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Egerian fossil flora from Kesztölc, NW Hungary

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Abstract: A taxonomic analysis, palaeoecological and palaeoclimatological reconstruction of a Hungarian Egerian flora are given. With 98 figures and 10 plates.

An outcrop containing palaeofloristic evidence can be found south of the village of Kesztölc, in bank of a streambed. This outcrop has been already mentioned by SCHRÉTER (1953), who published altogether 7 Mollusca species from here.

The geological section of the outcrop, as well as a comprehensive presentation of the Molluscan fauna has been given by BÁLDI (1973) and completed by LEÉL-ŐSSY (1984) for the upper strata (Figs 1 and 2).

The sequence of the outcrop, according to BÁLDI (1973), is the following from the bottom upwards:

1. 2 m of coarse sand.
2. 50 cm of shaly clay with leaf imprints and brown coal stringers.
3. 2 m of cross-stratified coarse sand with clay pebbles, and with a Polymesoda-Tympanotonus community (Ostrea cyathula, Polymesoda convexa, Teredo sp., Melanopsis impressa hantkeni, Pirenella plicata, Tympanotonus margaritaceus, Theodoxus pictus).
4. 1.5 m of cross-stratified coarse sand with very scarce fossils.
5. 30 cm of shaly clay with plant fossil impressions (Cinnamomophyllum).
6. 1 m of coarse sand with a thin band of clay containing plant fossil imprints.
7. 2 m of shaly-lamellar fine-grained sandstone.

An unexposed section of 8 m height is succeded by

8. 1 m of coarse-grained sandstone with fine pebbles and molluscs,
9. 2 m of sand with scarce fossils,
10. 2 m of coarse sand, locally with small pebbles, with abundant fossils at two levels: a Glycymeris latiradiata community below, and a Turritella fauna washed together in pockets above, representing a transition between the Pitar polytropa and Turritella venus communities.

Palaeobotanical investigations on the material of this locality were performed by PÁLFALVY, I. and RÁKOS, L. (PÁLFALVY 1965). Thirty taxa were identified based on the macroflora, on macrofloristical and pollen studies. As there is no description or illustration of the material, and the species names are not included in the collection, we began to work on the material as if it were a new, so far unidentified assemblage. The mentioned collection is deposited in the Palaeobotanical Collection of the Hungarian Geological Survey (MÁFI BK classification number).

There is also some unidentified material, collected by RÁSKY, K. and RÁKOSI, L. deposited in the Palaeobotanical Collection of the Hungarian Natural History Museum. The above material has been completed by the collection of the author now also deposited in the Hungarian Natural History Museum, Budapest.

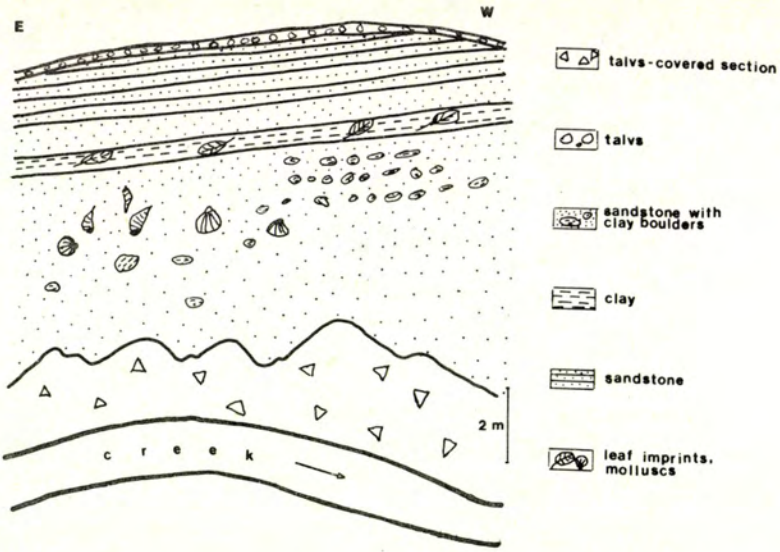


Fig. 1. Geological section of the Kesztölc locality, after Leél-Őssy, 1984.

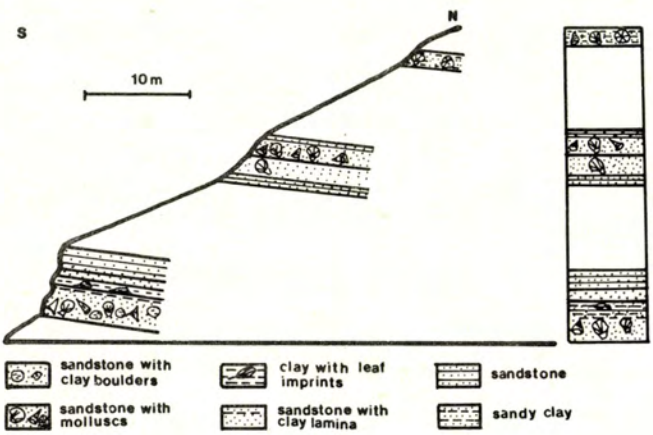


Fig. 2. Exposure in the valley just south of Kesztölc, after Leél-Őssy, 1984.

The macroflora taxa mentioned by PÁLFALVY (1965) are the following:

Schizaeaceae:
Lygodium cf. gaudini Heer
Abietaceae:
Pinus taedaeformis Ung.
Pinus sp.
Taxodiaceae:
Sequoia langsdorfii (Brongt.) Heer
Magnoliaceae:
Magnolia cf. diannae Ung.
Lauraceae:
Laurophyllum pseudoprinceps (Heer) Wld. et Kilpper
Laurophyllum reussii (Ett.) Bobrowska
Cinnamomophyllum lanceolatum (Ung.) Hantke
Cinnamomophyllum polymorphum (A. Br.) Kr. et Wld.
Cinnamomophyllum scheuchzeri (Heer) Kr. et Wld.
Litsea sp.
Papilionaceae:
Cassia ambigua Ung.
Dalbergia sp.
Sophora europaea Ung.
Leguminocarpon sp.
Meliaceae:
Cedrela macrophylla Andreánszky
Aquifoliaceae:
Ilex sp.
Rhamnaceae:
Rhamnus sp.
Ulmaceae:
Ulmus cf. longifolia Ung.
Betulaceae:
Carpinus grandis Ung.
Alnus kefersteinii (Goepp.) Ung.
Fagaceae:
Castanopsis decheni (Web.) Kr. et Wld.
Quercus sp. I.
Quercus sp. II.
Juglandaceae:
Carya serraefolia (Goepp.) Kr.
Engelhardtia macroptera (Brongt.) Ett.
Myricaceae:
Myrica lignitum (Ung.) Sap.
Myrica sp.
Salicaceae:
Salix sp.
Palmae:
Sabalites sp.

SYSTEMATIC DESCRIPTIONS

cf. Pteridophyta

Pl. I, Fig. 1.

Material: MÁFI: BK-2483

Small leaf fragment, the negative print of which was also partly preserved. We can give no closer taxonomic identification on the basis of the small, relatively uncharacteristic piece. The characteristic features of the vein system, however, seem to indicate that this fragment belongs to ferns.

Pineaceae
Pinus L.

Pinus sp.
Material: MÁFI: BK-2930

Long, straight pine needle of 4.8 cm length and 0.15 cm width. The vein running along the middle of the pine-needle can be clearly identified. As no more of such remains were found here, more precise identification of the taxon is not possible lacking more extensive information.

Taxodiaceae
Taxodium Rich.

Taxodium dubium (Sternberg 1823) Heer 1853
Pl. I, Figs 2-4.

1823 Phyllites dubius Sternb.; Sternberg, p. 37, Pl. 36, Fig. 3.
1825 Phyllites dubius Sternb.; ibid. 4, tent. et index.
1825 Filicites; ibid. 4, Pl. 24, Fig. 2, tent. et index.
1838 Taxodites dubius (Sternb.) Presl.; Presl in Sternberg, p. 204.
1853 Taxodium dubium (Sternb.) Heer; Heer, p. 136.
1971 Taxodium dubium (Sternb.) Heer; Bůžek, p. 37, Pl. 6, Figs 9-11; pl. 8, Figs 1-6.

Material: MÁFI: BK-1113, BK-1114, BK-1143

Fragment of sprouts of 1.0-1.9 cm. On the longest one, 7 pairs of leaves were preserved, in fairly good state of preservation on one side, while fragmented on the other side. The dimensions of the leaves are as follows:

length: BK-1114: 1.0, 0.7, 0.75 cm
BK-1143: 0.9, 0.8, 0.9, 0.8, 0.9 cm
width: 0.1-0.12 cm

The presence of Taxodium dubium denotes a marshy environment. Because this species is present on the site only in relatively small quantities and fairly fragmented specimens, it may be assumed that the pieces underwent a relatively long transport, representing the vegetation of a swamp relatively far from the actual site.

A mass accumulation of the species is known only from the Egerian strata of Vértesszőlős from Hungary (HABLY in press), though occassionally some specimens of the species in fragments were located at some other sites of the Kovačov Formation.

Lauraceae
Daphnogene Unger

Daphnogene bilinica (Unger) Kvaček et Knobloch
Pl. III, Figs 1-5; Pl. IV, Fig. 6; Pl. VII, Fig. 3.

1847 Ceanothus bilinicus Unger; Unger, p. 145, Pl. 49, Fig. 9.
1950 Cinnamomophyllum scheuchzeri (Heer) Kräusel et Weyland; Kräusel et Weyland, p. 68, Pl. 11, Fig. 7; Pl. 16, Figs 1-6; Pl. 17, Fig. 1; Pl. 18, Figs 2-4; Text-figs 25-26.
1963 Cinnamomophyllum polymorphum (Al. Br.) Kräusel et Weyland; Weyland et Kilpper, p. 104, Pl. 25, Figs 28-29; Text-fig. 10.
1964 Cinnamomophyllum bilinicum (Unger) Knobloch; Knobloch, p. 601.
1967 Daphnogene bilinica (Ung.) Knobloch et Kvaček; Knobloch et Kvaček, p. 201.
1971 Daphnogene bilinica (Ung.) Knobloch et Kvaček; Kvaček, p. 67. Pl. 2, Figs 1-4; Pl. 9, Figs 4-6; Text-fig. 14.
1978 Daphnogene bilinica (Ung.) Kvaček et Knobloch; Ticleanu et Givulescu, p. 140, Pl. 2, Figs 1-4, 8, 9; Pl. 3, Figs 6-7.
1979 Daphnogene bilinica (Ung.) Kvaček et Knobloch; Hably, p. 56; Text-fig. 1.
1985 Daphnogene bilinica (Ung.) Knobloch et Kvaček; Hably, p. 91, Pl. 9, Figs 1, 4-6; Pl. 10, Figs 1-7.

Material: MÁFI: BK-1108, BK-1111, BK-1120, BK-1124, BK-2449, BK-2450, BK-2456, BK-2461, BK-2481, BK-2903

The length of the leaf varies between 3.4-6.5 cm, its width is between 1.4-2.2 cm. Lamina is elongated obovate or elongated elliptical. Base and apex are acute. Basal veins generally running nearer to the margin than to the midvein. In the upper third of the leaf there are 1-2 pairs of secondary veins starting from the midvein which are linked together in a loop-like connection. The venation is suprabasal, imperfect. The apex is often terminated in a lengthened dropping apex.

Daphnogene cinnamomifolia (Brong. in Cuvier) Unger
Pl. V, Figs 1-5; Pl. VI, Fig. 1.

1822 Phyllites cinnamomifolia Brong. in Cuvier; Brongniart 2 Bd.
1850 Daphnogene cinnamomifolia Unger; Unger, p. 168, Pl. 39, Figs 7-9.
?1873 Cinnamomum rossmässleri Heer; Engelhardt, p. 26, Pl. 5, Fig. 4.
?1950 Cinnamomophyllum polymorphum (A. Br.) Kräusel et Weyland; Kräusel et Weyland, p. 70, Pl. 17, Figs 2-3; Pl. 18, Fig. 1.
1974 Daphnogene cinnamomifolia (Brong. in Cuvier) Unger; Kvaček et Walther, p. 199, Pl. 1, Figs 1-2; Pl. 2, Figs 1-5.
1974 Daphnogene cinnamomifolia (Brong. in Cuvier) Unger; Kvaček et Walther, ibid. 202, Pl. 1, Fig. 4; Pl. 3, Figs 1-5.
1974 Daphnogene cinnamomifolia (Brong. in Cuvier) Unger; Kvaček et Walther, ibid. 201, Pl. 1, Fig. 3; Pl. 4, Figs 1-3.
1978 Daphnogene cinnamomifolia (Brong. in Cuvier) Unger; Mai et Walther, p. 43, Pl. 2, Figs 24-25; Pl. 20, Figs 5-9; Pl. 21, Figs 1-2.
1985 Daphnogene cinnamomifolia (Brong. in Cuvier) Unger; Hably, p. 90.

Material: BP: 85. 267. 1., 85. 268. 1., 85. 269. 1., 85. 274. 1., 85. 275. 2., 85. 283. 1., 85. 309. 1.
MÁFI: BK-1112, BK-1116, BK-1130, BK-1132, BK-1139, BK-2480

The leaves are long and large, their length varies between 5.3-8.0 cm, their width is 2.2-4.4 cm. Lamina of the leaves is elongated ellipsoidal or elongated obovate. The margin of the leaf is entire, the venation is acrodromous, suprabasal and imperfect. Apart from the basal veins, in the upper third of the leaf secondary veins start from the midvein, connected to each other in a loop-like manner.

The veins branching out from the basal veins towards the margin are also connected in a loop-like manner. Between the midvein and the basal veins, a fine network of veins, roughly perpendicular to the midvein can be observed. The basal veins are connected to the midvein in the upper third of the lamina in a loop-like manner. This species is known from the Egerian in Hungary from Verőcemaros (HABLY 1982), Vértesszőlős (HABLY in press), as well as several so far unpublished outcrops. In the Lower Miocene flora of Ipolytarnóc a few specimens represent the species (HABLY 1985a).

This species was found at Kesztölc in relatively great quantity, thus we can consider it a typical, almost dominating species of the locality.

Daphnogene lanceolata Unger
Pl. I, Figs 5-7; Pl. II, Figs 1-6; Pl. VIII, Fig. 3.

1850 Daphnogene lanceolata Unger; Unger, p. 424.
1850 Daphnogene lanceolata Unger; Unger, p. 167, Pl. 34, Figs 1-7.
1873 Daphnogene ungeri Heer; Engelhardt, p. 27, Pl. 5, Fig. 5.
1873 Eucalyptus oceanica Unger; Engelhardt, ibid. 29, Pl. 5, Fig. 11.
1934 Daphnogene lanceolata Unger; Weyland, p. 83, Pl. 11, Fig. 6; Pl. 13, Fig. 7; Pl. 14, Fig. 8.
1950 Cinnamomophyllum scheuchzeri (Heer) Kräusel et Weyland; Kräusel et Weyland, p. 68, Pl. 11, Fig. 7; Pl. 16, Figs 1-6; Pl. 17, Fig. 1; Text-fig. 25.
1963 Cinnamomophyllum scheuchzeri (Heer) Kräusel et Weyland; Mai, Pl. 8, Figs 4-6.
1963 Laurophyllum acutimontanum Mai; Mai, ibid. Pl. 8, Fig. 10; Text-fig. 11 a-e.
1964 Cinnamomophyllum scheuchzeri (Heer) Kräusel et Weyland; Walther, p. 48, Pl. 17, Figs 1-4.
1965 Cinnamomophyllum bitterfeldense Schneider; Schneider, p. 1241, Pl. 4, Figs 11-13.
1976 Daphnogene lanceolata Unger; Bůžek, Holy et Kvaček, p. 100, Pl. 7, Figs 1-4; Pl. 19, Figs 3-7.

1978 Daphnogene lanceolata Unger; Mai et Walther, p. 40, Pl. 2, Figs 1-23; Pl. 19, Figs 1-15; Pl. 20, Figs 1-4.

Material: BP: 85. 276. 1., 85. 277. 1., 85. 278. 2., 85. 279. 1., 85. 280. 1/a., 85. 280. 1/b., 85. 282. 1., 85. 284. 1., 85. 289. 1., 85. 291. 1., 85. 295. 1., 85. 301. 2., 85. 306. 1., 85. 308. 1., 85. 312. 1., 85. 322. 1., 85. 363. 1.
MÁFI: BK-1123, BK-1127, BK-2453, BK-2459, BK-2463, BK-2468, BK-2469, BK-2472, BK-2473, BK-2476, BK-2477, BK-2488, BK-2492, BK-2902, BK-2909, BK-2910, BK-2918, BK-2920, BK-2921, BK-2935

The length of the leaves is 3.5-8.3 cm, their width varied between 0.9-2.5 cm. Lamina is strongly elongated, obovate. The venation is acrodromous, suprabasal, imperfect. The basal veins run nearer to the margin than to the midvein to which they are connected in the upper third of the lamina in a loop-like manner. There are 2-4 pairs of secondary veins branching out from the midvein in the upper third of the leaf.

This species is very frequent in the Egerian stage of Hungary. It was found at Verőcemaros (HABLY 1982), Vértesszőlős (HABLY in press), and it is present on a number of other localities not published so far. Some authors consider it as a light-leaf to D. cinnamomifolia, because these two species are occurring very frequently together.

Daphnogene polymorpha (A. Br. 1845) Ettingshausen 1851
Pl. IV, Figs. 1-5.

1845 Ceanothus polymorphus A. Braun; A. Braun, p. 171.
1847 Ceanothus bilinicus Unger; Unger, p. 145, Pl. 49, Fig. 9.
1851 Daphnogene polymorpha (A. Br.) Ettingshausen; Ettingshausen, p. 16, Pl. 2, Figs 23-25.
1855 Camphora polymorpha (A. Br.) Heer; Heer, p. 112, Pl. 1, Fig. 11.
1856 Cinnamomum polymorphum (A. Br.) Heer; Heer, p. 88, Pl. 91, Figs 11c, d, Pl. 93, Figs 25-28, Pl. 94, Figs 1-16, 19a, 20b, g, 21-26.
1914 Cinnamomum polymorphum (A. Br.) Heer; Jablonszky, p. 255.
1959 Cinnamomophyllum polymorphum (A. Br.) Kr. et Wld.; Rásky, p. 454.
1964 Cinnamomophyllum bilinicum (Ung.) Knobloch; Knobloch, p. 601.
1967 Daphnogene bilinica (Ung.) Kvaček et Knobloch, Knobloch et Kvaček, p. 203.
1971 XXVI. sensu Ferguson; Ferguson, p. 139, Pl. 25 A-H, Pl. 20, 21, Figs A, B.
1976 Daphnogene polymorpha (A. Br.) Ettingshausen; Knobloch et Kvaček, p. 52, Pl. 12, Figs 18, 20; Pl. 19, Figs 3, 4, 7; Pl. 23, Fig. 7; Pl. 26, Figs 9-12.
1985 Daphnogene polymorpha (A. Br.) Ettingshausen; Hably, p. 92, Pl. 11, Figs 1-4.

Material: MÁFI: BK-1101, BK-1109, BK-1119, BK-1128, BK-2496, BK-2927

The length of the leaves varies between 4.4-7.5 cm, their width is 2.8-5.0 cm; they are of medium to large dimensions, their shape is obovate, the apex is lengthened, the midvein is strong. The basal veins are thinner than the midvein, and always branch out from over the basis, nearly the same spot. The basis is frequently asymmetrical. The basal veins and the secondary veins starting from the midvein form a loop, among them a thick tertiary venation is present. The veins branching out from the basal veins towards the margin are strong, connected to each other in loops. The margin of the leaf is entire.

The species is generally considered to be characteristic of the Miocene, but in Hungary it is also present in several Egerian localities, though with definitely smaller specimens, similar to e.g. D. lanceolata. Some authors consider that D. polymorpha is the shadow leaf equivalent of D. bilinica. The joint occurrence of the two forms seems to support this view, yet this question has not been clarified from taxonomic point of view.

Daphnogene sp.
Pl. VI, Figs 2-3.

Material: BP: 85. 265. 1., 85. 266. 1., 85. 270. 1., 85. 271. 1a, 85. 271. 1b, 85. 272. 1., 85. 273. 1., 85. 281. 1., 85. 285. 1., 85. 286. 1., 85. 287. 1., 85. 288. 1., 85. 290. 1., 85. 292. 1., 85. 293. 1., 85. 294. 1., 85. 296. 1., 85. 297. 1., 85. 298. 1., 85. 299. 1., 85. 300. 1., 85. 302. 1., 85. 303. 1., 85. 304. 1., 85. 307. 1., 85. 308. 1., 85. 310. 1., 85. 311. 1., 85. 313. 1., 85. 321. 1., 85. 323. 1., 85. 355. 1.

MÁFI: BK-1102, BK-1110, BK-1137, BK-1109, BK-2448, BK-2457a, BK-2457b, BK-2460, BK-2466, BK-2475, BK-2479, BK-2482, BK-2486, BK-2487, BK-2493, BK-2498, BK-2901, BK-2904, BK-2905, BK-2906, BK-2907, BK-2908, BK-2911, BK-2912, BK-2913, BK-2919, BK-2920, BK-2922, BK-2928

Daphnogene is one of the dominant genera of the locality. There are fragmented several specimens of poor state of preservation, mainly basal fragmens. On these specimens, apart from the midvein and the basal veins, generally no significant identification marks can be observed, it is impossible to identify than to the species. Most likely they belong to several species.

The genus is present in all the Egerian floras in Hungary, as well as several floras of the Lower Miocene and Lower Oligocene. We can state about the genus - including the previously described Daphnogene species as well - that as a member of the subtropical laurel-forest vegetation, they probably comprised the shrub level of the forest. Considering their climatic requirements, they are palaeotropical elements preferring warm climate. Deduced from their great numbers and diversity, the genus flourished in the Egerian stage.

Laurophyllum Goeppert

Laurophyllum sp.
Pl. VI, Fig. 4.
Material: MÁFI: BK-1125, BK-2917

Only two specimens were classified as belonging to this taxon. They are long, elongated leaves of entire margin. The complete specimen is 1.2 cm wide and 8.4 cm long, while in case of the other piece only the width of the leaf was measureable, that is 0.9 cm. The apex and the base are acute. No other venation, apart from the midvein, can be observed.

Several species of the genus are known from different stages of the Tertiary. They prefer warm climate and represent the same biotope (laurel forest vegetation) as Daphnogene.

Platanaceae
Platanus L.

Platanus neptuni (Ett.) Bůžek, Holý et Kvaček
Pl. VI, Fig. 5; Pl. VII, Figs 1-5.

1866 Sparganium neptuni Ett.; Ettingshausen, p. 31, Pl. 7, Figs 9-15.
1866 Sparganium extinctum Ett.; ibid. p. 31, Pl. 7, Fig. 8.
1869 Bombax chorisiaefolium Ett.; Ettingshausen, p. 11, Pl. 42, Figs 2, 4, 5.
1869 Quercus arctocarpites Ett.; ibid. p. 63, Pl. 55, Fig 19.
1869 Ceratopetalum haeringianum Ett.; ibid. p. 6, Pl. 40, Figs 27-28; Pl. 41, Figs 4-5.
1885 Ceratopetalum cundraticiense Engelhardt; Engelhardt, p. 48, Pl. 11, Fig. 2.
1898 Fiburnum oligocenicum Engelhardt; Engelhardt, p. 96, Pl. 9, Fig. 61.
1898 Ampelopsis bohemica Engelhardt; Engelhardt, ibid. p. 101, Pl. 10, Figs 23-26.
1898 Elaeodendron grandifolium Engelhardt; Engelhardt, p. 107, Pl. 10, Fig. 30.
1898 Phyllites quercoides Engelhardt; ibid. p. 116, Pl. 11, Fig. 29.
1898 Phyllites amphirocioides Engelhardt; ibid. p. 116, Pl. 11, Figs 47, 68, 79.
1898 Equisetites ettingshauseni Engelhardt; ibid. p. 85, Pl. 9, Figs 6, 8, 11, 30, 31, 36, 37.
1967 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Bůžek, Holý et Kvaček, p. 205, Pl. 1, Figs 1-6; Pl. 2, Figs 1-9.
1973 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Knobloch, p. 281, Figs 1, 2, 4.
1975 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Knobloch, et al., p. 88, 89, 91.
1978 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Kvaček et Walther, p. 91, Text-fig. 5.
1978 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Bůžek, Kvaček et Walther, Pl. 3, Fig. 6.
1979 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Hably, Pl. 8, Figs 1-5; Pl. 9, Figs 2, 3, 5, 6; Pl. 10, Figs 1-5; Pl. 11, Figs 1-3.

1980 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Hably, p. 300, Pl. 1, Figs 1-8; Pl. 2, Figs 1-9; Pl. 3, Figs 1-6; Pl. 4, Figs 1-5; Pl. 5, Figs 1-6; Pl. 6, Figs 1-4; Pl. 7, Figs 1-4; Pl. 8, Figs 1-4; Pl. 9, Figs 1-4; Pl. 10, Figs 1-4.

1982 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Hably, Pl. 1, Figs 4, 6, 9, 10, 11; Pl. 2, Figs 1-2; Pl. 5, Figs 1-6; Pl. 6, Figs 1-6; Pl. 7, Figs 2-4; Pl. 8, Fig. 1.

1985 Platanus neptuni (Ett.) Bůžek, Holý et Kvaček; Hably, p. 101, Pl. 17, Fig. 6; Pl. 18, Figs 1-6; Pl. 19, Figs 1-5; Pl. 20, Figs 1-4, Pl. 21, Figs 1-3.

Material: BP: 85. 274. 1., 85. 317. 1., 85. 325. 1., 85. 326. 1.
MÁFI: BK-1107, BK-1109, BK-1117, BK-1120, BK-1121, BK-1122, BK-1127, BK-1141, BK-1142, BK-2465, BK-2915

The length of the leaves 3.0-9.5 cm, their width between 0.8-2.8 cm. Some of them are tanged, while others are simple leaves without tangs. Their shape is generally elongated oval, in some cases elongated obovate. The apex and the base are acute, the basis is typically asymmetrical in almost all specimens. The midvein is strong, the venation is camptodromous. Quite often, intermediate veins among the secondary veins can be observed, branching out from the midvein. The margin of the leaf is entire in the lower third, occasionally in the lower half, whereas in the apical phase it is toothed. The teeth are fairly characteristic, their apex is blunt, their apical side is essentially shorter than that of the basal one. The apical side is straight or concave, the basal side is slightly concave. The sinuses between the teeth are rounded.

The species is widely distributed in the Egerian stage of Hungary (HABLY 1980, 1982, 1983, 1985b and in press), and is equally present in the Lower Oligocene (HABLY 1979) and the Lower Miocene (HABLY 1985a). In Europe, it is known from the Eocene till the Karpatian from a number of localities. It is a palaeotropical element, a member of the subtropical rainforests, present mainly in the period of climate improvements. Probably it used to constitute extensive forests in the Egerian Stage of Hungary, which is indicated by its general and mass appearance on the Egerian localities.

Platanus fraxinifolia (John. et Gilm.) Walther
Pl. VIII, Figs 1-2, 4, Pl. VII, Fig. 3.

1921 Dewalquea hibernica Johnson et Gilmore; Johnson et Gilmore, p. 325, Pl. 11, Figs 1-3; Pl. 12, Figs 1, 2, 5, 11; Text-fig. 1.

1921 Dewalquea fraxinifolia Johnson et Gilmore; Johnson et Gilmore, p. 327, Pl. 11, Figs 4-11; Pl. 12, Fig. 3; Text-fig. 2.

1921 Dewalquea denticulata Johnson et Gilmore; Johnson et Gilmore, p. 327, Pl. 11, Figs 12-14; Pl. 12, Fig. 4; Text-fig. 3.

1963 Dicotylophyllum bellum (Heer) Sew. et Conw.; Koch, p. 66, Pl. 35, Pl. 36, Pl. 37; Text-fig. 24.

? 1921 Juglandiphyllum denticulatum (Heer) Koch; Koch, p. 42, Pl. 20, Fig. 3; Pl. 11, Pl. 12, Pl. 13, Pl. 14.

1985 Platanus fraxinifolia (John. et Gilm.) Walther; Mai et Walther, p. 55, Pl. 13, Figs 1-8; Pl. 9/3-6, p. 195, Pl. 13/1-2, p. 203.

Material: BP: 85. 361. 1., 85. 369. 1.
MÁFI: BK-1104, BK-1120, BK-1127, BK-2462, BK-2464, BK-2492

The leaf is 6.5-10.5 cm long, found with leaflets of 1.7-2.5 cm width. The leaflets are strongly elongated ovate or ellipsoid, the apex and the basis is acute. The venation is camptodromous. Intermediate veins branch out from the midvein between the secondary veins. The margin of the leaf is toothed. The teeth are rather similar to those of P. neptuni. In the basal part, the margin is entire, similar to the above species.

There was no complete leaf occurring at the Kesztölc site, still on the basis of some further finds of Egerian flora so far unpublished, the remains can be assigned to this species. The shape of the leaves and the character of the basis is essentially different from those of P. neptuni, though in respect of the character of the denticulation, they are very close to each other. In some dubious cases it is really hard to separate them. It can be supposed that all these remains are to be considered as one species of very wide range of variation. This hypothesis might be supported by the fact that both forms coexist in most of the Egerian lo-

calities in Hungary. At the same time, no P. fraxinifolia was found at the Kiscellian localities or at Ipolytarnóc, though these localities were fairly rich in P. neptuni.

Fagaceae
Castanopsis (D. Don.) Spach

cf. Castanopsis toscana (Bandulska) Krãusel et Weyland
Pl. VIII, Figs 5-6; Pl. IX, Fig. 1.

1931 Tristania toscana Band.; Bandulska, p. 668, Pl. 40, Figs 9-11.
1954 Castanopsis toscana (Band.) Kr. et Weyl.; Krãusel et Weyland, p. 135, Text-fig. 14, Pl. 29, Figs 3-9.
1971 L. sensu Ferguson; Ferguson, pp. 207-216, Text-fig. 37, Pl. 34-36.
1976 Castanopsis toscana (Band.) Kr. et Weyl.; Knobloch et Kvaček, p. 39, Pl. 4, Fig. 1; Pl. 16, Figs 10-11; Pl. 17, Fig. 16; Pl. 20, Figs 11, 15.

Material: BP: 85. 275. 2., 85. 282. 1., 85. 335. 1., 85. 337. 1., 85. 338. 1., 85. 340. 1., 85. 341. 1., 85. 342. 1., 85. 344. 1., 85. 347. 1., 85. 348. 1., 85. 350. 1., 85. 354. 1., 85. 356. 1.
MÁFI: BK-1126, BK-2455, BK-2470, BK-2474, BK-2497, BK-2932, BK-2933, BK-2934, BK-2935, BK-2936, BK-2937, BK-2938, BK-2939, BK-2940

The length of the leaves is 3.7-12.3 cm, their width varies between 1.4 and 2.8 cm. Their shape is elongated ellipsoidal, elongated or ovate. The apex of the leaf is acute or attenuate, the base is acute or rounded. The margin of the leaf is entire, the venation is camptodromous. Some of the leaves are petiolated, while others are without petiole.

The species is represented in the floral assemblage in very high number. KOVAR (1982) demonstrated its presence in the Egerian stage of Austria on basis of cuticular analysis. The Kesztölc remains contain no epidermis, thus assignment of the species could be performed on morphological grounds only.

The species, demonstrated by cuticular analysis from Miocene and Pliocene layers (KNOBLOCH and KVAČEK 1976), can be considered a typical Neogene element, already present in the Egerian, where Palaeogeneous and Neogeneous elements occur together.

Betulaceae
Alnus L.

Alnus sp.
Material: MÁFI: BK-1123, BK-1124

The length of the measurable leaf is 4.4 cm, its width is 2.3 cm. Its shape is obovate. The basis is acute, the apex is missing. The margin of the leaf is denticulated, the venation is craspedodromous. There are 6 pairs of secondary veins branching out from the midvein, which are slightly curved and terminate in teeth. The tertiary venation consist of a dense network of veins, perpendicular to the secondary veins.

The specimen found slightly resembles the species A. julianaeformis (Sternberg) Kvaček et Holý, but based on two specimens found altogether, as well as having no cuticle at all, they cannot be assigned unambiguously.

The species of this genus belong to the Arctotertiary flora, some representatives, however, like A. julianaeformis can persist in the subtropical climatic phases of the Miocene as well. The above species is a member of the swamp vegetation, which is not unlikely in the case of Kesztölc, in light of some other remains also coming possibly from marshy regions. The presence of the species Taxodium dubium denotes the presence of another type of vegetation apart from the laurel-forest.

Ulmaceae
Ulmuls L.

Ulmus pyramidalis Goepp.
Pl. IX, Figs 2-3.

1845 Ulmus bronni Ung. partim; Unger, Pl. 26, Fig. 1, non Figs 2-4.
1845 Ulmus longifolia Ung.; ibid., Pl. 26, Figs 5, 6.

1855 Ulmus pyramidalis Goepp.; Goeppert, p. 28, Pl. 13, Figs 10-12.
1859 Carpinus pyramidalis (Goepp.) Heer; Heer, p. 177, Pl. 87, Fig. 7f; Pl. 150, Figs 27, 28.
1881 Betula brongniartii Ett. partim; Engelhardt, p. 78, Pl. 1, Fig. 13, non Fig. 12.
1971 Ulmus pyramidalis Goepp.; Bůžek, p. 56, Pl. 19, Figs 3-18; Pl. 20, Figs 1-17; Pl. 21, Figs 1-8.
1976 Ulmus pyramidalis Goepp.; Knobloch et Kvaček, p. 49, Pl. 13, Fig. 9; Pl. 31, Fig. 12.

Material: MÁFI: BK-1134, BK-2451, BK-2454, BK-2491, BK-2914, BK-2925, BK-2926, BK-2991

The form of the most complete specimen is ellipsoidal. The lamina of the leaf becomes narrow toward the basis and the apex, however, both tips are missing. The measurable length of the leaf is 7 cm, the total length must have been about 8 cm, the width is 3.5 cm. There are 11 pairs of rigid, straight secondary veins branching from the midvein, all terminating in teeth. The venation is craspedodromous. The teeth are compound. The distance of the secondary veins from each other, measured from the basis towards the apex are the following:

left side: 0.65, - , - , 0.7, 0.8, 0.65, 0.65, 0.7, 0.45, 0.45
right side: 0.45, 0.65, 0.65, 0.75, 0.7, 0.6, 0.65, 0.6, 0.45, 0.4

The angles between the midvein and the secondary veins, also proceeding from the basis towards the apex, are the following:

left side: 52°, 49°, 48°, 49°, 44°, 39°, 45°, 35°, 29°
right side: 50°, 44°, 42°, 42°, 40°, 42°, 40°, 41°, 41°, 37°, 36°

The species is widely distributed in the European Tertiary. It is present in the Egerian stage floral localities almost everywhere in Hungary, sometimes in dominant number. It is an Arctotertiary element, which might have been a constituent of the vegetation of higher river catchments, a member of the intrazonal assemblage as such.

Ulmus sp.

Material: BP: 85. 321. 1., 85. 333. 1., 85. 371. 1., 85. 372. 1.
MÁFI: BK-2492, BK-2923, BK-2924, BK-2941

Some leaf fragments were assigned here that cannot be further defined because of their fragmented state. Probably they also belong to U. pyramidalis, however, this can be only supposed lacking concrete morphological evidence.

Zelkova Spach

Zelkova zelkovaefolia (Ung.) Bůžek et Kotl.
Pl. IX, Fig. 4.

1843 Ulmus zelkovaefolia Ung. partim; Unger, Pl. 24, Figs 9-13, non Fig. 7.
1851 Planera ungeri Ett.; Anonymus (ref. Ettingshausen), p. 145.
1851 Zelkova ungeri (Ett.) Kov.; Anonymus (ref. Kováts), p. 178.
1856 Zelkova ungeri (Ett.) Kov.; Kováts, p. 27, Pl. 5, Figs 1-12; Pl. 6, Figs 1-6.
1963 Zelkova zelkovaefolia (Ung.) Bůžek et Kotl.; Kotlaba, p. 59, Pl. 3, Figs 7-8.
1976 Zelkova zelkovaefolia (Ung.) Bůžek et Kotl.; Knobloh et Kvaček, p. 49, Pl. 17, Fig. 10.

Material: MÁFI: BK-2494

Only one single leaflet was found at the Kesztölc locality. Its length is 2.8 cm, width 2.3 cm. The apex is acute, the base is missing. The midvein is straight, the secondary veins are not visible. The margin of the leaflet is toothed, the teeth are big, simple, their apical side is straight or convex, and they are essentially shorter than their basal side which is convex.

The species was found in several Egerian sites from Hungary, thus from Verőcemaros (HABLY 1982), Vértesszőlős (HABLY in press), but is represented in the Egerian floras only with 1-2 specimens only. It only occurs in great quantities in Hungary in Miocene sites,

especially in its late periods (Sarmatian). Z. zelkovaefolia, though characteristic for the Miocene all over Europe, can also be found in some Egerian localities in small quantities, like in Upper Austria (KOVAR 1982).

Juglandaceae
Palaeocarya Jähnichen, Friedrich et Takáč

Palaeocarya orsbergensis (Wessel et Weber) Jähnichen, Friedrich et Takáč
Pl. IX, Fig. 5.

1852 Xanthoxylon braunii Weber; Weber, p. 224, Pl. 25, Fig. 6.
1853 Rhus prisca Ettingshausen; Ettingshausen, p. 79, Pl. 26, Figs 13-16, 20.
1853 Rhus juglandogene Ettingshausen; Ettingshausen, p. 80, Pl. 26, Figs 24-29.
1853 Rhus stygia Ettingshausen; Ettingshausen, p. 79, Pl. 26, Figs 40-42.
1856 Banksia orsbergensis Wessel et Weber; Wessel et Weber, p. 146, Pl. 25, Fig. 9a.
1856 Hakea lanceolata Wessel et Weber; Wessel et Weber, p. 147, Pl. 25, Fig. 13.
1865 Engelhardtia detecta Saporta; Saporta, p. 345, Pl. 12, Fig. 4.
1914 Myrica banksiaefolia Jablonszky; Jablonszky, pp. 263-264, Pl. 10, Fig. 4-5.
1957 Schinus oligocaenicum Andreánszky et Novák; Andreánszky et Novák, p. 49, Pl. 2, Figs 6-7; Pl. 3, Fig. 9.
1959 Anacardites cfr. Schinus molle L.; Andreánszky, p. 151, Text-fig. 174; Pl. 45, Fig. 5.
1959 Myrica lignitum (Ung.) Sap.; Rásky, p. 454.
1963 Schinus oligocaenicum Andreánszky et Novák; Andreánszky, p. 100, Pl. 2, Fig. 13.
1964 Myrica acuminata (Ung.) Sap.; Pálfalvy, p. 188.
1976a Myrica banksiaefolia Ung.; Pálfalvy, p. 95.
1976 Engelhardtia detecta Knobloch et Kvaček; Knobloch et Kvaček, p. 27, Pl. 10, Figs 2-7; Pl. 11, Fig. 3u; Pl. 12, Figs 1, 2u, 8; Pl. 17, Fig. 12; Pl. 19, Fig. 6u; Pl. 20, Fig. 2.
1977 Engelhardtia orsbergensis (Wess. et Web.) Jähnichen, Mai et Walther, Jähnichen, Mai et Walther, p. 323, Pl. 9, Fig. 4.
1981 Engelhardtia orsbergensis (Wess. et Web.) Jähn., Mai et Walther; Pálfalvy, p. 492.
1984 Palaeocarya orsbergensis (Wess. et Web.) Jähnichen, Friedrich et Takáč; Jähnichen, Friedrich et Takáč, p. 110, Pl. 1, Figs 1-6; Pl. 2, Figs 1-2; Pl. 3, Figs 1-3; Pl. 4, Figs 1-6; Pl. 5, Figs 1-7.
1985 Engelhardtia orsbergensis (Wessel et Weber) Jähnichen, Mai et Walther; Hably, p. 106, Pl. 20, Fig. 5; Pl. 24, Figs 3-6; Pl. 25, Figs 1-8; Pl. 26, Figs 1-6; Pl. 27, Fig. 5.

Material: BP: 85. 329. 1., 85. 351. 1., 85. 362. 1.
MÁFI: BK-1106, BK-2929

The length of the leaflets varies between 4.0-5.5 cm, their width between 0.8-1.2 cm. There were no complete leaves only leaflets found at the locality. Their shape is elongated ovate. The base and the apex is fragmented in most of the specimens, the apex is acute, the base is slightly rounded, asymmetrical. In case of several specimens, not only the base, but the whole lamina of the leaf is asymmetrical as well. The secondary veins terminae in teeth, among them a dense intermediate network of veins branches out from the midvein. The teeth are situated relatively far from each other, their apex is pointed, standing upwards. The basal side of the teeth is slightly concave or straight, and is essentially longer than the apical side, which is concave.

The species was mentioned by PÁLFALVY (1981) from the flora of the Wind-brickyard, Eger. It is also present in some other localities studied by the author, which are so far unpublished.

The species is widely distributed in the Tertiary of Europe, both from geographical and temporal aspects. Its most significant occurrence in Hungary is known so far from the Ipolytarnóc Lower Miocene (HABLY 1985a).

It is a typical palaeotropical element preferring warm climate, disappearing gradually from the Hungarian flora during the deterioration of the climate.

Symplocaceae
Symplocos Jacquin

Symplocos sp.
Pl. IX, Fig. 6.
Material: MÁFI: BK-1133

In the Kesztölc floral assemblage only one fragmented specimen of the species was found. The shape of the leaf cannot be determined exactly, probably it was of elongated ovate shape. The apex is missing. It is the basal part of the leaf which is preserved, though the basis itself is broken. The venation is camptodromous. The midvein is strong, the secondary veins are bent upwards in an arch, and among them in some cases the branching out of further veins can be observed, i.e. a dense tertiary venation network connecting the secondary veins.

The margin of the leaf is seemingly entire, however, with proper magnification small teeth, pointed, placed relatively far from each other can be spotted on the margin.

The leaf is similar to some other leaves from so far unpublished Egerian sites, and is seemingly identical with the leafprints described from the Wind-brickyard from Eger under the name Symplocos by ANDREÁNSZKY (1966).

Ebenaceae
Diospyros L.

Diospyros brachysepala A. Braun sensu Hantke
Pl. X, Fig. 1.

1845 Diospyros brachysepala A. Braun; A. Braun, p. 170.
1934 Diospyros brachysepala A. Br.; Weyland, p. 110.
1959 Diospyros brachysepala A. Br.; Rásky, p. 454.
1959 Diospyros brachysepala A. Br.; Andreánszky, p. 136, Pl. 42, Fig. 6; Pl. 44, Fig. 3.
1973 Diospyros brachysepala A. Braun; Nemejc et Knobloch, p. 714, Pl. 9, Fig. 7.
1985 Diospyros brachysepala A. Braun; Hably, p. 110, Pl. 29, Figs 1-2, 6.

Material: MÁFI: BK-1103

In the Kesztölc outcrop, only one leaf remain was found from the species. The original length of the leaf was 6.2 cm, its width 3.4 cm. The shape of the lamina is obovate, the apex is broken, the basis asymmetrical, ending in a petiole. The venation is camptodromous. The secondary veins run upwards in an arch.

The species is frequent in European Tertiary floras. It is present in several, mainly Miocene floras in Hungary, but never in great quantities, represented only by a few specimens.

Leguminosae
Leguminocarpon Heer

Leguminocarpon div. sp.
Pl. X, Figs 2-3.
Material: BP: 85. 365. 1., 85. 364. 1.
MÁFI: BK-1105, BK-2484

There are pieces of different length preserved from the fruit, the longest of which is 4.3 cm. Their width varies between 0.6-1.1 cm. The tip of the specimens is pointed. The distance of the seeds from each other is variable, in some instances they are closely packed, in some others they are rather loosely situated, 0.4 cm from each other. The seeds are typically round, their diameter is above 0.6-0.7 cm.

The remains possibly represent several species. A more detailed study will be carried out in cooperation with J. GREGOR in a separate issue reviewing the rich and characteristic leguminous flora of the Hungarian Egerian.

Aceraceae
Acer L.

cf. Acer sp.
Pl. X, Fig. 4.
Material: MÁFI: BK-1131

Only one, dubious specimen was assigned here, originating possibly from maple-tree, a separated endocarp.

Sapindaceae
Sapindus L.

Sapindus sp.
Pl. X, Fig. 5.
Material: MÁFI: BK-1138, BK-2467

Two leaf fragments were assigned to this genus. Their length is 5.0-5.1 cm, width 1.2 cm. The shape of the leaf is elongated elliptical, the apex and the base are acute. The venation is camptodromous. The interconnected phase of the secondary veins run parallel to the margin.

Smilacaceae
Smilax L.

Smilax weberi Wessel in Wessel et Weber

1847 Smilacites grandifolius Unger; Unger, p. 129, Pl. 40, Fig. 3.
1855 Smilax grandifolia (Ung.) Heer; Heer, p. 82, Pl. 30, Fig. 8.
1856 Smilax weberi Wessel; Wessel et Weber, p. 127, Pl. 21, Fig. 1.
1971 Smilax weberi Wessel; Bůžek, p. 89, Pl. 44, Figs 1-5; Pl. 45, Figs 1-4; Text-fig. 14.
1975 Smilax weberi Wessel; Christensen, p. 21, Pl. 5, Figs 1-8; Pl. 6, Figs 2, 4, 5, 6; Text-fig. 6A-F; Text-fig. 7, 8.
1976 Smilax weberi Wessel; Knobloch et Kvaček, p. 85, Pl. 39, Figs 1, 3, 6, 7; Pl. 40, Figs 1-3, Figs 50, 51.
1985 Smilax weberi Wessel; Hably, p. 118, Pl. 35, Figs 1, 2; Pl. 36, Fig. 2.

Material: BP: 85. 320. 1.

The original length of the leaf was approx. 4.8 cm, its measurable length 4.2 cm, width 3.0 cm. Its shape is wide ovate. The apex is broken, the base decurrent. The primary venation is 5-veined, the midvein is strong. The vein system is acrodromous. The pair of primary veins which is nearer to the midvein is thicker than the second one. The maximal distance of the primary vein from the midvein is 0.6 cm. The primary veins as well as the midvein meet at the base at a sharp angle. The track of the second primary vein pair and its apical termination cannot be described because of the fragmented state of the leaf. The midvein, the primary veins, as well as the region between the primary veins are connected with a further venation network.

The species has been mentioned from several outcrops and strata of the European Oligocene and Miocene. One of its richest outcrops in Hungary is in the Egerian flora of Vértesszőlős (HABLY in press), but it was also found in the Lower Miocene Ipolytarnóc floral assemblage (HABLY 1985). The species is not generally characteristic for the Hungarian Egerian, it can be met only at some sites.

This is a subtropical element preferring warm climate, a characteristic creeper plant of the subtropical forests.

cf. Palmae
Pl. X, Fig. 6.
Material: MÁFI: BK-2489

One fragmented remain of wide, parallel veined leaf was assigned here, without any more detailed identification: even the present allocation seems to be dubious.

Incertae sedis I.
Pl. XI, Fig. 1-2.
Material: MÁFI: BK-1136, BK-2495

The remains possibly belong to the same species. Their shape is elongated ovate, the apex is acute, the base is rounded, asymmetrical. The midvein is strong, secondary veins are curved upwards. Both observed specimens can be characterized by thinner pairs of secondary veins, branching out at the base, than the rest, and their track is fairly asymmetrical. This characteristic basal part is identical in both specimens, at the same time separating then from the leaves of other similar plants. The margin is fragmented, thus we can give no further data concerning it.

Incertae sedis II.
Pl. XI, Fig. 3.
Material: BK-1118

The shape of the leaf is obovate, apex broken, just the same as the basis. The lamina of the leaf becomes gradually narrow towards the basis. The midvein is very thick, strong, 8 pairs of secondary veins branch out from it, which curve upwards and are connected in a loop-like manner, forming a camptodromous type of venation. The margin of the leaf is entire. The thickness of the veins as well as the way of preservation indicate that the plant probably belonged to skinlike plants.

FLORISTICAL EVALUATION

There were 26 taxa separated in the Kesztölc flora. Concerning its composition we can state that ferns, gymnosperms and angiosperms, including both monocotyledonous and dicotyledonous elements, can equally be found in the flora. Naturally, the dicotyledons predominated in the assemblage, especially the family Lauraceae, dominant both in number and in the number of taxa. We must mention the genus Daphnogene in the first place represented by the most species within one genus in the Kesztölc assemblage. Among the species of the genus, D. lanceolata is predominant (36), though the species D. cinnamomifolia (13) and D. bilinica (10) are also present in a considerable numbers.

After Daphnogene, the second most numerous genus here is Castanopsis, represented only by one species here, Castanopsis toscana (24). Further species of notable quantities in the assemblage are Platanus neptuni (15), P. fraxinifolia (7) and Ulmus pyramidalis (8). The role of the species Palaeocarya orsbergensis (5) here is essentially smaller than in some other Egerian floras of Hungary. The other species are represented by 1-2 specimens only.

It is apparent from the above presentation that the species we consider predominant here can help us to reconstruct the flora and the vegetation in the first place.

We can state that among the predominant species there is only one which can be considered as an Arctotertiary element, Ulmus pyramidalis. If we consider the whole species list, this can be supplemented by 3 further taxa (cf. Acer sp., Alnus sp., Ulmus sp.), all of them represented by very low numbers and of which Ulmus sp. is likely to belong to U. pyramidalis, not assigned there only on account of its fragmented state. It is apparent that the amount of Arctotertiary species and specimens are not significant, apart from the abovementioned U. pyramidalis, which is a species generally occurring in the Egerian floral assemblages. As a species typical of river catchment areas, we can suppose that this species constituted the higher river catchment area vegetation of some river or stream, together with some Alnus species.

All the other species of the flora prefer warm climate, in most cases they are of subtropical climatic requirements. Zonal vegetation here is most likely to have been composed of a subtropical laurel-leaf forest. The species of the genus Daphnogene are likely to have had a significant role in it, composing the lower foliage level, that is, the shrub niveau of the vegetation. The species Castanopsis toscana and Platanus neptuni were present as essential constituents of the forest. Other species of warm climate completed the assemblage. The species Smilax weberi contributed to the formation of the creeper plant level.

We must mention the presence of the species Taxodium dubium, characteristic for

swamp environment. As we came across it in the Kesztölc flora in very low number of specimens, we can suppose that it drifted in from some more remote marshy areas where it could form extensive assemblages, but it could have occurred as single specimen in a marshy setting formed along the stream or river.

Based on the above considerations, there are two, or possibly three units which can be separable in the vegetation:

1. Extensive forest of sub-tropical laurel-trees, with Daphnogene div. sp. - Castanopsis toscana - Platanus neptuni as predominant species.
2. Vegetation of river catchment area, with Ulmus pyramidalis as predominant species.
3. Swamp vegetation, perhaps relatively far from the site, with Taxodium dubium as predominant species.

CLIMATOLOGICAL RECONSTRUCTION

There are two ways for reconstructing the climate, based either on the species composition and vegetation types presented above, or, on the basis of the dimensions of the leaves. Both of these possibilities were considered, because our former experience and data in the

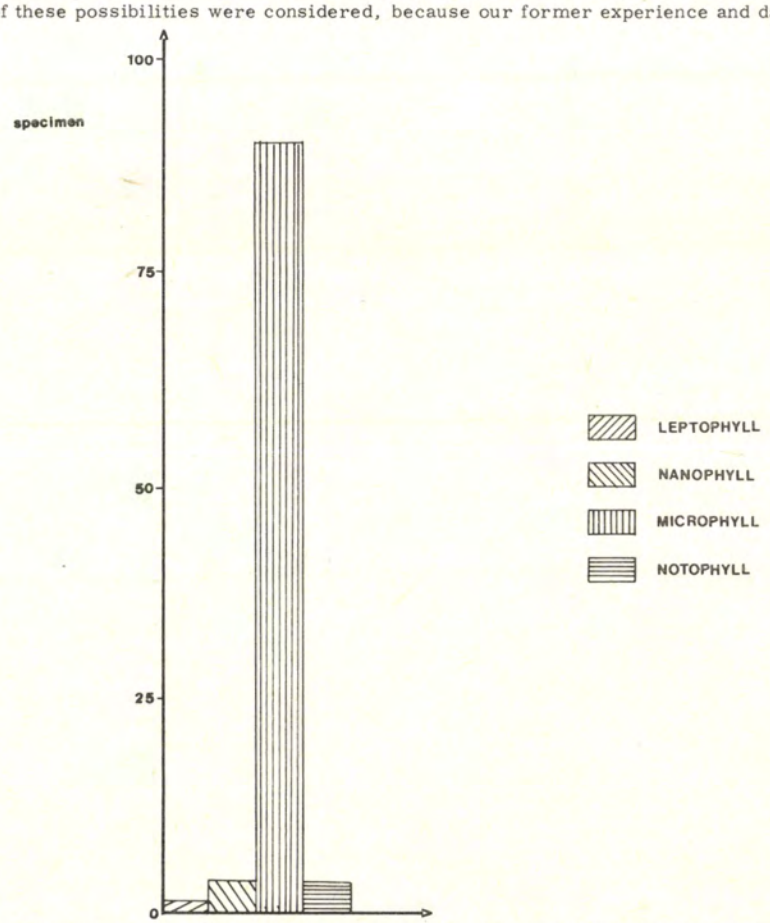


Fig. 3. Proportion of the leptophylous, nanophylous, microphylous and notophylous leaves in the flora of Kesztölc

technical literature (DOLPH and DILCHER 1980a, b, HABLY 1986) seem to convince us of the utility of both approaches. For the present study, however, the former one is adopted, because for the latter we need very large number of specimens, whereas the present amount of information on the Kesztölc flora is not likely to yield a sufficient amount of data.

Based on the species composition, considering the predominant species we can say that the zonal climate was in all probability subtropical. The Arctotertiary species present in the assemblage, as they are member of an intrazonal assemblage, signify no deterioration of the climate, only mark the edaphic relations of the period.

The reconstruction of the climate, based on the dimensions of the leaves, has been made by possible utilising the experimental results of DOLPH and DILCHER (1979, 1980a, b), thus no further explanation on the method is given here. The cited authors demonstrated that there is a strong interdependence between the size of the leaves and climate, valid in the case of a great amount of evidence only.

The leaves were grouped according to their size in the traditional way. Table shows the distribution of the leaf-size dimensions in the individual categories. There is no mesophylous, macrophylous or megaphylous leaf size present, the ruling category is that of the microphylous size group (Fig. 3). Based on this, the determination of the climate would be dubious, but as we have already mentioned, the investigations concerned a relatively small sample, especially the number of measurable leaves was low. Thus in the case of the Kesztölc flora, the climatic reconstruction based on the species composition seems more relevant.

Table.

Leaf size of the species

Species	No.	length	width	A (area)
Taxodium dubium	BK-1114	1.0 (0.75)	-	-
	BK-1143	1.9 (0.8)	0.12 (0.1)	-
Daphnogene bilinica	BK-1108	5.9	2.1	8.30
	BK-1111	4.2 (4.0)	1.8	5.06
	BK-1120	6.5	2.2	9.58
	BK-1129	4.5	1.7	5.12
	BK-2449	3.8 (3.3)	1.9	4.84
	BK-2450	6.5	1.6	6.97
	BK-2456	3.4	1.4	3.19
	BK-2461	4.1	1.9	5.22
	BK-2481	4.3	1.9	5.47
	BK-2903	4.0 (3.1)	2.2	5.90
Daphnogene cinnamomifolia	85.267.1	8.0 (6.8)	3.8	20.37
	85.268.1	6.3 (4.9)	3.0	12.66
	85.275.2	-	3.1	-
	85.283.1	-	3.0	-
	85.309.1	-	4.4	-
	BK-1112	5.4	2.6	9.05
	BK-1116	5.3 (4.0)	3.0	10.65
	BK-1130	6.2 (6.0)	2.8	11.63
	BK-1132	5.5 (5.3)	2.2	8.11
	BK-1139	5.6 (5.0)	3.6	13.51
	BK-2480	6.8 (6.3)	2.4	10.93
Daphnogene lanceolata	85.276.1	6.3	1.8	7.60
	85.278.2	6.5 (5)	1.9	8.27
	85.280.1a	3.5 (3.2)	1.3	3.05
	85.280.1b	3.7	1.5	3.72
	85.282.1	5.5 (4.8)	1.5	5.53
	85.284.1	4.3 (3.5)	1.2	3.46
	85.289.1	4.3 (3.4)	1.5	3.46

Table (cont. 1)

Species	No.	length	width	A (area)
Daphnogene lanceolata	85.291.1	5.0 (3.7)	1.6	5.36
	85.295.1	5.3	1.9	6.75
	85.301.2	6.5 (6.3)	1.2	5.23
	85.306.1	5.1 (4.5)	1.8	6.15
	85.308.1	5.2 (3.8)	1.2	4.18
	85.312.1	5.1	1.6	5.47
	85.363.1	8.3 (7.9)	2.5	13.90
	BK-1127	8.0 (7.8)	2.2	11.79
	BK-2453	6.0 (4.5)	2.1	8.44
		5.2	0.9	3.14
	BK-2459	5.8 (4.5)	1.4	5.44
	BK-2468	4.5 (3.8)	1.0	3.01
	BK-2469	5.0	1.0	3.35
	BK-2473	5.3	1.1	3.91
		4.4	1.1	3.24
	BK-2476	5.5 (4.2)	1.0	3.68
	BK-2477	6.2	1.5	6.23
	BK-2488	3.6 (3.1)	1.0	4.02
	BK-2492	6.8 (5.8)	1.8	8.20
	BK-2902	4.2 (3.9)	1.0	2.81
	BK-2909	5.5 (4.5)	1.7	6.26
	BK-2910	6.0 (5.5)	1.8	7.24
	BK-2918	4.6	1.1	3.39
	BK-2920	6.5 (5.4)	1.4	6.10
	BK-2921	5.3	1.5	5.33
	BK-2935	6.2	1.3	5.40
Daphnogene polymorpha	BK-1101	-	4.5	-
	BK-1109	-	3	-
	BK-1119	-	3.8	-
	BK-1128	7.5	5.0	25.12
	BK-2496	4.4 (3.5)	2.8	8.25
Laurophyllum sp.	BK-1125	8.4	1.2	6.75
	BK-2917	-	0.9	-
Platanus neptuni	85.274.1	3.0	0.8	1.61
	85.317.1	4.6 (3.2)+0.7	1.2	3.70
	85.325.1	4.2 (3.1)	1.2	3.38
	85.326.1	7.0 (4.1)	2.0	9.38
	BK-1107	6.3 (5.1)	1.3	5.49
	BK-1117	5.3 (4.2)	1.2	4.26
	BK-1120	6.5 (5.7)	2.0	8.71
	BK-1121	4.2	0.9	2.53
	BK-1122	6.0 (5.2)	1.9	7.64
	BK-1127	9.5 (7.2)	2.4	15.28
	BK-1142	-	1.5	-
		5.3 (4.7)	2.8	9.94
	BK-2465	5.0 (4.2)	1.8	6.03
Platanus fraxinifolia	BK-1120	6.5 (5.2)	1.7	7.40
	BK-1127	10.5 (7.3)	2.5	17.59
cf. Castanopsis toscana	BK-1126	5.0+0.4	1.4	4.69
	BK-2455	5.5 (4.8)	2.3	8.47
	BK-2470	4.6 (3.8)+0.5	1.8	5.55
	BK-2497	12.3 (12.0)	2.8	23.07
	BK-2933	4.0 (3.7)+0.5	1.85	4.96

Table (cont. 2)

Species	No.	length	width	A (area)
cf. Castanopsis toscana	BK-2938	5.2 (4.2)	2.5	8.71
	BK-2939	3.7 (3.4)	2.3 (1.8)	5.70
	BK-2940	5.7	1.8	6.87
Alnus sp.	BK-1123	4.4 (4.0)	2.3	6.74
Ulmus pyramidalis	BK-1134	8 (7)	3.5	18.76
	BK-2454	5.3 (4.2)	2.3	8.17
Zelkova zelkovaefolia	BK-2494	2.8 (2.7)	2.3	4.31
Palaeocarya orsbergensis	85.329.1	-	0.8	-
	85.351.1	5.5 (4.0)	1.2	4.42
	85.362.1	4.0	0.8	2.14
	BK-1106	4.8	1.0	3.22
Diospyros brachisepala	BK-1103	6.2 (5.9)	3.4	14.12
"Sapindus" sp.	BK-1138	5.0 (4.3)	1.2	4.02
	BK-2467	5.1	1.2	4.10
Smilax weberi	85.320.1	4.8 (4.2)	3.0	9.65

EXPLANATION OF THE PLATES

Plate I.

1. cf. Pteridophyta, BK-2483
2. Taxodium dubium, BK-1113
3. Taxodium dubium, BK-1143
4. Taxodium dubium, BK-1114
5. Daphnogene lanceolata, BK-2476
6. Daphnogene lanceolata, BK-24
7. Daphnogene lanceolata, BK-2477

Plate II.

Daphnogene lanceolata

1. BK-2488
2. BK-2492
3. BK-2469
4. BK-2472
5. BK-2473
6. BK-2459

Plate III.

Daphnogene bilinica

1. BK-1111
2. BK-1108
3. BK-2461
4. BK-2450
5. BK-2449

Plate IV.

Daphnogene polymorpha

1. BK-1128
2. BK-1128
3. BK-2496
4. BK-1101
5. BK-1119
6. Daphnogene bilinica, BK-2481

Plate V.

Daphnogene cinnamomifolia

1. BK-1129
2. BK-1132
3. BK-2480
4. BK-1139
5. BK-1116

Plate VI.

1. Daphnogene cinnamomifolia, BK-1112
2. Daphnogene sp., BK-1110
3. Daphnogene sp., BK-2487
4. Laurophyllum sp., BK-1125
5. Platanus neptuni, BK-2462
6. Platanus neptuni, BK-1117

Plate VII.

1. Incertae saedis II., BK-1118
2. Incertae saedis I., BK-1136
3. Platanus neptuni, BK-2494
4. Incertae saedis I., BK-2495
5. Platanus neptuni, BK-1142
6. Platanus neptuni, Daphnogene bilinica, BK-1120

Plate VIII.

1. Platanus fraxinifolia, B BK-2463
2. Platanus fraxinifolia, B BK-1127
3. Daphnogene lanceolata, BK-1127
4. Platanus fraxinifolia, BK-1104
5. cf. Castanopsis toscana, BK-1126
6. cf. Castanopsis toscana

Plate IX.

1. cf. Castanopsis toscana, BK-2455
2. Ulmus pyramidalis, BK-1134
3. Ulmus pyramidalis, BK-2454
4. Zelkova zelkovaefolia BK-2494
5. Palaeocarya orsbergensis, BK-1106
6. "Symplocos" sp., BK-1133

Plate X.

1. Diospyros brachysepala, BK-1103
2. Leguminocarpon sp., BK-1105
3. Leguminocarpon sp., BK-2484
4. Platanus neptuni, BK-1122
5. "Sapindus" sp., BK-1138
6. cf. Acer sp., BK-1131
7. cf. Palmae, BK-2489

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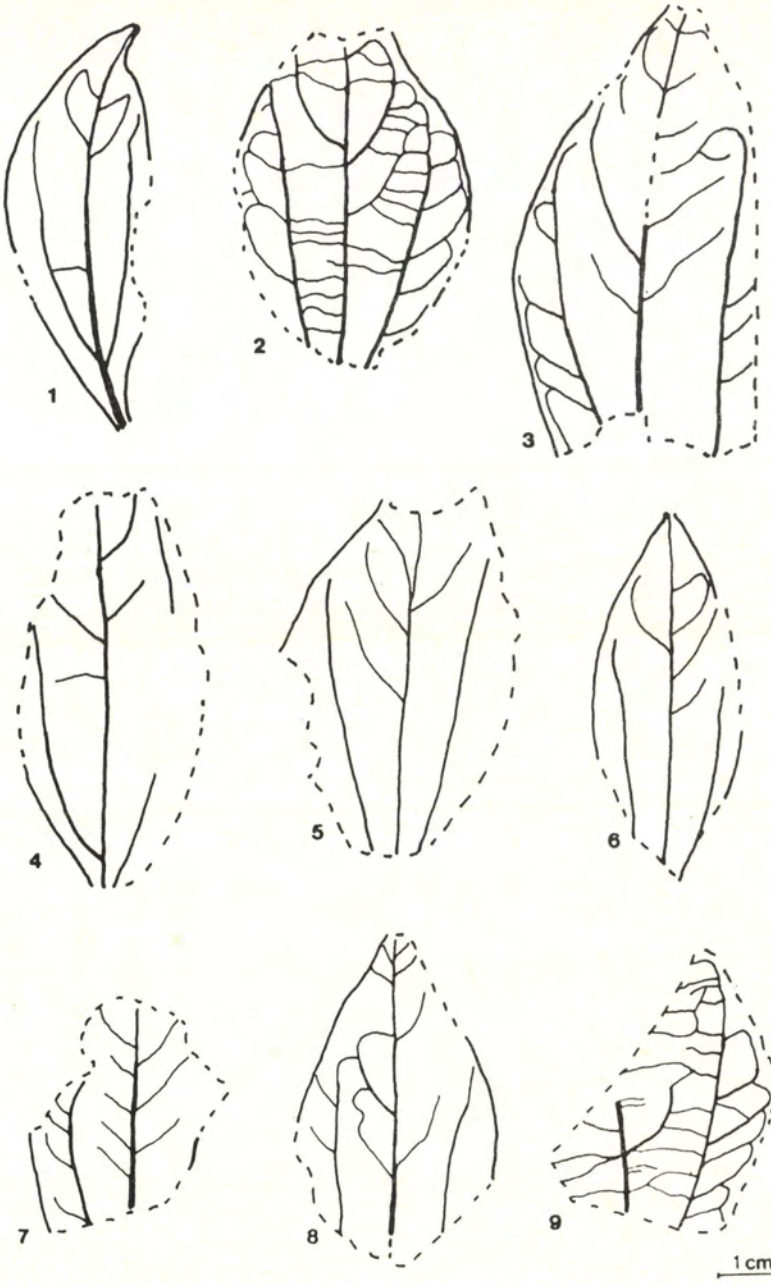
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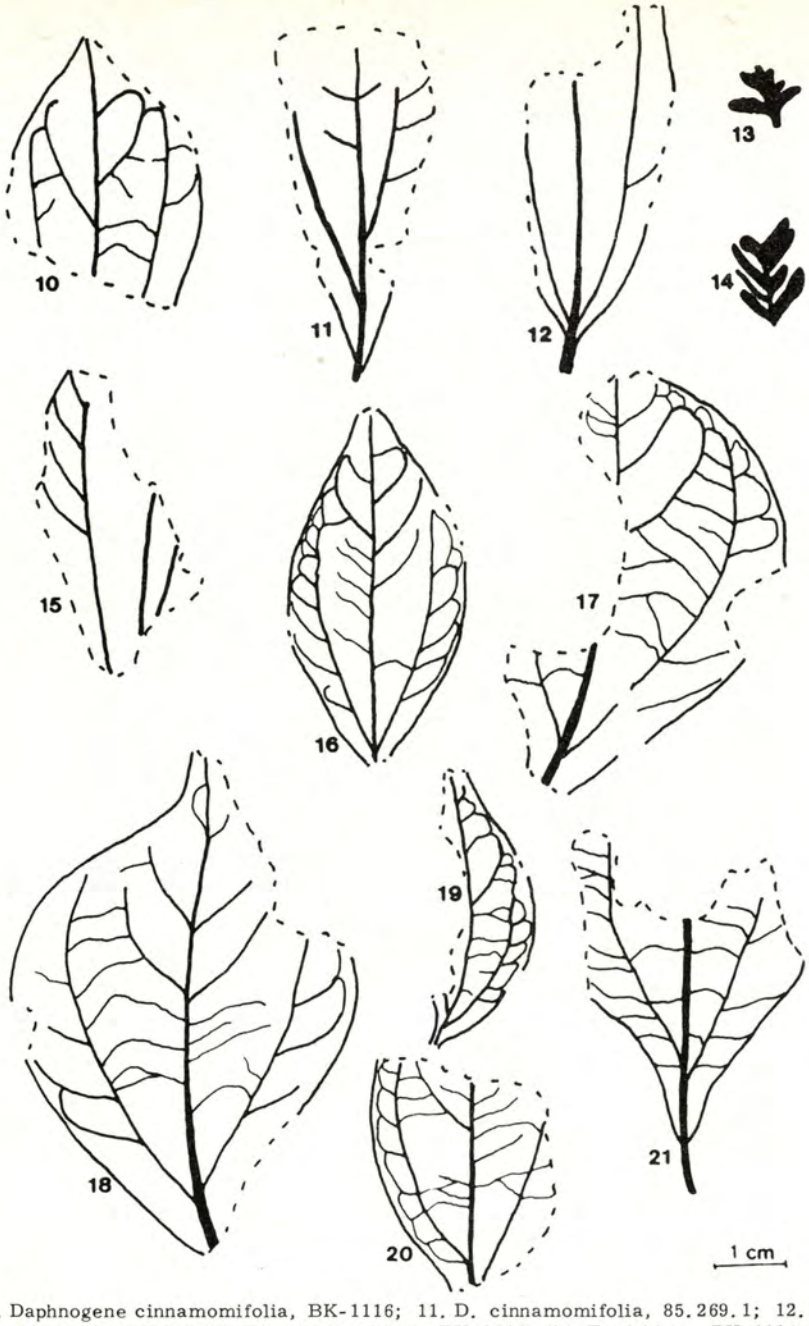
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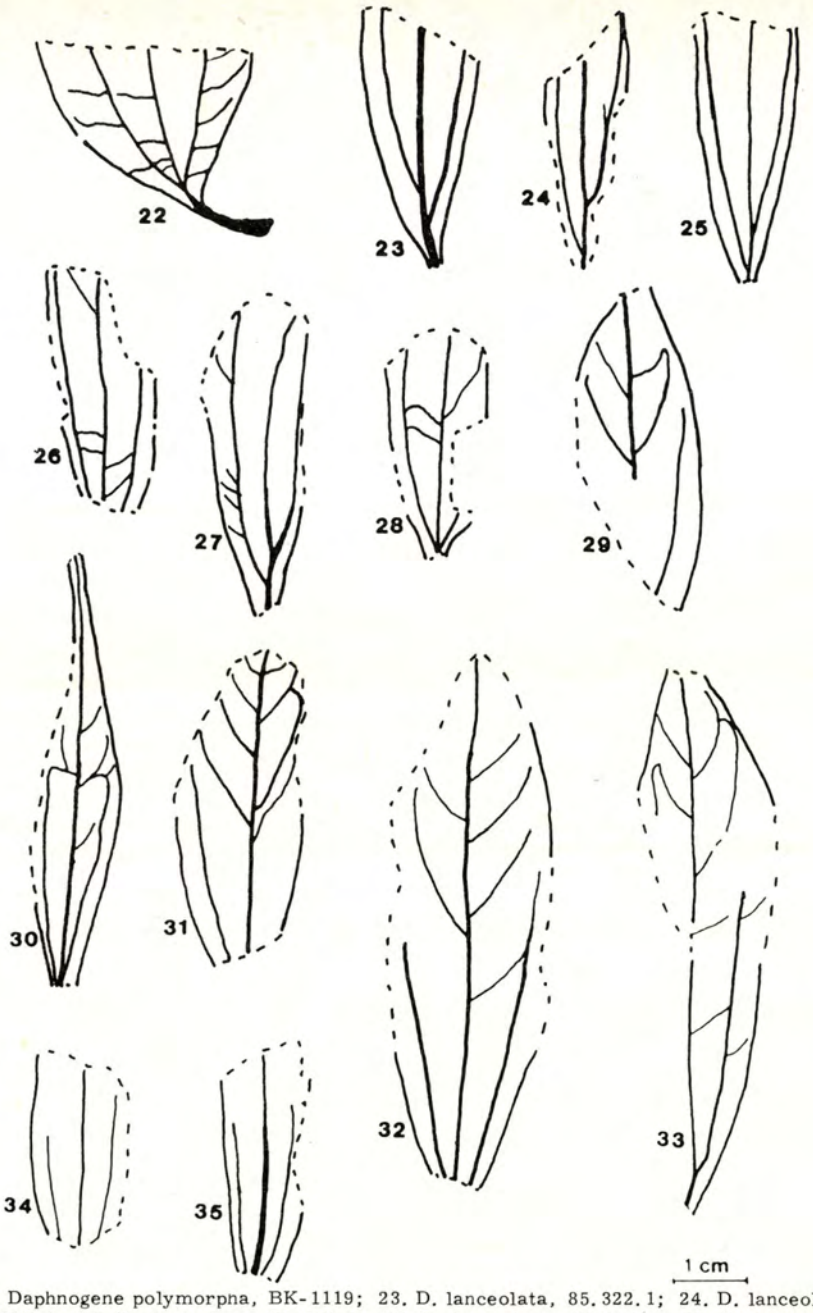
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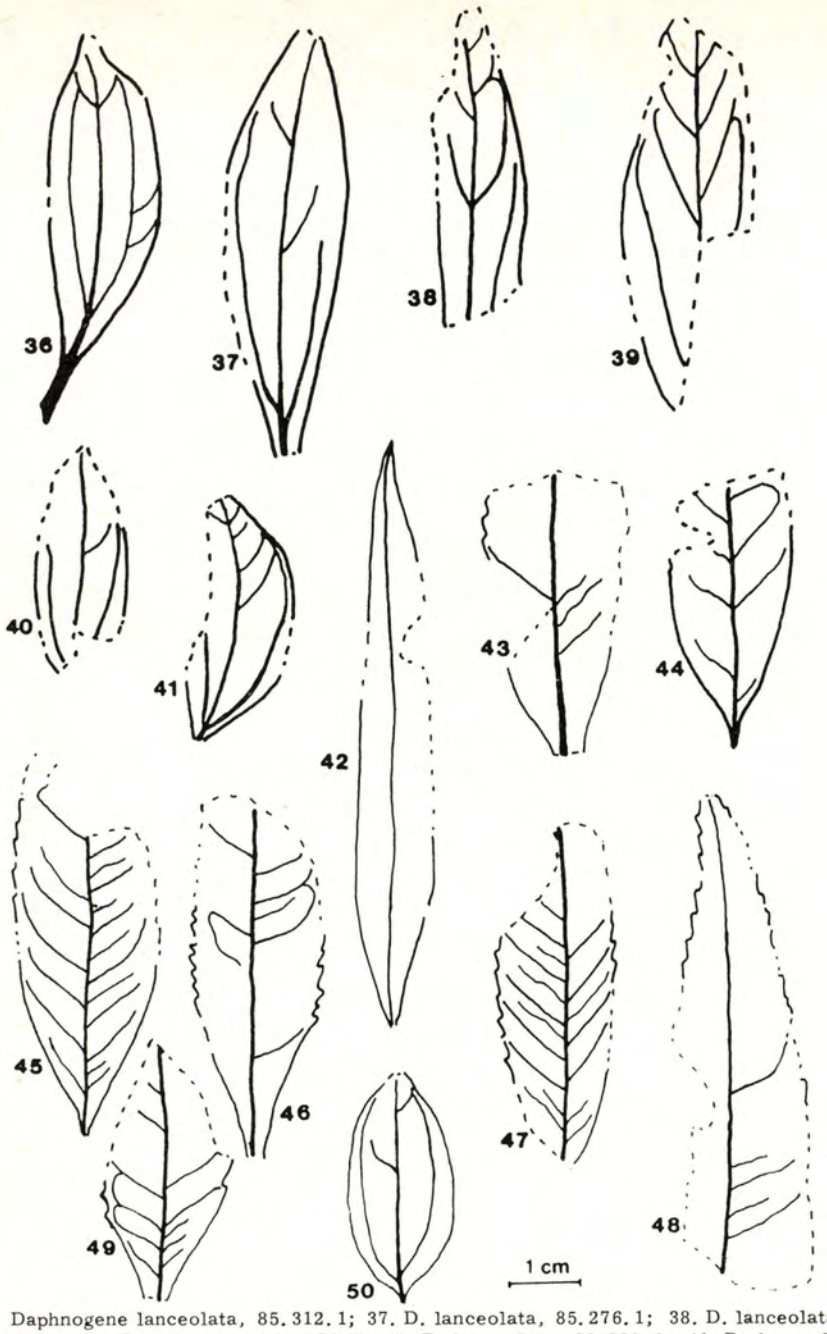
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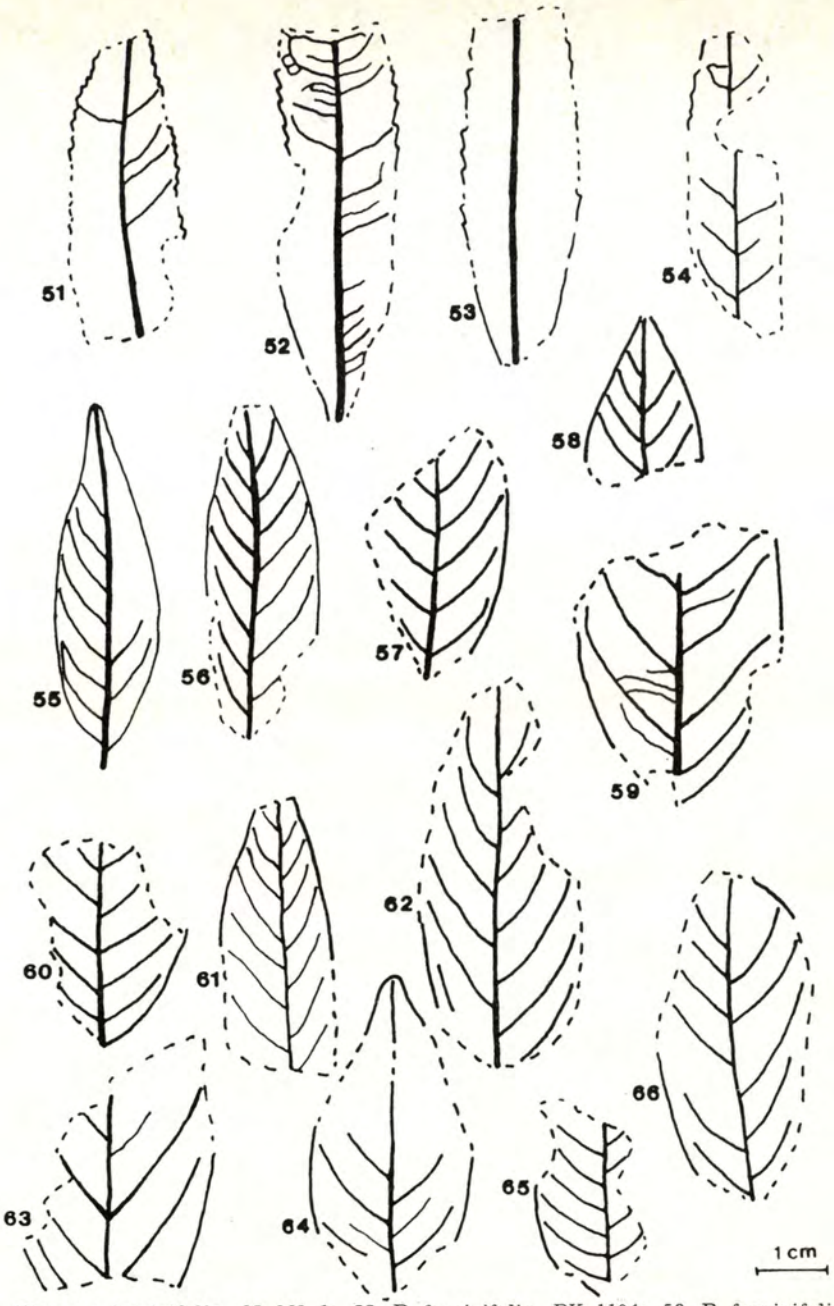
10. Daphnogene cinnamomifolia, BK-1116; 11. D. cinnamomifolia, 85.269.1; 12. D. cinnamomifolia, 85.268.1; 13. Taxodium dubium, BK-1113; 14. T. dubium, BK-1114; 15. Daphnogene cinnamomifolia, 85.274.1; 16. D. cinnamomifolia, BK-1112; 17. D. polymorpha, BK-1128; 18. D. polymorpha, BK-1128; 19. D. polymorpha, BK-1111; 20. D. polymorpha, BK-2496; 21. D. polymorpha, BK-1101



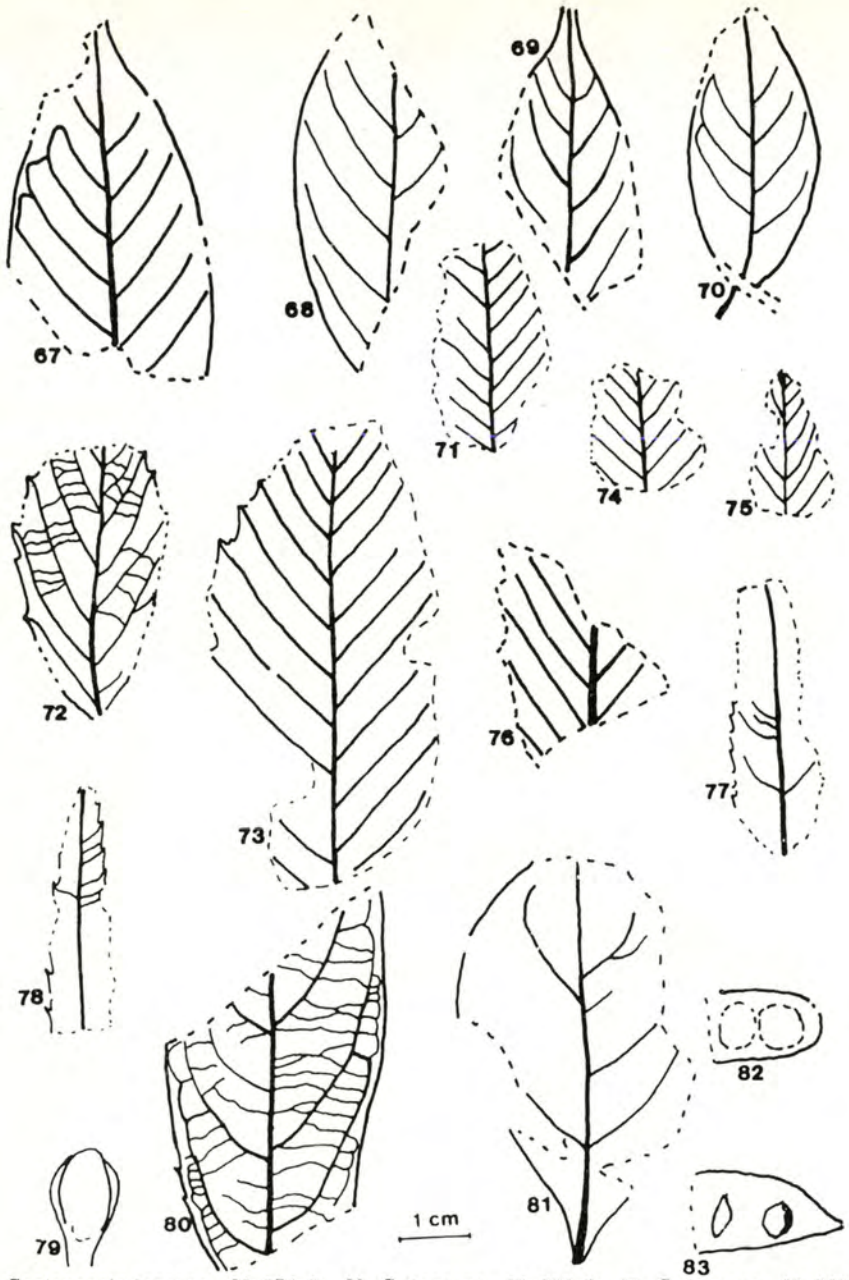
22. Daphnogene polymorpna, BK-1119; 23. D. lanceolata, 85.322.1; 24. D. lanceolata, 85.308.1; 25. D. lanceolata, 85.279.1; 26. D. lanceolata, 85.291.1; 27. D. lanceolata, 85.306.1; 28. D. lanceolata, 85.289.1; 29. D. lanceolata, 85.278.2; 30. D. lanceolata, 85.301.2; 31. D. lanceolata, 85.295.1; 32. D. lanceolata, 85.363.1; 35. D. lanceolata, BK-1127; 34. D. lanceolata, 85.277.1; 35. D. lanceolata, 85.284.1



36. Daphnogene lanceolata, 85.312.1; 37. D. lanceolata, 85.276.1; 38. D. lanceolata, 85.282.1; 39. D. lanceolata, 85.278.2; 40. D. lanceolata, 85.280.1; 41. D. lanceolata, 85.28.1; 42. Laurophyllum sp. BK-1125; 43. Platanus neptuni, 85.326.1; 44. P. neptuni, BK-1117; 45. P. neptuni, BK-1120; 46. P. neptuni, BK-1122; 47. P. neptuni, BK-1107; 48. P. neptuni, BK-1127; 49. P. neptuni, BK-1109; 50. Daphnogene bilinica, BK-1124



51. Platanus fraxinifolia, 85.369.1; 52. P. fraxinifolia, BK-1104; 53. P. fraxinifolia, BK-1120; 54. P. fraxinifolia, 85.361.1; 55. Castanopsis toscana, BK-1126; 56. C. toscana, 85.337.1; 57. C. toscana, 85.338.1; 58. C. toscana, 85.339.1; 59. C. toscana, 85.348.1; 60. C. toscana, 85.342.1; 61. C. toscana, 85.350.1; 62. C. toscana, 85.340.1; 63. C. toscana, 85.354.1; 64. C. toscana, 85.344.1; 65. C. toscana, 85.347.1; 66. C. toscana, 85.341.1



67. Castanopsis toscana, 85.275.2; 68. C. toscana, 85.356.1; 69. C. toscana, 85.282.1; 70. C. toscana, 85.335.1; 71. Ulmus sp., 85.333.1; 72. Alnus sp., BK-1124; 73. Ulmus pyramidalis, BK-1134; 74. Ulmus sp., 85.371.1; 75. U. sp., 85.372.1; 76. U. sp., 85.321.1; 77. Palaeocarya orsbergensis, 85.351.1; 78. P. orsbergensis, BK-1106; 79. Acer sp., BK-1131; 80. Symplocos sp., BK-1133; 81. Diospyros brachysepala, BK-1103; 82. Leguminocarpon sp., BK-1141; 83. L. sp., 85.364.1



84. Sapindus sp., BK-1138; 85. Smilax weberi, 85.320.1; 86. Incertae sedis, BK-1136; 87. Myrica sp., BK-1124; 88. Leguminocarpon sp., BK-1105; 89. L. sp., 85.365.1; 90-98. Incertae sedis, 90: BK-1118, 91: 85.349.2, 92: 85.345.1, 93: 85.346.1, 94: BK-1140, 95: 85.358.1, 96: 85.326.1, 97: BK-1135, 98: 85.334.1

PLATE I.

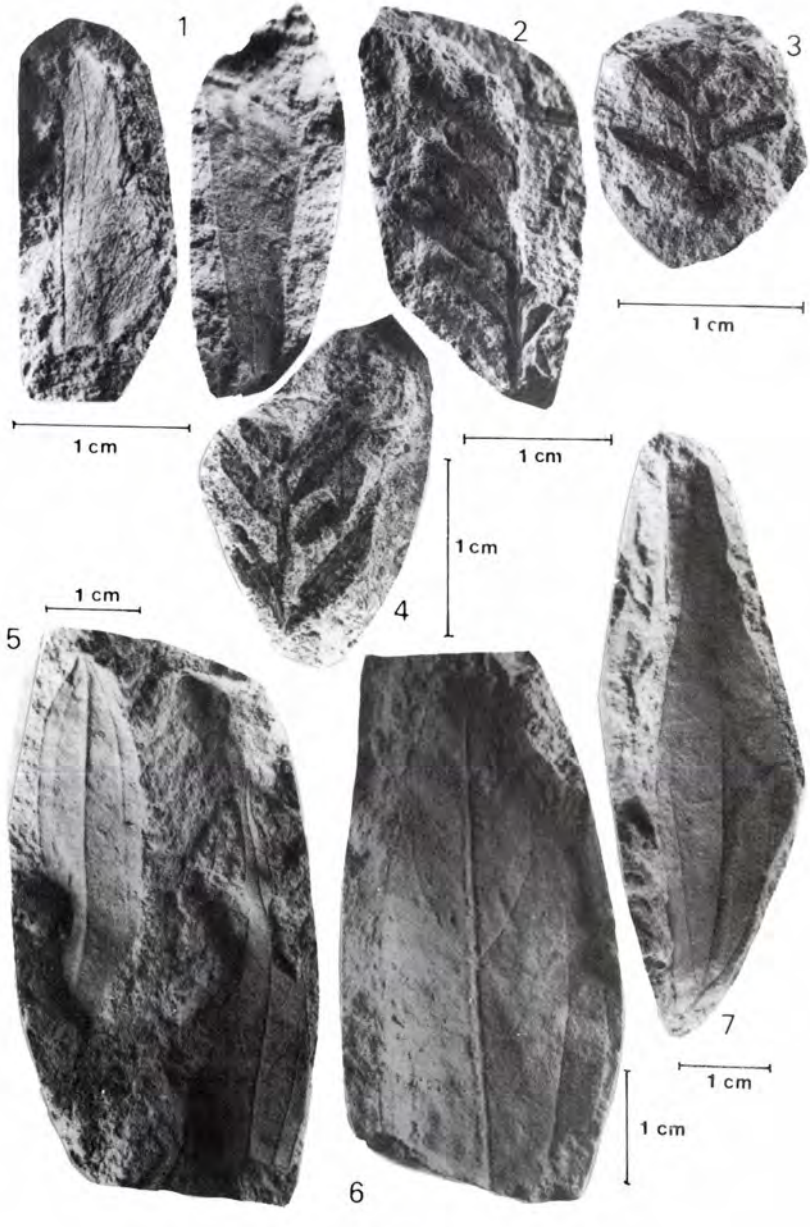


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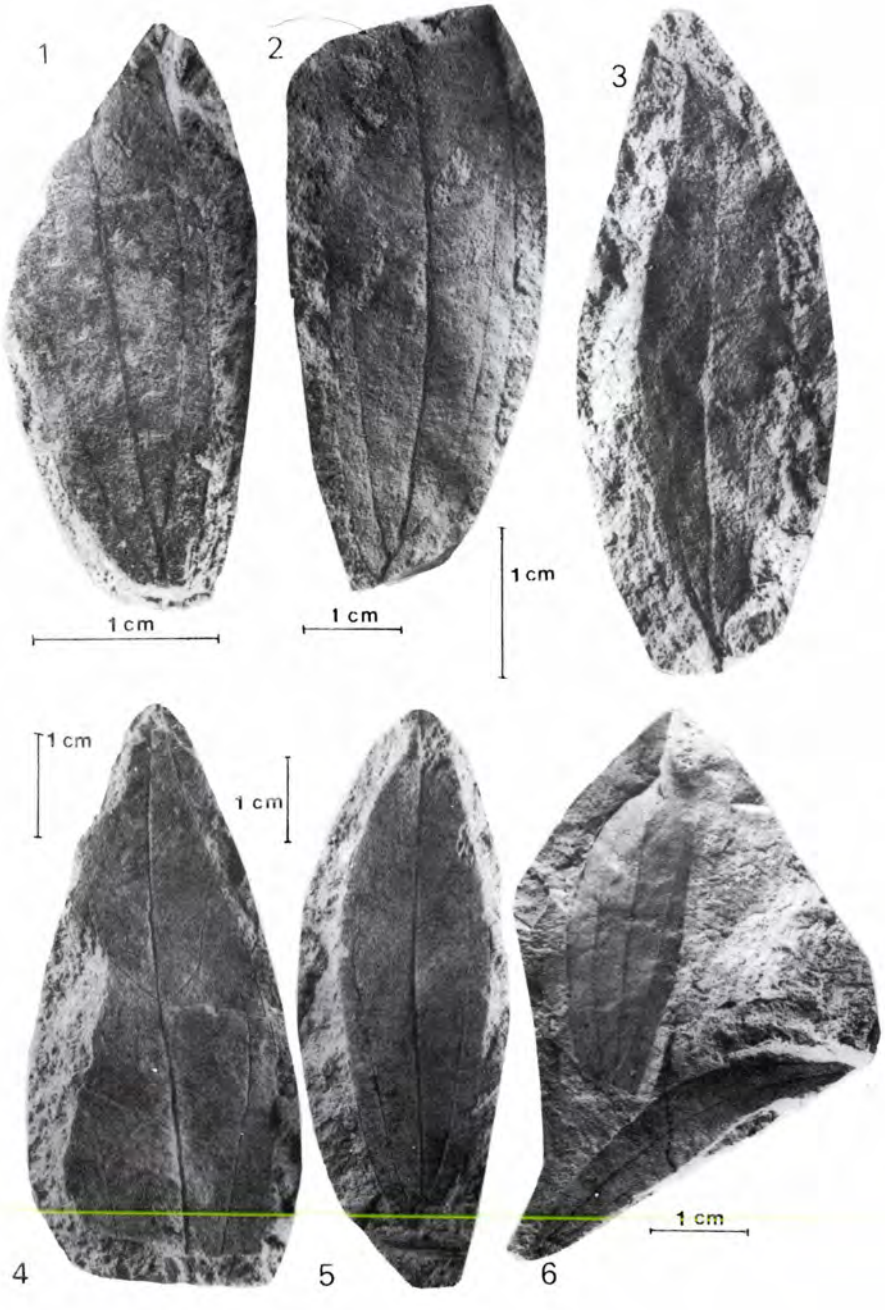


PLATE III.



PLATE IV.

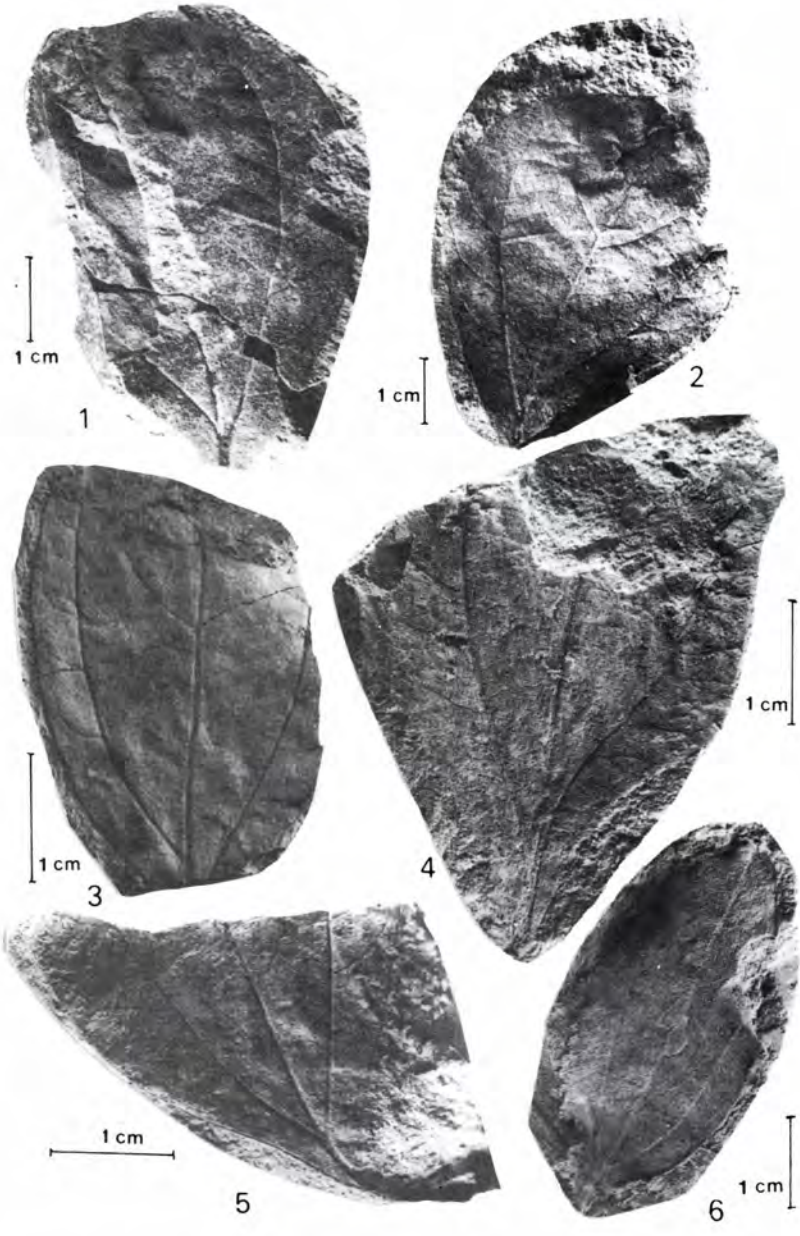


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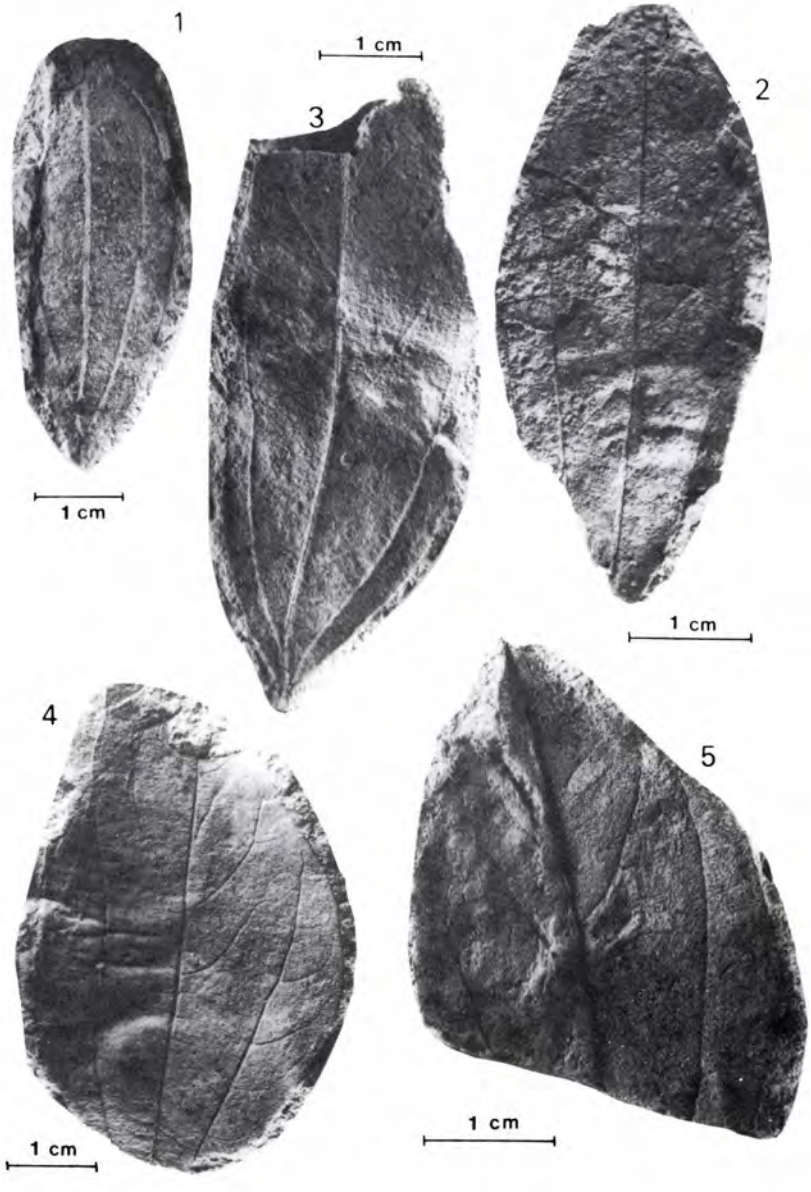


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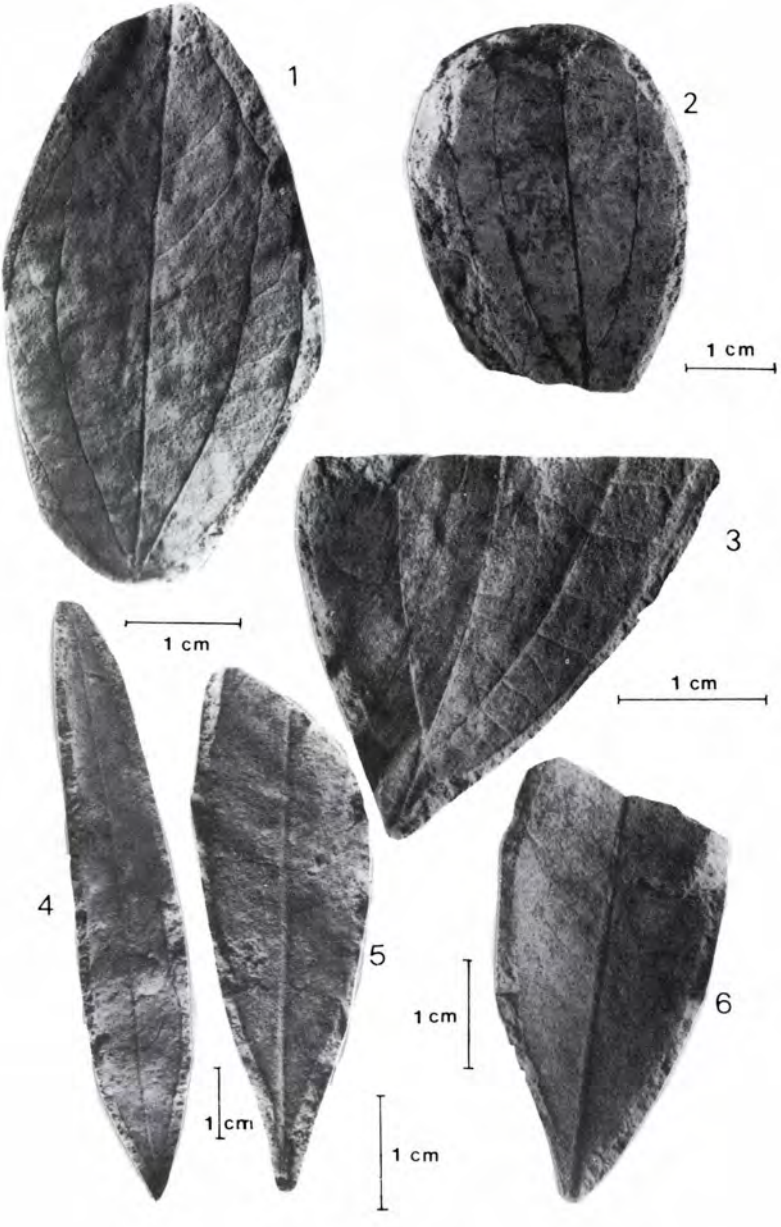


PLATE VII.

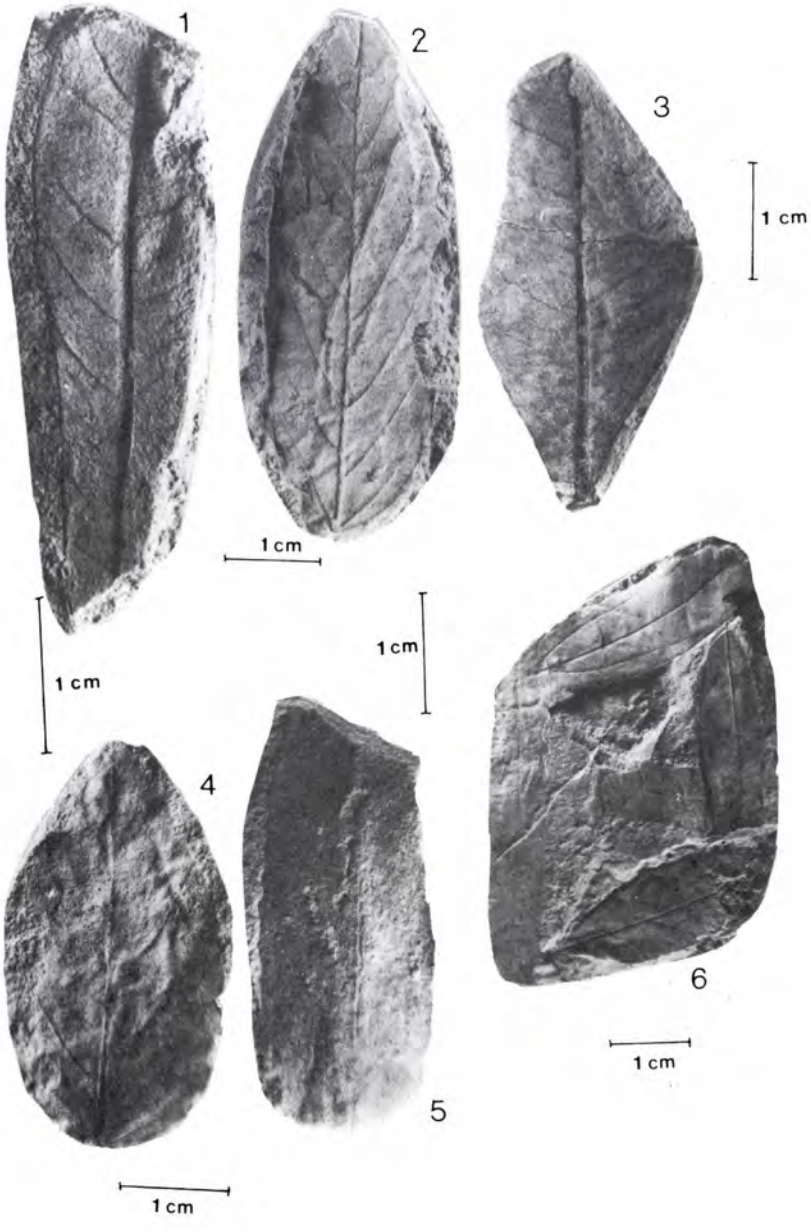


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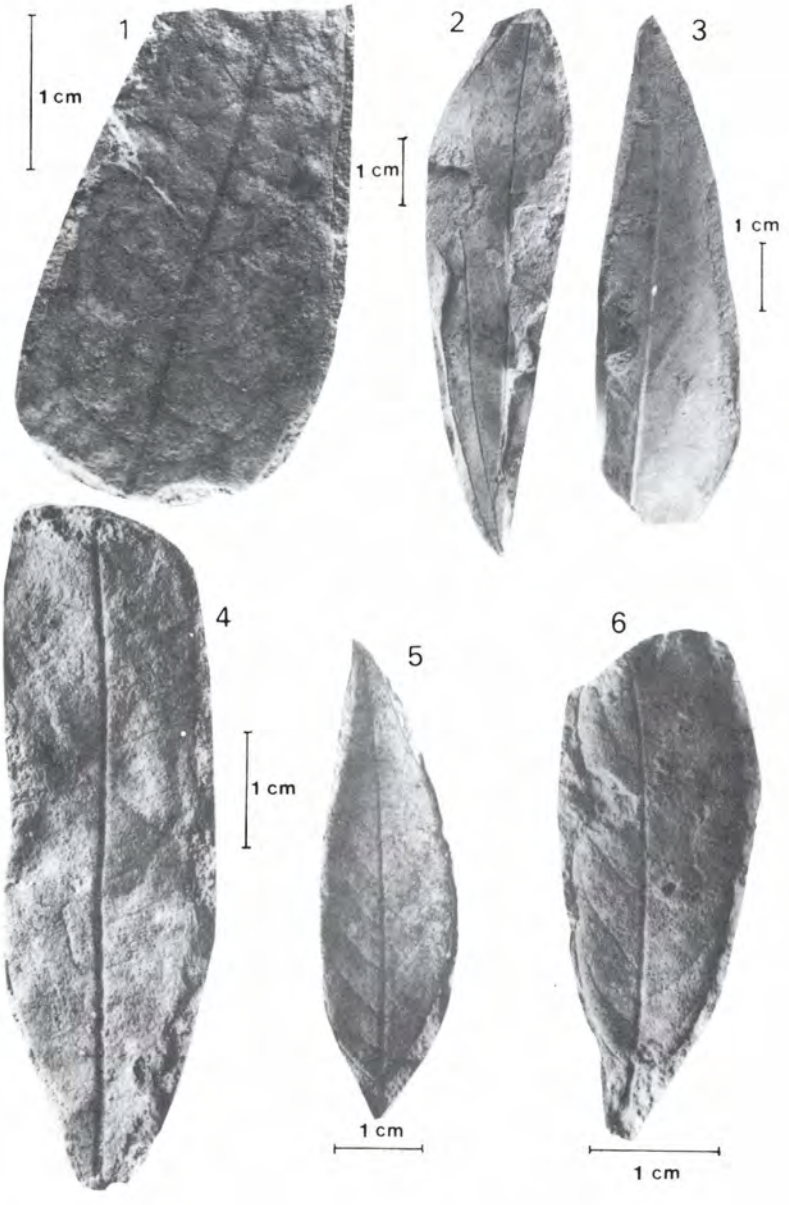


PLATE IX.

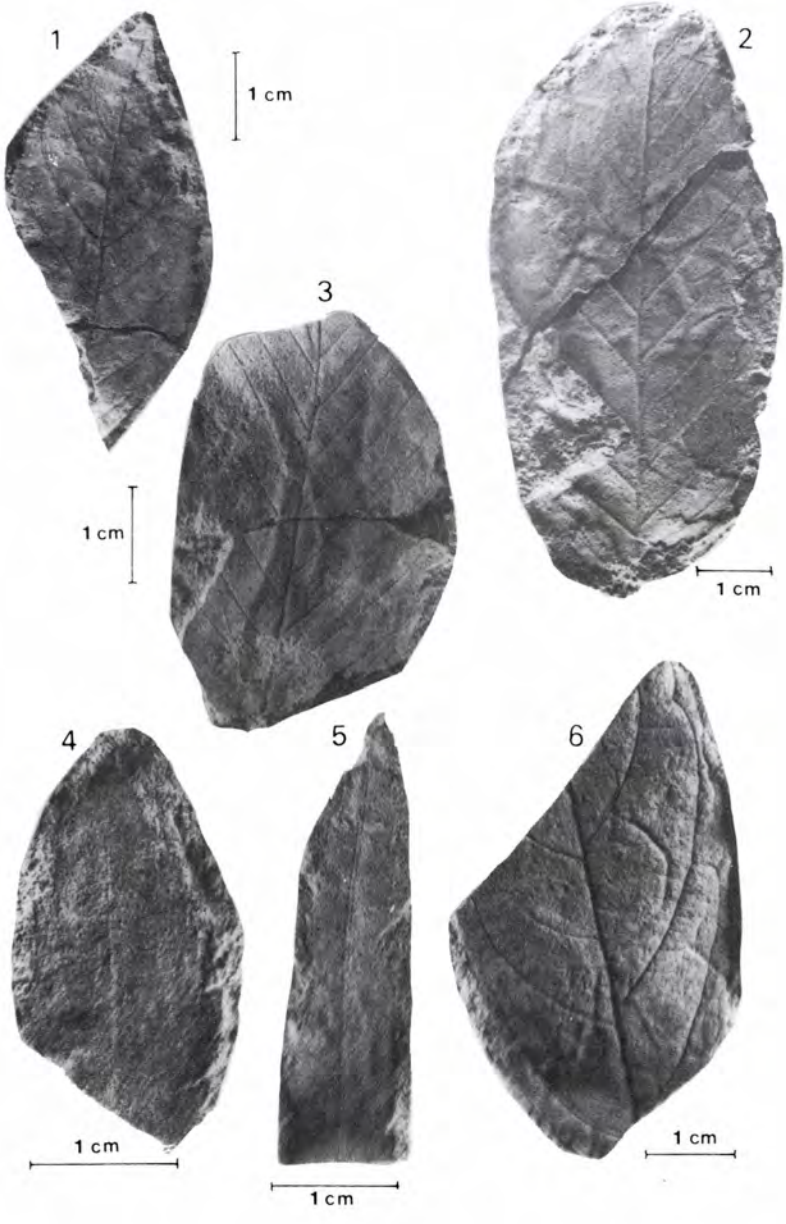


PLATE X.

