian

Macroflora	Microflora
Osmunda parschlugiana /Ung./And.	*Osmundacidites primarius primarius*
Ginkgo adiantoides/Ung./Heer	*Ginkgoretectina neogenica*
Pinus sp.	*Pinuspollenites labdacus*
Taxodium dubium/Stembg./Heer	
Glyptostrobus europaeus/Brgt./ Heer	*Taxodiaceaepollenites* sp.
G. tenerum/Kraus./Cosw.	
Sequioxylon gypsaceum/Goepp./Greg.	
Liquidambar europae A Br.	*Liquidambarpollenites styracifluaeformis*
Liquidambaroxylon speciosum Felix	
Nyssa diseminata /Ludw./Kirchh.	*Nyssapollenites contortus*
	N. pseudocruciatus
Myriophyllum sp.	*Myriophyllumpollenites balatonensis*
	M. minimus
	M. quadratus
Byttneriophyllum tiliaefolium /A.Br./Knobl. et Kvac.	*Reevesiapollis triangulus* /Sterculiaceae
Celtis sp.	*Celtipollenites komloënsis*

Celtixylon cf. *Celtis occidentails* L.	
Zelkova zelkovaefolia /Ung./Buz. et Kotl.	*Zelkovaepollenites potoniei*
Zelkovoxylon cf. *Zelkova serrata* L.	
Ulmus piramidalis Goepp.	*Ulmipollenites polyangulus*
Ulmoxylon cf. *Ulmus americana* L.	*U. stillatus*
	U. undulosus
Carpinus grandis Ung.	*Carpinipites carpinoides*
Betula alba L/*pub escens*/	
Betula macrophylla /Goepp./Heer	*Betulaepollenites betuloides*
Betula cf. *B. lanta* L.	
Betuloxylon priscum Felix	
Alnus crebrinervis É. Kov.	*Alnipollenites verus*
Alnus cf. *A. incana* /L./Inch.	
Alnus cf. *A. japonica* /Thunbg./Steud.	
Fagus sp./cf. *F. orientalis* Lipsky/	*Faguspollenites gemmatus*
F. haidingeri Kov. sensu Knobl.	5 *Faguspollenites* species
Quercus sp.	3 *Quercopollenites* species
Quercinium böckhianum Felix	
Juglans acuminata A. Br.	*Juglanspollenites verus*
Pterocarya castanaefolia /Goepp./Schl.	*Pterocaryapollenites mecseknsis*
	P. rotundus
	P. stellatus
Carya denticulata /Web./Schim p.	*Caryapollenites simplex simplex*
Engelhardtia macroptera /Brgt./Ett	*Engelhardtioidites microcoryphaeus*
Myrica sp.	*Myricipites myricoides*
	M. rurensis
Salix varians Goepp.	*Salixipollenites densibaculatus*
S. palaeo-purpurea Fr. Mey.	
Phragmites oeningensis A. Br.	*Graminidites* sp.
Palmoxylon sp.	*Sabalpollenites retareolatus*
Typha latissmia A. Br.	*Tetradomonoporites typhoides*

A total of 41 macrofossil species were compared with 41 spore-pollen species that might correspond to other genera (see Table 5). This comparison can hardly be used as a tool for dating since all the concerned species can also be found in Pontian formations. Perhaps, this fact allows to make it perceptible that the number of finds is much smaller here than in the Pontian (Table 6).

Table 6. Pontian

Macroflora	Microflora
Ginkgo biloba/lignite/	*Ginkgoretectina neogenica*
Sequoia sp.	*Sequoiapollenites polyformosus*
Taxodioxylon sequoianum /Mercklin/Gothan	
Taxodium distichum miocaenicus Heer	*Toxodiaceapollenites* sp.
Taxodioxylon taxodii Gothan	*Toxodiaceapollenites* sp.
Glyptostrobus europaeus/Brgt./Heer	
Pinus sp.	*Pinuspollenites labdacus*
Pinus cf. *P. cembra* L.	
Trapa cf. *T. natans* L.	*Sporotrapoidites hungaricus*
Acer campestre L. foss.	*Aceripollenites reticulatus*
A. monspessulanum L. foss. *pliocaenicus* Mädler	*A. rotundus*
A. opulifolium pliocaenicum Sap.	
A. polymorphum pliocaenicum Sap.	
Ulmus sp. /fol. et carp./	*Ulmipollenites maculosus*
	U. polyangulus
	U. stillatus
	U. undulosus
Zelkova ungeri Kov.	*Zelkovaepollenites potoniei*
Carpinus betulus L. foss.	*Carpinipites carpinoides*

Alnus cf. *A. incana* Mnch.	*Alnipollenites verus*
Fagus orientalis Lipsky	*Faguspollenites gemmatus*
Quercus drimeia Ung.	*Quercopollenites granulatus*
Quercus cf. *sessiliflora* Salisb.	*Q. petrea typus*
Quercus sp.	*Q. robur typus*
Engelhardtia brogniarti Sap.	*Engelhardtioites microcoryphaeus*
Salix sp.	*Salixipollenites densibaculatus*
Typha sp.	
T. latifolia L.	*Tetradomonoporites typhoides*
T. angustifolia	
Leguminosae/foliola/	Leguminosae sp.

A brief summary of the macroflora of Pontian Formation, in relation to the flora of Rózsaszentmárton was made partly by Pálfalvy (1952) and partly by Vörös (1955). Some 25 macroflora species were within reach for correlating them with 23 pollen species.

Through this contribution I wish to express my respects to Professor Birbal Sahni on the occasion of 14th November 1991, his one hundredth birth anniversary.

REFERENCES

Andreánszky, G. 1949. Néhány páfrány a Kárpátmedence harmadkorából. -Quelques fougéres de l' époque tertiaire du basin Carpatique. *Index Horti. bot. Univ. bpest.* **8** : 1-9.

Andreánszky, G. 1959. *Die Flora der Sarmatischen Stufe in Ungarian.* Akad. émai. Kiadó, Budapest, 360 pp.

Andreánszky, G. 1966. On the Upper Oligocene flora of Hungary. *Stud. biol. hung.* **5** : 1-151.

Greguss, P. 1967. *Fossil Gymnosperm woods in Hungary from the Permian to the Pliocene.* Akademae. Kiadó. Budapest.

Greguss, P. 1969. *Tertiary Angiosperm Woods in Hungary.* Akadémiae. Kiado, Budapest.

Hably, L. 1982. Egerian/Upper Oligocene/macroflora from Veröcemaros/Hungary/. *Acta bot. hung.* **28** (1-2) : 91-111.

Hably, L. 1985. Early Miocene plant fossils from Ipolytarnóc, N. Hungary. *Geol. hung. ser. Pal* **45** : 73-256.

Horváth, E. 1954. A megyaszói Csordáskút kovásodott fatörzseinek vizsgalata. *Bot. Közl. 44* (1-2) : 141-150.

Jablonszky, J, 1914. Die mediterrane Flora von Tarnóc. *M. Kir. Földt. Int. évk.* **22** (4) : 227-274.

Nagy, E. & Pálfavy, I 1960. Neuartige Anwendung palaeobotanischer Methoden in der Stratigraphie. *Acta bot. hung.* **6** (3-4) : 350-353.

Nagy, E. & Palfalvy, I. 1961. Felsó pannoniai novenyek Rudabanyarol. - Plantes du Pannonien superieur dans les environs de Rudabanya. *M. All. Föld. Int. évi. jel. 1957-1958 roöl.* **1:** 417- 426.

Nagy, E. & Pálfalvy, I. 1963. Az Egri Teglagyari szelveny osnovenytani vizsgalata. - Revision paleobotanique de la coupe de la briquetarie d' Eger. *M. All. Föld. Int. évi. jel.. 1960-roöl* : 223- 263.

Pálfalvy, I. 1952. Also pliocen novenymaradvanyok Rozsaszentmarton kornyekeról. - Plantes fossiles du Pliocene inferieur des environs de Rozsaszentmarton. *M. All. Föld. Int. évi. jel. Az. 1949 - roöl* : 63-66.

Pálfalvy, I. 1964. A Mecsek hegyseg helvet-torton floraja Die helvetisch-tortonische Flora des Mecsek-Gebirges. *M. All. Föld. Int. évi. jel. 1961 roöl* : 185-199.

Pálfalvy, I. 1976. Az ipolytarnoci labnyomos homokko novenymaradvanyai - Fossil plants in the "Sandstone with footprints" at Ipolytarnoc village in Hungary. *M. All. Föld. Int. évi. jel. 1974-roöl* : 95-96.

Rasksy, K. 1959. The, fossil flora of Ipolytarnóc. Jour. *Palaeontol.* **53** (3) : 453-461.

Voros, I. 1955. A rozsaszentmartoni felso pannoniai flora-Die Ober-Pannonische Flora von Rozsaszentmarton. *M. All. Föld. Int. évi. jel.* **44** (1) : 64-69.