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Notes on the Egerian stratotype flora at Eger (Wind brickyard), Hungary, Upper Oligocene

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Abstract - The flora of the Egerian holostratotype section in the Central Paratethys (Eger-Wind brickyard) is dated by foraminifers (*G. opima opima* zone) and nannoplankton (NP 24 upper part to NP 25 lower part) into the Upper Oligocene. A critical study of plant macrofossils resulted in the establishment of two new species: *Ulmus pseudopyramidalis* sp.n. and *Ilex ? andreanszkyi* sp.n. and several recombinations. Three different taphocenoses at lower, middle and upper level floras are explained as a result of depositional processes rather than climatic oscillations. The total flora includes a high proportion of subtropical plants (*Platanus neptuni, Engelhardia orsbergensis, Tetracentron*, Lauraceae, *Dryophyllum*, palms), in riparian habitats intermixed with deciduous elements. With 1 figure and 12 photoplates.

INTRODUCTION

In 1975 the section in the clay pit at Eger, called traditionally "Wind's brickyard" (EW in the following text) was chosen as the holostratotype of the stage Egerian within the Paratethys regional stratigraphy. In the monograph (BÁLDI & SENES 1975), however, only palynological data but not the macroflora from the EW were included.

Since ANDREÁNSZKY's summary of the flora (ANDREÁNSZKY 1966), in which he included most of the previous data scattered in the literature, the research of other Upper Oligocene sites took long strides (KOVAR 1982, HABLY 1982, 1988, 1989, 1990) and by now it has become necessary to re-evaluate also the flora of EW with respect to the new results gained in systematic palaeobotany. For this purpose we revised the most important parts of the collections of the Botanical Department of the Hungarian Natural History Museum, Budapest (BP), the Hungarian Geological Institute, Budapest (MÁFI) and the Mátra Museum in Gyöngyös (MM) (the latter housing the plant collection of Dobó István Vármúzeum in Eger). In 1990 the senior author together with Mr. A. DÁVID visited the site and collected some additional material. Although the specimens of the lower and partly from the middle level flora are carbonized, attempts to prepare cuticles were successful due to strong pyrite content. Hence the identifications of the macrofossils must be considered only as attempts to clarify the relationship on mere gross morphological features. Very scarce fruit remains associated with leaves yield only limited information of the composition of the flora.

The evaluation of the flora does not include palynological data, which have been given in separate papers (NAGY & PÁLFALVY 1963, PLANDEROVÁ, KLAUS & NAGY in BÁLDI & SENES 1975, NAGY 1979). Only in discussions on the vegetation, paleoclimatical and stratigraphical conclusions the palynological data are also considered.

GEOLOGICAL SETTING

Most of the macroflora remains have been collected in EW by a well-known Hungarian private collector FERENC LEGÁNYI, who kept precise written notes on his activities (now deposited at MM). The section of the clay pit was described by BÁLDI (e. g. BÁLDI 1966, 1973, in BÁLDI & SENES 1975). The lower part of the deposits is developed in marine facies, which upwards gradually merging into near-shore, brackish and limnic environment. The Eger Formation of the Egerian age rests conformably without any break of sedimentation on the Kiscell Clay (Early Oligocene) as shown by a core made in the pit.

Four members of the Eger Formation has been recognized at EW:

1 - Marine Glauconitic and Tuffitic Sandstone (without macroflora),

2 - Molluscan Clay (with rich deep littoral to bathyal fauna),

3 - Alternating Clays and Sandstones (With shallow marine fauna) and

4 - Coarse Sand with Intercalating Clays and Gravels (of brackish and limnic origin).

All the units are exposed at present in the clay pit. Three levels of the macroflora occur in the section. The lower level flora (EWL) is situated in the upper part of unit 2 and includes the lower and higher horizons marked by LEGÁNYI as x 2 and x 1. The middle level flora (EWM) is connected with the middle part of unit 3 and also forms several thin horizons. The upper level flora (EWU) is bound to sandy clays of unit 4. The thickness of the members differs today from those given by BÁLDI (1973) due to progressed excavations. EWU and EWM come closer together. The plant remains in EWL are carbonized and occurred obviously sparsely so that only the long-term activities of F. LEGÁNYI could result in well-represented gatherings. Most of the plant fossils come from EWU, where thicker leaf beds packed with impressions occurred. At present this horizon is exhausted and not well accessible. We have found best opportunity to collect isolated leaf impressions mainly in EWM.

The stratigraphical position of EWL and EWM is fixed by planktonic index fossils. Contrary to the original interpretation (in BÁLDI & SENES 1975) it has become clear that only the lower part of the Egerian is exposed at EW. According to A. NAGYMAROSY (letter of 13. 1. 1989): "the profile covers the lower part of the stage (Egerian), i.e. the foraminifera zone *G. opima opima* and the nannoplankton zones NP 24 (upper part) - NP 25 zone (lower part). Near this locality (EW) is the stratotype (parastratotype) Novaj-Nyárjas, where the zones NP 24 and NP 25 were proved. Unfortunately Mrs. BÁLDI some years ago has misdetermined a fossil from this section (*Sphenolithus belemnos*, NN 1) and she published it. Her new revision (and also my revision) proved that the fossil is not S. belemnos so this very young age is not valid in that profile."

We cannot expect a long-time gap between EWM and EWU and thus the whole flora reflects conditions of deeper parts of the Egarian only.

The situation in the clay pit is shown in the Fig. 1. The outline in broken line shows the profile in the 1960s (according to BÁLDI 1966), the full line indicates the present state of 1990.

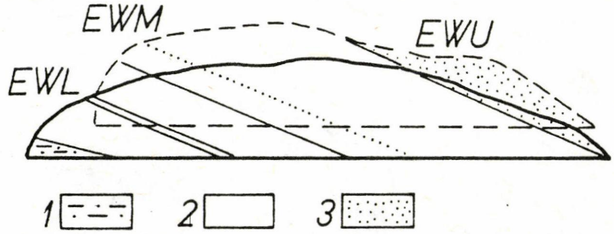

Fig. 1. Geological profile at the Wind's brickyard with the levels of macroflora (broken line - after BÁLDI 1966, full line - actual situation in 1990), 1 = Glauconitic sand, 2 = clays, 3 = sand

REVIEW OF THE FLORA

In the following systematic part a critical re-appraisal of the EW flora is given. Most of the original specimens of ANDREÁNSZKY's studies have been spotted in MM and BP together with some more identifications that ANDREÁNSZKY performed but not published when working on the material in BP. We have found great difficulties in revising PÁLFALVY's collections in MÁFI because only a few identification labels are attached to the specimens that obviously serred the basis of his studies. Hence we comment in more detail only what we have been able to examine authentically.

EQUISETOPSIDA

EQUISETACEAE

Equisetum sp. div.
(Plate I: 3)

Ribbed casts of horsetail stems 13-20 mm across, partly flattened with nodes at various intervals (15-35 mm) occur but rarely in EWU. ANDREÁNSZKY (1955) compared more robust specimens with *E. maximum* L., he identified slender ones as *E. braunii* UNG. However, the specimens are insufficient to allow specific determination.

FILICOPSIDA

Among the so far published records of ferns we have not been able to verify the occurrence of *Trichomanes radicans* L. sensu ANDREÁNSZKY (1949a, pl.9, f.1), *Osmunda parschlugiana* (UNG.) ANDREÁNSZKY (syn. *Osmunda heerii* GAUDIN) sensu PÁLFALVY (1951, pl. 1. f. 5, in NAGY & PÁLFALVY 1963, pl. 4. f. 3.), *Gleichenia* sp. sensu NAGY & PÁLFALVY (1963), *Lygodium gaudinii* HEER sensu NAGY & PÁLFALVY (1963), *Woodwardia roessneriana* (UNG.) HEER sensu NAGY & PÁLFALVY (1963) and *Woodwardites* sp. sensu NAGY & PÁLFALVY (1963, pl. 4. f. 6.). Such remains are obviously extremely rare.

OSMUNDACEAE

Osmunda lignitum (GIEBEL, 1857) STUR, 1870
(Plate I: 4).

Partly fragmentary pinnae with shallow lobes of rounded pinnules (about 6 mm wide) attaining a length of more than 10 cm and width up to 2.5 cm. They are rarely found at EMU (a single specimen in MM, more than 10 specimens in BP). The terminal pinna shows gradually shallowing lobes (the type-specimen of *O. leganyi* ANDREÁNSZKY) while side pinnae are abruptly narrowed at the apex. Although some identifications of ANDREÁNSZKY and PÁLFALVY are erroneous (see *Pronephirum stiriacum*) NAGY & PÁLFALVY (1963, pl. 4. f. 4) figured a very typical specimen with free, non-anastomosing venation (see also BARTHEL 1976). We hesitate to accept view of some authors to separate this species into the genus *Osmundastrum* PRESL.

BLECHNACEAE

Blechnum dentatum (GOEPPERT, 1836) A. BRAUN, 1852.
(Plate II: 3)

Complete bases, very asymmetrical, truncate, and middle parts of pinnae with slightly dentate margin, rather variable in the width (11-20-33 mm), are a common accessory member of EWU. A more complete specimen was figured by PÁLFALVY (1980, pl. 3, f. 3.) under this name while ANDREÁNSZKY (1952, 1966) preferred B. BRAUNII ETT., its later synonym (see BARTHEL 1976). On the average, the type-material from Lower Miocene of North Bohemia is slender.

ASPLENIACEAE

Asplenium egedense ANDREÁNSZKY, 1949

So far a single specimen of this obviously extremely rare fern has been recovered in EWL (ANDREÁNSZKY 1966, Textf. 2, MM, No. 61.803.1). Traces of venation, faintly seen in glycerin bath and also sori, clearly demonstrate the identity with the type from Kiseged. Very similar fern remains have been known from the Tertiary of Italy as *Anemia sepulta* SQUINABOL (1981, pl. 14, f. a).

THELYPTERIDACEAE

Pronephirum stiriacum (UNGER, 1847) KNOBLOCH et KVAČEK, 1976
(Plate I: 2)

Up to 25 cm long, more or less complete fans with longitudinally ribbed rhachis (up to 5 mm wide) and isolated shallowly crenulate to more deeply incised pinnae (more than 12 cm long), asymmetrical and cordate at base, up to 2.5 cm wide, with goniopterid type of venation, are common in EWU. A fertile specimen was figured by PÁLFALVY (1980, pl. 4, f. 1). ANDREÁNSZKY (1966, 16, textf. 1) argued the EW records to be specifically different from *Pronephrium stiriacum* and called them *Lastraea* cf. *oeningensis* (A. BR.) HEER but we do not share this view (see also BARTHEL 1976, PÁLFALVY 1980). Some small Fragments in MM and MÁFI were erroneously identified by ANDREÁNSZKY and PÁLFALVY as *Osmunda lignitum* (at MM and MÁFI) which occurs but rarely in EWU.

? POLYPODIACEAE vel ASPIDIACEAE
(Plate I: 1).

A fragment of two pinnules, partly fused, sterile, finely dentate, 4x7 mm size, with sharp sinuses, a bent thin midrib and rarely forked, not anastomosing craspedodromous secondaries has been newly found in MM (No. 56.1344.1) in the undetermined material of EWU. It may correspond to *Aspidium* or *Pteris* sensu NAGY & PÁLFALVY (1963) or *Pteridium crenatum* (WEBER) GIVULESCU see GIVULESCU (1973).

CONIFERAE

PINACEAE

Pinus sp. div.
(Plate II: 1)

Little can be added to ANDREÁNSZKY's treatment of this genus (ANDREÁNSZKY 1966: 20-22). The cones he figured (l. c. figs. 3 and 4) have not been found at MM. Another specimen (MM 64. 1089. 1) from EWL, represents a slender, badly preserved cone of the subgen. Strobus, as it is shown by a dorsal mucro preserved on the conescales of the cone apex. Similar pine cones have been known from the Paleogene of Europe, e.g. from the Oligocene of southern France (SAPORTA 1865, pl. 3, fig. 1 E sub *Pinus palaeostrobus* ETT.).

New collections from EWM include numerous specimens of pine needle leaves covering bedding planes. They lie parallel each other, arranged by current, probably joined into fascicles of two. In EWU the needle fragments (fascicles of two, three and five needles) occur rarely (two specimens at BP). They are referred to by NAGY & PÁLFALVY (1963, pl. 5, f. 1) as *Pinus* cf. *tuzsoni* NOVÁK, *P. palaeostrobus* ETT. and *P. taedaeformis* (UNG.) HEER. These authors record pine seeds (l. c. pl. 5, f. 8).

TAXODIACEAE

Sequoia couttsiae HEER, 1863.
(Plate II: 4, 5)

Female cones up to 2 cm across, partly with visible resin canals, showing peltate cone scales as big as 8 mm across, occur quite often in EWU. They are partly attached, partly associated with slender twigs with appressed, helically arranged small scale leaves. This foliage was erroneously identified as *Glyptostrobus* (ANDREÁNSZKY 1959, NAGY & PÁLFALVY 1963). A detached seed of the *Sequoia*-type (MM 61.211.1) has newly been recovered in the association of the cones. We agree with CHANDLER (1962) to range this species to *Sequoia* rather than to *Athrotaxis* because the seeds of the latter are different. *Sequoia couttsiae* represents certainly a species very distant from the living *S. sempervirens*.

CUPRESSACEAE

Tetraclinis sp.
(Plate II: 6)

Cones and detached cone scales of the *Tetraclinis*-type form a rare accessory elements of EWU (Nos. MM 56.1390.1, BP 56.1391.1, 67.141.1, 71.1276.1). They have been identified as *Callitrites brongniartii* (ANDREÁNSZKY 1955, pl. 1, f. 3) but we are not informed to what kind of foliage they belong. PÁLFALVY (in NAGY & PÁLFALVI 1963) reports both species as *T. salicornioides* (UNG.) KVAČEK (sub *Calocedrus salicornioides* (UNG.) PÁLFALVY comb. illegit.) and *T. brachyodon* (BRONGN.) MAI et WALTHER (sub *Tetraclinis brongniartii* ENDL. l. c. pl. 5, f. 7, 9) but we were unable to verify both the records in MÁFI.

? CEPHALOTAXACEAE

(Plate II: 2)

A single completely pyritized compression of a long-leaved shoot from EWL (MM 64.71.1.) was identified by ANDREÁNSZKY (1966, textf. 5) as *Sequoia langsdorfii* (BRONGN.) HEER. Although it recalls superficially Taxodiaceae it differs much from the true *Sequoia abietina* (BRONGN.) KNOBLOCH (syn. *S. langsdorfii*) by its sharply mucronulate leaf tips (revealed by additional preparation). The lack of cuticular structure prevents us to give a more satisfactory identification. Such kind of foliage (the length of leaves attainig 2,5 cm) is usually ascribed to *Cephalotaxus*. We have not found other taxodioid shoots that would match with Taxodiaceae (namely the record of *Taxodium dubium* (STERNB.) HEER indicated by PÁLFALVY in NAGY & PÁLFALVY 1963).

ANGIOSPERMAE

DICOTYLEDONES

LAURACEAE

Sassafras lobatum (SAPORTA, 1867) ANDREÁNSZKY, 1966
(Plate III: 1)

Trilobate leaves with narrow lobes do recall *Sassafras*. They show little of the detailed venation so that a precise comparison with the SAPORTA's type material is difficult. *Sassafras tenuilobatum* ANDREÁNSZKY (1959, pl. 1, f. 1, textf. 1) of Kiseged may not differ specifically because the size differences only are of little taxonomical value. We noted one specimen in EWM (MM 64.150.1 orig. ANDREÁNSZKY 1966, textf. 10) and some more (MM 56.1398.1, BP 56.1298.1) in EWU.

Daphnogene cinnamomifolia (BRONGNIART in CUVIER, 1822) UNGER, 1850
(Plate III: 4, 5)

Cinnamomoid leaves are well represented in all levels in typically variable form, found in other Oligocene sites in Europe. The narrow *"lanceolata"*-form prevails over the elliptical *"cinnamomifolia"*-form. Extremely large *"spectabile"*-forms described by ANDREÁNSZKY as *Litsea euryphylla* ANDREÁNSZKY (1962, pl. 1, pl. 1, f. 1) and identified in MM also as *Litsea macrophylla* are confined to EWU. Slender forms dominate the flora in EWM. They all are obviously referred to by PÁLFALVY (in NAGY & PÁLFALVY 1963) as *Actinodaphne germari* HEER, *Daphnogene septimontana* WLD., *Cinnamomum buchii* HEER, *C. spectabile* HEER, *C. sezannense* SAP., *Cinnamomophyllum lanceolatum* (UNG.) HANTKE, *C. scheuchzeri* (HEER) KR. et WLD., *C. polymorphum* (A. BR.) KR. et WLD., *Litsea magnifica* SAP., *Litsea* sp. (see l. c. pl. 5, f. 3, pl. 9, f. 5, pl. 10, f. 2). We believe - according to the cuticular studies (KVAČEK & WALTHER 1974) - that the high variability of the leaf forms is due to environmental conditions and we do not distinguish them as independent species.

Laurophyllum sp. div.
(Plate III: 3)

True lauroid leaves with irregularly looping secondaries are more frequently met in EWL and EWM, only occasionally in EWU.

Several leaf forms can be recognized - broad elliptic, recalling *Laurophyllum saxonicum* LITKE (sub *Oreodaphne* cf. *foetens* (AIT) NEES in ANDREÁNSZKY 1966, textf. 20, MM 64.148.1, MM 64.94.1-100.1), lanceolate one alike *Laurophyllum acutimontanum* MAI (sub *Laurus primigenia* UNG. in ANDREÁNSZKY 1966, textf. 17, MM 64.145.1, MM 64.79.1) or elliptic, similar to *Laurophyllum pseudoprinceps* WEYL. et KILPP. (sub *Persea* cf. *indica* (L.) SPRENG. in ANDREÁNSZKY 1966, textf. 19, MM 64.161.1, MM 64.83.1). The former one prevails in EWL, the latter two in EWM.

We consider some forms referred by ANDREÁNSZKY (1966) to Lauraceae as fagaceous (see cf. *Lithocarpus saxonica* WALTHER et KVAČEK, and ? Fagaceae gen., p. 00). GIVULESCU (1987) calls attention to the fact the so-called *Laurus primigenia* UNG. in many cases represents in fact Fagaceae. It surely applies also to many specimens of leaves in EWL but not knowing the cuticular structure we are unable to solve this problem.

TETRACENTRACEAE

Tetracentron agriense (ANDREÁNSZKY, 1962) comb. n.
(Plate IV: 1-4)

B a s i o n y m : *Acer agriense* ANDREÁNSZKY 1962, 230. pl. 3. f. 3. textf. 7. Diagnosis emend.: Leaves orbicular ovate, petiolate, 8-12 cm long and 3.5-6.0 cm wide (some fragnentary specimens of obviously larger size). Base slightly cordate to rounded, apex bluntly acuminate. Petiole fragment 33 mm long. Venation palmate, semicraspedodromous. Basal primaries 5-7, secondaries steep (the angle of divergence 20°-30°), looping along the margin, side veins forming another row of small loops, from which small veinlets enter the teeth. Tertiary veins dense, mostly percurrent, spidernet-like arranged. Margin simply coarsely crenulate, teeth glandular, blunt, sinuses rounded to widely cuneate.

H o l o t y p e : MM 76.11.2 (ANDREÁNSZKY 1962, textf. 7) - EWU (with its counterpart). - P a r a t y p e s : MM 61.811.1 (W 1559) (ANDREÁNSZKY 1962, pl. 3, f. 3) 61.812.1 (W 1325/a), 61.821.1 (W 13261a), 62.114.1, 62.189.1, 62.312.1 - all EWU.

A superficial resemblance of these leaves, which are rarely met in EWU, to Malvales is misleading. The glandular teeth exclude such a possibility. The picture given by ANDREÁNSZKY (1962, textf. 7) does not reflect true course of side veins, which are looping along the margin. In the marginal venation and teeth we find connecting features to Trochodendrales. The venation patterns best match with the extant *Tetracentron sinense* OLIV., which differs in finer teeth and attachment of the petiole. In the fossil species the petiole is attached from the underside while in the recent one it lies in the same plane with the leaf lamina.

Of the so far described fossil *Tetracentron* remains, the leaves of *Tetracentron hungaricum* ANDREÁNSZKY (1959b) from the Sarmatian tuffs at Balaton (Hungary) differ in the nearly entire margin, but we were unable to study the type specimen, which was missing from MM. The Cretaceous *Tetracentron potomacense* (WARD) ILJINSKAJA is very deeply cordate and finely crenulate, *T. wahrameevianum* ILJINSKAJA differs in its very small size, the arrangement of basal primaries (see ILJINSKAJA 1972). We found the same kind of attachment of petiole in the newly described *Tetracentron beringianum* CELEBAEVA et SANCER (in press) from the early Palaeogene of the Far East as well as in some species of *Trochodendroides* (*T. vassilenkoi* ILJINSKAJA et ROMANOVA).

Tetracentron sinense OLIV., a small deciduous tree of eastern and south-eastern China grows in mesophytic subtropical forests, and we can expect similar autecology of *T. agriense*.

PLATANACEAE

Platanus neptuni (ETTINGSHAUSEN, 1866) BŮŽEK, HOLY & KVAČEK, 1967
(Plate V: 4)

Typical oblong, bluntly simple toothed leaves with semicraspedodromous venation are more frequent only in EWL (about 20 specimens at MM) but quite rarely in EWM (MM 62.658.1, 64.39.1, 65.704.1). As already stated by HABLY (1985) they were described as *Cunonia oligocenica* ANDREÁNSZKY et NOVÁK (1957). ANDREÁNSZKY (1966) identified this type of leaves not only with *C. oligocenica* (l. c. textfig. 77, MM 61.816.1) but also as *Pterocarya denticulata* (O. WEBER) HEER (MM 64.73.1, 64.77.1) and *Quercus leganyi* ANDREÁNSZKY et KOVÁTS (MM 64.39.1).

P. neptuni is a common plant of the Hungarian Egerian and Kiscellian. Its occurrence was proved cuticular study (HABLY 1980).

ULMACEAE

Ulmus fischeri HEER, 1856
(Plate V: 2)

Large oval, strongly asymmetrical, partly deeply cordate leaves attaining a length of more than 10 cm, usually coarsly double serrate, in smaller specimens with simple dentation, represent the group of elm leaves, called by ANDREÁNSZKY *Ulmus* sp. type I. (ANDREÁNSZKY 1966, textfig. 60, 61). This species represents a typical accessory element in EWU (about 6 specimens at MM, much more at BP). ANDREÁNSZKY (1966) compared this leaf from with *U. drepanodonta* GRUBOV from the Oligocene of Kazachstan (see KRYSHTOFOVICH 1956) and also MAI & WALTHER (1978) did the same. We prefer the earlier name based on European material. True *U. drepanodonta* GRUBOV possesses more markedly lobate leaf apex in many cases (Z. K. pers. observ. at Leningrad), in other respect closely recalling *U. fischeri*. NAGY & PÁLFALVI (1963, pl. 9, f. 1) bring a picture of *U. fischeri* (sub ULMUS sp.).

Ulmus pyramidalis GOEPPERT, 1855
(Plate V: 1)

Slender lanceolate, 3-5.5 x 8-11 cm large, finely simple (to slightly double) serrate leaves with symmetrical base, cuneate to very slightly cordate, and dense numerous secondaries, rarely forked, are typically represented in EWM, exceptionally in EWL (MM 61.977.1, 61.963). Prevailing part of the record was identified by ANDREÁNSZKY (1966, textf. 28-30) as *Carpinus grandis* UNG. He was obviously influenced by a misleading interpretation of ETTINGSHAUSEN (1866). As rightly stressed by BŮŽEK (1971), such leaf forms are elms. In a few cases this form can be recognized in EWU (e.g. sub *Castanopsis* sp. I. sensu ANDREÁNSZKY 1966, textf. 31, MM 56.1342.1).

Ulmus pseudopyramidalis sp.n.
(Plate VI: 1)

D i a g n o s i s : Leaves oblong, 2-4 cm wide and 8-12 cm long, acuminate at the apex, rounded to truncate, mostly markedly asymmetric at the base, simple (to finely double) serrate. Teeth broad, mostly blunt. Venation craspedodromus, midrib straight, secondaries dense, in 12 to 20 pairs, at angles of 40°-90° to the midrib, rarely forked, tertiaries dense percurrent, rarely preserved.

H o l o t y p e : s.n. MM (Plate VI: 1) - EWU - Paratypes: MM 6689, 3281, 1334, 56.1095. - EWU.

We agree with ANDREÁNSZKY (1966) that some forms of the elm leaves occurring in EWU do not exactly agree with *U. pyramidalis* GOEPPERT. They differ first of all by the strongly asymmetrical leaf base, coarser teeth and partly also by the greater size. ANDREÁNSZKY included this form into his *Ulmus*-type II (l. c. textf. 62-64) and partly also to *Ulmus*-type III (l. c. textf. 65). It is represented both at MM and BP in several, but rarely complete specimens. Without knowing the associated type of fruits we do not suggest relationship to any recent species as also ANDREÁNSZKY (1966) did. One of the fragmentary specimen of *U. pseudopyramidalis* was identified by PÁLFALVY (in NAGY & PÁLFALVY 1963, pl. 9, f. 6) as *U. longifolia* UNG. nom. illegit.

Ulmus sp.

Smaller, asymmetrical laef forms (ANDREÁNSZKY 1966, Ulmus-type IV, V, textf. 66-69) occur both in EWM and EWU, in either level in low frequency. Most of the material is kept at BP and deserves a special study. A monographic treatment was being prepared, but not finished by Mrs. CZIFFERY-SZILLÁGY.

? **Zelkova zelkovifolia** (UNGER, 1843) BŮŽEK et KOTLABA in KOTLABA, 1963
(Plate V: 3)

A single leaf and its counterpart (MM W 1442) from EWM matches by ovate, slightly asymmetrical form and coarse simple teeth with *Zelkova*. If our identification is correct then this species was extremely rare in EW. NAGY & PÁLFALVY (1963) noted the occurrence of *Zelkova ungeri* KOV. nom. illegit. but we have not found such specimens at MÁFI.

FAGACEAE

Quercus rhenana (KRÄUSEL et WEYLAND, 1950) KNOBLOCH et KVAČEK, 1976 (Plate VI: 2,3)

Fragmentary lanceolate leaves c. 3 cm wide and more than 10 cm long, entire-margined, acuminate at the apex, with stout midrib passing into a thick petiole, and regulary looping dense secondaries (at 60°-80° angles to the midrib) were identified at BP as *Apocynophyllum* sp. (BP 70.102.1, 70.451.1), or *Lithocarpus* sp. II sensu ANDREÁNSZKY (1966, textf. 35, BP 67.72.1). We do not hesitate to identify them with *Q. rhenana*, a common member of Late Oligocene-Lower Miocene swamp forests. All specimens come from EWU.

cf. **Lithocarpus saxonicus** WALTHER et KVAČEK in KVAČEK et WALTHER, 1987 (Plate VII: 4)

Rare lanceolate entire-margined leaves about 4-5 cm wide and up to 20 cm long are characteristic by camptodromous fagaceous venation, secodaries very regular, steep (at an angle of 30° at the leaf apex) and distinct percurrent tertiaries directed perpendicularly to the midrib or nearly so. They partly correspond to the entity called by ANDREÁNSZKY (1966) *Litsea* cf. *terza* (L.) MERR. (l. c. textf. 12, MM 7394, 64.176.1, non f. 13 - see ? Fagaceae gen.) and are confined to EWM. In their leaf form they well match with a newly described *Lithocarpus saxonicus* from the Oligocene of Germany (KVAČEK & WALTHER 1987) but differ by the less oblique course of tertiary venation.

Dryophyllum callicomifolium (ANDREÁNSZKY, 1962) comb. n. (Plate VI: 4)

B a s i o n y m : *Castanopsis callicomaefolia* Andreánszky, 1962, 221. pl. 2. f. 2-4. pl. 3. f. 1
S y n o n y m s :
Quercus agriensis ANDREÁNSZKY, 1962, 224. pl. 3. f. 2
Quercus crassipetiolata ANDREÁNSZKY et KOVÁTS in ANDREÁNSZKY 1966. 64. textf. 50-53
Quercus leganyi ANDREÁNSZKY et KOVÁTS in ANDREÁNSZKY 1966. 52. textf. 36, 37.
H o l o t y p e : ANDREÁNSZKY 1962, pl. 2, f. 4 (missing at MM) - EWL. - P a r a t y p e s : MM 61.793.1, ANDREÁNSZKY 1962, pl. 2, f. 3 - EWL, MM 61.817.1, ANDREÁNSZKY 1962, pl. 2. f. 2 - EWL.

This leaf form peculiar by its slender form and regular, blunt and partly S-shaped teeth is a common element in EWL, much rarer in EWM. We have not found any essential difference between the three ANDREÁNSZKY's species: *Castanopsis callicomifolia*, *Quercus crassipetiolata* and *Q. leganyi* and unite them under one entity. Since there is no real basis for a generic determination we suggest to accomodate it into the form genus *Dryophyllum* in a common sense (see KVAČEK & WALTHER 1989a, b). It is not excluded that this Late Oligocene species is a descendent of *Eotrigonobalanus furcinervis* (ROSSM.) WALTHER et KVAČEK but it decidedly differs in its much slender and less variable leaf form. Not knowing the epidermal characters we can hardly decide this question. *Callicoma egedensis* ANDREÁNSZKY et NOVÁK (1957, pl. 2. f. 3) from Kiseged does not differ in its leaf form and dentation (see also ANDREÁNSZKY 1966: 88) but the type (BP 83.256.1-5181) shows no details of venation except secondaries, the surface is covered by false contours left by fossilisation processes and thus there is no serious basis to employ this basionym for *D. callicomifolium. Quercus agriensis* in our opinion represents only an aberrant small leaf of this species. We found also almost entire-margined forms (e.g. MM 64.129.1) similar to that figured by ANDREÁNSZKY (1962, pl. 3. f. 1).

? **Trigonobalanopsis rhamnoides** (ROSSMÄSSLER, 1840) KVAČEK et WALTHER, 1988 (Plate VI: 5)

A single specimen described as *Quercus tenuipetiolata* ANDREÁNSZKY (1962, 222. textf. 2, BP 83.278.2) and its counterimprint (BP 26030) match well with this well-known subtropical element of European Tertiary, mainly of eucamptodromous venation, better seen in the counterimprint and oblique course of tertiary veins. It was found in EWM as well as *Berchemia cuneata* ANDREÁNSZKY (1962, 232. textf. 8, MM 78.08.1), which we are inclined to consider only as a very large specimen of the same. Another leaf from EWU ascribed by ANDREÁNSZKY (1966, 103. textf. 97, BP 70.136.1) to *Cornus buchii* HEER may also belong to *T. rhamnoides*.

? FAGACEAE gen.
(Plate VII: 5)

Numerous entire-margined leaf forms occurring mainly in EWL, occasionally also in EWM and EWU recall by its regular eucamptodromous venation Fagaceae but their specific determination is quite impossible. In general they correspond with the "*Laurus*" *primigenia*-type (see above p.00). Broader forms were identified partly as *Litsea* cf. *terza* (L.) MERR. (ANDREÁNSZKY 1966, textf. 13, MM 64.184.1), slender forms as *Litsea* cf. *lancifolia* (ROXB.) BENTH. et HOOK. f. (ANDREÁNSZKY 1966, textf. 15), *Neolitsea* cf. *intermedia* MERR. (l. c. textf. 16) and *Laurus primigenia* UNG. (l. c. textf. 17, MM 64.145.1). No essential difference in general shape and venation can be found also in *Ficus agriensis* ANDREÁNSZKY (1962, 227. textf. 4.MM 78.10.1), partly also in *Quercus palaeofournierii* ANDREÁNSZKY et KOVÁTS (in ANDREÁNSZKY 1966, 56. textf. 40, MM 78.05.1). A lauraceous affinity cannot be fully excluded but we believe that rather some evergreen Fagaceae are represented by these remains. Unfortunately, the cuticular structure, which would easily solve this problem, has not been preserved in any of the specimens studied.

BETULACEAE

Alnus oligocaenica ANDREÁNSZKY, 1962
(Plate VII: 1-3)

Alder leaves are quite common and variable in size and shape in EWU. They essentially belong to the group of *Alnus nostratum* UNG. complex, which includes elongate to broadly ovate leaves with eucamptodromous to semicraspedodromus venation and finely serrate to almost entire margin. We adhere to the ANDREÁNSZKY's species because the populations from EW differ from the type of *A. nostratum* often having forked secondaries and an almost entire margin. The type-specimen of *A. oligocaenica* (MM 78.01.1) is an extremely small but the whole suite (ascribed by ANDREÁNSZKY 1966 to *Alnus* cf. *sporadum* UNG. var. *phocaeensis* SAPORTA - textf. 25, MM 64.23.1, *A.* cf. *nepalensis* DON, - textfigs. 22-24, BP 67.68.1, MM 83.371.L, BP 67.67.1, *Rhamnus* cf. *purshiana* DC textf. 89) is connected with transitions. Some more slender forms, which are strongly serrate, recall *A. gaudinii* (HEER) KNOBL. et KVAČEK. Infructescences of alder occur sporadically in EWU (BP 71.428.1, sub *Alnus* sp. in ANDREÁNSZKY 1966, textf. 27). They are rather small, unlike those associated with *A. gaudinii* elsewhere. Another type of bigger cones mentioned by Andreánszky (1966: 42) from EWM has not been available. According to the description it may not be excluded eventually that it will turn out to be a cone of *Sequoia couttsiae*.

MYRICACEAE

Myrica longifolia UNGER, 1850
(Plate VIII: 1)

A very common type of leaves with finely and widely seerate margin, partly very narrow (0,4 mm) identified as *M. angustissima* WATELET, partly wider, but always linear, longly cuneate at the base, is met with in EWU, quite rarely in EWM (MM 64.203.1) and EWL (MM 61.945.1, 61.966.1, 61.976, 64.84.1, 64.120.1). ANDREÁNSZKY unjustly rejected this name in view of the homonymous *M. longifolia* TEYSM. et BINN., which was published later and cannot endanger the usage of *M. longifolia* (Dr. S. G. ZHILIN, pers. communication). The differentation of fragmentary material between *M. longifolia* and *Engelhardia orsbergensis* (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER is sometimes made difficult when detailed marginal venation is not preserved.

cf. **Myrica integerrima** KRÄUSEL et WEYLAND, 1954
(Plate VIII: 4)

These elongate leaves with entire margin and thin regular secondaries that form with the stouter midrib wide angles (80-45°) and join by large loops, occur mainly in EWL, less often in EWM and EWU. They can attain a length of over 10 cm. They recall entire-margined Myricas (namely *M. integerrima* KRÄUS. et WEYL. common in the Lower Miocene strata) but without anatomical evidence their taxonomic status must remain open. they were identified by ANDREÁNSZKY (1966) as various entities: *Lithocarpus debilinervis* ANDREÁNSZKY et KOVÁTS (l. c. textf. 32, MM 78.03.1), *Lithocarpus colchica* KOLAK. (l. c. textf. 34, MM 65.28.1), *Myrica* cf. *longifolia* TEYSM. et BINN. (l. c. textf. 55, BP 67.95.1), *Quercus salicina* SAPORTA (l. c. textf. 42-44, BP 67.109.1, 67.108.1).

Comptonia dryandroides UNGER, 1850
(Plate VIII: 2)

Very characteristic linear lobate leaves partly with fully separated lobes, partly with incised lamina halfway to the midrib, with lobes directed towards the leaf apex, often finely toothed, are confined to EWU. We have not attempted to revise this common Oligocene leaf form, known also in Swiss Molasse (e. g. *Myrica graeffii* HEER) and elsewhere. A part of the leaf forms indeed recall the common *Comptonia acutiloba* BRONGN. and differ mostly in the form of lobes, which can often be dentate. ANDREÁNSZKY (1955) may have rightly reduced this entity to the variety level (*Myrica acutiloba* var. *dentata* ANDREÁNSZKY, 1955, BP 71.418.1) but unjustly established new, clearly conspecific taxa - *Myrica grandis* ANDREÁNSZKY (1966: 73, nom. nov. for *M. grandifolia* ANDREÁNSZKY, 1955 non UNGER) and perhaps *M. onocleaefolia* ANDREÁNSZKY (1955, pl. 2, f. 7). In a discussion with S. G. ZHILIN we arrived to a conclusion that the whole set of forms from Kazachstan to Europe should be studied in order to clarify their taxonomy. Without knowing the details of pubescence it is difficult even to decide the generic assignement.

JUGLANDACEAE

Engelhardia orsbergensis (WESSEL et WEBER, 1856) JÄHNICHEN, MAI et WALTHER, 1977
(Plate VII: 3)

Narrow elongate leaflets, prevailingly sessile, asymmetrically cuneate at base, slightly falcate, widely serrate with very thin teeth and dense semicraspedodromous venation very often occur in EWU, occasionally also in EWM. Some specimens attain a considerable size (*Carya falcata* ANDREÁNSZKY, 1956, 221. pro parte. pl. 2. f. 3,4, BP 83.261.2), the ordinary leaf form was usually identified by ANDREÁNSZKY (1955, 1966) as *Myrica lignitum* (UNG.) SAP., but also as *Pterocarya denticulata* (O. WEB.) HEER (e.g. MM 64.76.1), a single specimen from EWM as *Quercus tenerrima* Web. (l. c. textf. 38, MM 63.35.1).

Engelhardia macroptera (BRONGNIART, 1828) UNGER, 1866

As already stated by ANDREÁNSZKY (1966) the *Engelhardia* fruits (involucra) are very rare at EW. They show a characteristic triveined pattern. We spotted only two specimens in EWU (MM 55.5842.1, BP 1161). PÁLFALVY (1981) records both the species in EW (see also NAGY & PÁLFALVY 1963, pl. 6, f. 2).

JUGLANDACEAE gen.
(Plate VIII: 5)

Asymmetrical leaflets of juglandaceous nature, with semicraspedodromous venation and secondaries diverging from the right to about 45° angles on one side of the midrib and 45-30° on the other, occur very rarely in EWM (MM 64.72.1 sub *Juglans* cf. *cinerea* L. in ANDREÁNSZKY 1966, textf. 54, BP 83.295.1 sub *Carya falcata* ANDREÁNSZKY) and EWL (MM 64.278.1 sub *Castanopsis* sp., BP W 2518). On the label of one of the specimens ANDREÁNSZKY at first suggested *Carya* sp., but later he changed it for *Juglans*. In view of the occurrence of fruits (sub *Juglans* in NAGY & PÁLFALVY 1963, pl. 6, f. 7, 8) and pollen grains the Juglandaceae family is surely represented at EW and for the leaflets described above *Carya* would be a most probable match.

? THEACEAE

"Viburnum" atlanticum ETTINGSHAUSEN, 1868
(Plate VIII: 6)

A single leaf fragment (BP 54.1415.1) identified as *Banisteria* cf. *sinemariensis* DC. from EWU shows a portion of oval slightly crenulate leaf with glangular (?) teeth and fine semicraspedodromous brochydodromous secondary venation. The tertiary veins are very fine, forked, and directed very obliquely to the secondaries. Identical leaf forms occur in Oligocene and Lower Miocene strata in North Bohemia (BŮŽEK 1971) and according to the cuticular structure (pers. observation) they correspond with Theaceae, namely with *Eurya* THUNB.

"Arbutus" praeunedo ANDREÁNSZKY, 1962
(Plate IX: 1)

The drawing of the holotype (ANDREÁNSZKY 1962, textf. 10, BP 83.266.1-3291) from EWM is partly misleading because the black imprint shows widely spaced secondaries that loop (semicraspedodromous venation). The blunt but fine teeth and the leaf shape recall *Platanus neptuni* but tips of the teeth seem to be thickened (? glandular) and thus rather suggest Theaceae. Without anatomical evidence this interpretation remains a mere guess. The paratypus (MM 64.217.1) also from EWM is slightly different in forked secondaries and more or less craspedodromous venation. The teeth are triangular and sharp. It recalls an aberrant *Ulmus pyramidalis* GOEPP.

SALICACEAE

Salix vel **Populus** sp.
(Plate IX: 2)

Linear leaves (up to 1.5 cm wide and over 10 cm long) with salicoid venation, but rather widely spaced secondaries looping well within the lamina with additional small meshes towards the margin and side veins entering widely spaced glandular teeth, have been rarely met, mainly in EWL (MM 64.103.1, 64.102.1, 64.210.1 - orig. ANDREÁNSZKY 1966, textf. 57, sub *Salix lavateri* HEER) 66.35.1 - orig. ANDREÁNSZKY 1966, textf. 58, and some more), rarely in EWM (MM 64.61.1, 64.109.1, 64.107.1) and in EWU (BP 67.249.1 - orig. ANDREÁNSZKY 1966, textf. 21. sub *Lomatites auqensis* SAP.). They do recall aberrant willow leaves and were mostly assigned to this genus by ANDREÁNSZKY (1966).

They do not exactly correspond with the species they were referred to. We noticed in some specimens indistinct basal veins (see Plate IX: 2) that suggest rather a narrow-leaved *Populus*. Dr. ZHILIN (Leningrad) called our attention to a species of poplar occurring in the Oligocene of Kazachstan, which very well corresponds with the above-described material. Similar leaf forms were described by HEER (1859, pl. 131, f. 11-13) as *Carya heerii* (Ett.) Heer from the Swiss and German Molasse.

ROSACEAE

Rosa lignitum HEER, 1869
(Plate IX: 3)

A simple ovate leaflet without its base, about 2 cm wide with shallowly crenulate margin and fine craspedodromous venation, dense secondaries arching towards the margin (MM s.n.), from EWU can be identified with *Rosa lignitum*, a common accessory element of Oligocene and Lower Miocene floras (see MAI & WALTHER 1978).

LEGUMINOSAE

Leguminocarpon sp. div.
(Plate X: 1-3)

Among numerous pods of Leguminosae occurring in EWU, at least four kinds can be reliably recognized. *Leguminocarpon* sp. 1 (e.g. MM 56.1333.1, 56.1336.1, 62.123.1, and others) are pods more than 8 cm long and about 1 cm wide with distinct elongated areolated venetion but without any trace of the seeds. *Leguminocarpon* sp. 2 (MM 56.1335.1, 56.1263.2, 56.1264.1, 56.1278.1, 56.1282 etc.) are similar in size but differ in blumt apex and well visible seeds traces (up to 8). *Leguminocarpon* sp. 3 occurs very rarely (MM 56.1455.1, 55.5450.1) and represents short ("*Podogonium*"-like) pods that recall *Gleditsia knorrii* (HEER) GREGOR. It was described as *Legominocarpum machaerioides* ANDREÁNSZKY (1962, 227. textf.5) from EWU but the type-specimen has been missing from MM. *Leguminocarpon* sp. 4 are pods with narrowings according to the seed positions (MM 56.1281.1, 56.1271.1), otherwise similar to the first of the species. A thorough study and comparison with the so far described species scattered in the literature (e.g. UNGER 1850, WESSEL & WEBER 1855, SAPORTA 1867, 1873, etc.) will be in a separate paper (HABLY in prep.).

Leguminosites sp. div.

Leaflets of legums are a characteristic feature of EWU, where they occur in various sizes and forms, some narrow elliptic, hardly attaining 4 cm in length, others ovate acuminate, more than 6 cm long, prevailingly with dense brochidodromous, fine and not always visible venation. Their specific differentiation would be a difficult task. We refrain from doing it and refer to a separate study (HABLY in prep.).

MELIACEAE

Cedrela macrophylla ANDREÁNSZKY, 1955
(Plate X: 4)

One of the dominant species in EWU is represented by large elongate leaflets with nearly parallel margins and sometimes very asymmetric shallow cordate base. From among the type-specimens indicated by ANDREÁNSZKY we suggest BP 54.1511.1, left (ANDREÁNSZKY 1955, textf. 5, extreme left specimen) as the lectotype. *Rhus succedanoides* ANDREÁNSZKY (1962, 229. textf. 6, MM 78.04.1) is only a smaller leaflet of *C. macrophylla*. Similar leaf remains were described by BŮŽEK (1971) as *Juglans acuminata* Al. Br. from the North Bohemian Lower Miocene, They differ from the type-specimens (see HANTKE 1954) and can be conspecific with *C. macrophylla*. The generic assignment seems to be probable in view of the friuts of *Cedrela* occurring in Tertiary strata. However, no such fruit remains associated with the above-described foliage have been recovered at EW so far.

ACERACEAE

Acer tricuspidatum BRONN, 1838
(Plate X: 5)

Another dominant species of EWU is *Acer tricuspidatum*. Along with the standart form *A. tricuspidatum* f. *tricuspidatum* also rare *A. tricuspidatum* f. *brachyphyllum* (HEER) PROCHÁZKA et BŮŽEK and *A. tricuspidatum* f. *productum* (AL. BR.) PROCHÁZKA et BŮŽEK can be met with. The populations of this maple occurring at EW and elsewhere in the European Late Oligocene differ from the Lower Miocene ones by another quite frequent leaf from the standart *A. tricuspidatum*. It possesses finely serrate lobes that are longly tapered. ANDREÁNSZKY (1955b) treated it as a separate species *Acer hungaricum* ANDREÁNSZKY but we suggest to reduce it to a form (*Acer tricuspidatum* BRONN forma *hungaricum* (ANDREÁNSZKY) **stat. n.** (Basionym: *Acer hungaricum* ANDREÁNSZKY 1955, 81.200. pl. 22, f. 1, 2, Lectotype: BP 83.284.1 = l. c. f. 2). Similar leaf forms were described from the Oligocene of Bois d'Asson, Manosque as *Acer tenuilobatum* SAPORTA (1867) and from the Jiu Valley as *A. hungaricum* ANDREÁNSZKY by GIVULESCU (1973). In all sites this form is associated with other forms of *A. tricuspidatum*.

More than 10 specimens maple samaras have been recovered in in EWU in the association of the above leaves. They are all of the same kind and exactly correspond with the fruits ascribed to *Acer tricuspidatum* (e. g. BŮŽEK 1971).

AQUIFOLIACEAE

Ilex ? andreanszkyi sp. n.
(Plate XI: 1-3)

Diagnosis: Leaves broadly lanceolate, oblanceolate to broadly ovate, 6.5-8 cm long and 3-3.5 cm wide, acuminate, narrowly to widely cuneate at the base, very shortly petiolate. Petiolate 1 mm long or not preserved, margin simply coarsly and widely dentate in the upper part of the leaves, indistinctly dentate towards the leaf base, thickened, teeth sharply pointed, sinuses rounded. Venation pinnate, semicraspedodromous, midrib straight, secondaries thin, indistinctly imprinted, diverging mostly at an angle of 60°, intersecondary veins one or two, parallel with the secondaries forming with the tertiary veins irregular meshes, partly parallel with the secondaries, loops of secondaries well inside the leaf lamina connected with smaller loops towards the margin, which give off side veins into the teeth. Higher order venation not preserved.

Holotype: MM W 1142 (pl. XI, f. 2, 3) - EWU. - Paratypes: MM 1144, W 1183a, W 1040 (Plate XI: 1) - EWU.

Only few leaves of this remarkable species have been recovered in MM, BP and MÁFI, and among the unidentified material from EWU. Similar leaf fossils have been described from Tertiary strata as various species of *Ilex*. *Ilex celastrina* SAPORTA (1865) from the Oligocene of southern France differs in its steeper and denser secondaries, *I. cassineformis* KOLAKOVSKIJ (1964) and *I. microcassine* KOLAKOVSKIJ (1964) from the Pliocene of Abhasia show looping of secondaries only very near the margin. The same venation pattern and cuticular structure characterise *I. pseudocanariensis* GIVULESCU (1982) from the late Miocene of Romania. Having no anatomical evidence the generic assignment of the above-described material is only tentative. They can be well compared with the extant North American *Ilex cassine* L. or *Ilex caroliniana* MILL.

OLEACEAE

Fraxinus sp.
(Plate X: 7)

Some incomplete sessile, oblong, finely serrate, about 2 cm wide and more than 6 cm long leaflets show venation patterns characteristic of *Fraxinus*: semicraspedodronous secondaries leave the midrib in large arches and give off side veins that enter the sinuses of the teeth. Such rare specimens (MM 66.370.1, 62.230.1, BP 70.54.1) from EWU were found unidentified or designated as *Pterocarya denticulata* WEB. They resemble the foliage previously referred to as *Juglans bilinica* UNG. (sub *Juglans juglandiformis* sensu BŮŽEK 1971) or *Fraxinus ungeri* (GAUDIN) KNOBLOCH et KVAČEK.

RHAMNACEAE

Ziziphus cf. **ziziphoides** (UNGER, 1850) WEYLAND, 1943
(Plate XI: 4)

Asymmetrical oval acuminate leaves with acrodromous basal veins and very finely toothed margin were compared by ANDREÁNSZKY (1966, textf. 93) with a common Oligocene element, *Z. ziziphoides*. This leaf form occurs quite rarely both in EWL (MM 64.269.1, 66.252.1) and in EWM (MM 64.267.2, 64.266.1), smaller specimens come from EWU (BP 60.745.1, 71.420.1). All of them exceed by larger size (up to 9 cm long) the type specimens from Socka, as already stressed by ANDREÁNSZKY (1966: 99).

MONOCOTYLEDONES

SMILACACEAE

Smilax weberi WESSEL in WESSEL et WEBER, 1855
(Plate XII: 2)

As already stated by ANDREÁNSZKY, (1966), *Smilax* leaves occur very rarely in EWU (MM 62.2951.1, W 1576, BP 70.135.1-orig. ANDREÁNSZKY 1966, textf. 99). In view of the known variability of the foliage we include both oval and hastate forms into a single species and thus depart from the view expressed by ANDREÁNSZKY (1966).

ZINGIBERACEAE

Spirematospermum wetzleri (HEER, 1859) CHANDLER, 1925

This species was recorded at EW by PÁLFALVY (in NAGY & PÁLFALVY 1963) and the material was verified at MÁFI.

PALMAE

Sabal major (UNGER, 1847) HEER, 1855
(Plate V: 5)

Fragmentary leaf fans of sabaloid palms occur but rarely at EW. One specimen representing a basal part of the leaf with a stout petiole (2.5 cm across) and leaf lamina segmented into quite narrow parts (5 mm wide) has been found at EWM (MM s.n. other specimens figured by ANDREÁNSZKY (1949, pl. 3-BP 83.288.1) and PÁLFALVY (in NAGY & PÁLFALVY 1963, pl. 9, f. 8) and fragments of segments (MM 64.26.1, 56.1451.1 etc) safely demonstrate this warm element also in EWU.

Calamus noszkyi JABLONSKY, 1914

Leaf fans of calamoid palms are a regular accessory element of EMU. Complete leaves can be met (NAGY & PÁLFALVY 1963, pl. 10, f. 1) along with numerous fragmentary specimens (MM 66.367.1,) 66.416.1, s.n., BP 83.383.1). We do not consider *Phoenicites leganyi* ANDREÁNSZKY (1955, 48. pl. 3. f. 15 - BP 71.419.1) to be specifically different and include this fragment together with *Phoenicites* sp. (ANDREÁNSZKY 1955, pl. 3, f. 14. -BP 83.383.1) into *C.noszkyi.*

Tuzsonia hungarica ANDREÁNSZKY, 1949
(Plate X: 6)

Theese peculiar inflorescences were described in detail by ANDREÁNSZKY (1949b) but unfortunately we have not been able to study the type-specimens, which are missing from BP. The material kept in BP (67.192.1 etc) and MM (s.n.) show enough details but we do not venture to attempt a revision since we are not specialists in the taxonomy of palms. These fossils occur rarely in EWU.

ANGIOSPERMAE inc. sed.

"Elaeocarpus" europaeus ETTINGSHAUSEN, 1869
(Plate IX: 4)

A single leaf compression from EWL (MM 66.137.2 - orig. ANDREÁNSZKY 1966, 94. textf. 88) is well comparable with a characteristic form of unknown systematic position occurring in the North Bohemian Oligocene floras.

"Ficus" latsonoides ANDREÁNSZKY, 1966
(Plate III: 2)

Orbicular leaves with palmate venation, slightly asymmetrical, longly petiolate rather suggesting Malvalean affinities or even Menispermaceae. In spite of numerous attemps we have not been able to prepare cuticles from the carbonized lamina often preserved on the type-material.

The most complete specimen is suggested to be the lectotype (MM 78.07.2 - Andreánszky 1966, textf. 71). About 20 other specimens are available at MM, all from EWL. The fragments from EWM (ANDREÁNSZKY 1966, textf. 70) are questionable.

"Quercus" cruciata AL. BRAUN, 1851

The record from EW was referred to as *Quercus gigantum* Ett. (ANDREÁNSZKY 1966. textf. 46-49, NAGY & PÁLFALVY 1963, pl. 7, f. 1, 2) and revised in a separate paper (KVAČEK & WALTHER 1981). About 10 specimens are available at MM from the EWL. This plant is surely a thermophillous element but no exact match among recent plants can be suggested.

"Rhamnus" warthae HEER, 1872
(Plate XII: 1, 4)

One of the commonest leaf form in EWU was described or referred to under very different names. ANDREÁNSZKY (1966) identified it with *Symplocos* (e.g. *Symplocos* cf. *phanerophlaebia* MERR. l. c. textf. 95) but also as *Styrax* cf. *japonica* SIEB. et ZUCC. (l. c. textf. 76) or *Elaeocarpus palaeolanceolatus* KOLAKOVSKIJ (l. c. textf. 87). The largest specimens have widely cuneate base and acuminate apex and attain at least 15 cm in length. Smaller forms are lanceolate to oblanceolate. All variable forms are connected with the same type semicraspedodromous venation, which form steep loops of widely spaced secondaries. The secondaries and tertiaries are fine but very distinct forming characteristic areoles along the margin. Tiny side veins enter the marginal spiny teeth that can be very indistinct.

According to the character of the impressions showing distinct venation but only little quantity of coaly matter the leaves were obviously chartaceous. Their mass occurrence in the riparian vegetation in EWU and also at Jiu Valley (see STAUB 1887, sub *Rhamnus warthae*, pl. 38, f. 1, 2, *Juglans heerii*, pl. 27. f. 1a, *Laurus primigenia*, pl. 28, f. 6, pl. 29, f. 1, pl. 34-35, f. 1d) recalls a similar association of the Lower Miocene of North Bohemia. The Miocene riparian forest there included masses of leaves of *Rubus merianii* (HEER) KOLAKOVSKIJ. Therefore, we tried to match *"Rhamnus" warthae* with some *Rubus* species and indeed have found representatives with simple leaves belonging to the sect. Sozostyli FOCKE from southern China and other subtropical SE. Asia that recall our fossils (e. g. *R. mairei* LÉVEILLÉ). They differ by at least the apical craspedodromous secondaries, though.

"Talauma" egerensis ANDREÁNSZKY, 1955
(Plate XII: 3, 5)

Large oval to longly ovate-obovate entire-margined leaves with broadly cuneate base and acuminate apex up to 6 cm wide and more than 15 cm long occur sporadically in EWU. Very regular camptodromous venation looping along the margin and obliquely forked tertiary veins offer little evidence as to the affinities of these leaves. The mere large size cannot document the relationship to Magnoliaceae. We have studied well preserved specimens (MM more than 10 specimens, BP 83.294.1 - type ANDREÁNSZKY 1955, 38. pl. 1, f. 4) but have not found good arguments for a generic assignment.

VEGETATION AND CLIMATE

According to BÁLDI (1973) the deposition of the three flora levels at EW took place in very different environment. In view of the taphonomical studies of recent sediments (e. g. GASTALDO et al. 1989, GASTALDO in press) we think the depositional environment greatly influenced the composition of the assemblages.

The Molluscan Clay (the EWL assemblage) was deposited in deep littoral to bathyal environment, i. e. in the sea, deeper than about 100 m. The leaf remains are carbonized, pyritized and occur solitarily. The sorting of the leaf fossils was extreme, only the tough remains have survived the deposition and transport. Thus in the EWL coriaceous (evergreen) elements prevail: Lauraceae, *Platanus neptuni*, ? Fagaceae gen., cf. *Myrica integerrima*, and above all *Dryophyllum callicomifolium*. As additional accessories *Pinus*, Juglandaceae, *Salix* vel *Populus* sp., *Ziziphus* cf. *ziziphoides*, "*Ficus*" *latsonoides* and "*Quercus*" *cruciata* should be added. The species with toothed leaves obviously prevail over the entire-margined ones. The assemblage does not seem to be extremely thermophilous.

The best extant forest to compare with appears in the warm temperate to subtropical mixed mesophytic forest of East Asia. In this estimation we are close to ANDREÁNSZKY's view (ANDREÁNSZKY 1966:127), the vegetation, however, does not correspond to a gallery forest but to mesophytic forests and hence the humidity of climate was not reduced. On the contrary, the total annual precipitation was surely above 1000 mm.

The environment of the shallow marine Alternating Clay and Claystone, in which drift levels of the EWM assemblage are interbedded, suggests a far front delta deposits that brought plant detritus from the shore and river banks. The assemblage is dominated by pine remains and *Daphnogene* together with other Lauraceae, *Ulmus pyramidalis*, evergreen Fagaceae, *Myrica longifolia*, cf. *Myrica integerrima* and accessory *Engelhardia* and other Juglandaceae, *Salix* vel *Populus*, *Ziziphus* cf. *ziziphoides* and exceptional *Alnus*. The pines are common elements of warm temperate and subtropical sea shore vegetation. *Ulmus* and *Daphnogene* seem to represent riparian forests. Here again we must expect strong sorting of leaf remains that underwent long-distance transport. The parallel orientation of abundant leaf remains on one bedding plane is a result of the delta regime with occasional increase of current during floods.

The mollusc fauna of the uppermost member of the section, the Coarse Sands with clay lenses refer to brackish to freshwater swamp conditions. Indeed, in the EWU assemblage we met with many swampy and riparian plants that dominated the forests around the standings waters. The forest included mostly *Alnus*, *Acer tricuspidatum*, *Cedrela* and masses of "*Rhamnus*" *warthae* (as an undergrowth element - ? *Rubus*). The forests might not be purely deciduous. Thermophile elements *Daphnogene*, *Engelhardia*, palms, *Sequoia couttsiae*, Leguminosae and common accesories as *Tetracentron*, *Ilex*, *Comptonia dryandroides*, *Myrica longifolia*, "*Talauma*" *egerensis* refer to quite equable frostless climate. The riparian forests of warmer zones are today often dominated by deciduous elements (Himalayas, SE China) and thus we cannot attribute much weight to them in climatic estimations. The remains of EWU underwent little transport because complete leaf fans of ferns (*Pronephrium*) or at least fragments and palms (*Calamus*) occur in little demaged specimens.

According to the above-summarized composition of the assemblages we gather that the climatic conditions did not change much from the EWL to EMU. The time-span between them was certainly not long enough to reflect a pronounced change in the climatic trend. Hence we do not fully agree with ANDREÁNSZKY (1966) who expects warming trends between EWL and EWU, but neither with PLANDEROVÁ et al. (1975) who see cooling trends in the influx of riparian ("Arcto-Tertiary") elements, mainly in EWU. NAGY (1979) rightly stressed the role of palaeoenvironment and noted "Arcto-Tertiary" elements at all three levels of the macroflora at EW. Her palynological data and climatic estimates largely correspond with the conditions given below.

According to the macroflora of EW the climate was similar to that confied today to Central and Eastern China. The influence of an extensive warm sea prevented long and severe frosts and more pronounced temperature changes. The mean annual temperature does not seem to be very high (about 15 °C) and the mean annual range of temperature might vary about 20-25 °C (cf. WOLFE 1979). The conditions in the early Egerian were surely not so optimal as in the Early Oligocene or late Early Miocene, when Mastixiaceae floras thrived.

CORRELATION AND COMPARISONS

The question of floristic correlations can be satisfactorily solved only when corresponding vegetational units are compared.

The similarity of two assemblages need not mean their same age and, on the contrary, assemblages from various environmental settings in the same period (stratigraphical level) can look very differently.

Within the Paratethys area the swamp-riparian assemblage of EWU shares most taxa with the same type of vegetation from the Upper Oliocene Jiu Valley. With some corrections made by GIVULESCU (1973, 1983, 1986, 1987) and our own observations we meet there the same set of pteridophytes (abundant *Osmunda lignitum*, *Pronephrium stiriacum*, *Blechnum dentatum*, a very similar riparian-swamp forests with *Alnus nostratum* complex, *Acer tricuspidatum* (incl. *hungaricum*), *Myrica longifolia*, "*Rhamnus*" *warthae*, *Calamus noszkyi* just to name the most important species. For ecological reasons *Platanus neptuni* is not represented and mesophytic elements (*Pinus*, *Tetraclinis*, *Trigonobalanopsis*) are scarce or absent both in EWU and the Jiu Valley. The latter differs also in the conifers, which include also *Taxodium*, *Glyptostrobus* and *Sequoia abietina* there. This may be caused by more pronounced coal-forming awampy conditions in the lignite basin.

The other Egerian floras in Hungary (HABLY 1982, 1985, 1987, 1989, 1990) are dominated by *Platanus neptuni*, *Daphnogene* and a few other accessories. They all match well with the EWL and EWM assemblages and include regularly fragments of riparian and swamp forests of EWU ((Leguminosae, *Alnus oligocaenica*, *Acer*, *Myrica longifolia*, "*Rhamnus*" *warthae*, *Calamus*), according to the sedimentation conditions. However, *Dryophyllum callicomifolium* is not represented. The richer local flora from Vértesszőlős (HABLY 1990) differs also in the higher frequency of *Taxodium*, *Betula* sp. div., *Acer* *angustilobum*, *Cornus*. All these elements occur both in the Early Oligocene and Lower Miocene and cannot prove differences in the age of these sites. On the other hand, the Egerian floras from the environment of Linz (KOVAR 1982) and Krumvir (KNOBLOCH 1975) do include new elements that allow one to consider both localities younger than EW. It is first of all *Cunninghamia* and *Fagus* (a cupule at Krumvir, own observation) that link these floras with those of Germany (Witznitz and Thierbach Complexes - see KVAČEK, WALTHER & BŮŽEK 1989). These assemblages include a higher representation of *Tetraclinis* and *Trigonobalanopsis*, *Comptonia acutiloba* instead of *V. dryandroides* together with some more Miocene elements (*Buxus egeriana*, *Alnus julianiformis*).

The EW flora has probably many common features with the Upper Oligocene-Lower Miocene floras of Swiss Molassa (e.g. Monod) and France (e.g. BOIS D'ASSON) but we are unable to bring a more precise comparison without their modern revision.

The Lower Miocene floras of North Bohemia (e.g. BŮŽEK 1971), partly include elements that occur at EW (*Ulmus pyramidalis*, ROSA, "*Viburnum*" *atlanticum*, *Fraxinus*, *Acer tricuspidatum*, *Calamus* and differ distinctly by lacking Oligocene (Palaeogene) elements such as *Osmunda lignitum*, *Dryophyllum*, "*Elaeodendron*" *europea*, *Comptonia dryandroides*, "*Rhamnus*" *warthae*.

* * *

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Table 1. List of the revised flora of the Egerian stratotype section at Eger ("Wind's brickyard) (° = one specimen, + = 2=20 specimens, ! = more than 20 specimens, ∞ = dominant element)

Taxon	EWL	EWM	EWU
Equisetum sp. div.			+
Osmunda lignitum			+
Blechnum dentatum			!
Asplenium egedense	.		
Pronephrium stiriacum			!
?Polypodiaceae vel Aspidiaceae			.
Pinus sp. div.	+	∞	+
Sequoia couttsiae			!
Tetraclinis sp.			+
? Cephalotaxaceae	.		
Sassafras lobatum	.		+
Daphnogene cinnamomifolia	!	∞	∞
Laurophyllum sp. div.	!	!	+
Tetracentron agriense			+
Platanus neptuni	!	+	
Ulmus fischeri			!
Ulmus pyramidalis		!	+
Ulmus pseudopyramidalis			+
Ulmus sp.		+	+
? *Zelkova zelkovifolia*		.	
Quercus rhenana			+
cf. *Lithocarpus saxonicus*		+	
Dryophyllum callicomifolium	∞	+	
? *Trigonobalanopsis rhamnoides*		+	.
? Fagaceae gen.	!	+	+
Alnus oligocaenica			∞
Myrica longifolia		+	!
cf. *Myrica integerrima*	!	+	+
Comptonia dryandroides			!
Engelhardia orsbergensis		+	!
Engelhardia macroptera			+
Juglandaceae gen.	+	+	
"*Viburnum*" *atlanticum*			.
"*Arbutus*" *praeunedo*		.	
Salix vel *Populus* sp.	+	+	
Rosa lignitum			.
Leguminocarpon sp. div.			!
Leguminosites sp. div.			!
Cedrela macrophylla			∞
Acer tricuspidatum			∞
Ilex ? *andreanszkyi*			+
Fraxinus sp.			+
Ziziphus cf. *ziziphoides*	+	+	+
Smilax weberi			+
Spirematospermum wetzleri			+
Sabal major			+
Calamus noszkyi			!
Tuzsonia hungarica			+
"*Elaeocarpus*" *europaeus*	.		
"*Ficus*" *latsonoides*	+		
"*Quercus*" *cruciata*	+		
"*Rhamnus*" *warthae*			∞
"*Talauma*" *egerensis*			+

Plate I

1 = ? Polypodiaceae vel Aspidiaceae, fragmentary pinna, EWU, No. MM 56.1344.1, x 3 - 2 = *Pronephrium stiriacum* (UNG.) KNOBLOCH et KVAČEK, leaf fan, EWU, No. MM 66.372.1, x 0.9 - 3 = *Equisetum* sp., fragmentary stem, EWU, No. MM 65.726.1, x 1.5 - 4 = *Osmunda lignitum* (GIEBEL) STUR, pinnules, EWU, MM sine num., x 3.5

Plate II

1 = *Pinus* (*Strobus*) sp., cone, EWL, No. MM 64.1089.1, x 1.4 - 2 = ? Cephalotaxaceae, detail of the foliage, orig. ANDREÁNSZKY 1966, sub *Sequoia langsdorfii*, textf.5, EWL, No. MM 64.71.1, x 2.5 - 3 = *Blechnum dentatum* (GOEPP.) A. Br., pinna, EWU, No. MM 61.136.1, x 2. - 4-5 = *Sequoia couttsiae* HEER, cones, EWU, Nos. MM 56.5827, x 3; MM 56.1287.1, x 1.6 - 6 = *Tetraclinis* sp., cone scale, EWU, No. MM 56.1390.1, x 10

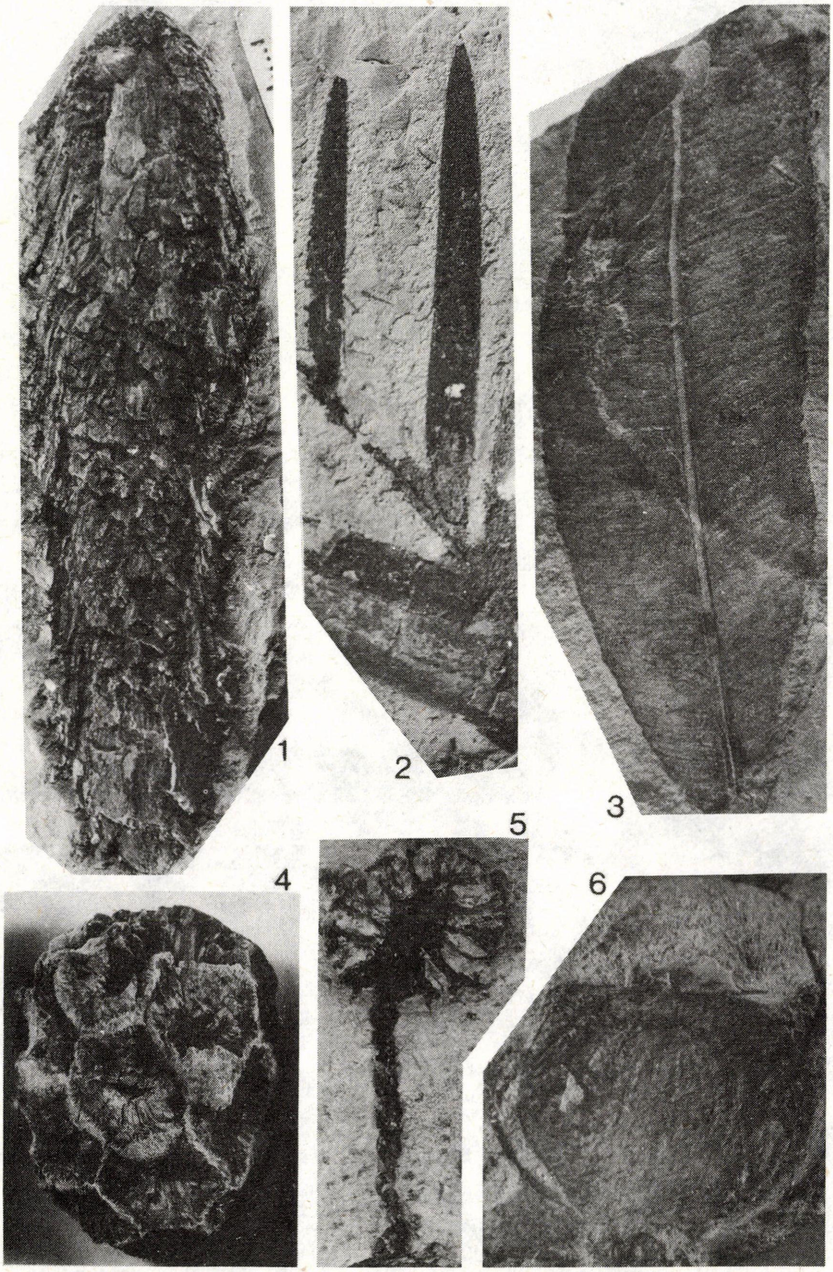

Plate III

1 = *Sassafras lobatum* (SAPORTA) ANDREÁNSZKY, EWU, No. MM 56.1398.1, nat. size - 2 = "*Ficus*" *latsonoides* ANDREÁNSZKY, detail of the leaf base, EWL, No. MM 61.222.1, x 2.5. - 3 = *Laurophyllum* sp. (cf. *L. acutimontanum* MAI), EWL, No. MM 64.227.1, nat. size - 4 = *Daphnogene cinnamomifolia* (BRONGN.) UNG., "*lanceolata*" leaf form, EWM, No. 64.67.1, x 1.5 - 5 = *Daphnogene cinnamomifolia* (BRONGN.) UNG., "*cinnamomifolia*" leaf form, EWM, No. MM 64.30.1, nat. size

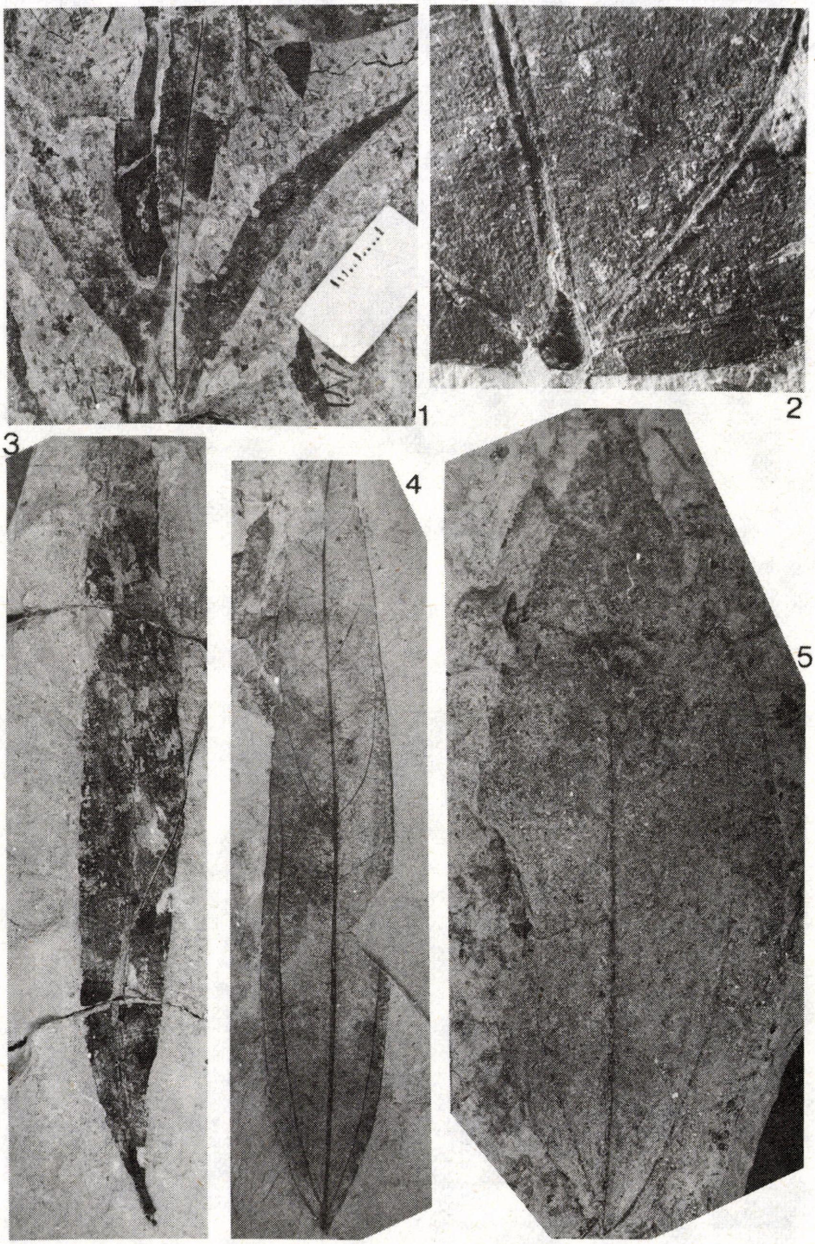

Plate IV

1-4 = *Tetracentron agriense* (ANDREÁNSZKY) comb. n., EWU: 1 = holotype, No. MM 78.11.2, nat. size - 2 = detail of margin, counterimprint of the holotype, No. MM 9a, x 3.5 - 3 = leaf basis, No. MM 61.821.1 (W 13261a), x 3 - 4 = leaf apex, MM 61.812.1, x 3.5

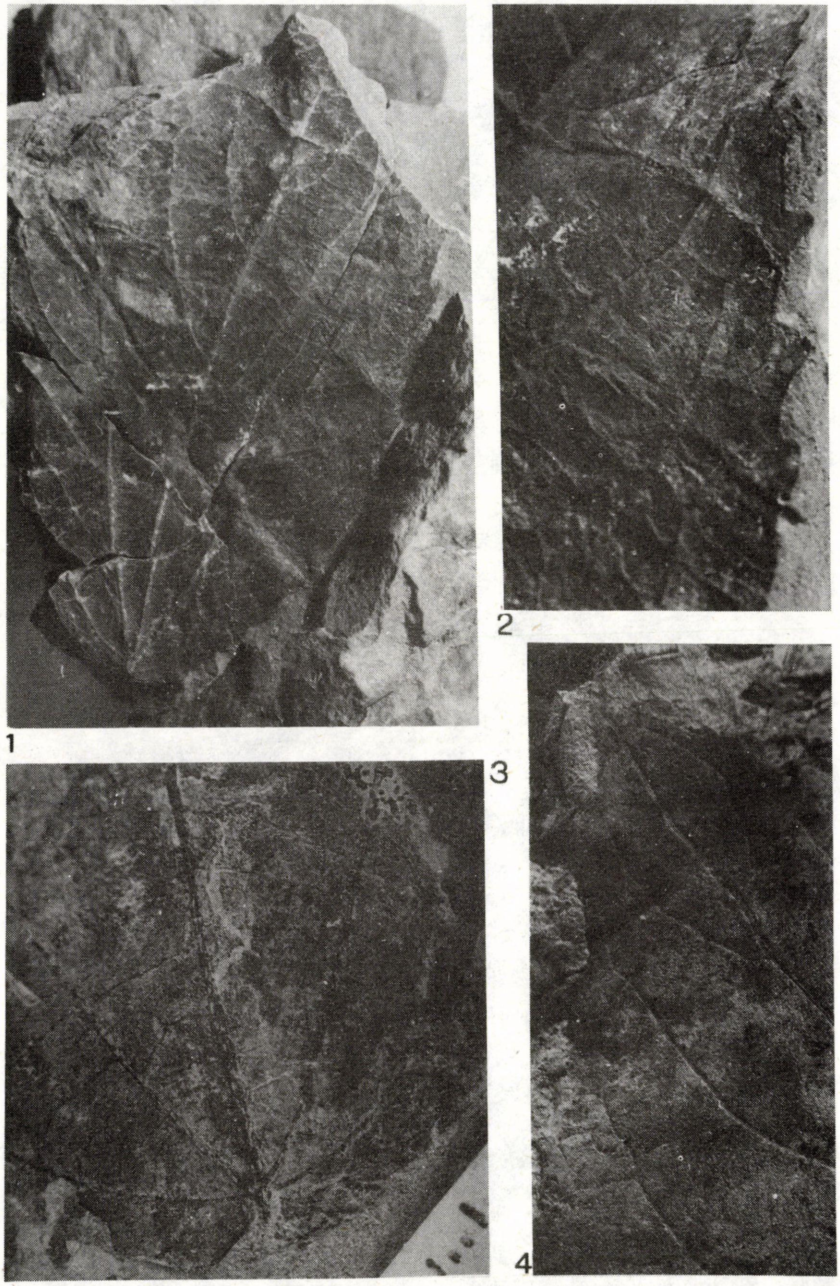

Plate V

1 = *Ulmus pyramidalis* GOEPP., EWU, No. MM 61.789.1, x 1.5 - 2 = *Ulmus fischeri* HEER, EWU, No. MM 56.696.1, nat. size - 3 = ? *Zelkova zelkovifolia* (UNG.) BŮŽEK et KOTLABA, EWM, No. W 1442, x 2 - 4 = *Platanus neptuni* (ETT.) BŮŽEK, HOLY et KVAČEK, EWL, No. 64.93.1, x 1.5 - 5 = *Sabal major* (UNG.) HEER, basal part of the leaf fan, EWM, MM sine num., x 0.5.

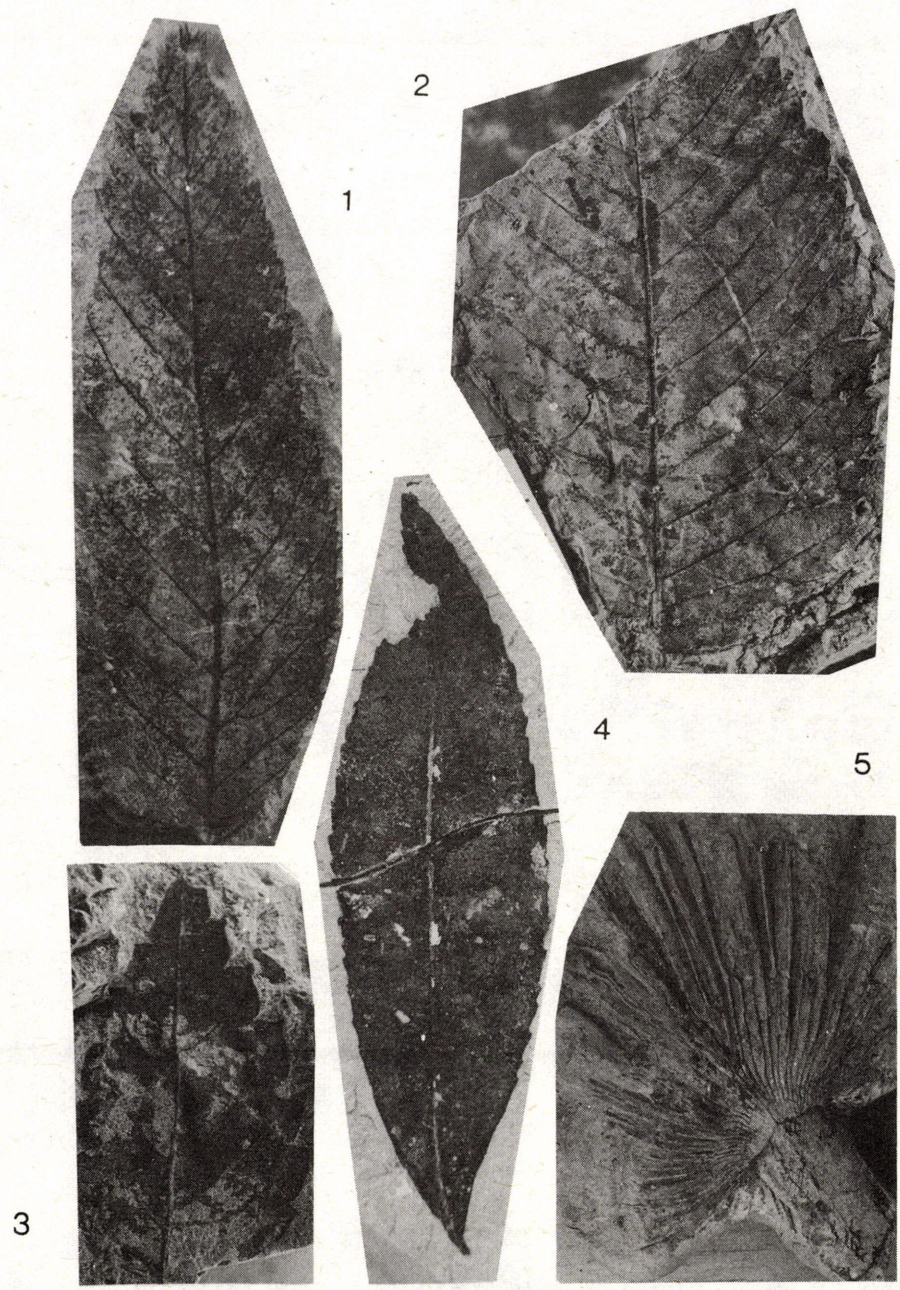

Plate VI

1 = *Ulmus pseudopyramidalis* sp.n., holotype, EWU, MM sine num., x 0.9 - 2-3 = *Quercus rhenana* (KRÄUS. et WEYL.) KNOBLOCH et KVAČEK, EWU, Nos. BP 70.102.1, x 1.2; BP 70.451.1, nat. size - 4 = *Dyophyllum callicomifolium* (ANDREÁNSZKY) comb. n., detail of the paratype, EWL, orig. ANDREÁNSZKY 1962, pl. 2, f. 3, No. MM 61.793.1, x 2.5 - 5 = ? *Trigonobalanopsis rhamnoides* (ROSSM.) KVAČEK et WALTHER, detailed venation of leaf, orig. ANDREÁNSZKY 1966, textf. 97, sub *Cornus buchii* HEER, EWU, No. BP 70.136.1, x 4

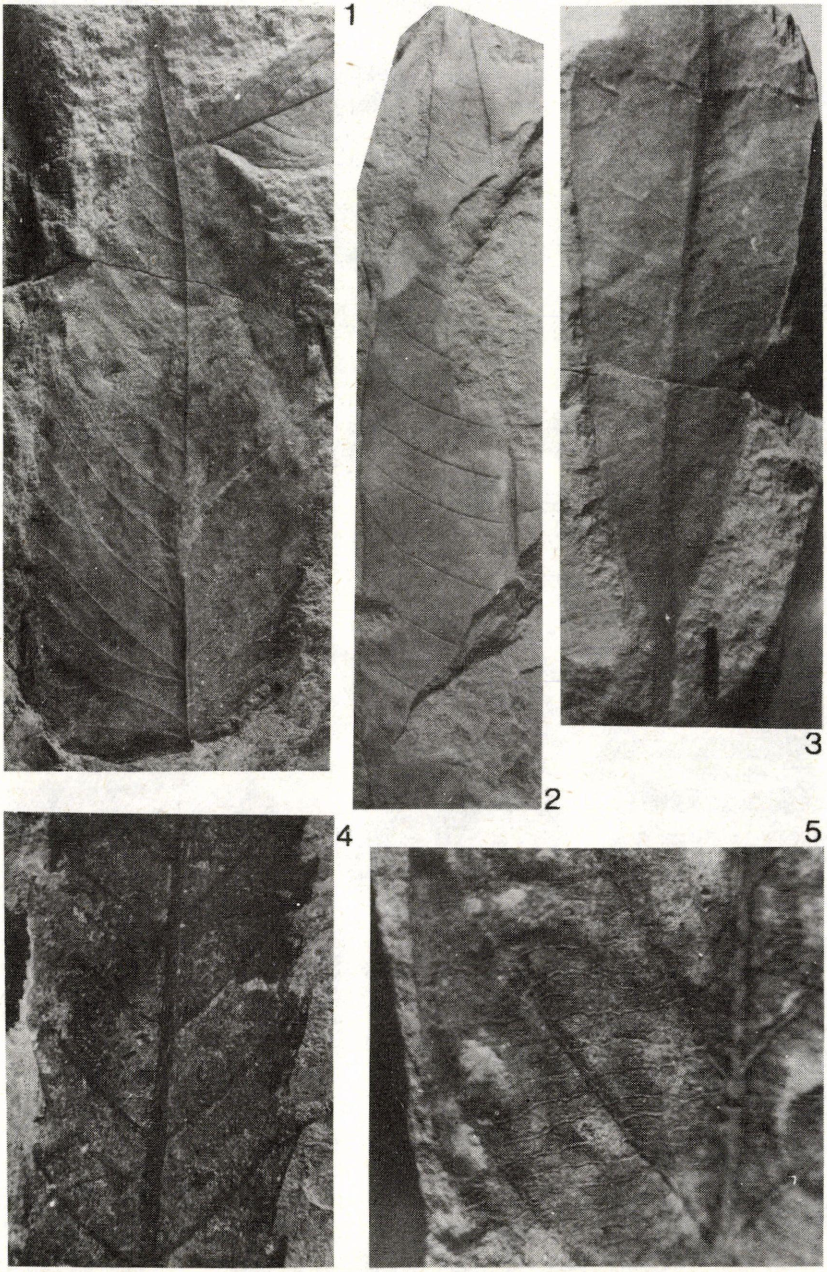

Plate VII

1 - 3 = *Alnus oligocaenica* ANDREÁNSZKY, EWU: 1 = detail of leaf margin, No. MM 62.102.1, x 3.5 - 2 = No. MM 64.219.1, x 2.5 - 3 = infructescence, No. BP 71.428.1, x 4 - 4 = cf. *Lithocarpus saxonicus* WALTHER et KVAČEK, EWM, No. 64.176.1, nat. size - 5 = Fagaceae gen., EWL, No. MM 64.177.1, nat. size

Plate VIII

1 = *Myrica longifolia* UNG., EWL, No. MM 64.84.1 (6221), x 1.5 - 2 = *Comptonia dryandroides* UNG., No. MM 62.267.1, x 1.5 - 3 = *Engelhardia orsbergensis* (WESS. et WEB.) JÄHNICHEN, MAI et WALTHER, EWU, No. MM 56.1325.1, x 2 - 4 = cf. *Myrica integerrima* KRÄUS. et WEYL., EWL, No. MM 64.170.1, nat. size - 5 = Juglandaceae gen., orig. ANDREÁNSZKY 1966, textf. 54, sub *Juglans* cf. *cinerea* L., EWM, No. MM 64.72.1 (7366), x 5 - 6 = "*Viburnum*" *atlanticum* ETT., EWU, No. BP 54.1415.1, x 2.5.

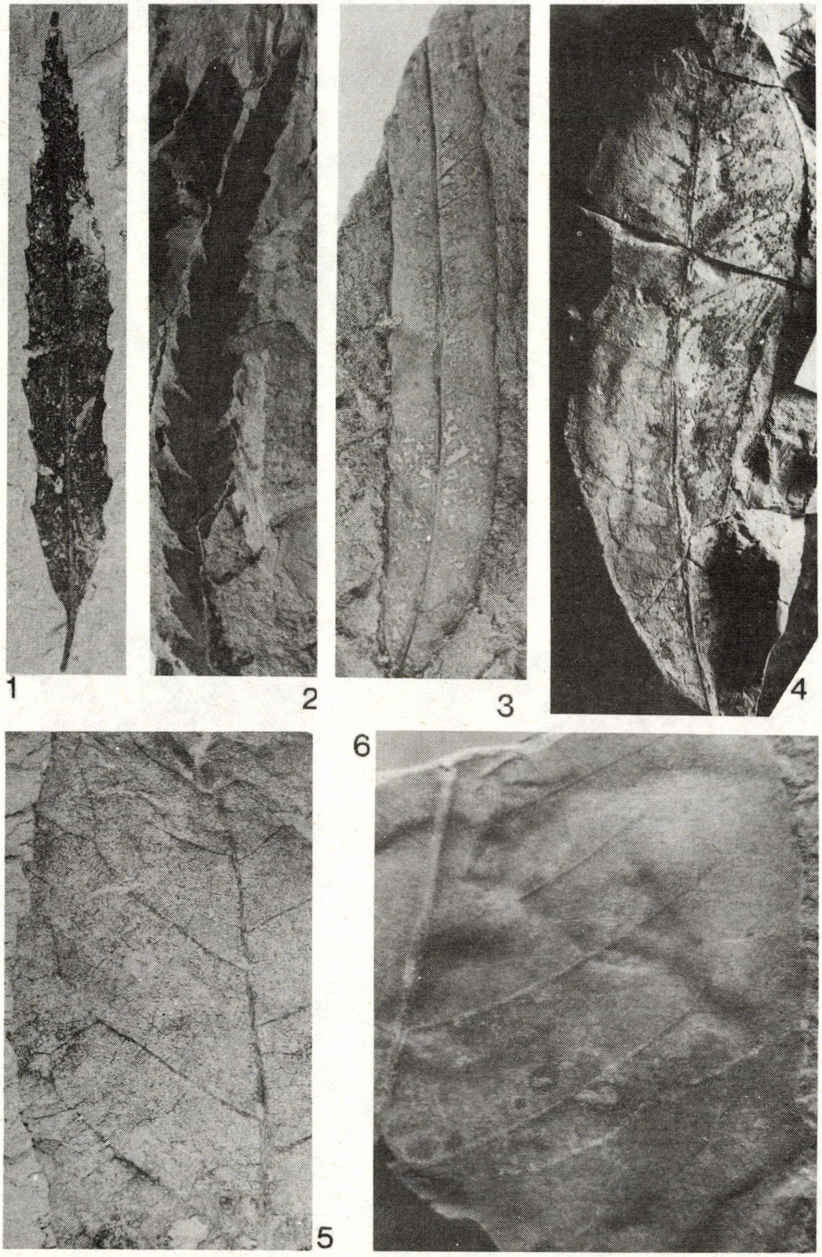

Plate IX

1 = "*Arbutus*" *praeunedo* ANDREÁNSZKY, detail of the holotype, orig. ANDREÁNSZKY 1962, textf. 10, EWM, No. BP 83.266.1 (3291), x 3.5 - 2 = *Salix* vel *Populus* sp., EWL, No. MM 64.103.1, x 2.5 - 3 = *Rosa lignitum* HEER, EWU, MM sine num., x 2.5 - 4 = "*Elaeocarpus*" *europaeus* ETT., detail of the leaf, orig. ANDREÁNSZKY 1966, textf. 88, EWL, No. 66.137.2, x 2.5

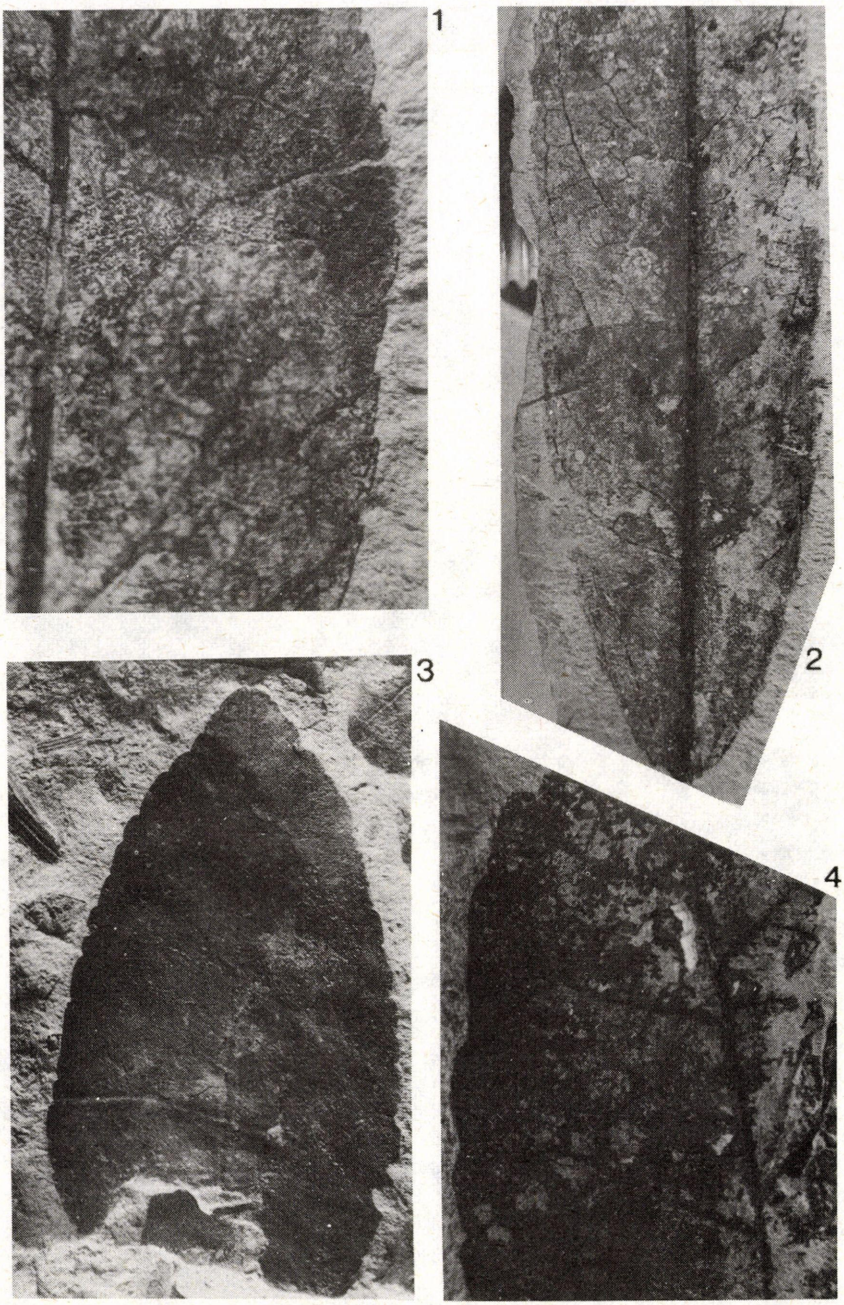

Plate X

1 = *Leguminocarpon* sp. 1, EWU, No. MM 56.1333.1, x 3 - 2 = *Leguminocarpon* sp. 2, EWU, No. MM 6587, nat. size - 3 = *Leguminocarpon* sp. 4, EWU, No. MM 56.1281.1, x 3.5 - 4 = *Cedrela macrophylla* ANDREÁNSZKY, EWU, MM 55.5791.1, nat. size - 5 = *Acer tricuspidatum* BRONN, samara, EWU, No. 56.1097.1, x 3.5 - 6 = *Tuzsonia hungarica* ANDREÁNSZKY, inflorescence, EWU, MM sine num., x 4 - 7 = *Fraxinus* sp., EWU, No. MM 66.370.1, x 2,5

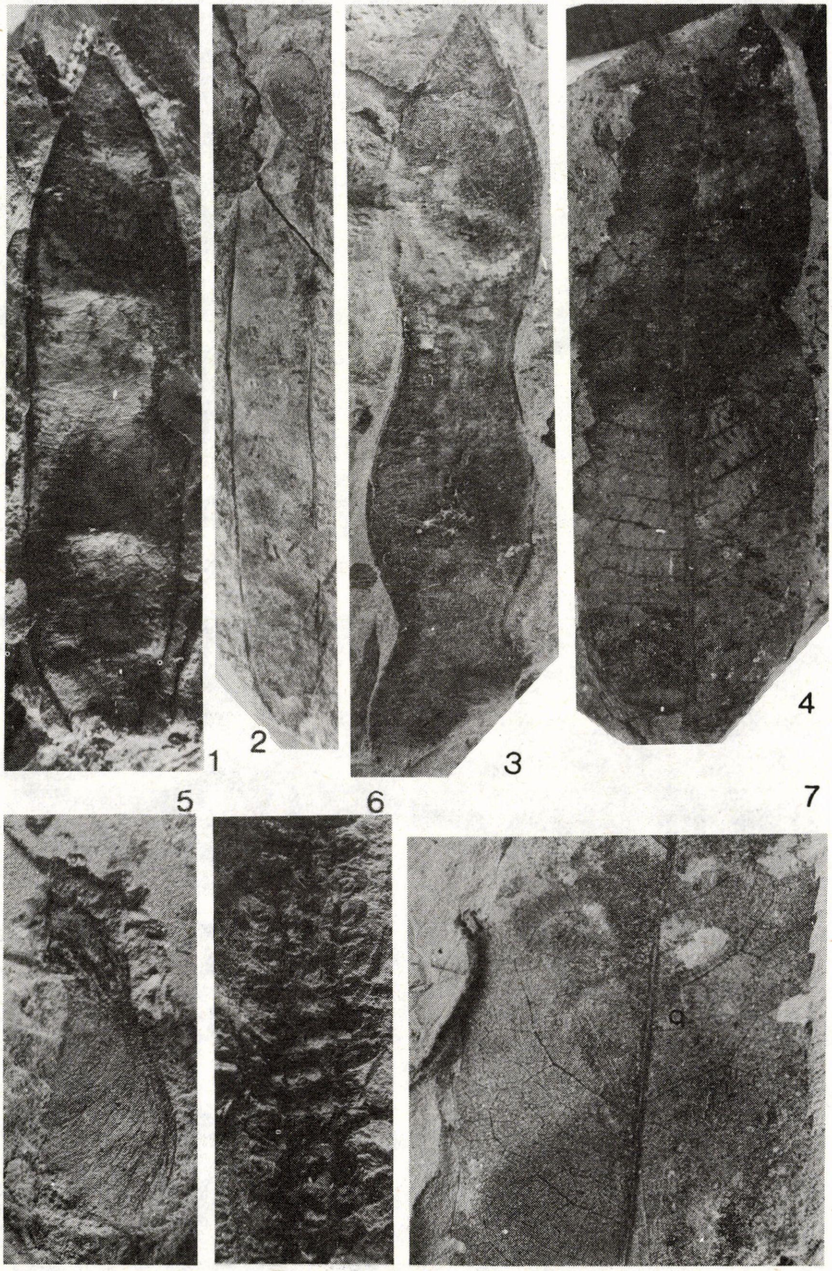

Plate XI

1 - 3 = *Ilex* ? *andreanszkyi* sp. n., EWU 1 = paratype, MM W 1040, x 1.5 - 2-3 = holotype, No. MM W 1142, x 1.5 and x 3.5 - 4 = *Ziziphus* cf. *ziziphoides* (UNG.) Weyl., EWU, BP 71.420.1, x 2.5

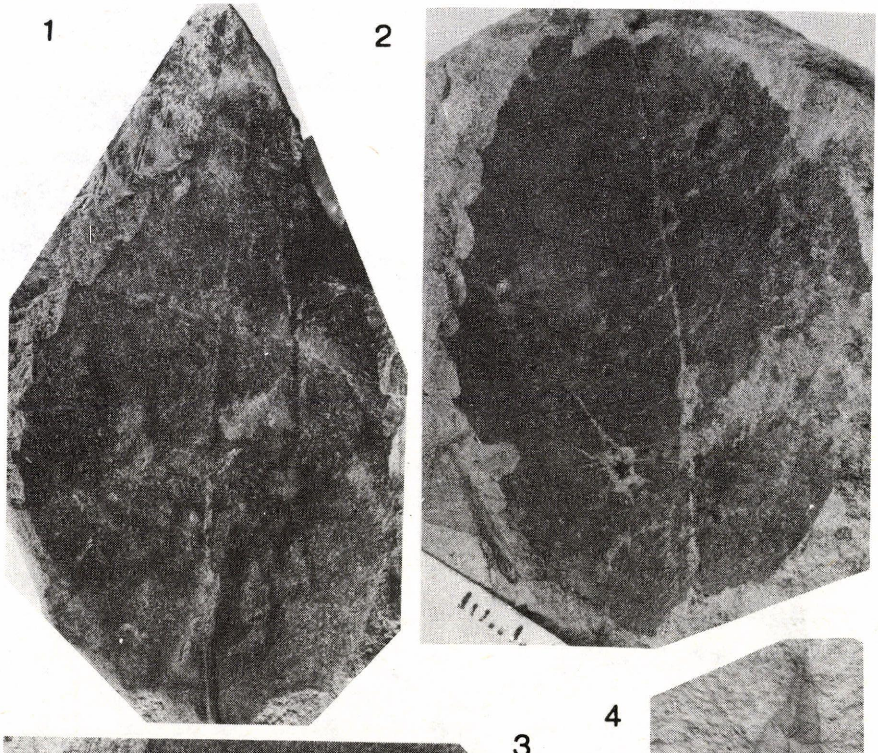

Plate XII

1 = "*Rhamnus*" *warthae* HEER, EWU, No. MM 62.228.1, x 1.5 - 2 = *Smilax weberi* WESS., EWU, No. MM W 1576, x 1.5 - 3 = "*Talauma*" *egerensis* ANDREÁNSZKY, EWU, No. MM 62.304.1, x 0.8 - 4 = "*Rhamnus*" *warthae* HEER, detail of leaf margin, EWU, No. MM 56.1428.1, x 3 - 5 = "*Talauma*" *egerensis* ANDREÁNSZKY, EWU, detailed venation, EWU, No. MM 62.260.1, x 1.5.