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THE OLIGOCENE VOLCANIC FLORA OF KUNDRATICE NEAR LITOMĚŘICE, ČESKÉ STŘEDOHOŘÍ VOLCANIC COMPLEX (CZECH REPUBLIC) - A REVIEW

ZLATKO KVAČEK
Faculty of Science, Charles University, Albertov 6, 128 43 Praha 2, Czech Republic

HARALD WALTHER
Staatliches Museum für Mineralogie und Geologie, Landesmuseum des Freistaates Sachsen, Augustusstrasse 2, 01067 Dresden, Federal Republic of Germany

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Abstract. A survey of the Early Oligocene flora of Kundratice, North Bohemia, is given. This locality known from the last century has yielded 1 bryophyte, 2 ferns, 4 conifers and 82 angiosperms. *Betula buzekii* sp. n. and *Dicotylophyllum deichmuelleri* sp. n. have been described as new taxa. New combinations *Cephalotaxus parvifolia* (WALTHER) comb. n., *Toxicodendron herthae* (UNGER) comb. n., *Daphnogene cinnamomifolia* (BRONGNIART) UNGER forma *lanceolata* (UNGER) stat. n. and *Dicotylophyllum heeri* (ENGELHARDT) comb. n. have been suggested. The preservation in oil shale and diatomite permitted the study of cuticles of coriaceous foliage. The reconstructed vegetation corresponds to a riparian and mesophytic forest with lower share of evergreen versus deciduous elements. The best equivalent of modern vegetation can be found in the warm-temperate zone of eastern China (the so-called Mixed Mesophytic Forest type). The site is dated by K-Ar radiometric method of the overlying basaltoid rock to 32.75±0.82 MA. A new floristic complex Seifhennersdorf/Kundratice has been proposed for the middle part of the Early Oligocene of Central Europe.
■ flora, Oligocene, volcanites, Central Europe

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Introduction

After a long period of preparations and inspections of the collected fossil plant material from the "Jesuitengraben" of Kundratice (Kundratitz), a well-known Early Oligocene site in the České středohoří Volcanic Complex, we present a review of the flora as well as interpretations of vegetation and palaeoecology. This study started in the 60's but the most extensive field work was done together with the late Čestmír Bůžek in 1976 and 1977. Then also most of the new collections were acquired. At that time the site was considerably uncovered by a group of workmen (fire-brigade from Březiny, which worked also at the site Bechlejovice), so that fresh diatom shale and diatomite, partly unweathered, became accessible. Many new suitably preserved fossils were gathered and deposited provisionally in a small depository of the Czech Geological Survey in Prague. The first report of these activities (Bůžek, Kvaček and Walther 1978) deals with the local geological situation and stratigraphy. Independently, some taxa were dealt within separate studies: conifers (Kvaček 1976, 1984, 1989), *Platanus* (Bůžek, Holý and Kvaček 1967), *Acer* (Walther 1972, Procházka and Bůžek 1975), *Ampelopsis* (Bůžek, Kvaček and Walther 1981), *Pungiphyllum, Ilex* (Kvaček and Walther 1981), *Craigia* (Bůžek, Kvaček and Manchester 1989) and Icacinaceae (Kvaček and Bůžek 1995). A correlation with the other Palaeogene localities in North and West Bohemia was attempted on the basis of palaeobotanical, palynological and palaeozoological data (Bůžek et al. 1990). The present account on the flora of Kundratice continues a series of review articles on the Palaeogene volcanic floras of Central Europe that has started with the flora of Suletice-Berand (Kvaček and Walther 1995) and Seifhennersdorf (Walther 1996) with the aim to cover this subject more extensively (further sites Bechlejovice by Knobloch, Kvaček and Walther, in prep., Kleinsaubernitz by Walther, in press, Hammerunterwiesenthal by Walther 1998).

The diatomite at Kundratice was first mentioned by Jokély (1858: 401). As a fossil plant locality it was reported by Raffelt (1878), grammar-school teacher from Litoměřice, who brought also the first list of the fossil plants, determined by Unger. Further excavations were accomplished in 1880 and 1881 by Deichmüller, the assistant and later the director of the K. Mineralogical-geological Museum in Dresden, Engelhardt, grammar-school teacher in Dresden-Neustadt and Castelli, manager of the coal mines in Zálezly. The first accounts on the flora of Kundratice were published by Engelhardt (1883, 1885). His descriptions were based on the private collections by Raffelt (housed in the Natural History Museum, Vienna), Deichmüller (National Museum, Prague) and Castelli (mostly missing), and on the collection of the Museum in Litoměřice.

In the 1890's also Menzel, a physician from Dresden, undertook own field works in various sites in North Bohemian Tertiary including Kundratice. This collection, preliminarily described and identified (Menzel 1898) is located in the Staatliches Museum für Mineralogie und Geologie zu Dresden. Undetermined or unpublished collections by Raffelt from 1884 and by Bayer from Prague from 1878 and 1897 are deposited in the National Museum. The locality was obviously accessible also later (collections by Němejc in 1927 in the National Museum, Prague).

New field activities were started by Procházka, geologist of the Czech Geological Survey in 1950 and 1951 (Procházka 1951), who later organized a group of students, among them N. Kulawcziková-Obrhelová, V. Houša, Č. Bůžek, E. Knobloch, to help him with collecting works in 1956. The same year, the core KU-1 was made. Procházka deposited his collections in the Czech Geological Survey, where they partly remained till now. In the 1950's and 1960's the site was visited by further specialists working in other groups, Řeháková (diatoms), Obrhel (algae), Obrhelová (fishes). As mentioned above, more extensive collections were done by Bůžek and Kvaček together with the technicians Vrána (in 1964), Váňa and a school-boy J. Kvaček (in 1976 and 1977). At that time the site was well accessible for collections and visited by excursions (e.g. in 1977, International conference on Advances in Angiosperm Palaeobotany in Liblice) and also by Kubát, the former keeper from the District Museum in Litoměřice. Since that time no more extensive excavations have been done. In the summer of 1996, Z. Kvaček visited the outcrop together with his students Sakala and Prokop, and Radoň, the keeper of the District Museum in Teplice and found it fully demolished, inaccessible. Only rare pieces of oil shale under the tree roots indicated the position of the site.

The fossil plant material dealt within this work includes the collections described by Engelhardt (1885) and housed in the Natural History Museum, Vienna (W) and the National Museum, Praha (NM) as well as the District Museum, Litoměřice (Mus. Lit.). We were also able to revise the tentatively determined and published material by Menzel (1898, 1901) in the Staatliches Museum für Mineralogie und Geologie zu Dresden (MMG). More important specimens from the District Museum Litoměřice of unknown collectors were selected and borrowed by Bůžek and were located again when the Czech Geological Survey moved from the building on the Malostranské Square to the new address Klárov 7 in 1994. Later on we studied and macerated fresh material obtained in 1976 and 1977, deposited now provisionally at the Faculty of Science of the Charles University in Prague (PRC) with the intention to transfer a part of it to the National Museum, Prague. Some of the original and type material remained in the collections of the Czech Geological Survey, Praha (UUG), particularly in the depository in Lužná near Rakovník. Other museum collections in Dresden and Prague were only briefly studied. In view of the extent of the material (thousands of specimens), we cannot rule out a possibility that some further taxa, represented by individual specimens will be recovered in the future. A large amount of fossil flowers has been omitted with the intention to study them again in detail (together with Konzalová) and publish separately.

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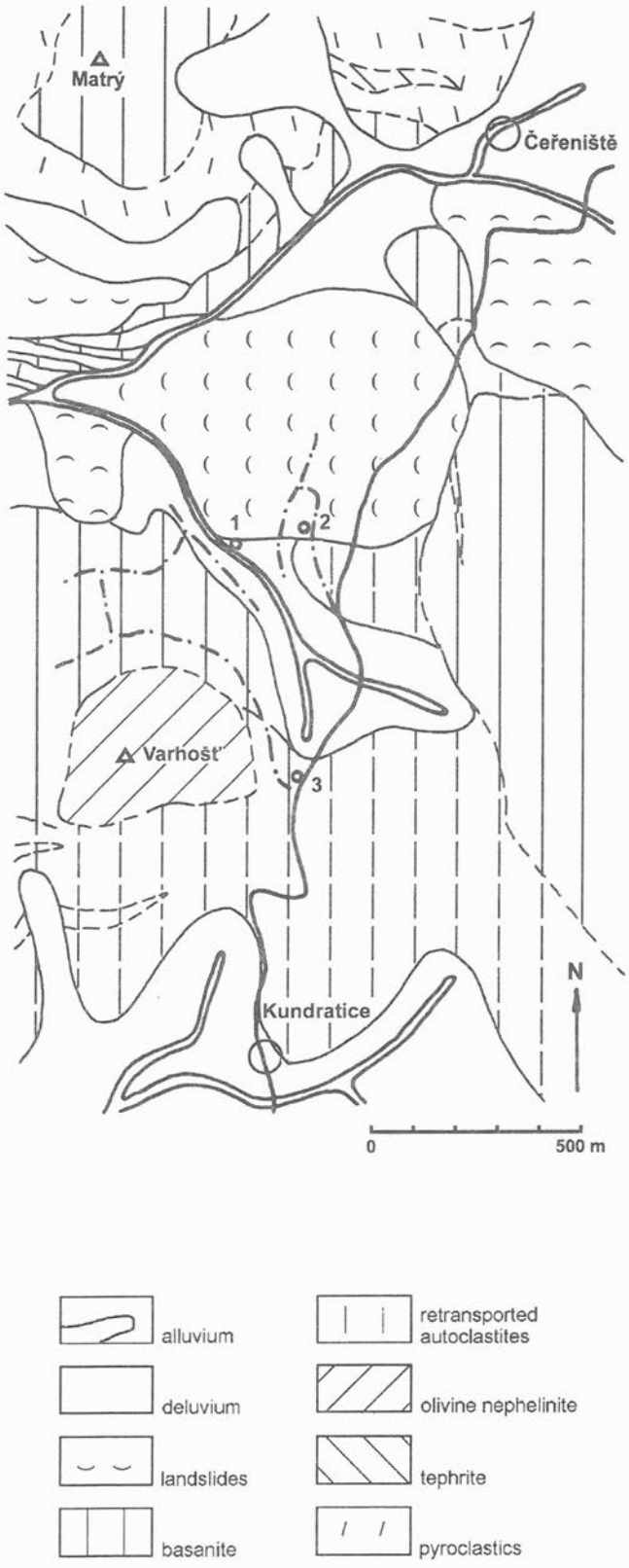
Geological setting

The geology of the surroundings of Kundratice was described several times (Hibsch and Seeman 1913, Shrbený 1967, 1969, Bůžek et al. 1978), lately in connection with radiometric correlation of fossil flora and fauna (Bellon et al. in press) and mapping of landslides (Šebesta et al. 1997). The site known in the palaeobotanical literature as "Jesuitengraben bei Kundratitz" lies in northern Bohemia halfway between the towns Litoměřice and Ústí nad Labem (text-fig. 1, Cajz 1996 - as Čeřeniště, Tschersing) in the valley of the Rytina Creek between the hills Varhošť and Matrý 1.2 km north of the village Kundratice. The exact position of the fossiliferous outcrop is at about 450 m alt. (text-fig. 2) on the right side of a ravine, called in the last century "Jesuitengraben", belonging to the left tributary of the Rytina Creek. According to Hibsch and Seemann (1913, p. 51), the diatom claystone was exposed in the length of about 50 m downstream 450 m from the forest spring "Frisches Brünnel". The lower part of the volcanic complex was penetrated by the core KU-1 about 500 m south (text-fig. 3). The base of the volcanic complex lies at 222.5 m alt. just above the Upper Cretaceous deposits. Further up about 200 m thick complex of volcanoclastic rocks with two thicker layers (at alt. 360-368 m and 433-445 m) and several interbeds of diatomite, and alkaline basalt on the top (between 487 and

Text-fig. 1. Location of the village Kundratice in North Bohemia.



Text-fig. 2. Geological map of the environs of the site Kudratice. 1 - the fossiliferous outcrop in the "Jesuitengraben", 2 - surface radiometric sample, 3 - core KU-1 (according to Cajz in Šebesta 1997).

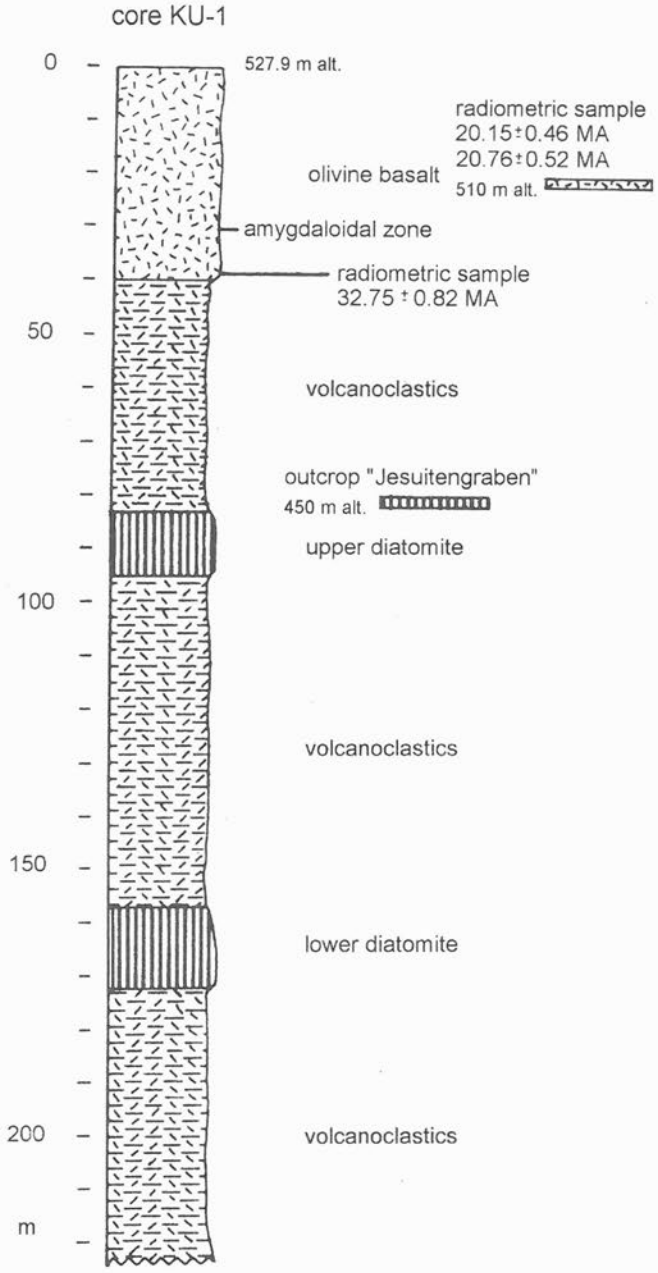
527 m alt.) are developed. The complete thickness of the volcanic complex attains more than 300 m, when the hill Varhošť (olivine nephelinite) is added (top at 638.6 m alt.). The lower part of the basaltoid sheet, which covers the fossiliferous layer, was dated to 32.75 ± 0.82 MA (Early Oligocene), the upper part, separated by an amygdaloidal zone and exposed along the road Kundratice - Čeřešniště, to 20.15±0.46 and 20.76±0.52 (Early Miocene) (Bellon et al. in press). The fossiliferous outcrop of diatomite in the "Jesuitengraben" was correlated with the upper layer of the diatomite in the core KU-1. The lower layer of the diatomite struck by the core has yielded an older assemblage of flora (Bůžek et al. 1978) and fish fauna (Obrhelová 1969) probably of Late Eocene age (Bellon et al. in press). Thus the volcanic activity took place for a long period with some substantial gaps.

The geological map (text-fig. 2) shows that the environs of the locality Kundratice are built of nephelinic basanite sheets with mighty tuffitic, autoclastite, and autometamorphosed layers. Most of them arose in water environments (Cajz 1992, personal communication). In these volcanic lakes, layers of diatomite and bitumenous diatom claystone ("Brandschiefer") deposited during calm periods with low volcanic activity. Their extent might have been several kilometres. Thus the lower layer of diatomite in the core KU-1 may coincide with diatomite intercalations in cores LB-1 and Úc-9 at Lbín and Hlinná 2 km SSE of the core KU-1 with the same diatom oligotrophic flora (the assemblage *Melosira distans - Eunotia* cf. *clevei - Fragilaria*, see Řeháková 1967). The upper diatomite layer exactly corresponds to the eutrophic diatom assemblage found in the outcrop 500 m far and belongs certainly to the same lake fill. This assemblage (Řeháková 1967) includes a much more diversified diatom flora with the representatives of both centric and pennate taxa. Characteristic elements are *Melosira* ex gr. *islandica-granulata, Melosira hibschii, Tetracyclus ellipticus, Fragilaria construens, F. pinnata, Gomphonema intricatum, Navicula clementis, Synedra acus* etc. (Řeháková 1967). The land flora has a considerable proportion of riparian elements (*Alnus gaudinii* etc. see p. 29), which refer to the azonal vegetation belt around the lake.

The Miocene volcanic bodies may have larger extent than previously expected in this area. Some newly recovered flora in tuffite near the top of the Matrý hill (Radoň, personal communication) has much younger aspects than that of Kundratice. The so far identified taxa (*Pinus rigios, Tetraclinis salicornioides, Liriodendron procaccinii, Daphnogene cinnamomifolia, Laurophyllum* sp., *Betula brongniartii, Platanus neptuni,* cf. *Ulmus pyramidalis, Acer* sp.) corroborate also a different, younger phase of volcanic activity. The geomorphology of the landscape is strongly influenced by the landslides, which make correlations of geological structures difficult. Further cores, more radiometric datings and petrological studies are necessary to reconstruct more precisely this volcanic complex in view of timing of phases, genesis and structure.

Material and methods

Two sorts of fossiliferous rock are represented in this site. The more common and richer in plant fossils is the well bedded bitumenous diatomaceous claystone ("Brandschiefer") of



Text-fig. 3. Section of the core KU-1 with the situation of radiometric samples and fossiliferous layers (according to Bůžek in Bellon et al., in press).

yellowish brown colour. This sediment is usually well oxidized and only coriaceous plant remains bear remnants of cuticles. One layer of thick, less weathered claystone is more resistant and its colour passes from dark brown to blackish grey in the inner part of slabs. Plant fossils in blackish parts are carbonized, not oxidized, and yielded pieces of well preserved cuticles. The second sort of the rock is unbedded light brown diatomite. Even in this case, coriaceous leaf remains are covered with cuticles, which are partly damaged by diatom imprints.

The cuticle remains curl off the shale only exceptionally (e.g. in conifers or *Ilex*). In this case, pieces of cuticle were removed by preparation needle, rinsed in 5% KOH and water right on the slide and mounted in glycerine. Most other cases were more laborious. A transfer-collodion film-technique was then applied. On a small portion of leaf lamina, preferably on the edge of a rock sample, a small collodion drop was spread and, before drying, this spot was chipped off by the preparation needle and submerged in hydrofluorid acid. After a short time (c. 5 minutes) the collodion film was mechanically removed from the soften rest of the rock fragment. After rinsing in water, the collodion film was treated in KOH, again rinsed and mounted in glycerine. Both impression and counterimpression were macerated because they were covered by the adaxial and abaxial cuticle respectively. In many cases, this procedure was unsuccessful. Either the cell structure was invisible except for areas on thicker veins or the cuticle was covered by remnants of sediment. As a rule, also pollen grains adhered to the film. In most cases epidermal structures were mostly discernible in phase-contrast or interference-contrast light. Only in cases of fully carbonized samples, fragments of leaf lamina were removed mechanically and cuticles were macerated by the current method in Schulze solution. For the study of pollen in situ, a small amount of carbonized substance was removed from the stamens, then treated by 5% KOH on the slide and again rinsed and mounted in glycerine.

Systematic descriptions

A brief survey of all recognized taxonomic entities is arranged alphabetically. The systematic arrangement of taxa is shown in table 3, together with relative abundance. Synonym lists mostly include the determinations of located and personally inspected specimens published by Engelhardt (1885), Menzel (1898) or in other accounts concerning the flora of Kundratice. Not all illustrations by Engelhardt are accurate. Hence they cannot serve as a real basis for determination of the missing specimens, unless the plant taxa have characteristic morphology. Isolated needle-leaves of conifers are safely determinable with the aid of the epidermal structure only. In cases of several angiosperm foliage, the systematic affinities have not been elucidated in spite of the preserved leaf morphological and anatomical characters.

Acer angustilobum HEER

Pl. 1, figs 1-3, pl. 2, figs 1-5, text-fig. 13/11

1885 *Acer angustilobum* HEER; Engelhardt, p. 53, pl.13 (20), figs 9, 11-13, 16
1885 *Acer dasycarpoides* HEER; Engelhardt, in sched.
1885 *Acer integrilobum* WEBER; Engelhardt, p. 53
1885 *Acer trilobatum* HEER; Engelhardt, p. 52, pl.12 (19), figs 15, 17, 19-20, 24, pl. 21 (28), fig. 11, pl. 13 (20), fig. 3
1885 *Acer rueminianum* HEER; Engelhardt, p. 53, pl. 14 (21), fig. 4
1885 *Acer* sp., Engelhardt, in sched.
1972 *Acer angustilobum* HEER; Walther, p. 40, pl. 5, figs 1-3, 5, 7, 10, pl. 35, figs 6-9
1975 *Acer dasycarpoides* HEER forma *angustilobum* (HEER) PROCHÁZKA et BŮŽEK, p. 37, pl. 21, figs 7- 8, text-fig. 14 g
1978 *Acer dasycarpoides* HEER forma *angustilobum* (HEER) PROCHÁZKA et BŮŽEK; Bůžek, Kvaček and Walther, p. 356, pl. 2, fig. 8

Description: Leaves trilobate, petiolate, leaf lobes slender, margin shallowly irregularly dentate (for more details see Walther 1972, Procházka and Bůžek 1975). Adaxial cuticle thin,

showing polygonal cells 22-37 μm across with nearly straight anticlines. Abaxial cuticle papillate with doomed cells. Course of anticlines not well discernible. Stomata seen as roundish to broadly oval outlines of guard cell pairs (25-) 15-13 μm long and (17-) 13-10 μm wide. Pore widely oval, nearly reaching to the stomatal poles, medium thickened.

Remarks: This leaf species, prevailing on the locality, is connected with *Acer palaeosaccharinum* STUR by transition forms with more distinctly dentate margin. It is therefore not certain, whether all specimens indicated below do belong to this species. The characteristic strongly papillate undersurface (Walther 1972) is less distinct (? due to preservation mode) in the studied specimens.

Material studied: NHM Wien: Pb 00221, Pb 00223, Pb 00224, Pb 00225, Pb 00231, Pb 00236, Pb 00237, Pb 00238, Pb 00240, Pb 00242, Pb 00243, Pb 00250, Pb 00255, Pb 00256, Pb 00260,Pb 00261, Pb 00262, Pb 00263, Pb 00264, Pb 00265, Pb 00266, Pb 00267, Pb 00269, Pb 00270, Pb 00271, Pb 00272, Pb 00273, Pb 00274, Pb 00275, Pb 00276, Pb 00297, Pb 00299, Pb 00406 b.

MMG Dresden: Ku 1, Ku 4, Ku 8, Ku 10 a, b, Ku 11, Ku 12, Ku 13, Ku 14 a, b, Ku 16, Ku 17, Ku 18, Ku 19, Ku 20 a, b, Ku 22, Ku 23, Ku 24, Ku 25, Ku 26, Ku 27, Ku 31, Ku 34, Ku 36, Ku 37, Ku 39, Ku 42, Ku 48, Ku 50, Ku 53, Ku 58, Ku 60, Ku 68 (diatomite), Ku 74, Ku 75, Ku 76, Ku 81, Ku 91, Ku 92, Ku 205, Ku 207, Ku 208, Ku 305 a, b, Ku 331, Ku 410, Ku 413 a, b, 47 specimens without numbers.

NM Praha: G 53 - 2, G 237, G 240, G 244, G 245 - 3, G 246, G 247 - 1, G 248, G 249 - 1, G 251, G 253 - 1, G 254 - 1, G 2093, G 3574, G 3587, G 3617 - 1, G 4645, G 5035.

Mus. Litoměřice: ML 3 - 1, ML 18 - 2, ML 37, ML 57 - 1, ML 96 - 1, ML 100, ML 102, ML 115, ML 141 - 2, ML 183, ML 184, ML 183, ML 184, ML 185, ML 186, ML 196.

Charles Univ. Praha: CKU 77, CKU 79, CKU 96, CKU 98, CKU 101, CKU 102, CKU 204, CKU 206, 41 specimens without numbers.

Cuticular preparations: PRKU 96, PRKU 102, PRKU 308.

Acer integrilobum WESSEL et WEBER emend. WALTHER

Pl. 1, fig. 6

1885 *Acer integrilobum* WEBER; Engelhardt, p. 53, pro parte, ? pl. 13 (20), figs 20-21

Description: Leaves trilobate, c. 60 mm long and 70 mm wide, petiolate, entire-margined, only on the basal part of the side lobes occasionally a small tooth, base rounded.

Remarks: Such nearly entire-margined trilobate maple-leaves occur very rarely in the volcanic floras, e.g. at Seifhennersdorf (Walther 1967) or Suletice-Berand (Kvaček and Walther 1995). They were described as *Acer loclense* HANTKE (Walther 1967) and *A.* cf. *decipiens* A. BRAUN (Kvaček and Walther 1995). We accept the concept of the species given by Walther (1972).

Material studied: NHM Wien: Pb 00222.

MMG Dresden: Ku 206 a, b, Ku 321.

Acer palaeosaccharinum STUR

Pl. 1, fig. 5, pl. 2, fig. 6, text-fig. 13/21

1885 *Acer angustilobum* HEER; Engelhardt, p. 53, pl. 13 (20), figs 5, 8, pl. 14 (21), fig. 6

1885 *Acer dasycarpoides* HEER; Engelhardt, in sched.

1885 *Acer grosse-dentatum* HEER; Engelhardt, p. 53, pl. 13 (20), fig. 8

1885 *Acer integrilobum* WEBER; Engelhardt, p. 53, pl. 14 (21), fig. 1

1885 *Acer palaeosaccharinum* STUR; Engelhardt, in sched.

1885 *Acer subplatanoides* ENGELHARDT, p. 54, pl. 14 (21), fig. 7-8

1885 *Acer trilobatum* STERNBERG, Engelhardt, p. 52, pl. 12 (19), figs 13, 16, pl. 13 (20), figs 2, 7

1885 *Acer* sp., Engelhardt, in sched.

1885 *Acer* sp. [and *Depazea picta* HEER]; Engelhardt, p.14, pl. 1 (8), fig. 5

1898 *Acer bruckmannii* A. BRAUN; Menzel, p. 9, pl. 1, fig. 5

1972 *Acer palaeosaccharinum* STUR; Walther, p. 97, pl. 19, figs 4-6, pl. 20, fig. 5, pl. 21, figs 8-9, pl. 52, figs 1, 4, pl. 53, figs 1-5

1975 *Acer palaeosaccharinum* STUR; Procházka and Bůžek, text-fig. 21 F

Description: Leaves tri-to pentalobate, coarsely and sharply dentate, medial lobe narrowing towards its base, leaf size and form rather variable (see Walther 1972). Epidermis structure (Walther 1972, p. 100) obtained only from one specimen : adaxial cuticle smooth, partly finely striated, showing polygonal cells 15-50 μm across with slightly bent anticlines, abaxial cuticle smooth, non-papillate, showing polygonal cells smaller than in the abaxial side (15-25 μm across), stomata anomocytic, broadly oval, (15-) 18.5 (-25) μm long and (15-) 17.5 (-22.5) μm wide, pore with thickened ledges, trichome bases solitary on thicker veins.

Remarks: This species shows similarities in gross morphological architecture with *Acer haselbachense* WALTHER (1972), which differs in the papillate leaf underside with distinctly doomed cells. In the material of the Kleinsaubernitz core (Walther, in press), maple leaves of similar morphology are also papillate and hence assigned to *Acer haselbachense* (the first record in the volcanic floras).

Material studied: NHM Wien: Pb 00003, Pb 00219, Pb 00220, Pb 00239, Pb 00241, Pb 00245, Pb 00248, Pb 00251, Pb 00256, Pb 00258.

MMG Dresden: Ku 2a, Ku 7, Ku 33, Ku 46, Ku 52, Ku 65, Ku 86, Ku 136, Ku 304, Ku 330 a, b, 10 specimens without numbers.

NM Praha: G 234, G 236, G 250, G 256, G 257, G 2071, G 2072, G 5569.

Mus. Litoměřice: ML 101, ML 103, ML 187.

Charles Univ. Praha: 6 specimens without numbers.

Acer rueminianum HEER

Pl. 1, fig. 4

1972 *Acer rueminianum* HEER; Walther, p. 132, pl. 28, fig. 3, pl. 57, figs 2, 4, 7-9

Remarks: This form-species with characteristic narrow and nearly entire-margined three lobes occurs only sporadically in Tertiary floras of Europe (Walther 1972). Hantke (1965) believes this species to be an ancestor of *A. angustilobum*. Walther (1972) considers this taxon as extinct during the Tertiary without any extant analogon, while De Jong (1976) has found similarities to *Acer pilosum* MAXIM. of the series *Pubescentia* POJARKOVA. According to morphology of associated fruits, Mai (1997) prefers the connection with sect. *Palmata*.

Material studied: MMG Dresden: Ku 54, Ku 64, Ku 69

Mus. Litoměřice: ML 32.

Acer cf. *tricuspidatum* BRONN

Pl. 1, fig. 7, pl. 2, fig. 7, text-figs 4, 13/22

1885 *Acer dasycarpoides* HEER; Engelhardt, in sched.
1885 *Acer trilobatum* STERNBERG; Engelhardt, p. 52, pl. 12 (9), figs 14, 18, pl. 13 (20), figs 1, 3, pl. 14 (21), fig. 5
1885 *Acer trilobatum* f. *productum* STERNBERG; Engelhardt, p. 52, pl. 13 (20), figs 4, 13, 17, pl. 14 (21), fig. 5
1885 *Acer trilobatum* f. *tricuspidatum* STERNBERG; Engelhardt, p. 52, pl. 13 (20), fig. 4.
1885 *Acer* sp., Engelhardt, in sched.
1885 *Acer* sp. [and *Phyllerium kunzei* (A. BRAUN) HEER]; Engelhardt, p. 13, pl. 1 (8), fig. 2
1885 *Acer* sp. [and *Rhytisma palaeoacerium* ENGELHARDT, holotype]; Engelhardt, p. 14, pl. 1 (8), figs 8, 8a-c
1972 *Acer tricuspidatum* BRONN; Walther, p. 56, pl. 16, figs 1-8, pl. 40, figs 1-5

Description: Leaves mostly trilobate, rarely subpentalobate. Gross morphology and marginal dentation correspond to the characteristics given by Walther (1972) for this species. Cuticular remains rarely reflecting cell structure. Abaxial epidermis with non-papillate polygonal cells, 12-17 μm across stomata anomocytic, roundish, 8-15 μm wide and 15-20 μm long, with prominent elliptical aperture. Trichome bases exceptionally observed.

Remarks: Small forms, described by Walther (1972) from the Early Miocene of Břešťany with prominent medial lobe, are noteworthy. Such forms are not known in the present collection. The epidermal structure described above differs from the type specimen and other material from the Miocene (Walther 1972) in the absence of trichomes. Nomenclature note. Only Bronn (1838) must be cited as the author of the name *Acer tricuspidatum* (see Walther 1968) and not A. Braun et Agassiz in Bronn (see e.g. Takhtajan and Gochtuni 1972, Zhilin 1974, Knobloch in Knobloch and Kvaček 1976). *Acer tricuspidatum* A. BRAUN et AGASSIZ is quoted only as a synonym in Bronn (1838), which is not an ascription in sense of the Art. 46.3 ICBN.

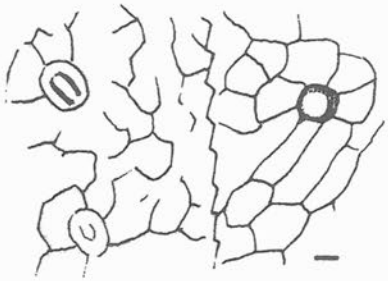
Material studied: NHM Wien: Pb 00218, Pb 00221, Pb 00244, Pb 00247, Pb 00249, Pb 00252, Pb 00254, Pb 00257, Pb 00259, Pb 00277, Pb 00277, Pb 00298.

MMG Dresden: Ku 3, Ku 5, Ku 6, Ku 9 a, b, Ku 15, Ku 28, Ku 29 a, b, Ku 31, Ku 32, Ku 33, Ku 35 a, b, Ku 38, Ku 39, Ku 40, Ku 43, Ku 44, Ku 45, Ku 49 (diatomite), Ku 55, Ku 56, Ku 57 a, b, Ku 61, Ku 63, Ku 67, (diatomite), Ku 71, Ku 78, Ku 79, Ku 80, Ku 82, Ku 83, Ku 84, Ku 87, Ku 96, Ku 97, Ku 98, Ku 99, Ku 100, Ku 101.

NM Praha: G 235, G 239, G 241, G 242, G 243.

Charles Univ. Praha: CKU 97, CKU 205, CKU 207, CKU 231, CKU 241.

Cuticular preparations: PRKU 102, PRKU 231, PRKU 241.



Text-fig. 4. ***Acer* cf. *tricuspidatum* BRONN, abaxial cuticle, PRKU 241/1 (scale bar 10 μm).**

? *Acer* sp. (flores)

1885 ? *Acer* sp., Engelhardt, p. 54, pl. 13 (20), figs 22-25
1898 *Acer trilobatum* STERNBERG; Menzel, p. 9, fig. 6

Remarks: Flower impressions that show more than 8 stamens, and a longly stalked cup-like basal discus occur occasionally at Kundratice. They are relatively more common in comparison with other kinds of fossil flowers. Engelhardt (1885) interprets them as possible flowers of a maple. By a higher number of stamens they deviate from variation known in extant maples.

Material studied: NHM Wien: Pb 00279.

MMG Dresden: Ku 126, Ku 280 b, 4 specimens without numbers.

Charles Univ. Praha: CKU 248, CKU 311, 20 specimens without numbers.

Acer sp. (fructi)

Pl. 1, fig. 8, pl. 2, fig. 8, text-fig. 13/10

1885 *Acer angustilobum* HEER; Engelhardt, p. 53, pl. 13 (20), fig. 6, 15, pl. 21 (28), fig. 18
1885 *Acer eupterigium* UNGER; Engelhardt, p. 54, pl. 13 (20), fig. 27
1885 *Acer grosse-dentatum* HEER; Engelhardt, p. 53, pl. 13 (20), fig.19
1885 *Acer rueminianum* HEER; Engelhardt, p. 54, pl. 14 (21), figs 2-3
1885 *Acer trilobatum* HEER; Engelhardt, p. 52, pl. 12 (19), figs 21-23, pl. 13 (20), fig. 10
1885 *Acer* sp., Engelhardt, in sched.

Remarks: Maple winged fruits, mostly divided in halves, are represented by numerous specimens. Their exact determination to the species level is, according to Mai (personal communication), not possible in impression material.

Material studied: NHM Wien: Pb 00226, Pb 00228, Pb 00229, Pb 00230, Pb 00232, Pb 00234, Pb 00235, Pb 00246, Pb 00268.

MMG Dresden: Ku 95, Ku 102, Ku 103, Ku 105, Ku 106, Ku 107, Ku 108, Ku 109, Ku 110, Ku 111, Ku 112, Ku 113, Ku 114, Ku 115 (diatomite), Ku 209, Ku 320, Ku 388 a, Ku 411 (extreme form), Ku 412 a, b, Ku 414, Ku 415 a, b, Ku 445, 36 specimens without numbers.

NM Praha: G 104 - 2, G 230, G 231, G 232, G 252, G 5123, G 5124, G 5125, G 5126.

Mus. Litoměřice : ML 188, ML 189, ML 190, ML 191, ML 192, ML 193, ML 194, ML 195.

Charles Univ. Praha: 15 specimens without numbers.

Ailanthus sp.

Pl. 4, fig. 4, text-fig. 13/28

1885 *Carya elaenoides* UNGER; Engelhardt, p. 67, pl. 18 (25), figs 3-6
1885 *Castanea atavia* UNGER; Engelhardt, p. 25, pl. 4 (11), fig. 35
1885 *Myrica banksiaefolia* (UNGER) HEER; Engelhardt, p. 19, pl. 2 (9), fig. 1
1885 *Myrica hakeaefolia* UNGER; Engelhardt, p. 20, pl. 2 (9), figs 3, 5, 8
1885 *Quercus gmelini* A. BRAUN; Engelhardt, p. 23, pl. 3 (10), figs 9, 18
1885 *Quercus lonchitis* UNGER; Engelhardt, p. 22, pl. 2 (9), figs 31-32
1978 *"Myrica" hakeaefolia* UNGER sensu ENGELHARDT; Bůžek, Kvaček and Walther, p. 356, pl. 2, fig. 7
1981 indet.; Kvaček and Walther, p. 81, pl. 12, figs 4-5

Description: Leaves (leaflets ?) mostly fragmentary, oblong-lanceolate, with slightly asymmetric base, coarsely simple dentate, teeth admedially bent, acute, sometime mucronate. Venation semicraspedodrome, midrib thick, secondaries in more than 12 pairs, subopposite to alternate, densely spaced, at wider angles to the midrib.

Remarks: These somewhat enigmatic leaf remains can best be compared with the foliage of *Ailanthus* DESF. No epidermal structure has been obtained to help elucidate the systematic position. Such fossils occur in several volcanic floras (e.g. Rott, Suletice-Berand, Seifhennersdorf, Kleinsaubernitz) in various frequence. Only the record from the core at Kleinsaubernitz near Bautzen yielded the epidermal structure (*Ailanthus prescheri* WALTHER in press), which shows little useful characters to prove this generic assignment. Engelhardt (1885) compared this leaf form with the Myricaceae, Juglandaceae or Fagaceae but none of these possibilities seems to be satisfactory.

Material studied: NHM Wien : Pb 00024, Pb 00043, Pb 00044, Pb 00046, Pb 00047, Pb 00048, Pb 00122, Pb 00280 b, Pb 00329, Pb 00330, Pb 00333, Pb 00337.

MMG Dresden: Ku 221 a, Ku 478, Ku 479, Ku 480 a, b, Ku 481 a, b, Ku 482, Ku 483 a, b, Ku 484, 10 specimens without numbers.

NM Praha: G 4, G 58 - 1, G 60, G 61, G 2102, G 2103, G 2111, G 5091.

Mus. Litoměřice: ML 4, ML 5, ML 13, ML 44 - 1, ML 45, ML 64, ML 67, ML 135, ML 200, ML 215, ML 216, ML 217.

Charles Univ. Praha: CKU 5 specimens without numbers.

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK

Pl. 3, figs. 1-3, text-figs 13/4-5

1885 indet. [and *Sphaeria amygdali* ENGELHARDT, holotype], Engelhardt, p.14, pl. 1 (8), fig. 10
1885 *Amygdales pereger* UNGER; Engelhardt, p. 71 (pro parte), pl. 19 (26), figs 2, 14
1885 *Berberis miocenica* ENGELHARDT, p. 49, pl. 10 (17), fig. 26
1885 *Bombax chorisiaefolium* ETTINGSHAUSEN; Engelhardt, p. 50 (pro parte)
1885 *Carpinus pyramidalis* GAUDIN; Engelhardt, p. 25
1885 *Celastrus acherontis* ETTINGSHAUSEN; Engelhardt, p. 57, pl. 11 (18), fig. 3
1885 *Celastrus bruckmanni* ETTINGSHAUSEN; Engelhardt, p. 58
1885 *Celastrus ungeri* ENGELHARDT, p. 56, pl. 14 (21), fig. 23 (holotype)
1885 *Colliguaja protogaea* ETTINGSHAUSEN; Engelhardt, p. 64, pl. 15 (22), fig. 15
1885 *Elaeodendron bohemicum* ENGELHARDT [and *Phillerium croxoxylontis* ENGELHARDT, holotype], p. 13, 60, pl. 15 (22), fig. 8 (holotype)
1885 *Engelhardia brongniarti* SAPORTA; Engelhardt, p. 67, pl. 17 (24), fig. 22
1885 *Euphorbiophyllum parvifolium* ENGELHARDT, p. 64, pl. 15 (22), figs 26, 28 (syntypes)
1885 *Euonymus napaearum* ETTINGSHAUSEN; Engelhardt, p. 59 (pro parte)
1885 *Fraxinus lonchoptera* ETTINGSHAUSEN; Engelhardt, p. 37, pl. 8 (15), fig. 37
1885 *Ficus jynx* UNGER; Engelhardt, p. 28, pl. 6 (13), fig. 7
1885 *Gleditschia celtica* UNGER; Engelhardt, p. 80
1885 indet. [and *Sphaeria salicis* ENGELHARDT, holotype], p. 14, pl. 1 (8), fig. 14
1885 *Juglans bilinica* UNGER; Engelhardt, p. 65, pl. 16 (23), fig. 28, pl. 17 (24), figs 1, 7
1885 *Juglans hydrophila* UNGER; Engelhardt, p. 66
1885 *Maytenus europaeus* ETTINGSHAUSEN; Engelhardt, p. 58, pl. 15 (22), fig. 8
1885 *Myrica carpinifolia* GOEPPERT; Engelhardt, p. 19, pl. 1 (8), fig. 39
1885 *Myrsine plejadum* ETTINGSHAUSEN; Engelhardt, p. 40, pl. 9 (14), fig. 12
1885 *Palaeolobium sotzkianum* UNGER; Engelhardt, p. 74
1885 *Prunus olympica* ETTINGSHAUSEN; Engelhardt, p.72, pl. 18 (25), fig. 19
1885 *Pterocarya denticulata* (WEBER) HEER; Engelhardt, p. 67, pl. 18 (25), fig. 11
1885 *Pyrus pygmaeorum* UNGER; Engelhardt, p. 72, pl. 17 (24), fig. 13
1885 *Rhamnus gaudinii* HEER; Engelhardt, p. 63, pl. 16 (23), figs 7-8, 14
1885 *Rhus prisca* ETTINGSHAUSEN; Engelhardt, p. 68, (pro parte), pl. 16 (23), figs 9-11
1885 *Rhus pyrrhae* UNGER; Engelhardt, p. 68
1885 *Rhus triphylla* UNGER; Engelhardt, p. 68, pl. 16 (23), fig. 20
1885 *Salix varians* GOEPPERT; Engelhardt, p. 28 (pro parte), pl. 5 (12), figs 7-8
1885 *Salix lavateri* HEER; Engelhardt, p. 29, pl. 5 (12), fig. 9
1885 *Sapindus cassioides* ETTINGSHAUSEN; Engelhardt, p. 55, pl. 12 (19), figs 6-7, 10, pl. 14 (21), figs 13, 16
1885 *Tecoma basellii* ENGELHARDT, p. 40, pl. 9 (16), fig. 13 (holotype)

Description: Leaves longly oval to narrow elongate with cuneate to rounded base and tapered (anomally emarginate) apex, higly variable in size, longly petiolate, petiole to 15 mm long. Size of lamina varies in range of 18-120 mm in length and 10-68 mm in width. Margin very fine and almost regularly dentate, teeth small, with swallen (non-glandular ?) tips, abmedial side concave to straight. Venation distinctly impressed, craspedodrome to semicraspedodrome. Midrib thick, secondaries in up to 10 pairs, subopposite, widely spaced, bent, running towards the margin, entering the teeth, tertiaries obliquely orientated to secondaries, percurrent, side veinlets from the secondaries entering the teeth. Leaf lamina thick, bearing usually coal substance. Cuticle thin. Adaxial epidermis smooth, consisting of polygonal cells 25-32 μm across with straight anticlines. Abaxial epidermis also smooth, ordinary cells polygonal, 17-20 μm across, with sinuous anticlines. Stomata anomocytic to laterocytic, guard cell pairs roundish, rather variable in size, (15-) 20-30 μm wide and (22-) 25-30 (-50) μm long, with largely opened spindle-like aperture and prominent ledges. Rare poly- to quadricellular bases of glandular peltate hairs on veins.

Remarks: *Alnus gaudinii* represents an important riparian element in the Tertiary floras (Knobloch and Kvaček 1976, Mai and Walther 1988, Belz and Mosbrugger 1994). This alder has not been found in such an abundance as at Kundratice in any other volcanic flora. It is a persistent species with stratigraphic span from the Oligocene to the late Pliocene in Central Europe.

Material studied: NHM Wien: Pb 00001 a, Pb 00002, Pb 00025, Pb 00078, Pb 00120, Pb 00121, Pb 00171, Pb 00194, Pb 00280 a, b, Pb 00281, Pb 00282, Pb 00291, Pb 00307, Pb 00310, Pb 00316, Pb 00317, Pb 00324, Pb 00326, Pb 00334, Pb 00335, Pb 00338, Pb 00339, Pb 00351, Pb 00359, Pb 00373, Pb 00376, Pb 00387 a, Pb 00392, Pb 00404, Pb 00427, Pb 00427, Pb 00435.

MMG Dresden: Ku 221 b, Ku 223, Ku 224, Ku 225, Ku 292 a, b, Ku 293, Ku 301 b, Ku 308 a, Ku 318 a, b, Ku 335, Ku 355 a, Ku 357 a, b, Ku 358, Ku 362, Ku 400, Ku 401, Ku 402 a, b, Ku 403 a, b, Ku 404, Ku 405, Ku 406 a, b, Ku 466 a, b, Ku 467, Ku 468 a, b, Ku 502 d, Ku 503 b, Ku 514, 178 specimens without numbers.

NM Praha: G 7, G 8, G 9, G 10, G 11, G 53 - 3, G 54, G 57 - 3, G 84 - 1, G 87, G 95, G 127, G 128, G 130, G 183, G 185, G 186, G 187, G 194, G 204 - 2, G 211, G 212, G 213, G 214, G 216, G 219, G 245 - 1, G 253 - 2, G 766 - 2, G 2104, G 2091, G 5039, G 5049, G 5058, G 5059, G 5086, G 5106, G 5117.

Mus. Litoměřice: ML 41, ML 42, ML 43, ML 44 - 1, ML 47, ML 48, ML 49, ML 50, ML 52, ML 97, ML 166, ML 174, ML 766, ML 177, ML 178, ML 179, ML 180, ML 202, ML 203, ML 223.

Charles Univ. Praha: CKU 72, CKU 125, CKU 72, CKU 125, CKU 219, CKU 220, CKU 222, 70 specimens without numbers.

Cuticular preparations: PRKU 219, PRKU 220.

Alnus kefersteinii (GOEPPERT) GOEPPERT

Pl. 3, figs 5-6, text-fig. 13/6

1885 *Alnus kefersteinii* GOEPPERT; Engelhardt, p. 21, pl. 1 (8), figs 34-36, pl. 2 (9), figs 12-14, 36

1898 *Carpolithes rhoides* MENZEL, p. 12, pl. 1, fig. 24 (holotype)

Remarks: These big infructescences must be identified with *Alnus kefersteinii* and belong obviously to the foliage of *Alnus gaudinii*.

Material studied: NHM Wien: Pb 00036, Pb 00037, Pb 00038, Pb 00039, Pb 00040.

MMG Dresden: Ku 128, Ku 143 a, b, ? Ku 144, Ku 212 b, Ku 240 a, b, Ku 272, Ku 273, Ku 274, Ku 275, Ku 276, Ku 277, Ku 278, Ku 279, Ku 281, Ku 282, Ku 283 a, b, Ku 311, Ku 343, Ku 355 b, Ku 469 a, b, Ku 470.

NM Praha: G 26, G 27, G 28, G 38, G 39, G 2109, G 2110, G 5065 - 1.

Mus. Litoměřice: ML 46, ML 116, ML 117.

Charles Univ. Praha: 2 specimens without numbers.

Alnus sp. (amenta)

Pl. 3, fig. 4

1885 *Alnus kefersteinii* GOEPPERT; Engelhardt, p. 21, pl. 21(28), figs 9-10, 10a, 12

Description: Male inflorescences catkin-like, 25-40 mm long and 3-6 mm wide, longly stalked, stalk to 6 mm long. Details of florets not discernible. Pollen in situ pentaporate with arci.

Remarks: These catkins belong obviously to the foliage of *Alnus gaudinii*. They are easily recognizable by stout stalks.

Material studied: Charles Univ. Praha: CKU 29, CKU 82, CKU 83, CKU 84, CKU 85, CKU 99, CKU 123, CKU 124.

Amenta gen. et sp. div.

1885 *Betula* sp., p. 21, pl. 2 (9), figs 18-20

1885 *Carpinus grandis* UNGER; Engelhardt, p. 25, pl. 4 (11), figs 23-24

1885 *Corylus* sp., Engelhardt, p. 24, pl. 21 (28), fig. 1

1885 *Fraxinus Dioscurorum* UNGER; Engelhardt, p. 37, pl. 21 (28), figs 14-15

1885 *Myrica* sp., Engelhardt, p. 20, pl. 2 (9), figs 10-11, pl. 21 (28), fig. 17

Remarks: Catkins of various form, which cannot be safely determined to a natural genus without study of pollen in situ.

Material studied: MMG Dresden: Ku 159 b, Ku 166, Ku 167, Ku 180, Ku 186, Ku 287, Ku 288 a, b, Ku 289, Ku 372 a, b, Ku 471 a, b, 7 specimens without numbers.

NM Praha: G 18, G 19, G 20, G 39, G 2106, G 2107, G 2108.

Mus. Litoměřice: ML 38, ML 39, ML 113, ML 122 -1, ML 123, ML 125, ML 126.

Charles Univ. Praha: 8 specimens without numbers.

Ampelopsis hibschii BŮŽEK, KVAČEK et WALTHER

Pl. 1, fig. 11, text-fig. 13/32

1885 *Populus mutabilis* HEER; Engelhardt, p. 29, pl. 6 (13), fig. 9

1981 *Ampelopsis hibschii* BŮŽEK, KVAČEK et WALTHER; Bůžek, Kvaček and Walther, p. 127, pls. 1-6, text-figs 1-7

Description: Leaves simple, roundish, irregularly and coarsely dentate. Leaf apex sometimes separated from the rest of the leaf lamina (transition to compound leaf type). Cuticles thin. Adaxial epidermis smooth, compound of polygonal cells 15-40 μm across with straight to slightly wavy anticlines. Solitary stomata near thicker veins, trichomes simple, bent, thin-walled, 50-75 μm long and 15-30 μm wide sparcely on veins. Abaxial epidermis striated, ordinary cells polygonal with straight to slightly wavy anticlines, hardly visible due to striation. Stomata anomocytic, oval, 10-20 μm wide and 16-30 μm long, with thickened ledges and radially striated periphery. Simpe trichomes 15-50 μm wide and 50-160 μm long on veins and leaf margin. (For further information see Bůžek et al. 1981).

Remarks: Typical leaf fossils of this species have been treated separately (Bůžek et al. 1981). There are only few fossils to be added to this record, which are somewhat aberrant, but fit into this accessory element of the Oligocene floras in Central Europe.

Material studied: NHM Wien: Pb 00126.

MMG Dresden: Ku 252 a, b, Ku 475 a, b

Charles Univ. Praha: CKU 410, 5 specimens without number.

Cuticular preparations: PRKU 38-47, 50-55, 410.

Antholithes sp. div.

Pl. 1, fig. 10

1885 *Antholithes coriaceus* ENGELHARDT, p. 83, pl. 21 (28), fig. 43 (holotype)

1885 *Antholithes decheni* ENGELHARDT, p. 83, pl. 21 (28), fig. 47 (syntype)

1885 *Antholithes dentatus* ENGELHARDT, p. 83, pl. 21 (28), fig. 37 (holotype)

1885 *Antholithes haueri* ENGELHARDT, p. 82, pl. 21 (28), figs 20, 21 (syntypes)

1885 *Antholithes lacinatus* HEER var. *major* ENGELHARDT, p. 82, pl. 21 (28), fig. 19 (holotype)

1885 *Antholithes poranoides* ENGELHARDT, p. 83, pl. 21 (28), figs 31, 32 (syntypes)

1885 *Antholithes subglobosus* ENGELHARDT, p. 83, pl. 21 (28), fig. 44 (holotype)

1885 *Acer eupterigium* UNGER; Engelhardt, p. 54, pl. 13 (20), fig. 26

1885 *Borraginites myosotifolius* HEER; Engelhardt, p. 39, pl. 9 (16), fig. 7

1885 *Cinnamomum polymorphum* (A. BRAUN) HEER; Engelhardt, p. 32, pl. 6 (13), fig. 17

1885 *Eucalyptus oceanicus* UNGER; Engelhardt, p. 70
1885 *Melastomites pilosus* ENGELHARDT, p. 70, pl. 21 (28), figs 38-39 (syntypes)
1885 *Melastomites tococaoides* ENGELHARDT, p. 71, pl. 21 (28), figs 40-41 (syntypes)
1885 *Porana ungeri* HEER; Engelhardt, p. 40, pl. 9 (16), fig. 26
1885 *Ulmus minuta* GOEPPERT; Engelhardt, p. 26 (pro parte), pl. 3 (10), fig. 22
1885 *Viburnum atlanticum* ETTINGSHAUSEN; Engelhardt, p. 36, Pl. 8 (15), fig. 15
1898 *Antholithes lageniferus* MENZEL, p. 11, pl. 1, figs 11 a, b (holotype)
1898 *Antholithes myrtaceus* MENZEL, p. 11, pl. 1, figs 10 a, b (holotype)

Remarks: Various fossil flowers require a study of pollen in situ and comparative palynological research. They will be treated in a separate account.

Material studied: NHM Wien: Pb 00162, Pb 00167, Pb 00168, Pb 00170.

MMG Dresden: Ku 132 a, b, Ku 133 a, b, Ku 170, Ku 183, Ku 184 a, b, Ku 185, Ku 186, Ku 187, Ku 188, Ku 189, Ku 436, Ku 437, Ku 438, Ku 439 a, b, Ku 440 b, Ku 441.

NM Praha: G 75, G 88 - 3, G 122, G 191, G 258, G 259, G 260, G 261, G 262, G 276, G 277, G 278, G 315, G 316, G 317, G 318, G 319, G 320, G 321, G 322, G 323, G 324, G 325, G 326, G 327, G 5107.

Mus. Litoměřice: ML 32, ML 36, ML 70 - 1.

Charles Univ. Praha: CKU 249, about 20 specimens without numbers.

Apocynospermum striatum REID et CHANDLER

Pl. 1, fig. 9

Description: Seeds very narrow oval, longitudinally striated, about 20 mm long, with an apical pappus.

Remarks: According to Reid and Chandler (1926) such seeds belong to the family Apocynaceae. Previous authors believed that they would rather suggest an affinity to the Compositae (*Cypselites* spp.). The true affinity is still debatable. Similar remains occur very rarely also in other volcanic floras, e.g. at Suletice-Berand (Kvaček and Walther 1995).

Material studied: Mus. Litoměřice: ML 112.

Charles Univ. Praha: KU 285.

Betula buzekii KVAČEK et WALTHER, sp. n.

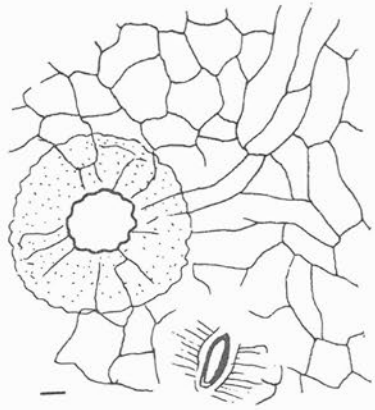
Pl. 3, figs 8-10, text-figs. 5, 13/1

1885 *Aesculus palaeocastanum* ETTINGSHAUSEN; Engelhardt, p. 61, pro parte (non pl. 15, fig. 27)
1885 *Alnus kefersteinii* GOEPPERT; Engelhardt, p. 21, pl. 2 (9), fig. 15
1885 *Betula brongniartii* ETTINGSHAUSEN; Engelhardt, p. 21, pl. 2 (9), figs 21, 25
1885 *Betula dryadum* BRONGNIART; Engelhardt, p. 21, pl. 2 (9), fig. 17
1885 *Carpinus grandis* UNGER; Engelhardt, p. 24 (pro parte), pl. 4 (11), fig. 2

Holotypus: Charles Univ. Praha, CKU 143, pl. 3, fig. 9.

Derivatio nominis: After the Czech palaeobotanist Čestmír Bůžek, who started new excavations on the site of Kundratice.

Locus typicus: Kundratice near Litoměřice, České středohoří Mts.



Text-fig. 5. *Betula buzekii*, sp. n., abaxial cuticle with a peltate gland, PRKU 145/1 (scale bar 10 μm).

Stratum typicum: Volcanic Complex of the České středohoří, Early Oligocene.

Description: Leaves simple, ovate, petiolate, mostly 22-32 mm wide and 37-55 mm long, widely cuneate at the base, slightly apiculate, apex acute. Margin double serrate, teeth triangular, biconvex with extended tips. Venation craspedodrome, midrib straight to slightly bent, secondaries straight, subopposite, in 7-8 pairs. Cuticle medium thick. Abaxial epidermis smooth, compound of polygonal cells 20-30 μm across with straight anticlines. On the midvein simple hair-basis with roundish to oval outline, c. 6 x17 μm in size. Abaxial epidermis more cutinized. Ordinary cells polygonal, variable in size, 12-30 μm across with straight to slightly bent anticlines. Stomata anomocytic (to laterocytic), with periphery on lateral cells radially strongly striate to rugulose. Guard cell pairs narrow elliptic 7-15 μm wide and 17-32 μm long. Aperture spindle-shaped, narrow, reaching almost to the stomatal poles. Rare or sparce roundish remains of peltate glandular hairs c. 75 μm across with polycellular bases, mainly on veinlets. On thicker veins simple hair bases c. 10 μm across.

Remarks: The form and double serrate margin with extended tips suggest affinities with the Betulaceae, particularly *Betula*, and partly to *Ostrya* and *Carpinus*. The latter fossils occurring in the same fossiliferous layer differ in denser secondaries. The epidermal structure well preserved on the described material well corresponds with that of birch. In older literature (e.g. Engelhardt 1885), such birch-like fossils were differentiated into three form-species: *Betula dryadum* BRONGNIART, *B. prisca* ETTINGSHAUSEN and *B. brongniartii* ETTINGSHAUSEN. None of the holotypes connected with the mentioned epithets compares with the material at hand. *B. dryadum* is based on a fruit and the connection with leaves later ascribed to this taxon by Saporta (1865) cannot be proved. *B. prisca* is based on doubtful, poorly preserved material from Arsenal in Vienna, which is not determinable. It may correspond to *B. subpubescens* GOEPPERT (Hummel 1991a). In our opinion, the same applies to *B. brongniartii*. The material from the volcanic flora of Žichov near Bílina (Ettingshausen 1866 - sub *B. brongniartii*) is better comparable with *B. buzekii*, but differs by more delicately dissected marginal teeth. Leaf forms that have been also assigned to *B. brongniartii* from the Miocene (Ettingshausen 1866, pl. 14, fig. 13, Belz and Mosbrugger 1994,

pl. 5, fig. 3, pl. 10, fig. 5b, text-fig. 32-35) belong in fact to *Alnus menzelii* RANIECKA-BOBROWSKA (1954).

Among the material identified by Engelhardt (1885) as *Aesculus palaeocastanum*, unfigured specimens partly belong to *B. buzekii*, while the figured one (Engelhardt 1885, pl. 15, fig. 27) represents a leaflet of *Carya serrifolia* (GOEPPERT) KRÄUSEL (see p. 11). The differentiation between the foliage of *Betula* and *Alnus* based only on the leaf morphology is an uneasy task (e.g. Knobloch and Kvaček 1976, Hummel 1991b, Zastawniak and Walther, in press). Birch leaf fossils occur also but rarely in other volcanic floras, e.g. Seifhennersdorf (Mai 1963, Walther 1964) or Kleinsaubernitz (Walther, in press).

Material studied: NHM Wien: Pb 00030, Pb 00311.

MMG Dresden: Ku 284, Ku 285 a, b, 5 specimens without numbers.

NM Praha: G 23, G 25, G 32, G 5064.

Charles Univ. Praha: CKU 74a, CKU 227, CKU 142, CKU 143 (HOLO), CKU 144, CKU 145, CKU 215, CKU 227, 12 specimens without numbers.

Cuticular preparations: PRKU 143 (HOLO), 145, 215, 227.

Betula sp. (fructi)

Pl. 3, fig. 7

1885 *Betula dryadum* BRONGNIART; Engelhardt, p. 21, pl. 2 (9), fig. 23
1885 *Betula* sp. Engelhardt, p. 21, pl. 2, (9), fig. 24
1885 *Diachaenites microspermus* ENGELHARDT, p. 45, pl. 10 (17), fig. 8 (holotype)

Remarks: Winged fruits, which are safely assignable to *Betula*, occur but very rarely at Kundratice. Due to poor preservation, more precise determination is impossible.

Material studied: MMG Dresden: Ku 519.

NM Praha: G 21, G 22, G 24, G 218 - 2, G 279.

Charles Univ. Praha: CKU 281, CKU 282, CKU 283.

Bryophyta gen. et sp.

Pl. 3, fig. 11

1885 *Hypnum heppii* HEER; Engelhardt, p. 15
1885 *Hypnum* sp., Engelhardt, p. 15

Remarks: Bryophyte remains occur but rarely in the fossiliferous shales in the form of impressions. Due to the delicate nature of these remains, critical characters are not preserved (venation and cell structure of phylloids), the remains are all sterile. Such conditions prevent an exact determination.

Material studied:NHM Wien: Pb 00005, Pb 00442.

MMG Dresden: Ku 519.

NM Praha: G 2078, G 2079, G 2097, G 5072.

Charles Univ. Praha: CKU 286.

Carpinus grandis UNGER

Pl. 4, fig. 16, text-fig. 13/2

1885 *Carpinus grandis* UNGER; Engelhardt, p. 24 (pro parte), pl. 3 (10), figs 30-31, pl. 4 (11), fig 6
1885 *Carpinus pyramidalis* GAUDIN; Engelhardt, p. 25, pl. 4 (11), figs 9, ? 10
1885 *Alnus kefersteinii* GOEPPERT; Engelhardt, p. 21, pl. 2 (9), fig. 16
1885 *Betula brongniartii* ETTINGSHAUSEN; Engelhardt, p. 21
1885 *Ulmus bronnii* UNGER; Engelhardt, p. 25
1885 *Ulmus minuta* GOEPPERT; Engelhardt, p. 26, pl. 3 (10), fig. 21
1885 *Ulmus plurinervia* UNGER [and *Sphaeria glomerata* ENGELHARDT (holotype)]; Engelhardt, p. 14, 25, pl. 1 (8), fig. 4

Description: Leaves oval to oblong-oval, 23-55 mm long and 12-23 mm wide, short petiolate, apex short apiculate, base rounded to slightly cordate, margin indistinctly double serrate, teeth fine, with blunt, rarely elogate tip, slightly biconvex. Venation craspedodrome, midrib thick, secondaries dense, in c. 8-12 pairs, straight into the main teeth running, sending at the margin abmedial veinlets into the secondary teeth. Intersecondaries lacking, tertiaries percurrent, rarely forked, perpendicular to slightly oblique to the secondaries.

Remarks: *Carpinus grandis* UNGER represents a formal aggregate unit (see e.g. Mai and Walther 1978, 1991). Due to uniform leaf morphology among species in *Carpinus*, its differentiation according to gross morphological and leaf anatomical characters is not possible, while carpological records allow to recognize several natural species (Mai 1981, 1995). The leaf remains at hand differ in overall outline and smaller size from those occurring at Seifhennerdorf (Mai 1963, Walther 1964). Smaller leaves were interpreted as juvenile foliage, but we assume now that they were blown by wind from the top of the trees into the sediment (Ferguson 1985). Hornbeam foliage is far less frequent at Kundratice than at Seifhennersdorf.

Material studied: NHM Wien: Pb 00027, Pb 00028, Pb 00029, Pb 00030, Pb 00034, Pb 00035, Pb 00041, Pb 00042, Pb 00063, Pb 00075, Pb 00079, Pb 00080, Pb 00095, Pb 00096, Pb 00102.

MMG Dresden: Ku 212 a, Ku 235 a, Ku 239, Ku 241, Ku 242, Ku 243, Ku 244, Ku 298, Ku 370, Ku 422 a, b, Ku 423, Ku 425, Ku 426, Ku 427 a, b, Ku 503 b, 26 specimens without numbers.

NM Praha: G 33, G 34, G 35, G 36, G 37, G 38, G 40, G 41.

Mus. Litoměřice: ML 143 - 1

Charles Univ. Praha: CKU 212, CKU 213, 12 specimens without numbers.

Carpinus mediomontana MAI

Pl. 4, fig. 15

Description: Involucra simple, on one side entire, on the other side slightly coarsely toothed, small, c. 10 mm long (immature ?).

Remarks: The remains are well comparable with those from the type locality Haselbach (Mai and Walther 1978).

Material studied: MMG Dresden: Ku 159 a, Ku 202 a, Ku 416.

Carpolithes sp. (cf. ***Palaeohosiaea*** sp.)

Pl. 9, fig. 7

Remarks: One flattened endocarp, oval in outline, 19 mm long and 10 mm wide, bears on its surface indistinct coarse network of meshes. It might show the inner side of an endocarp of the Icacinaceae, known e.g. from the flora of Suletice (Kvaček and Bůžek 1995).

Material studied: Mus. Litoměřice: ML 114.

Carya serrifolia (GOEPPERT) KRÄUSEL

Pl. 4, fig. 5, text-fig. 13/40

1885 *Aesculus palaeocastanum* ETTINGSHAUSEN; Engelhardt, p. 61, pl. 15 (22), fig. 27
1885 *Callicoma bohemica* ETTINGSHAUSEN; Engelhardt, p. 48, pl. 10 (17), fig. 32 (syntype)
1885 *Callicoma media* ENGELHARDT, p. 48, pl. 10 (17), fig. 21 (holotype)
1885 *Carpinus grandis* UNGER; Engelhardt, p. 24 (pro parte)
1885 *Carya elaenoides* UNGER; Engelhardt, p. 67 (pro parte)
1885 *Juglans bilinica* UNGER; Engelhardt, p. 64 (pro parte)
1885 *Juglans palaeoporcina* ENGELHARDT, p. 66, pl. 17 (24), fig. 5 (holotype)
1885 ? *Juglans rectinervis* ETTINGSHAUSEN; Engelhardt, p. 66, pl. 17 (24), fig 10
1885 *Planera ungeri* (KOVATS) ETTINGSHAUSEN; Engelhardt, p. 25 (pro parte), pl. 4 (11), fig. 27
1885 *Pterocarya denticulata* (WEBER) HEER; Engelhardt, p. 67 (pro parte), pl. 17 (24), fig. 8
1885 *Quercus reussii* ETTINGSHAUSEN; Engelhardt, p. 23

Description: Leaflets asymmetric, elongate, up to 75 mm long and 20-30 mm wide, sharply serrate on margin, base asymmetric widely cuneate. Venation craspedodrome, midrib thick, slightly bent, secondaries subopposite, at 40-54° to the midrib, more times forked near the margin. Other details corresponding to the characteristics in Walther (1974). No cuticular structure remained preserved.

Remarks: This thermophile deciduous taxon, which occurs so abundantly at Seifhennersdorf, is represented at Kundratice (like *Carpinus grandis*) less frequently.

Material studied: NHM Wien: Pb 00051, Pb 00088, Pb 00101 a, Pb 00196, Pb 00321, Pb 00326, Pb 00340.

MMG Dresden: Ku 265, Ku 296 b, Ku 302 a, b, Ku 315, Ku 325, Ku 363, Ku 364, Ku 504, Ku 507.

NM Praha: G 15, G 17, G 84 - 1, G 112, G 124 - 2, G 5050.

Mus. Litoměřice : ML 53, ML 98, ML 211, ML 212, ML 213, ML 214.

Charles Univ. Praha: CKU 158, 5 specimens without numbers.

Carya sp. (amenta)

Pl. 4, fig. 7

Remarks: Inflorescences catkin-like, fragmentary, 45 mm long and 4 mm wide, shortly stalked. Details of the flower arrangement not recognizable. Pollen in situ of the *Carya*-type.

Material studied: Charles Univ. Praha, CKU 1, CKU 87.

cf. *Carya costata* (STERNBERG) BRONGNIART

Pl. 4, fig. 6

Description: Impression of an endocarp, rounded in outline, 30 mm across. No further morphological details preserved.

Remarks: One of the rare fruit remains corresponds to a completely flattened endocarp. By its size it recalls the fruit of *Carya*, but nothing from the inner structure has been preserved. It may correspond with the foliage of *Carya serrifolia*, described above. Similar but better preserved remains have been described in Seifhennersdorf (Mai 1963).

Material studied: MMG Dresden: Ku 296 a.

Celtis sp.

Pl. 4, fig. 8, text-fig. 13/25

1885 *Sterculia deperdita* ETTINGSHAUSEN; Engelhardt, p. 51, pl. 11 (18), fig. 15

Description: Leaves ovate, slightly asymmetric, up to 64 mm long and 35 mm wide, on the base asymmetric, rounded, finely teethed on the margin. Venation semicraspedodrome, two basal veins acrodrome, subopposite, partly starting beneath the leaf base, higher secondaries alternate, under narrow angles. Tertiaries perpendicular to secondaries.

Remarks: *Celtis* leaves occur but rarely in the European Oligocene (e.g. at Seifhennersdorf, Walther 1996, Kleinsaubernitz, Walther in press). Their specific relations need some clarification.

Material studied: MMG Dresden: Ku 510,

NM Praha: G 229 - 1.

Charles Univ. Praha: CKU 232, 1 specimen without number.

Cephalotaxus parvifolia (WALTHER) comb. n.

Pl. 4, figs 1-3

1964 *Amentotaxus parvifolia* WALTHER, Jb. Staatl. Mus. Mineral. Geol. 1964, p. 8, pl. 1, figs 1-5 (Seifhennersdorf) (basionym)
1984 "*Amentotaxus*" *parvifolia* WALTHER; Kvaček, p. 484, fig. 9 a-g
1996 *Cephalotaxus* sp., Walther, p. 16 (Seifhennersdorf)

Description: Leaves lineal, flattened, univeined, up to 17 mm long and 2-2.5 mm wide, cuneate at base and blunt at the apex, entire-margined. Abaxial (upper) epidermis without stomata, composed of fairly regular quadrangular isometric to slightly elongate cells in longitudinal rows, adaxial (lower) epidermis with two lateral and one medial non-stomatal zones composed of similar cells as those in abaxial side, and two stomatal bands, containing longitudinally arranged stomata partly densely, partly widely spaced, in irregular closely set rows. Stomata inconspicuous, incompletely amphicyclic, mostly with two polar and two lateral cells and quadrangular elongate stomatal pit. Cells outside stomatal zones at the apex inconspicuously papillate or with cutine ridges (for more detail see Kvaček 1984).

Remarks: According to the kind of papillate area and to the stomatal type, this foliage must be transferred to *Cephalotaxus* (see also Walther in Ferguson et al. 1978), although it deviates from all so far known species in the average leaf size. It only occurs very rarely at Seifhennersdorf and Kundratice.

Material studied: NM Praha: G 7576

Charles Univ. Praha: CKU 10, CKU 24, CKU 68, CKU 315.

Cuticular preparations: PRKU 10, PRKU 24, PRKU 68, PRKU 315.

Cercidiphyllum crenatum (UNGER) R. BROWN

Pl. 4, figs 10-14, text-fig. 13/29

1885 *Elaphrium antiquum* UNGER; Engelhardt, p. 69, pl. 17 (24), fig. 23 (fructus)
1885 *Embothrium leptospermon* ETTINGSHAUSEN; Engelhardt, p. 35, pl. 6 (13), fig. 8 (semen)
1885 *Ficus tiliaefolia* A. BRAUN; Engelhardt, p. 27
1885 *Ficus asarifolia* ETTINGSHAUSEN; Engelhardt, p. 26, pl. 4 (11), fig. 32, 34

1885 *Grewia crenata* UNGER; Engelhardt, p. 51, pl. 10 (17), figs 33-35, pl. 11 (18), figs 20, 24, pl. 12 (19), figs 1-4
1885 *Smilax reticulata* HEER; Engelhardt, p. 16, pl. 1 (8), fig. 21
1978 *Cercidiphyllum crenatum* (UNGER) BROWN; Bůžek, Kvaček and Walther, p. 356, pl. 3, fig. 2

Description: Leaves dimorph, 40-50 mm long and 25-40 mm wide, mostly rounded cordate, apex almost indistinct, rarely widely ovate with blunt apex and rounded base; transitions between those extreme forms rare. Leaves longly petiolate, petiole up to 20 mm long. Margin glandular crenulate. Venation actinodrome-brochidodrome. 3-5 (-7) basal primaries starting from the very leaf base, secondaries rare, forming loops along the margin, tertiaries oblique. Fruits in clusters of 2-4 or isolated, follicles spindle-like, bluntly pointed. Dispersed seeds oval, hardly 1 mm long, with an asymmetric triangular wing.

Remarks: The above described leaf forms match well the other records, also in the dimorphy, like in the modern *Cercidiphyllum* SIEB. et ZUCC. (see Jähnichen et al.1980, Kvaček and Konzalová 1996). In contrast to the locality Seifhennersdorf, this element occurs more frequently at Kundratice.

Material studied: NHM Wien: Pb 00107, Pb 00111 a, Pb 00115, Pb 00127, Pb 00197, Pb 00198, Pb 00199, Pb 00201, Pb 00202, Pb 00203, Pb 00204, Pb 00205, Pb 00206.

MMG Dresden: Ku 181 a, b, Ku 182 a, b, Ku 196 d, Ku 339 a b, Ku 340, Ku 341, Ku 375 a, b, Ku 487, Ku 488, Ku 489, 16 specimens without numbers

NM Praha: G 85, G 171, G 172, G 177, G 222, G 223, G 224, G 225, G 226, G 227 - 1, G 2090 - 1, G 4640, G 5110.

Mus. Litoměřice: ML 35, ML 158.

Charles Univ. Praha: CKU 168, CKU 169, CKU 193, CKU 279, CKU 280.

Cornus studeri HEER

Pl. 4, fig. 9, text-figs 6, 13/31

1885 *Cornus paucinervis* ENGELHARDT, p. 47, pl. 10 (17), fig. 30 (holotype)
1885 *Elaeagnus acuminata* WEBER; Engelhardt, p. 35, pl. 8 (15), fig. 32
1885 *Juglans acuminata* A. BRAUN; Engelhardt, p. 67 (pro parte)
1885 *Rhamnus decheni* WEBER; Engelhardt, p. 67, pl. 16 (23), fig. 17
1885 *Rhamnus graefii* HEER; Engelhardt, p. 63, pl. 16 (23), fig. 13
1885 *Rhamnus eridani* UNGER; Engelhardt, p. 63, pl. 16 (23), fig. 16

Text-fig. 6. *Cornus studeri* HEER, abaxial cuticle, PRKU 307/1 (scale bar 10 μm).

Description: Leaves ovate-oval, entire-margined, apex blunt, base rounded, slightly decurrent, petiolate, petiole up to 15 mm long. Venation acrodrome, midrib thin, secondaries bent, in up to 4 pairs, alternate, convergent in the upper part of the leaf towards apex. Lamina thin. Abaxial cuticle slightly striated, showing poor structure - sparce simple hair-bases on veins, oval outlines of stomata 10-12 μm wide and 20-25 μm long.

Remarks: This species occurs only rarely at Bechlejovice, Suletice-Berand, Hrazený and Seifhennersdorf. Its position within the Cornaceae remains uncertain.

Material studied: NHM Wien: Pb 00185 a, Pb 00315, Pb 00320, Pb 00343, Pb00345.

MMG Dresden: Ku 474 (diatomite), Ku 518.

NM Praha: G 14 - 1, G 282, G 283, G 306 - 2, G 5055, G 5112 - 2.

Mus. Litoměřice: ML 60, ML 160.

Charles Univ.: CKU 149, 5 specimens without numbers.

Cuticular preparation: PRKU 307

Craigia bronnii (UNGER) KVAČEK, BŮŽEK et MANCHESTER

Pl. 5, fig. 2, text-fig. 13/14

1885 *Ulmus bronnii* UNGER; Engelhardt, p. 25, pl. 3 (10), figs 10-14
1978 *Pteleaecarpum europaeum* (BRONN) BŮŽEK et KNOBLOCH; Bůžek, Kvaček and Walther, p. 356, pl. 3, fig. 10

Remarks: Typical of all Oligocene volcanic floras in Central Europe, these characteristic fruit valves, partly with attached, serially arranged seeds occur in Kundratice quite frequently, but always isolated. The foliage of *Dombeyopsis lobata* UNGER is assumed to belong to the same plant (Kvaček 1993). For details see Bůžek et al. (1989) - as *Pteleaecarpum bronnii* (UNGER) WEYLAND, and Kvaček et al. (1991).

Material studied: NHM Wien: Pb 00087, Pb 00089, Pb 00090 a, Pb 00097, Pb 00104, Pb 00106.

MMG Dresden: Ku 144, Ku 145, Ku 146, Ku 147, Ku 148, Ku 149 a, b, Ku 150, Ku 204 b, Ku 246, Ku 247, Ku 248, Ku 249, Ku 306, Ku 368 (diatomite), 18 specimens without numbers.

NM Praha: G 63, G 64, G 5056, G 5112 - 3, G 5068.

Mus. Litoměřice: ML 226.

Charles Univ. Praha: about 20 specimens without numbers.

cf. *Crataegus* sp.

Pl. 5, fig. 3

Description: Leaves widely oval, 10- c. 30 mm long, shortly petiolate, widely cuneate at base, slightly asymmetric, apex blunt, lamina on either side with one inconspicuous lobe, margin irregularly crenulate-dentate. Venation craspedodrome, subbasal secondaries subopposite, higher secondaries alternate, widely spaced, occasionally with intersecondaries.

Remarks: Such isolated leaves occur very rarely in volcanic floras, e.g. at Hrazený (*Crataegus pirskenbergensis* KNOBLOCH 1961) and now at Kundratice. They recall in morphology the foliage of *Crataegus* L. but the affinity is equivocal.

Material studied: MMG Dresden: Ku 297.

Charles Univ. Praha: CKU 229.

cf. ***Cyclocarya cyclocarpa*** (SCHLECHTENDAL) KNOBLOCH

Pl. 5, fig. 4

1885 *Betula brongniartii* ETTINGSHAUSEN; Engelhardt, p. 21 (pro parte)
1885 *Callicoma media* ENGELHARDT, p. 48
1885 *Callicoma microphylla* ETTINGSHAUSEN; Engelhardt, p. 48, pl. 10 (17), fig. 25
1885 *Carpinus grandis* UNGER; Engelhardt, p. 24 (pro parte), pl. 4 (11), fig. 11
1885 *Elaeodendron dubium* ETTINGSHAUSEN; Engelhardt, p. 60, pl. 15 (22), fig. 5

Description: Leaflets oval-lanceolate, up to more than 100 mm long and 31 mm wide, slightly asymmetric, base rounded, only in terminal leaflets symmetric, apex longly acuminate, margin irregularly serrate. Venation craspedodrome (to inconspicuously semicraspedodrome), midrib thick, usually slightly bent, secondaries subopposite, mostly in 20 pairs.

Remarks: These scanty remains match well the analogous fossils from Seifhennersdorf (Mai 1963, Walther 1964) and from the former mine Bockwitz near Borna, identified as *Cyclocarya cyclocarpa* (Mai and Walther 1991).

Material studied: NHM Wien: Pb 00033, Pb 00065.
MMG Dresden: Ku 215 b.
NM Praha: G 70, G 71, G 210, G 5118.
Mus. Litoměřice: ML 22.1, ML 25, ML 29, ML 62, ML 84, ML 11, ML 121, ML 134, ML 138, ML 139, ML 151, ML 209.
Charles Univ. Praha: CKU 74b, CKU 159, CKU 221, 9 specimens without numbers.

Daphnogene cinnamomifolia (BRONGNIART) UNGER
forma ***cinnamomifolia***

Pl. 5, fig. 5

1885 *Cinnamomum scheuchzeri* HEER; Engelhardt, p. 32 (pro parte)
1885 *Cinnamomum polymorphum* A. BRAUN; Engelhardt, p. 32, pl. 7 (14), fig. 11
1885 *Cinnamomum rossmässleri* HEER; Engelhardt, p. 31, pl. 7 (14), fig. 8
1885 *Litsea deichmuelleri* ENGELHARDT, p. 34, pl. 8 (15), fig. 5 (holotype)
? 1885 *Populus mutabilis* HEER; Engelhardt, p. 29, pl. 6 (13), fig. 21
1885 *Strychnos europaea* ETTINGSHAUSEN; Engelhardt, p. 38, pl. 6 (13), fig. 3
1885 *Quercus artocarpites* ETTINGSHAUSEN; Engelhardt, p. 23 (pro parte)

Description: Leaves oval to widely oval, entire-margined, petiolate, petiole fragmentary preserved, apex acuminate, partly elongate, base widely cuneate. Venation brochidodrome-acrodrome, similar to the form *lanceolata*, lamina thin.

Remarks: This large form represents shade-leaves of this in the Oligocene widely distributed species, which cannot be maintained along with *Daphnogene lanceolata* as an independent form-species, as suggested by Kvaček and Walther (1974). Much logical is to merge these former form-taxa (*D. cinnamomifolia* and *D. lanceolata*) into a single species with two forms. The oldest epitheton "*cinnamomifolia*" has priority and should be employed for the name of this species (see Kvaček and Walther 1995). Both forms are connected with transitions and their limits are difficult to assess.

Material studied: NHM Wien: Pb 00131, Pb 00141.
MMG Dresden: Ku 500 a, b, 2 specimens without numbers.
NM Praha: G 2 - 2, G 306 - 1, G 769, G 2101, G 4642, G 4696.
Mus. Litoměřice: ML 59, ML 66, ML 197, ML 198.
Charles Univ. Praha: CKU 65, CKU 163, 7 specimens without numbers.

Daphnogene cinnamomifolia (BRONGNIART) UNGER
forma ***lanceolata*** (UNGER) stat. n.

Pl. 5, figs 6-7, text-fig. 13/8

1850a *Daphnogene lanceolata* UNGER, Genera et species, p. 424 (Socka) (basionym)
1850b *Daphnogene lanceolata* UNGER; Unger, p. 167, pl. 34, figs 1-7 (Socka)
1885 *Acacia sotzkiana* UNGER; Engelhardt, p. 81 (pro parte)
1885 *Cassia ambigua* UNGER; Engelhardt, p. 78, pl. 20 (27), fig. 18
1885 *Cassia pseudoglandulosa* ETTINGSHAUSEN; Engelhardt, p. 79, pl. 20 (17), fig. 23
1885 *Cinnamomum lanceolatum* UNGER; Engelhardt, p. 33, pl. 7 (14), figs 6, 17-22, 25, pl. 8 (15), figs 3, 6, 12-13
1885 *Cinnamomum scheuchzeri* HEER; Engelhardt, p. 38, pl. 5 (12), figs 15-16, 18-19, 21, pl. 6 (13), fig. 11-12, pl. 7 (14), figs 1, 9, 14, 16, 26
1885 *Cinnamomum* sp., Engelhardt, in sched.
1885 *Celastrus elaenus* UNGER; Engelhardt, p. 58, pl. 11 (18), fig. 26
1885 *Daphnogene ungeri* HEER; Engelhardt, p. 33, pl. 8 (15), figs 8-10
1885 *Eucalyptus oceanica* UNGER; Engelhardt, p. 70, pl. 18 (15), figs 20, 23-24
1885 *Eugenia haeringiana* UNGER; Engelhardt, p. 70, pl. 18 (25), fig. 14
1885 *Litsea dermatophyllum* (ETTINGSHAUSEN) ETTINGSHAUSEN; Engelhardt, p. 33, pl. 7 (14), fig. 24
1885 *Loranthus palaeo-eucalypta* ETTINGSHAUSEN; Engelhardt, p. 47
1885 *Oxylobium miocenicum* ETTINGSHAUSEN; Engelhardt, p. 73, pl. 19 (26), fig. 17
1885 *Sapotacites minor* UNGER; Engelhardt, p. 42, pl. 8 (15), fig. 33
1887 *Zyzyphus ovatus* WEBER; Menzel, p. 10, pl. 1, fig. 7
1978 *Daphnogene lanceolata* UNGER; Bůžek, Kvaček and Walther, p. 356, pl. 3, fig. 3 right.

Description: Leaves lanceolate, in extreme cases lineal-lanceolate or oval-lanceolate, 30-100 mm long and 6-24 mm wide, on the twigs alternate, entire-margined, petiolate, petiole up to 10 mm long, apex blut to narrow elongate, base cuneate. Venation camptodrome-acrodrome, midrib thick, subbasal secondaries reaching nearly to the apex, rarely to the middle of the leaf length, alternate, starting at various distance from the leaf base (see also Mai and Walther 1978), higher secondaries much thinner, rarely starting under the half of the leaf length, tertiaries perpendicular between the midrib and the secondaries, side veinlets looping from the secondaries towards the margin. Cuticle medium thick. Adaxial epidermis consisting of polygonal cells with straight anticlines showing small thickenings. Abaxial epidermis with sparce simple hair bases. Stomata paracytic, stomatal complexes roundish, with a small aperture in the centre. Lense-shaped oil cells common.

Remarks: This form representing sun leaves prevails not only at Kundratice, but also in other volcanic floras, e.g. in tuffites near Valeč in the Doupovské hory Mts. and Hammerunterwiesenthal (Walther 1998).

Material studied: NHM Wien: Pb 00046, Pb 00082 b, Pb 00132, Pb 00133, Pb 00134, Pb 00137, Pb 00138, Pb 00139, Pb 00140, Pb 00142, Pb 00143, Pb 00144, Pb 00145, Pb 00146, Pb 00147, Pb 00149, Pb 00150, Pb 00151, Pb 00152, Pb 00153, Pb 00154, Pb 00155, Pb 00156, Pb 00157, Pb 00179, PB 00181, Pb 00189, Pb 00286, Pb 00365, Pb 00372, Pb 00366, Pb 00378, Pb 00406 b Pb 00427, Pb 00428, Pb 00430, Pb 00436, Pb 00452.

MMG Dresden: Ku 135, Ku 204 a, Ku 222, Ku 237, Ku 238, Ku 301 a, Ku 308 b, Ku 374, Ku 440 a, Ku 498, Ku 499, Ku 501 a, b, 315 specimens without numbers.

NM Praha: G 96, G 97, G 98, G 99, G 100, G 101, G 102, G 103, G 104, G 107, G 108, G 109, G 110, G 115, G 124, G 125, G 126, G 163, G 249 - 2, G 267, G 268, G 576, G 577, G 578, G 579, G 762, G 763, G 764, G 765, G 771, G 772, G 773, G 774, G 776 - 1, G 5047, G 5047, G 5895.

Mus. Litoměřice: ML 65, ML 70, ML 96 - 2, ML 131, ML 132, ML 199, Ml 200, ML 201.

Charles Univ. Praha: CKU 78, CKU 161, CKU 162, CKU 298, 81 specimens without numbers.

Cuticular preparations: PRKU 298.

Dicotylophyllum deichmuelleri sp. n.

Pl. 6, figs 7-12, text-fig. 13/37

1985 *Amygdalus pereger* UNGER; Engelhardt, p. 71 (pro parte)
1885 *Cassia berenices* UNGER; Engelhardt, p. 78 (pro parte), pl. 20 (27), fig. 13
1885 *Celastrus andromedae* UNGER; Engelhardt, p. 57, pl. 14 (21), fig. 24 (?)- 25
1885 *Celastrus cassinefolia* UNGER; Engelhardt, p. 57, pl. 14 (21), figs 10-12
1885 *Celastrus lucinae* ETTINGSHAUSEN; Engelhardt, p. 68, pl. 14 (21), fig. 19, pl. 15 (22), fig. 1
1885 *Celastrus oxyphyllus* UNGER; Engelhardt, p. 52, pl. 11 (18), fig. 16
1885 *Crataegus teutonica* UNGER; Engelhardt, p. 72, pl. 19 (26), fig. 8
1885 *Elaeocarpus europaeus* ETINGSHAUSEN; Engelhardt, p. 52, pl. 12 (29), fig. 8
1885 *Euonymus phithiae* UNGER; Engelhardt, p. 59, pl. 15 (22), fig. 13
1885 *Ilex sinularis* UNGER; Engelhardt, p. 61, pl. 15 (22), fig. 6
1885 *Ilex stenophylla* UNGER; Engelhardt, p. 61, pl. 15 (22), fig. 33
?1885 *Palaeolobium haeringianum* UNGER; Engelhardt, p.74 (pro parte), pl. 19 (26), fig. 1
1885 *Pterocarya denticulata* (WEBER) HEER; Engelhardt, p. 67 (pro parte), pl. 17 (24), fig. 12
1885 *Rhus elaeodendroides* UNGER; Engelhardt, p. 68, pl. 18 (25), figs 8-9
1885 *Rhus pyrrhae* UNGER; Engelhardt, p. 68 (pro parte), pl. 16 (23), figs 25, 27, pl. 17 (24), fig. 18
1885 *Ulmus bronnii* UNGER; Engelhardt, p. 25 (pro parte), pl. 4 (11), fig. 25
1885 *Ulmus minuta* GOEPPERT; Engelhardt, p. 26 (pro parte)
1885 *Zanthoxylon serratum* HEER; Engelhardt, p. 69, pl. 17 (24), fig. 17
1976 "*Viburnum*" *atlanticum* ETTINGSHAUSEN 1868; Bůžek, Holý and Kvaček, p. 110, pl. 14, figs 5-6, pl. 20, figs 2-4
1995 "*Elaeodendron* " sp.; Kvaček and Walther, p. 33, pl. 8, fig. 4, (Suletice-Berand)

Holotypus: Charles Univ. Praha, CKU 136, pl. 6, fig.12, preparation PRKU 136

Derivatio nominis: After the custodian of the museum in Dresden, Prof. J. V. Deichmüller.

Locus typicus: Kundratice, České středohoří Mts.

Stratum typicum: Volcanic complex of the České středohoří Mts., Early Oligocene.

Description: Leaves oval to oval-lanceolate, 23-60 mm long and 8-22 mm wide, petiolate, petiole thick and short, apex blunt, base cuneate to rounded, margin simple crenulate-toothed, probably glandular. Venation semicraspedodrome, midrib thick, straight, secondaries direct, densely spaced, at wider angles, at the margin twice forked or in two thirds of the length directed towards the apex, forked ends looping or joining the margin near the teeth notches, intersecondaries rare, tertiaries joined into network of elongate meshes, texture of lamina coriaceous. Cuticle medium thick. Adaxial epidermis smooth, compound of polygonal cells 10-27 μm across, with lense-shaped thickenings on slightly wavy anticlines. Abaxial epidermis compound of ordinary polygonal cells c. 20 μm across with undulate smooth anticlines. Stomata brachyparacytic with wide subsidiary cells and elliptic guard cell pairs 15-17 μm wide and 17-20 μm long. Aperture roundish, short. No pubescence observed.

Remarks: This species is characteristic of the volcanic floras in České středohoří Mts. (Kundratice, Bechlejovice, Markvartice, Suletice-Berand). In leaf morphology it recalls the Theaceae but the type of paracytic stomata deviates from the most of the members except *Stewartia* L. and *Hartia* DUNN (Kvaček and Walther 1984a). In spite of characteristic leaf form and epidermal structure the affinities have not been clarified.

Material studied: NHM Wien: Pb 00201, Pb 00278, Pb 00280, Pb 00289, Pb 00292, Pb 00295, Pb 00312, Pb 00350, Pb 00357, Pb 00362 Pb 00382, Pb 00385, Pb 00407, Pb 00411, Pb 00429c.

MMG Dresden: Ku 177, Ku 190, Ku 191, Ku 192, Ku 329, Ku 371, Ku 376 b, b', Ku 377, Ku 378, Ku 379, Ku 380, Ku 381, Ku 448, Ku 449, Ku 450, Ku 451, Ku 452, (diatomite), Ku 453, Ku 508 c, 26 specimens wihout numbers.

NM Praha: G 106 - 2, G 150, G 188, G 189, G 190, G 192, G 198, G 199, G 200, G 4639, G 4649, G 5045, G 5048.

Mus. Litoměřice: ML 74, ML 90, ML 91, ML 155, ML 157, ML 173, ML 175, ML 207, Ml 208 - 2.

Charles Univ. Praha: CKU 80, CKU 136 (holotype), CKU 185, CKU 186, CKU 187, CKU 188, CKU 189, CKU 190, CKU 191, CKU 192, 29 specimens without numbers.

Cuticular preparations: PRKU 136, 191.

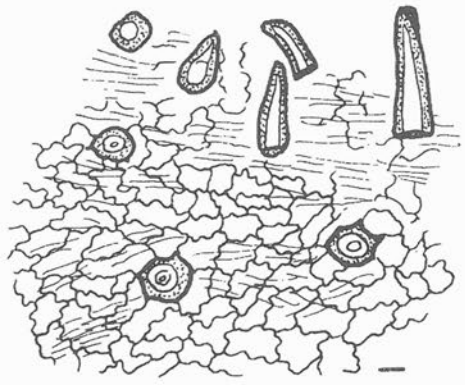
Dicotylophyllum heeri (ENGELHARDT) comb. n.

Pl. 6, figs 3-6, text-figs 7-8, 13/28

1885 *Euonymus heeri* ENGELHARDT, Nova Acta Leopold. Carol. Acad., 48, p. 59, pl. 15 (22), fig. 3 (basionym, holotype)
1885 *Ardisia myricoides* ETTINGSHAUSEN; Engelhardt, p. 42, pl. 9 (16), figs 14-15
1885 *Celastrus dubius* UNGER; Engelhardt, p. 56, pl. 14 (21), fig. 26
1885 *Elaeodendron degener* UNGER; Engelhardt, p. 60 (pro parte), pl. 15 (22), figs 17, 19-24, 30-31
1885 *Euonymus napaearum* ETTINGSHAUSEN; Engelhardt, p. 59
1885 *Icacorea primaeva* ETTINGSHAUSEN; Engelhardt, p. 42, pl. 9 (16), fig. 19
1885 *Juglans bilinica* UNGER; Engelhardt, p. 65, pl. 17 (24), fig. 3
1885 *Juglans vetusta* HEER; Engelhardt, p. 66, pl. 17 (24), fig. 11
1885 *Machaerium palaeogaeum* ETTINGSHAUSEN; Engelhardt, p. 78, pl. 19 (26), fig. 45
1885 *Prunus olympica* ETTINGSHAUSEN; Engelhardt, p. 72, pl. 18 (25), fig. 1

1885 *Rhus pyrrhae* UNGER; Engelhardt, p. 68 (pro parte)
1885 *Samyda borealis* UNGER; Engelhardt, p. 50, pl. 11 (18), fig. 12
1885 *Samyda tenera* UNGER; Engelhardt, p. 50, pl. 11 (18), fig. 8
1885 *Sapindophyllum falcatum* ETTINGSHAUSEN; Engelhardt, p. 56, pl. 14 (21), fig. 22
1885 *Symplocos radobojana* UNGER; Engelhardt, p. 44, pl. 10 (17), fig. 5
1885 *Ternstroemia bilinica* ETTINGSHAUSEN; Engelhardt, p. 52, pl. 12 (19), fig. 12, pl. 15 (22), fig. 29

Description: Leaves elongate-oval, rarely oval, 30-90 mm long and 12-24 mm wide, petiolate, petiole up to 15 mm long, apex blunt acute, base rounded, margin regularly finely crenulate to indistinctly crenulate. Venation semicraspedodrome, midrib thick, almost straight, secondaries at wide angles, widely spaced, near the margin connected by rounded loops, the latter bordered with smaller loops, which send side veinlets into teeth or near the notches, or merge with margin. Tertiaries irregular, forming network with elongate meshes parallel to the secondaries, with still smaler areoles within. Lamina chartaceous. Cuticles medium thick. Adaxial epidermis finely striated, consisting of polygonal cells 20-40 μm across with finely undulate anticlines. Conical trichome papillae on the midvein. Abaxial epidermis striated, around stomata concentrically, ordinary cells polygonal, c. 20 μm across, with finely undulate anticlines. Stomata cyclocytic, with a narrow thickened peripheral zone, widely oval, (15-) 23-35 μm wide and 25-32 (-50) μm long. Aperture broadly oval, reaching to the stomatal poles. Solitary hair bases (or papillae) 10 μm across.



Text-fig. 7. *Dicotylophyllum heeri* (ENGELHARDT) comb. n., trichomes on the adaxial cuticle of the midrib, PRKU 226/1 (scale bar 10 μm).

Text-fig. 8. *Dicotylophyllum heeri* (ENGELHARDT) comb. n., abaxial cuticle, PRKU 223/3 (scale bar 10 μm).

Remarks: This species occurs quite often, but its relationship has not been safely deciphered. Some previously described Theaceae (*Ternstroemites floersheimensis* KVAČEK et WALTHER 1984b, *Ternstroemites sokolovensis* KVAČEK et WALTHER 1984b), similar in leaf morphology, differ in details of the cuticular structure (striation, hair-bases).

Material studied: NHM Wien: Pb 00090 b, Pb 00119, Pb 00172, Pb 00300 a, Pb 00301, Pb 00303, Pb 00306, Pb 00308, Pb 00309, Pb 00323, Pb 00353, Pb 00415.

MMG Dresden: Ku 210, Ku 369, Ku 384, Ku 385 a, b, Ku 386 a, b, Ku 387 a, b, Ku 389, Ku 405, Ku 407, Ku 408, Ku 409 a, b, Ku 502 d, 52 specimens without numbers.

NM Praha: G 13, G 57-2, G 58-2, G 129, G 109-2, G 195, G 202, G 203, G 204.1, G 205, G 206, G 207, G 245.2, G 274, G 275, G 276, G 295, G 300, G 2090-2 (holotype), G 4646, G 4648, G 5036, G 5060, G 5080, G 5088.

Mus. Litoměřice: ML 77, ML 80, ML 81, ML 86, ML 87, ML 151, ML 152, ML 168.

Charles Univ. Praha: CKU 1,CKU 121, CKU 182, CKU 223, CKU 224, CKU 225, CKU 226, CKU 263, 54 specimens without numbers.

Cuticular preparations: PRKU 103, 121, 223, 226, 283.

Dicotylophyllum sp. 1

Pl. 6, fig. 1

1885 *Diospyros brachysepala* A. BRAUN ("*brachisepala*"); Engelhardt, p. 43 (pro parte)

Description: Leaf oblong, 40 mm long and 13 mm wide, entire-margined, with solitary tiny widely triangular teeth in the apex region. Petiole 7 mm long, apex acute, base widely cuneate, slightly asymmetric. Venation camptodrome, midrib straight, thick, secondaries thin, widely spaced, bent or wavy converging to the margin, in the leaf apex exceptionaly forked, higher-order venation more or less distinct, reticulate.

Remarks: An unusual but fully enigmatic leaf form is represented by a single leaf impression.

Material studied: NHM Wien: Pb 00177.

Dicotylophyllum sp. 2

Pl. 5, fig. 10

1885 *Samyda borealis* UNGER; Engelhardt, p. 50, pl. 11 (18), fig. 6
1885 *Sapindus pythii* UNGER; Engelhardt, p. 55, pl. 21 (28), fig. 3

Description: Leaves narrow oval, 75 mm long and 30 mm wide, petiolate, petiole short, 2 mm long and thick, apex long acuminate, base strongly asymmetric, margin double finely serrate, abmedial sides of teeth convex, admedial sides straight and short, secondary teeth small. Venation semicraspedodrome, secondaries densely spaced in 16 pairs, subopposite, at angles of 40 to 53°, near the margin forked, abmedial branch once more forked, entering the main and secondary teeth, intersecondaries much thinner, not reaching the margin.

Remarks: The leaf morphology recalls the Juglandaceae (e.g. *Carya*), but deviates from the so far described fossil species.

Material studied: NHM Wien: Pb 00191, Pb 00283.

Dicotylophyllum sp. 3

Pl. 5, fig. 8

1885 *Andromeda vaccinifolium* UNGER; Engelhardt, p. 44, pl. 10 (17), fig. 11

1885 *Rhamnus paucinervis* ETTINGSHAUSEN; Engelhardt, p. 64, pl. 16 (23), fig. 19

Remarks: This form includes small, narrow oval entire-margined leaves with camptodrome to indistinctly acrodrome venation. Without epidermis structure, its affinity remains dubious.

Material studied: NHM Wien: Pb 00212, Pb 00314.

Dicotylophyllum sp. 4

Pl. 5, fig. 11

1885 *Corylus insignis* HEER; Engelhardt, p. 25, pl. 18 (25), fig. 28

Description: Leaf narrow oval, 55 mm long and 22 mm wide, petiolate, petiole 8 mm long, lamina asymmetric, apex acute, base cuneate, margin double serrate, main teeth with swallen (? glandular) tips. Venation semicraspedodrome, midrib thin, slightly bent, secondaries in 10 pairs, subopposite, near margin bent, forked, abmedial branch running into the tooth, tertiaries oblique to the secondaries.

Remarks: This asymmetric form recalls superficially some Ulmaceae but differs from the genus *Ulmus* by the semicraspedodrome venation.

Material studied: NHM Wien: Pb 00358.

Dicotylophyllum sp. 5

Pl. 5, fig. 9

Description: Leaf narrow oval, 35 mm long and 15 mm wide, petiolate, petiole 8 mm long, apex acute with rounded tip, base rounded, margin double dentate-serrate, teeth blunt with partly sharp notches. Venation craspedodrome, midrib straight, secondaries opposite, in 6 pairs, near margin forked, intersecondaries present.

Material studied: NHM Wien: Pb 4667.

Dicotylophyllum sp. 6

Pl. 6, fig. 2

Description: Leaf small, suborbiculate, 16 mm long and 13 mm wide, entire-margined to widely crenulate, petiolate, petiole slightly winged, 5 mm long. Venation camptodrome, midrib thick at the base, higher up suddenly thinner, secondaries very irregular, densely spaced, more times forked, direct to slightly undulate, near margin forming fine and dense meshes, tertiaries forming elongate areolas.

Remarks: Venation of this single specimen recalls petaloid - tepaloid nature, but the winged petiole suggests a leaf remain.

Material studied: MMG Dresden: Ku 511 a, b.

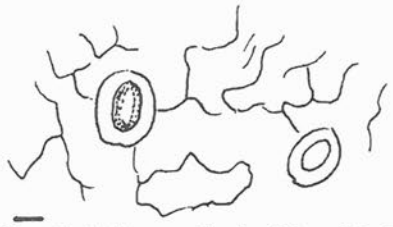
Dicotylophyllum sp. 7

Pl. 7, figs 1-2, text-fig. 9

Description: Leaf elongate-ovate, 30 mm wide, fragmentary in length, simple finely dentate, teeth blunt. Venation semicraspedodrome, midrib slightly bent, secondaries regular and dense, at angles of 40-60°, intersecondaries always present, tertiaries oblique to the secondaries, areolas with free ending veinlets. Adaxial epidermis smooth, consisting of polygonal cells c. 25 μm across with deeply undulate anticlines. Abaxial epidermis poorly preserved, only faint outlines of elliptical stomata 10-20 μm wide and 20-25 μm long observable. Anticlines of ordinary cells probably undulate.

Material studied: Charles Univ. Praha: CKU 296.

Preparation: PRKU 296.



Text-fig. 9. *Dicotylophyllum* sp. 7, abaxial cuticle, PRKU 296/1 (scale bar 10 μm).

Dicotylophyllum sp. 8

Pl. 5, fig. 12

1885 *Myrsine radobojana* UNGER; Engelhardt, p. 41, pl. 8 (15), fig. 26

Description: Leaf oval, 14 mm long and 11 mm wide, apex acute, base cuneate, margin simple to double dentate, teeth with partly elongate tips, notches rounded. Venation craspedodrome, secondaries steep, slightly bent running into the teeth.

Remarks: The leaf may represent a juvenile form of some Ulmaceae.

Material studied: NM Praha: G 292.

Dicotylophyllum sp. 9

Pl. 7, fig. 9

Description: Leaf oval, 73 mm long and 32 mm wide, entire-margined, apex blunt, base widely cuneate. Venation camptodrome, midrib thick, straight, secondaries in 6 pairs, alternate, basal pair subopposite, tertiaries not preserved, lamina very thin.

Remarks: Such leaf forms have been usually assigned to *Diospyros* L.

Material studied: Mus. Litoměřice: ML 224.

Dicotylophyllum sp. 10

Pl. 6, fig. 13

Description: Leaf spatulate, 23 mm long and 8 mm wide, entire-margined, shortly petiolate, petiole thick, apex rounded, base narrow cuneate. Venation brochidodrome, midrib straight, incompletely preserved, secondaries very steep, bent, many times forked, connected into a complicate network.

Remarks: This leaf form recalls the Loranthaceae.

Material studied: Charles Univ. Praha: CKU 178.

Dicotylophyllum sp. 11

Pl. 7, figs 3-5

Description: Leaf elongate-oval, 80 mm long and 22 mm wide, entire-margined. Venation brochidodrome, midrib straight, thin, secondaries very thin, widely spaced, joined by long flat loops, intersecondaries perpendicular to the midrib, several between two secondaries, also joined by loops, tertiaries very irregular, forming elongate meshes perpendicular to the midrib, areolas polygonal. Only abaxial cuticle preserved, thin, slightly striated, showing cyclocytic broadly elliptic stomata (25-32 μm long and 20-25 μm wide) with widely open stomatal ledges and a narrow circle of subsidiary cells of unknown number. Anticlines of ordinary cells finely undulate, hardly seen.

Material studied: Charles Univ. Praha: CKU 292.

Preparation: PRKU 292.

Dicotylophyllum sp. 12

Pl. 7, figs 6-8

Description: Leaves elongate oval, variable in size, petiolate, petiole c. 5 mm long, apex acute, base cuneate, margin regularly finely crenulate. Venation craspedodrome-semicraspedodrome, midrib thick, secondaries widely spaced, bent, convergent towards the margin and entering the teeth or sending abmedial side veinlets into the teeth, intersecondaries present, tertiaries forming polygonal network.

Remarks: This form recalls the foliage of *Salix* but lacks cuticular remains.

Material studied: Charles Univ. Praha: CKU 244, CKU 256, CKU 299, CKU 300.1.

Dicotylophyllum sp. 13

Pl. 8, figs 1-4

Description: Lower parts of oblong leaves 20-30 mm wide, entire-margined, near the petiole with two symmetric crenulate teeth. Venation brochidodrome, secondaries densely spaced, nearly perpendicular to the midrib, looping along the margin. Due to carbonized leaf lamina other details of venation not observable. Adaxial cuticle smooth and medium thick, showing polygonal, more or less isodiametric cells 20-40 μm across with slightly undulate anticlines, in phase contrast light covered within distict thickenings in sinuses. Abaxial cuticle thinner, showing similar ordinary cells as in the adaxial side, but distinctly striated radially around stomata. Stomata anisocytic ?, guard cell pairs 18-30 μm long and 15-22 μm wide, occasionally enlarged stomatal hydathodes. No trichome bases observed.

Material studied: Mus. Litoměřice: ML 75.

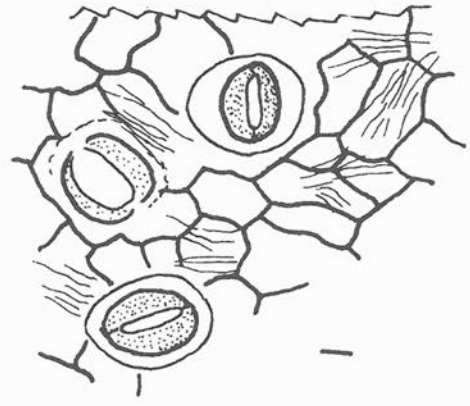
Charles Univ. Praha: CKU 260, CKU 262.

Preparations: PRKU 260, PRKU 262.

Dicotylophyllum sp. 14

Pl. 8, fig. 5, text-fig. 10

Description: Leaf oblong, slightly asymmetric, 20 mm wide and 55 mm long, entire-margined, apex rounded, damaged by insect chewing, base not preserved. Venation brochidodrome, midrib straight, thick, secondaries densely spaced, in 10 pairs, alternate, at angles c. 60°, near the margin united by narrow loops, tertiaries irregular, oblique to secondaries, with higher-order veins forming elongate meshes. Cuticle medium thick. Adaxial epidermis smooth, compound of polygonal cells 22-37 μm across, anticlines slightly wavy to sinuous, pitted. Abaxial cuticle strongly striated, ordinary cells polygonal, c. 25 μm across, anticlines straight to finely undulate. Stomata anomocytic, roundish, 30-32 μm in size, surrounded by radial striation.



Text-fig. 10. *Dicotylophyllum* sp. 14, abaxial cuticle, PRKU 201/3 (scale bar 10 μm).

Material studied: Charles Univ. Praha: CKU 201.

Cuticular preparations: PRKU 201.

Dicotylophyllum sp. 15

Pl. 8, figs 8-9

Description: Leaf fragmentary, oval (?), 50 mm wide, apex and base missing, entire-margined. Venation eucamptodromous, midrib straight, secondaries thin, steep, widely spaced, looping very near the margin. Only abaxial cuticle poorly preserved, irregularly striated and papillate, roundish hair bases occasionally preserved. Stomata anomocytic ?, narrow oval with radially striated periphery.

Material studied: Charles Univ. Praha: CKU126.

Cuticular preparations: PRKU 126.

Dicotylophyllum sp. 16

Pl. 8, fig. 6, text-fig. 11

Description: Leaf ovate, entire-margined, 20 mm wide, apex missing, base widely cuneate, venation nearly acrodromous, midrib straight, secondaries widely spaced, basal pair subopposite, higher secondaries alternate, thin abmedial veinlets looping from the secondaries. Abaxial cuticle thin, slightly striated over thicker veins, ordinary cells with undulating anticlines, about 16-25 μm long and 10-17 μm wide, stomata widely spaced, seen as spindle-like outlines of stomatal ledges, stomatal type unknown, solitary oil cells.

Remarks: Gross morphology is suggestive to the Lauraceae and recalls the leaf form identified as *Eugenia haeringiana* UNGER by Engelhardt (1885, pl. 18 (15), figs 14-15).

Material studied: Charles Univ. Praha: CKU 293.1.

Cuticular preparations: PRKU 293.1.

Text-fig. 11. *Dicotylophyllum* sp. 16, abaxial cuticle and an oil mesophyll cell, PRKU 293/1 (scale bar 10 μm).

Dicotylophyllum sp. 17

Pl. 9, figs 1-2

Description: Leaf incomplete, oval, entire-margined, 20 mm wide, venation brochidodromous, midrib straight, secondaries very thin, at wide angles, dense, looping within the margin. Cuticle poorly preserved. Abaxial cuticle showing large anomocytic to cyclocytic stomata 27-35 μm across, occasionally as "giant" stomata.

Remarks: Leaf venation recalls the Leguminosae.

Material studied: Charles Univ. Praha: CKU 240b.

Cuticular preparations: PRKU 240b.

Dombeyopsis lobata UNGER

Pl. 5, fig. 1

1885 *Ficus tiliaefolia* A. BRAUN; Engelhardt, p. 27, pl. 5 (12), figs 3-6

Description: Incomplete large leaves, rounded-trilobate, over 100 mm across, entire-margined, petiolate, petiole up to 82 mm long, attached from the abaxial leaf side, apex and lobes blunt, base deeply cordate, symmetric, venation palmate, brochidodrome, up to 7 basal primaries radiating from the very base, partly forked near the margin, sending side veins of various orders that loop along the margin, higher secondaries rare, widely spaced, looping with the primaries along the margin, tertiaries in a form of a spider net between the primaries and secondaries, percurrent or rarely forked.

Remarks:This deciduous foliage, belonging probably to the plant of *Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER (Tiliaceae) (see Kvaček 1993) occurs as thermophilous element rarely in other volcanic floras (Bechlejovice, Seifhennerdorf).

Material studied: NHM Wien: Pb 00111, Pb 00113, Pb 00114, Pb 00117.

NM Praha: G 5131.

CHARLES UNIV. Praha: CKU 316, 3 specimens without numbers.

cf. *Dusembaya* sp.

Pl. 9, fig. 10, pl. 16, figs 7-8

1885 *Viburnum atlanticum* ETTINGSHAUSEN; Engelhardt, p. 36 (pro parte), pl. 8 (15), fig. 17

Description: Seeds roundish, 4 mm across, poorly preserved as impressions.

Remarks: These remains can be compared with seeds of the Nymphaeales, which occur more abundantly also at Seifhennersdorf (Mai 1963, as *Brasenia*). According to the revision by Mai (1988) they belong to an exctinct genus *Dusembaya* DOROFEEV. A rhizome fragment with rounded root scars may belog to the same plant.

Material studied: MMG Dresden: Ku 178, Ku 445, Ku 446, Ku 512, Ku 516, one specimen (rhizome) without number.

NM Praha: G 170, G 309, G 310.

Mus. Litoměřice: ML 1.

Charles Univ. Praha: CKU 194, CKU 314.

Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER

Pl. 9, fig. 6

Remarks: The only two leaflets so far found at Kundratice match exactly with other records of the European Tertiary.

Material studied: MMG Dresden: Ku 518.

NM Praha: G 7604.1.

Fraxinus sp.

Pl. 8, fig. 7

Description: Winged samaras lineal-oblanceolate, 35 mm long and 5 mm wide. Fruit region indistinctly thickened, wing apex blunt.

Remarks: The fruits correspond to those of various species of *Fraxinus*. Representatives of this genus were recovered extremely rarely in the volcanic floras in Central Europe. A corresponding foliage has not been found at Kundratice.

Material studied: Mus. Litoměřice: ML 10, ML 120.

cf. *Gordonia* sp.

Pl. 9, figs 8-9

1885 *Embothrium microspermum* HEER; Engelhardt, p. 35 (pro parte)

1885 *Embothrium salicinum* HEER; Engelhardt, p. 36, pl. 6 (13), figs 24-25

Remarks: This type of winged seeds occur occasionally in other European floras (e.g. Kumi). It has been usually interpreted as remains of the Proteaceae. According to Manchester (personal communication) they match with the seeds of extant and extinct species of *Gordonia* ELLIS (see Grote and Dilcher 1992). Similar seeds have been recently desribed as *Saportaspermum occidentale* MEYER et MANCHSTER from the Oligocene of Oregon, USA (Meyer and Manchester 1997).

Material studied: NHM Wien: Pb 00151 b

MMG Dresden: Ku 317 a, b, Ku 356 b, Ku 433.

NM Praha: G 173, G 174, G 175, G 5092.

Mus. Litoměřice: ML 117.

Icaciniphyllum artocarpites (ETTINGSHAUSEN) KVAČEK et BŮŽEK

Pl. 9, figs 3-5, text-fig. 13/30

1885 *Aesculus palaeocastanum* ETTINGSHAUSEN; Engelhardt, p. 61 (pro parte)
1885 *Carya elaenoides* UNGER; Engelhardt, p. 67 (pro parte)
1885 *Cissus* sp.; Engelhardt, p. 46, pl. 20 (27), fig. 48
1885 *Myrica hakeaefolia* UNGER; Engelhardt, p. 20, pl. 2 (9), fig. 7
1885 *Quercus artocarpites* ETTINGSHAUSEN; Engelhardt, p. 23, pl. 3 (10), fig. 17
1885 *Quercus charpentieri* HEER; Engelhardt, p. 23, pl. 3 (10), fig. 2
1898 *Cunonia formosa* FRIEDRICH; Menzel, p. 9, pl. 1, fig. 4
1995 *Icaciniphyllum artocarpites* (ETTINGSHAUSEN) KVAČEK et BŮŽEK, p. 132, pl. 3, figs 1-4, pl. 4, figs 7-9, pl. 6, figs 1-5, text-fig. 1

Description: Leaves elongate to obovate, usually exceeding 80 mm in length, margin widely minutely toothed. Venation craspedodrome to semicraspedodrome, secondaries widely spaced, forked near margin, abmedial branch entering the teeth or looping along the margin, admedial branch joining intersecondary or the next secondary vein, tertiaries fairly irregular. Cuticle medium thick. Adaxial epidermis smooth, consisting of polygonal cells 12-20 (-30) μm across with straight to sinuous anticlines, occasionally thickened in sinuses. Costal areas well differentiated. Abaxial epidermis also smooth, ordinary cells polygonal, 10-17 μm across with sinuous anticlines. Stomata cyclocytic, guard cell pairs 7-10 μm wide and 10-13 (-15) μm long, rare "giant" stomata up to 20 $\times$ 22 μm in size. Aperture short, oval. Subsidiary cells darker, narrow, 3-4 in number. Thicker veinlets well exposed as costal zones. (For further information see Kvaček and Bůžek 1995).

Remarks: According to Kvaček and Bůžek (1995) this type of foliage, highly variable in form but with characteristic epidermal structure, belongs to the fruits assigned to an extinct genus of the Icacinaceae *Palaeohosiea* KVAČEK et BŮŽEK. In contrast to its abundant occurrence at Suletice-Berand, these leaves are far less frequent at Kundratice.

Material studied: NHM Wien: Pb 00021, Pb 00045, Pb 00052, Pb 00304, Pb 00355, Pb 00409.

MMG Dresden: Ku 134 a, b, Ku 168 a, b, Ku 453 b, 6 specimens without numbers.

NM Praha: G 56-1, G 221-1.

Mus. Litoměřice: ML 21, ML 88, ML 105, ML 106, ML 107, ML 108, ML 109, ML 205.

Charles Univ. Praha: Pb 00005, Pb 00006, Pb 000079, CKU 100, CKU 129, CKU 131, CKU 132, CKU 135.

Cuticular preparations: PRKU 129-131, 134, 135, Pb 52/1.

Ilex castellii KVAČEK et WALTHER

Pl. 9, figs. 12-13, text-fig. 13/17

1885 *Lomatia pseudoilex* UNGER; Engelhardt, p. 36, pl. 8 (15), fig. 19
1981 *Ilex castellii* KVAČEK et WALTHER, p. 82, pl. 4, figs 2 (holotype), 4, 6

Description: Leaves oval, sharply coarsely dentate, teeth large and pointed with rounded notches. Venation semicraspedodrome. Lamina coriaceous. Cuticle thick. Adaxial epidermis smooth, compound of polygonal cells with strongly undulate anticlines. Solitary thickened simple hair bases 30-40 μm across. Abaxial epidermis also smooth, ordinary cells of the same kind as in the adaxial epidermis. Stomata broadly oval, 35-45 μm long, stomatal type unclear. Periphery of stomata slightly thickened. Guard cell pairs with rounded cuticular ring inside. Aperture slit-like. Hair bases of the same kind as in the adaxial epidermis, very rare (for further information see Kvaček and Walther 1981).

Remarks: This remarkable type of foliage is extremely rare at Kundratice and obviously endemic at this site.

Material studied: NHM Wien: Pb 00159.

MMG Dresden: Ku 175 a, b.

Charles Univ. Praha: CKU 2, CKU 34.

Cuticular preparations: Pb 00159/1, PRKU 2, 34, 175.

Juglandaceae gen. et sp.

Pl. 9, fig. 11, text-fig. 13/36

1885 *Callicoma bohemica* ETTINGSHAUSEN; Engelhardt, p. 48, pl. 1 (8), fig. 13 [and *Phyllerium callicomae* ENGELHARDT, holotype], pl. 10 (17), fig. 23, pl. 21 (28), fig. 2
1885 *Carya elaenoides* UNGER; Engelhardt, p. 67 (pro parte)
1885 *Juglans bilinica* UNGER; Engelhardt, p. 65 (pro parte)
1885 *Pterocarya denticulata* HEER; Engelhardt, p. 67 (pro parte)
1885 *Quercus argute-serrata* HEER; Engelhardt, p. 23, pl. 3 (10), fig. 19
1885 *Quercus godeti* HEER; Engelhardt, p. 22, pl. 3 (10), fig. 16

Remarks: This type of foliage with dentate margin and various types of semicraspedodrome venation may represent folioles of the Juglandaceae. Exact generic affinities are uncertain due to the lack of epidermal structures and distinct morphological characters.

Material studied: NHM Wien: Pb 00187, Pb 00210, Pb 00327, Pb 00336, Pb 00417.2, Pb 00429 b.

MMG Dresden: Ku 162, Ku 310, Ku 505, Ku 506, Ku 508 b, 35 specimens without numbers.

NM Praha: G 57-1, G 111, G 2073, G 2098, G 5069.

Mus. Litoměřice: ML 8, ML 58, ML 110.

Charles Univ. Praha: 10 specimens without numbers.

Laurophyllum acutimontanum MAI

Pl. 10, figs 4-5, text-fig. 13/9

1885 *Apocynophyllum sessile* UNGER; Engelhardt, p. 39, pl. 9 (16), fig. 5
1885 *Cassia ambigua* UNGER; Engelhardt, p. 78, pl. 19 (26), fig. 43
1885 *Dodonea antiqua* ETTINGSHAUSEN; Engelhardt, p. 56, pl. 11 (18), fig. 5
1885 *Eugenia haeringiana* UNGER; Engelhardt, p. 70 (pro parte), pl. 18 (25), figs 13, 15
1885 *Laurus primigenia* UNGER; Engelhardt, p. 30, pl. 6 (13), fig. 20
1885 *Salix longa* A. BRAUN; Engelhardt, p. 29, pl. 5 (12), fig. 11

Description: Leaves elongate oval, about 60 mm long, entire-margined. Venation pinnate, brochidodrome. Lamina coriaceous. Cuticle thick. Cell structure well preserved, corresponding to that of the type material (Mai 1963). Particularly characteristic amphicycloparacytic stomata with deeply sunken guard cells and thickened narrow subsidiary cells. Lens-shaped oil cells common in the mesophyll tissue.

Remarks: This species in the Oligocene widely distributed is not frequent at Kundratice, like in the other volcanic floras (Seifhennersdorf, Markvartice, Kleinsaubernitz).

Material studied: NM Praha: G 23, G 88-5, G 145, G 146, G 264, G 265, G 5081, G 5120.

Mus. Litoměřice: ML 61, ML 122.2, ML 133.

Charles Univ. Praha: CKU 113, CKU 114, CKU 116, CKU 127, CKU 233, CKU 236, CKU 290, CKU 291, CKU 305.1, CKU 306, CKU 427.

Cuticular preparations: PRKU 113, 114, 116, 127, 233, 236, 290, 291, 305.1, 306, 427.

Laurophyllum medimontanum BŮŽEK, HOLÝ et KVAČEK

Pl. 10, figs 1-2

Description: Leaves oval, entire-margined, base cuneate. Venation camptodrome, midrib very thick, secondaries widely spaced, lamina chartaceous. Cuticle thin. Adaxial epidermis smooth, consisting of polygonal cells 7-20 μm across with slightly wavy anticlines. Abaxial cuticle showing only oval traces of stomata 7-12 μm wide and 12-20 μm long. Lens-shaped oil cells rarely preserved.

Remarks: Characteristic papillae on the abaxial leaf side are not preserved in the studied specimens due to poor preservation. This species ranges from the Late Eocene to Early Oligocene (Kvaček 1988).

Material studied: Charles Univ. Praha, CKU 106, CKU 108a, CKU 111, CKU 295.

Cuticular preparations: PRKU 106, 108a, 111, 295.

Laurophyllum cf. *pseudoprinceps* WEYLAND et KILPPER

Pl. 19, fig. 3

1885 *Laurus lalages* UNGER; Engelhardt, p. 30, pl. 7 (14), fig. 4
1885 *Laurus princeps* HEER; Engelhardt, p. 31, pl. 7 (14), fig. 3
1885 *Leguminosites sparsinervis* ENGELHARDT, p. 79, pl. 20 (27), fig. 19
1885 *Nectandra raffeltii* ENGELHARDT, p. 33, pl. 8 (15), fig. 11 (holotype)
1885 *Rhamnus gaudinii* HEER; Engelhardt, p. 63 (pro parte)
1885 *Vaccinium acheronticum* UNGER; Engelhardt, p. 44 (pro parte), pl. 9 (16), fig. 35

Description: Leaves lanceolate oval, entire-margined, apex elongate acuminate, base narrow cuneate. Venation camptodrome, midrib thick, secondaries bent, looping, alternate, widely spaced, the lowermost pair slightly more pronounced, acrodromous.

Remarks: In spite of several attempts no cuticular structure has been obtained from this leaf form. Although it matches morphologically with the common *Laurophyllum pseudoprinceps*, its identity remains very uncertain.

Material studied: NHM Wien: Pb 00302, Pb 00302, Pb 00318, Pb 00420, Pb 00426.

NM Praha: G 288.

Laurophyllum sp.

Pl. 10, fig. 6

1885 *Acacia sotzkiana* UNGER; Engelhardt, p. 81 (pro parte)
1885 *Diospyros paradisiaca* ETTINGSHAUSEN; Engelhardt, p. 43, pl. 10 (17), fig. 2
1885 *Eugenia haeringiana* UNGER; Engelhardt, p. 70 (pro parte)
1885 *Eucalyptus oceanica* UNGER; Engelhardt, p. 70, pl. 18 (25), fig. 24, pl. 19 (26), fig. 6
1885 *Ficus* sp., Engelhardt, in sched.
1885 *Inga icari* UNGER; Engelhardt, p. 77, pl. 20 (27), fig. 10
1885 *Juglans bilinica* UNGER; Engelhardt, p. 65 (pro parte)
1885 *Laurus primigenia* UNGER; Engelhardt, p. 30, pl. 7 (14), fig. 2
1885 *Sapindus cupanoides* ETTINGSHAUSEN; Engelhardt, p. 55 (pro parte)
1885 *Sapindus falcifolius* A. BRAUN; Engelhardt, p. 55, pl. 11 (18), fig. 14
1885 *Styrax stylosa* HEER; Engelhardt, p. 43, pl. 10 (17), fig. 3-4

Remarks: Leaves assigned to this entity are penniveined lauroid forms without cuticular structure. Its affinity to the Lauraceae is not fully guaranteed.

Material studied: NHM Wien: Pb 00110, Pb 00112, Pb 00284, Pb 00285, Pb 00288,

Pb 00325, Pb 00356, Pb 00360, Pb 00364, Pb 00438, Pb 00444.

MMG Dresden: Ku 354, Ku 356 a, Ku 376 a, Ku 388 b, 70 specimens without numbers.

NM Praha: G 217, G 266, G 298, G 299-1, G 301, G 302, G 5085.

Mus. Litoměřice: ML 141-2.

Charles Univ. Praha: CKU 237, more than 20 specimens without numbers.

Leguminosae gen. et sp. forma 1

Pl. 10, fig. 9, pl. 11, fig. 1

1885 *Cassia ambigua* UNGER; Engelhardt, p.78, pl. 20 (27), figs 7-8
1885 *Cassia bernices* UNGER; Engelhardt, p. 78, pl. 20 (27), fig. 21
1885 *Dalbergia podocarpa* UNGER; Engelhardt, in sched.
1885 *Dalbergia primaeva* UNGER; Engelhardt, p. 76 (pro parte)
1885 *Vaccinium vitis japeti* UNGER; Engelhardt, p. 48, pl. 9 (16), fig. 31
1885 ? *Vaccinium* sp., Engelhardt, p. 44

Remarks: This form of leguminous foliage belongs to the smallest category reaching hardly 15 mm in length. Like other leaf fossils of this sort, the generic affinities remain dubious.

Material studied: NHM Wien: Pb 00182, Pb 00396, Pb 00397, Pb 00398, Pb 00406 a, Pb 00419, Pb 00423, Pb 00434.

MMG Dresden: Ku 342, 3 specimens without numbers.

NM Praha: G 289.

Leguminosae gen. et sp. forma 2

Pl. 10, fig. 10, text-fig. 13/23

1885 *Caesalpinia oblongoovata* HEER; Engelhardt, p. 77, pl. 19 (26), fig. 36
1885 *Cassia ambigua* UNGER; Engelhardt, p. 78 (pro parte), pl. 20 (27), figs 6, 9
1885 *Cassia berenices* UNGER; Engelhardt, p. 75, pl. 20 (27), figs 15, 36
1885 ? *Cassia cordifolia* HEER; Engelhardt, p. 79, pl. 20 (27), fig. 14
1885 *Cassia lignitum* HEER; Engelhardt, p. 78 (pro parte), pl. 19 (26), fig. 42
1885 *Celastrus bruckmannii* HEER; Engelhardt, p. 58
1885 *Dalbergia cassioides* ENGELHARDT, p. 76, pl. 19 (26), fig. 37
1885 *Dalbergia nostratum* HEER; Engelhardt, p. 76, pl. 19 (26), fig. 24

1885 *Gleditschia allemanica* HEER; Engelhardt, p. 80, pl. 20 (27), fig. 30
1885 *Ledum limnophyllum* UNGER; Engelhardt, p. 45, pl. 10 (17), fig. 17
1885 *Vaccinum vitis japeti* UNGER; Engelhardt, p. 44, pl. 9 (16), fig. 32

Description: Leaflets 15 to 25 mm long and 7 to 14 mm wide. Subsessile, apex acute, blunt, entire-margin. Venation brochidodrome.

Remarks: This surely formal entity includes medium sized leaflets. The affinity of all these specimens to the Leguminosae cannot be fully guaranteed.

Material studied: NHM Wien: Pb 00184 b, Pb 00282, Pb 00400, Pb 00403, Pb 00416.

MMG Dresden: Ku 299, Ku 319 a, b, Ku 334, Ku 337, Ku 338, Ku 365, Ku 428, Ku 429, Ku 432 a, b, 21 specimens without numbers.

NM Praha: G 140, G 143, G 144, G 147, G 159, G 174, G 249.3, G 299.2.

Charles Univ. Praha: CKU 197, CKU 198, CKU 199, 4 specimens without numbers.

Leguminosae gen. et sp. forma 3

Pl. 10, fig. 7, pl. 11, figs 2-3, text-fig. 13/33

1885 *Caesalpinia bohemica* ENGELHARDT, p. 77, pl. 19 (26), fig. 47
1885 *Cassia berenices* UNGER; Engelhardt, p. 78 (pro parte), pl. 20 (27), figs 11, ?38
1885 *Cassia lignitum* UNGER; Engelhardt, p. 78, pl. 19 (26), figs 40, 47
1885 *Cassia phaseolithes* UNGER; Engelhardt, p. 79 (pro parte)
1885 *Palaeolobium heterophyllum* UNGER; Engelhardt, p. 74, pl. 19 (26), fig. 22
1885 *Palaeolobium sotzkanianum* HEER; Engelhardt, p. 74 (pro parte)
1885 *Palaeolobium sturi* ETTINGSHAUSEN; Engelhardt, p. 75 (pro parte)
1885 *Porana ungeri* HEER; Engelhardt, p. 40, pl. 9 (16), fig. 6
1885 *Rhamnus brevifolius* A. BRAUN; Engelhardt, p. 64, pl. 16 (23), fig. 18

Description: Leaflets rounded to oval, 27-40 mm long and 11-20 mm wide, shortly petiolate, petiole up to 2 mm wide. Venation camptodrome. Adaxial cuticle showing large polygonal cells 20-40 μm across with sinuate anticlines. Abaxial cuticle densely hairy. Hair bases simple, c. 10 μm across. Ordinary cells with wavy anticlines. Stomata anomocytic, broadly oval to roundish, 13-17 μm wide and 20-25 μm long with prominent ledges and lineal aperture.

Material studied: NHM Wien: Pb 00313, Pb 00372, Pb 00379, Pb 00383, Pb 00401, Pb 00402, Pb 00408, Pb 00409, Pb 00410, Pb 00412, Pb 00414, Pb 00445, Pb 00448.

MMG Dresden: Ku 171, Ku 172, 7 specimens without numbers.

NM Praha: G 148, G 160, G 167, G 307, G 4643, G 5056.

Mus. Litoměřice: ML 68, ML 69, ML 92, ML 219.

Charles Univ. Praha: CKU 261.1, 11 specimens without numbers.

Cuticular preparation: PRKU 261.1.

Leguminosae gen. et sp. forma 4

Pl. 10, fig. 11

1885 *Cassia hyperborea* UNGER; Engelhardt, p. 79, pl. 21 (28), fig. 5
1885 *Cassia phaseolites* UNGER; Engelhardt, p. 79, pl. 20 (27), fig. 38
1885 *Pyrus euphemes* UNGER; Engelhardt, p. 72 (ex parte), pl. 9 (16), fig. 16
1885 *Sapotacites minor* (UNGER) ETTINGSHAUSEN; Engelhardt, p. 42, pl. 9 (16), fig. 21

Description: Leaflets obovate, 42 to 60 mm long and 23 to 31 mm wide, entire-margined, shortly petiolate, petiole 4 mm long, thick, apex rounded, base cuneate. Venation camptodrome.

Material studied: NHM Wien: Pb 00418.

MMG Dresden: Ku 155, 6 specimens without numbers.

NM Praha: G 131, G 296, G 5054.

Mus. Litoměřice: ML 15, ML 1671.

Charles Univ. Praha: 9 specimens without numbers.

Leguminosae gen. et sp. forma 5

Pl. 11, fig. 7

1885 *Diospyros myosotis* UNGER; Engelhardt, in sched.

Description: Leaflet oval, slightly asymmetric, 74 mm long, 34 mm wide, entire-margined, base rounded, apex acute, very shortly petiolate, petiole 1 mm long. Venation camptodrome, secondaries alternate, in 6 pairs, tertiaries indistinct, forming with higher-order veins network of irregular meshes.

Material studied: NHM Wien: Pb 00426.

MMG Dresden: Ku 430, 5 specimens without numbers.

Charles Univ. Praha: 3 specimens without numbers.

Leguminosae gen. et sp. (fructi)

Pl. 10, fig. 8

1885 *Acacia microphylla* UNGER; Engelhardt, p. 81, pl. 20 (27), fig. 37
1885 *Cassia berenices* UNGER; Engelhardt, p. 78, pl. 20 (27), fig. 22

Remarks: These fragmentary pods 15 to 20 mm wide with subparallel sides and acuminate apex without traces of seeds belong surely to some of the above described foliage of the Leguminosae. Also in this case generic affinities are uncertain.

Material studied: MMG Dresden: Ku 333.

NM Praha: G 134, G 5041.

Charles Univ. Praha: 1 specimen without number.

Magnolia sp.

Pl. 11, figs 4-6, text-fig. 13/7

1885 *Aralia palaeogaea* ETTINGSHAUSEN; Engelhardt, p. 45, pl. 10 (17), fig. 15
1885 *Bombax grandifolium* ENGELHARDT, p. 50, pl. 11 (18), fig. 10
1885 *Cinchona aesculapi* UNGER; Engelhardt, p. 37, pl. 8 (15), fig. 35
1885 *Ficus lanceolata* HEER; Engelhardt, p. 28, pl. 6 (13), fig. 4
1885 *Sterculia grandifolia* ENGELHARDT, p. 51, pl. 12 (19), fig. 5 (holotype)

Description: Leaves elongate to oval, longer than 100 mm and about 30-50 mm wide, entire-margined, petiolate, petiole thick, apex bluntly acute, base rounded to widely cuneate. Venation brochidodrome, midrib straight and thick, secondaries thin, subopposite, widely spaced, bent towards the margin, intersecondaries short, per one to two interspaced between secondaries, at wide angles to the midrib, tertiaries perpendicular to the secondaries, forked and joined to meshes, higher-order venation in areolas. Adaxial epidermis showing faint outlines of polygonal cells 12-25 μm across with straight anticlines. Serial trichome bases consisting of several short cells 15 μm across on veins and occasionally in the intercostal areas.

Remarks: This type of large leaves occur in several volcanic floras, e.g. Suletice-Berand, Kleinsaubernitz. At Seifhennersdorf these leaves are associted with the seeds of *Magnolia* L. (Mai 1963).

Material studied: NHM Wien: Pb 00185 a, Pb 00214, Pb 00215, Pb 00217.

MMG Dresden: Ku 349 a, b, Ku 350 a, b, Ku 351, Ku 353, 46 specimens without numbers.

NM Praha: G 88-1, G 89-1, G 94, G 308, G 586, G 4644.

Charles Univ. Praha: Pb 00078, CKU 109, CKU 126, CKU 170, CKU 171, CKU 172, 16 specimens without numbers.

Cuticular preparations: PRKU 109.

cf. ***Matudaea*** sp.

Pl. 12, figs 1-3

Description: Two bases of oval leaves, entire-margined, base widely cuneate. Venation camptodrome, two basal secondaries opposite, direct on the leaf base, sending abmedially looping side veinlets. Cuticle of the abaxial epidermis thin, faintly striate, with isolated polygonal large hair-bases (? of stellate trichomes), 20 × 30-32 μm across, faint oval outlines of stomata 10-17 μm wide, 12-20 μm long, type of stomata not discernible.

Remarks: Such triveined leaves are met with in *Matudaea menzelii* WALTHER (see Walther 1980). The type of the trichome bases found on the fossil leaves corresponds with the Hamamelidaceae. *M. menzelii* lacks cuticular striation found in the specimens at hand.

Material studied: Charles Univ. Praha: CKU 112, CKU 263.

Preparation: PRKU 112, 263.

Menispermaceae gen. et sp.

Pl. 12, fig. 8

1885 *Ficus populina* HEER; Engelhardt, p. 27, pl. 6 (13), fig. 2

Description: Leaves fragmentary, rounded, subtruncate to cordate, partly subpeltate at base, entire-margined. Venation acrodrome-brochidodrome, primaries 7, lateral ascending, forked towards two thirds of the leaf length, lamina extremely thin.

Remarks: The subpeltate base and venation suggest an affinity to the Menispermaceae.

Material studied: NM Wien: Pb 00109, Pb 00118.

MMG Dresden: Ku 509 a, b.

Mimosites haeringianus ETTINGSHAUSEN

Pl. 11, figs 8-9, text-fig. 13/26

1885 *Acacia parschlugiana* UNGER; Engelhardt, p. 61, pl. 20 (27), fig. 31

1885 *Mimosites haeringianus* ETTINGSHAUSEN; Engelhardt, p. 81, pl. 20 (27), figs 39, 42-43

1978 *Mimosites haeringianus* ETTINGSHAUSEN; Bůžek, Kvaček and Walther, p. 356, pl. 2, fig. 13

Description: Leaves paripinnate (?), up to 80 mm long, leaflets subopposite, lineate, subsessile, 10-18 mm long and 2-3 mm wide, truncate and strongly asymmetric at base, apex rounded to blunt acute. Venation camptodrome, midrib slightly bent, thin, secondaries steep, widely spaced with many intersecondaries, tertiaries forming network of elongate meshes parallel with the secondaries.

Remarks: This formal unit is a characteristic component of Late Eocene to Oligocene mesophytic vegetation in Central Europe.

Material studied: NHM Wien: Pb 00424, Pb 00431, Pb 00432, Pb 00433.

MMG Dresden: Ku 161 a, b, Ku 165, Ku 202 b, Ku 261, Ku 322, Ku 463, Ku 508 d, 73 specimens without numbers.

NM Praha: G 135-1, G 136, G 137, G 138, G 139, G 229.1, G 5046.

Mus. Litoměřice: ML 63, ML 96-4, ML 104.

Charles Univ. Praha: CKU 166, CKU 167, 12 specimens without numbers.

Monocotyledonae gen. et sp.

Pl. 11, fig. 11

1885 *Panicum miocenicum* ETTINGSHAUSEN; Engelhardt, in sched.

1885 *Pinus saturni* UNGER; Engelhardt, p. 18, pl. 1 (8), fig. 41

1885 *Poacites caespitosus* HEER; Engelhardt, p. 16, pl. 1 (8), figs 24-25

1885 *Poacites laevis* A. BRAUN; Engelhardt, p. 16, pl. 1 (8), figs 23, 26

1885 *Poacites rigidus* HEER; Engelhardt, p. 16

Description: Ribbon-shaped to lineate monocotyledonous leaf fragments with parallel venation, without any other characters useful for indentification.

Material studied: NHM Wien: Pb 00006 a, b, Pb 00007 a, b, Pb 00008, Pb 000425.

MMG Dresden: Ku 477.

NM Praha: G 2082, G 2083, G 2084, G 2085, G 2086, G 2087, G 5056, G 5097.

Mus. Litoměřice: ML 17.

Charles Univ. Praha: 4 specimens without numbers.

Osmunda lignitum (GIEBEL) STUR

Pl. 11, fig. 10

Description: Fragment of a pinna with subtriangulate pinnules, rounded at apex, to about one half of the length fused, less than 5 mm long, margin slightly crenulate. Venation open (veinlets not interconnected), main veinlet slightly wavy, secondaries alternate, basal ones close to one another entering into the notch, but not joined with those of the neighbouring pinnule.

Remarks: According to the venation, this specimen is the only evidence of *Osmunda lignitum* in volcanic floras, which is so typical of other Eocene and Oligocene sites (see Barthel 1976).

Material studied: Charles Univ. Praha: CKU 228.

Ostrya atlantidis UNGER

Pl. 12, figs 4-7, text-figs 13/34-35

1885 *Betula brongniartii* ETTINGSHAUSEN; Engelhardt, p. 21 (pro parte)
1885 *Betula prisca* ETTINGSHAUSEN; Engelhardt, p. 20, pl. 2 (9), fig. 22
1885 *Carpinus pyramidalis* GAUDIN; Engelhardt, p. 24, pl. 3 (10), fig.1, pl. 4 (11), fig. 4, 8
1885 *Ostrya atlantidis* UNGER; Engelhardt, p. 24, pl. 3 (10), figs 3-8, 24-26, pl. 4 (11), fig. 1
1885 *Ulmus minuta* GOEPPERT; Engelhardt, p. 26 (pro parte), pl. 3 (10), fig. 20
1885 *Ulmus* sp., Engelhardt, in sched.
1978 *Ostrya atlantidis* UNGER; Bůžek, Kvaček and Walther, p. 356, pl. 3, figs 1, 12

Description: Leaves narrow oval to lanceolate-oval, 25-100 mm long and 13-48 mm wide, petiolate, preserved petiole 8 mm long, apex acuminate, base cuneate to narrow cuneate, margin indistinctly double serrate, main teeth longer, all with long mucro. Venation craspedodrome, midrib thin, secondaries densely spaced, in 15-16 pairs, subopposite to alternate, straight, entering the main teeth, sending side veinlets into the secondary teeth, intersecondaries exceptional in the basal leaf part, tertiaries percurrent, rarely forked, nearly perpendicular to secondaries. Very poorly preserved epidermal structure, showing costal areas and faint outlines of oval stomata 10-15 μm wide and 12-17 μm long with spindle-shaped aperture. Associated involucra oval, 11-25 mm long and 5-14 mm wide, with small pointed tip, showing acrodrome venation of 8-10 subparallel veins. Impressions of small oval nutlets, one per involucrum oval, 3 × 5 mm in size rarely preserved.

Remarks: This deciduous element is abundantly represented in Kundratice, while it occurs far rarely elsewhere (Bechlejovice) or is absent (Seifhennersdorf, Kleinsaubernitz). The morphological transitions to the foliage of *Carpinus grandis* (without mucronate teeth) make delimitation of both species difficult.

Material studied: NHM Wien: Pb 00055, Pb 00056 Pb 00057, Pb 00058, Pb 00059, Pb 00060, Pb 00061, Pb 00062, Pb 00064, Pb 00066, Pb 00067, Pb 00068, Pb 00069, Pb 00070, Pb 00072, Pb 00073, Pb 00074, Pb 00076, Pb 00077, Pb 00086, Pb 00189 b (fructus).

MMG Dresden: Ku 198, Ku 199, Ku 200, Ku 201, Ku 213, Ku 215 a, b, Ku 218 1a, 2a, Ku 219 a, b, Ku 220 a, b, Ku 227, Ku 228, Ku 229, Ku 230, Ku 231, Ku 232, Ku 233, Ku 234, Ku 235 b, Ku 250, Ku 251, Ku 252, Ku 253, Ku 254, Ku 255, Ku 256, Ku 257, Ku 258, Ku 259, Ku 266, Ku 267, Ku 268, Ku 269, Ku 270 a, b, Ku 290 (diatomite), Ku 296 c, Ku 300, Ku 301 a, Ku 309, Ku 314, Ku 359 b, Ku 361, Ku 373 a, Ku 417 a, b, Ku 418, Ku 419, Ku 420, Ku 421 a, b, 111 specimens without numbers.

NM Praha: G 42, G 43, G 44, G 45, G 46 (fructus), G 47 (fructus), G 48 (fructus), G 49, G 50 (fructus), G 51, G 52 (fructus), G 73, G 2105, G 5067, G 5070, G 5071 (fructus), G 5076, G 5078, G 5096, G 5102.

Mus. Litoměřice: ML 20, ML 28.

Charles Univ. Praha: CKU 75, CKU 211, CKU 215, CKU 216, CKU 217, CKU 272, CKU 273, CKU 274, 37 specimens without numbers.

Cuticular preparations: PRKU 75.

"Palaeolobium" sp. 1

Pl. 13, figs 1-2, text-fig. 13/24

1885 *Andromeda protogaea* UNGER; Engelhardt, p. 54, pl. 10 (17), fig. 10, pl. 11 (18), fig. 1
1885 *Bumelia oreadum* UNGER; Engelhardt, p. 43, pl. 9 (16), fig. 17
1885 ? *Carpinus gracilis* UNGER; Engelhardt, in sched.
1885 *Cassia hyperborea* UNGER; Engelhardt, p. 79, pl. 20 (27), fig. 1
1885 *Cassia phaseolites* UNGER; Engelhardt, p. 79, pl. 20 (27), figs 2-4, 20, 23
1885 *Palaeolobium haeringianum* UNGER; Engelhardt, p. 74, pl. 19 (26), figs 21, 24
1885 *Myrtus aphrodites* UNGER; Engelhardt, p. 69, pl. 18 (24), fig. 16
1885 *Notelaea phylirae* ETTINGSHAUSEN; Engelhardt, p. 38, pl. 8 (15), fig. 36

Description: Leaves oval-lanceolate to oblanceolate, up to 50 mm long, and 15 mm wide, entire-margined, longly petiolate, petiole up to 9 mm long, apex acuminate, base narrow cuneate. Venation brochidodrome, midrib thick, secondaries in c. 15 pairs, subopposite, straight, at angles about 25-30°, usually in the two thirds of the length steeply forked, forking repeated two to three times, intersecondaries 1-3 between two secondaries, all joined in narrow loops near the margin and within the lamina, tertiaries very oblique to the secondaries. Cuticle very delicate, hardly reflecting epidermal structure. Adaxial epidermis smooth, compound of polygonal cells 7.5-25 μm across with sinuous anticlines. Abaxial cuticle showing dense simple hair bases with thickened peripheral wall 17-25 μm across. Stomata anomocytic (?), roundish, (12-) 15-17 μm wide and (15-) 20-25 μm long with broadly open aperture and thickened periphery. Ordinary cells indistinct, probably with sinuous anticlines.

Remarks: This leaf type is surely not a member of the Leguminosae, as Engelhardt (1885) suggested, in view of longly petiolate foliage. The venation recalls the form genus *Rhodomyrtophyllum* KRÄUSEL et WEYLAND (see Mai and Walther 1985), but the lamina is chartaceous, the epidermal structure quite different. This is another enigmatic type of deciduous foliage, quite common at Kundratice, which requires further comparative studies.

Material studied: NHM Wien: Pb 00116, Pb 00169, Pb 00175, Pb 00300 b, Pb 00367, Pb 00382, Pb 00383.

MMG Dresden: Ku 173 a, b, Ku 174, Ku 203, Ku 315 b, Ku 324, Ku 328, Ku 344, Ku 456, Ku 457, Ku 458, Ku 459, Ku 460, Ku 461 a, b, Ku 462 a, Ku 502 b, 44 specimens without numbers.

NM Praha: G 135-2, G 150, G 151, G 152, G 153, G 154, G 156, G 157, G 158, G 162, G 165, G 166, G 168, G 284, G 285, G 4641, G 5057, G 5088, G 5090.

Mus. Litoměřice: ML 76, ML 82, ML 93, ML 154, ML 163, ML 164, ML 165.

Charles Univ. Praha: CKU 70, CKU 200, CKU 203, CKU 266, CKU 269, CKU 270, CKU 271, CKU 301, 11 specimens without numbers.

Cuticular preparations: PRKU 70, 200, 266, 269-271, 301.

"Palaeolobium" sp. 2

Pl. 13, fig. 4

1885 *Glyzyrhiza deperdita* UNGER; Engelhardt, p. 77, pl. 19 (26), fig. 46
1885 *Palaeolobium haeringianum* UNGER; Engelhardt, p. 74, pl. 19 (26), fig. 19
1885 *Palaeolobium sotzkianum* UNGER; Engelhardt, p. 74 (pro parte)
1885 *Palaeolobium sturi* ETTINGSHAUSEN; Engelhardt, p. 75, pl. 19 (26), fig. 27
1885 *Viburnum atlanticum* ETTINGSHAUSEN; Engelhardt, p. 36, pl. 8 (15), fig. 14

Description: Leaves elongate-oval, entire-margined, more than 50 mm long and 25 and more mm wide, petiolate, petiole fragmentary, 4 mm preserved length, apex blunt, mucronate, base narrow cuneate, slightly asymmetric. Venation camptodrome, midrib thick, slightly bent, secondaries bent, densely spaced, in 15-16 pairs, near margin more times forked, tertiaries very oblique to the secondaries.

Remarks: This form matches well the previous "*Palaeolobium*" sp. 1 in venation and perhaps represents only larger leaves of it. No epidermal structure has been obtained to confirm this assumption.

Material studied: NHM Wien: Pb 00161, Pb 00163, Pb 00164, Pb 000165, Pb 00176, Pb 00380, Pb 00381, Pb 00384, Pb 00386, Pb 00393, Pb 00417.

MMG Dresden: Ku 336, Ku 454, Ku 455.

NM Praha: G 169.

Charles Univ. Praha: 2 specimens without numbers.

Platanus neptuni (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK

Pl. 11, figs 9-15, text-figs 13/12-13

1885 *Amygdalus pereger* UNGER; Engelhardt, p. 71, pl. 19 (26), fig. 3
1885 *Ardisia myricoides* ETTINGSHAUSEN; Engelhardt, p. 42, pl. 9 (16), fig. 23
1885 *Bombax chorisiaefolium* ETTINGSHAUSEN; Engelhardt, p. 50, pl. 11 (18), fig. 7
1885 *Carya elaenoides* UNGER; Engelhardt, p. 67 (pro parte)
1885 *Carya* sp.; Engelhardt, in sched.
1885 *Ceratopetalum bilinicum* ETTINGSHAUSEN; Engelhardt, p. 48, pl. 10 (17), fig. 27
1885 *Ceratophyllum haeringianum* ETTINGSHAUSEN; Engelhardt, p. 49, pl. 10 (17), fig. 24
1885 *Cissus* sp.; Engelhardt, in sched.
1885 *Cunonia bilinica* ETTINGSHAUSEN; Engelhardt, p. 47, pl. 10 (17), fig. 29
1885 *Juglans bilinica* UNGER;. Engelhardt, p. 65 (pro parte), pl. 16 (23), figs 23, 29, pl. 17 (24), fig. 6
1885 *Myrica acuminata* UNGER; Engelhardt, p. 20, pl. 2 (9), fig. 9
1885 *Myrica hakeaefolia* (UNGER) HEER; Engelhardt, p. 20 (pro parte), pl. 2 (9), figs 4, 6, 27
1885 *Myrsine clethrifolia* SAPORTA; Engelhardt, p. 40, pl. 9 (16), figs 10-11
1885 *Quercus mediterranea* UNGER; Engelhardt, p. 22, pl. 2 (9), fig. 33
1885 ? *Poacites rigidus* HEER; Engelhardt, p. 16 (pro parte)
1885 ? *Sparganium valdense* HEER; Engelhardt, p. 17, pl. 2 (9), fig. 2
1967 *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK, p. 205, pls 1-4 (non pl. 56, fig. 1)
1978 *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK; Bůžek, Holý and Kvaček, p. 356, pl. 3, fig. 6

Description: Leaves obovate-lanceolate, 35-100 mm long and 12-34 mm wide, petiolate, petiole slightly swallen at the base, up to 17 mm long, bud in the leaf axille free, apex acuminate, base narrow cuneate, margin crenate-toothed, teeth partly irregularly spaced, lacking in the lower third of the leaf length. Venation semicraspedodrome, midrib thick and straight, secondaries bent, interspaced with in tersecondaries reaching two thirds of the distance towards the margin, together with the secondaries regular loops in more rows along the margin, side veinlets entering the teeth. Lamina thick, coriaceous. Cuticle medium thick. Adaxial epidermis compound of polygonal cells with broadly undulate anticlines. Abaxial epidermis partly striate, hair bases polycellular, "platanoid". Stomata anomocytic, largely roundish with broad stomatal ledges and large outer cavity. Aperture slit-like. The structure matches exactly that of other records of this species (see Bůžek et al. 1967, Walther in Mai and Walther 1978). Associated infructescences/inflorescences unisexual, male inflorescences globose, smaller, 4 mm across, shortly stalked, tuberculate on the surface by the tips of stamens, female inflorescences globose bristly with protruding styles of the carpels, similar in size to the male ones, ripe infructescences globose, about 20 mm across, with long remains of styles, isolated fruits up to 15 mm long, lanceolate, with style tips bent. Bases of stipules ribbon-shaped, truncate at base and split at the upper part, distal leaf-like portion not preserved.

Remarks: This species of *Platanus* is a characteristic component, mostly confined to Oligocene and Early Miocene (see e.g. Walther 1985, Hably 1985) and seems to have occupied various habitats, usually near lakes and rivers, but avoided flooded areas.

Material studied: NHM Wien: Pb 00007 c, Pb 00192, Pb 00193, Pb 00195, Pb 00209, Pb 00213, Pb 00437, Pb 00886.

MMG Dresden: Ku 157 a, b (inflorescence), Ku 160, Ku 163, Ku 196, Ku 197 a, b (diatomite), Ku 326, Ku 402 a, b, Ku 490 a, b (diatomite), Ku 491 a, b, Ku 492, Ku 493 a, b, Ku 494 (diatomite), Ku 495 a, b, Ku 496, Ku 497 a, b, 42 specimens without numbers.

NM Praha: G 1, G 2.1, G 3, G 5, G 6, G 12, G 68.2, G 69, G 88.4, G 227.2, G 294, G 771.1, G 766.3, G 2112, G 4647, G 5077.2, G 7066, G 7067.

Mus. Litoměřice: ML 34, ML 118, ML 142, ML 181, ML 208.1, ML 218.

Charles Univ. Praha: CKU 117, CKU 122, CKU 128, CKU 133, CKU 150a, CKU 151, CKU 152, CKU 153, CKU 154, CKU 155, CKU 156, CKU 157, CKU 173, CKU 174, CKU 175, CKU 195, CKU 196, CKU 238b, 43 specimens without numbers.

Cuticular preparations: PRKU 11, 122, 128, 133, 154, 156, 157, 173, 174, 238b.

Populus zaddachii HEER

Pl. 13, fig. 3

Description: Leaf base of round-oval leaf, 70 mm wide, incomplete, longly petiolate, petiole wide (? flat), margin glandular crenulate, two bigger glands on either side of the petiole. Venation acrodrome, primaries 3, starting from the very base, lateral bent towards the apex, side veinlets widely spaced, entering the teeth.

Remarks: This incomplete fossil leaf fragment belongs undoubtedly according to the margin, basal glands and venation to this poplar, distributed in the European Oligocene. It immigrated from the Turgay and Baltic regions into Central Europe, where it thrived mainly in the riparian forests (e.g. Floristic Complex Thierbach - Mai and Walther 1991). It is rarely represented in volcanic floras, e.g. Hrazený, Suletice-Berand and Seifhennersdorf.

Material studied: MMG Dresden: Ku 299b.

Pronephrium stiriacum (UNGER) KNOBLOCH et KVAČEK

Pl. 13, fig. 9

Remarks: Fragments of leaf fronds with typical goniopterid venation (rarely preserved) are extremely rare at Kundratice.

Material studied: MMG Dresden: Ku 158 a, b, Ku 179, Ku 517.

Mus. Litoměřice: ML 9.

Charles Univ. Praha: CKU 317, 1 specimen without number.

Pungiphyllum cruciatum (A. BRAUN) FRANKENHÄUSER et WILDE

Pl. 13, fig. 10, text-fig. 13/19

1885 *Ilex gigas* ENGELHARDT, p. 61, pl. 16 (23), fig. 4 (holotype)
1898 *Quercus tephroides* UNGER; Menzel, p. 6, pl. 1, fig. 2
1981 "*Quercus*" *cruciata* A. BRAUN; Kvaček and Walther, p. 85, pl. 7, fig. 1, pl. 8, fig. 2, pl. 11, figs 2-5, text-fig. 7

Description: Leaves obovate, widely coarsely dentate, margin thickened, teeth thorny. Venation craspedodrome. Cuticles extremely thin. Adaxial epidermis smooth, compound of polygonal cells larger than 15 μm across, with straight to slightly sinuate anticlines. Abaxial epidermis also smooth, showing faint outlines of anomocytic (?) stomata. Guard cell pairs roundish to broadly oval, 12-18 μm wide and 18-25 μm long, with ledges slightly thickened and spindle-shaped outer cavity. Trichome bases not observed (for further detatails see Kvaček and Walther 1981).

Remarks: These peculiar leaf forms have been recently revised. Kvaček and Walther (1981) stated on the basis of the material of Kundratice, that stomatal type would not correspond to the situation in *Quercus* L. and removed this species from the Fagaceae. Frankenhäuser and Wilde (1995) erected a new form genus *Pungiphyllum* on the basis of the well preserved material from the Eocene of Eckfeld, Germany for this type of foliage. In spite of characteristic morphology and knowledge of epidermal structure, no extant analogue can be suggested so far.

Material studied: NHM Wien, Pb 4664 (holotype of *Ilex gigas* ENGELHARDT).

MMG Dresden: Ku 137.

NM Praha: G 5129, G 5130.

Charles Univ. Praha: CKU 33, 1 specimen without number.

Cuticular preparations: PRKU CKU 33.

Rosa lignitum HEER

Pl. 13, figs 5-8, text-fig. 13/15

1885 *Rosa lignitum* HEER; Engelhardt, p. 73, pl. 19 (26), figs 11-12
1885 *Rosa bohemica* ENGELHARDT, p. 73, pl. 19 (26), fig. 10 (holotype)
1885 *Cassia berenices* UNGER; Engelhardt, p. 78, pro parte, pl. 20 (27), fig. 16
1885 *Celastrus oxyphyllus* UNGER; Engelhardt, p. 57, pl. 11 (18), fig. 11
1885 *Celastrus palaeo-acuminatus* ENGELHARDT, p. 58, pl. 15 (22), fig. 2, (holotype)
1885 *Cissus rhamnifolia* ETTINGSHAUSEN; Engelhardt, p. 46, pl. 10 (17), fig. 20
1885 *Gleditschia celtica* UNGER; Engelhardt, p. 80, pl. 20 (27), figs 27, 29
1885 *Juglans parschlugiana* UNGER; Engelhardt, in sched.
1885 *Planera ungeri* KOVATS; Engelhardt, p. 26, pl. 3 (10), fig. 33, pl. 4 (12), fig. 21
1885 *Prinos cundraticiensis* ENGELHARDT, p. 62, pl. 15 (22), fig. 7 (holotype)
1885 *Rhamnus gaudinii* HEER; Engelhardt, p. 63 (pro parte), pl. 16 (23), fig. 6
1885 *Rhus prisca* ETTINGSHAUSEN; Engelhardt, p. 69, pl. 16 (23), fig. 12
1885 *Rhus* sp., Engelhardt, in sched.
1885 *Spiraea osiris* ETTINGSHAUSEN; Engelhardt, p. 73, pl. 17 (24), fig. 20
1885 *Ulmus bronnii* UNGER; Engelhardt, p. 25 (pro parte), pl. 4 (11), fig. 30
1885 *Weimannia sotzkiana* UNGER; Engelhardt, p. 47, pl. 10 (17), fig. 18
1898 ? *Carpolithes empleuriformis* MENZEL, p. 11, pl. 1, fig. 12 (holotype) (fructus)

Description: Rarely complete imparipinnately composed leaves with two leaflet pairs, mostly isolated leaflets, oval to longly oval, 23-55 mm long and 13-20 mm wide, shortly petiolulate, petiolule up to 8 mm long, apex slightly acuminate or acute, base rounded to widely cuneate, margin simple serrate to crenulate-serrate, up to 13 teeth on 1 cm. Venation semicraspedodrome, midrib straight, secondaries slightly bent, densely spaced, partly with intersecondaries. Terminal leaflet longly petiolulate, subcordate, lateral leaflets slightly asymmetric, subsessile. Twig fragments with falcate thorns. A dubious fruit recalling a rose hip.

Remarks: This material corresponds to the specimens described by Walther (in Mai and Walther 1978) from Haselbach. This species occurs in Oligocene to Middle Miocene in Central Europe. It is a characteristic element of the volcanic floras in SE Germany and North Bohemia. The scarcity of fruits (more frequent e.g. at Bechlejovice) and more complete characteristics of vegetative organs leaves doubts about its natural extent and specific affinities.

Material studied:NHM Wien: Pb 00098, Pb 00188, Pb 00211, Pb 00290, Pb 00294, Pb 00319, Pb 00342, Pb 00346, Pb 00368, Pb 00369, Pb 00374, Pb 00388, Pb 00389, Pb 00390, Pb 00391, Pb 00404, Pb 00405 b, Pb 00429 a, Pb 00446.

MMG Dresden: Ku 118, Ku 151, Ku 176, Ku 211 a, b, Ku 214, Ku 263, Ku 264 a, Ku 291, Ku 348, Ku 366 (diatomit), Ku 382, Ku 383, Ku 434 a, b, (thorn), Ku 435 (thorn), Ku 476, 10 specimens without numbers.

NM Praha: G 72, G 141, G 142, G 149, G 184, G 220, G 254-2, G 5065, G 5077, G 5094.

Mus. Litoměřice: ML 40, ML 140, Ml 143-2, ML 204.

Charles Univ. Praha: CKU 22, CKU 146, CKU 147, CKU 148, CKU 177, 12 specimens without numbers.

Smilax sp.

Pl. 14, fig. 1

1885 *Ficus lereschii* HEER; Engelhardt, p. 27, pl. 5 (12), fig. 14

Description: Leaves subtriangular, subcordate, 50-100 mm long and 22-50 mm wide, entire-margined, apex acuminate. Venation actinodrome-acrodrome. Primaries 5, the medial one thicker, higher-order venation faintly seen as irregular coarse meshes of various order. Faint elliptic outlines of stomata observed on both leaf sides. Stomata partly subparallel orientated, guard cell pairs 15-20 μm wide and 27-30 μm long. Aperture *Pseudonavicula*-shaped.

Remarks: Very rare specimens recalling *Smilax* by overall form and venation differ from *S. weberi* WESSEL et WEBER known also from the Miocene by acuminate apex. Such leaf forms occur mainly in the Oligocene as rare accessory elements, e.g. at Seifhennersdorf and Suletice-Berand.

Material studied: MMG Dresden: Ku 307 a, b.
NM Praha: G 86.
Mus. Litoměřice: ML 14.
Charles Univ. Praha: CKU 251.
Cuticular preparations: PRKU 251.

Taxus engelhardtii KVAČEK

Pl. 14, figs 2-4, text-fig. 13/3

1885 *Taxodium distichum miocenicum* HEER; Engelhardt, p. 17, pl. 1 (8), fig. 20
1885 *Sequoia ? langsdorfii* HEER; Engelhardt, in sched.
1976 *Taxus engelhardtii* KVAČEK, p. 295, figs. 9 b, c (holotype)
1984 *Taxus engelhardtii* KVAČEK; Kvaček, p. 473, figs 1a, 1b

Description: Incomplete foliage shoots with distichous needle leaves, occurring also isolated, shortly decurrent and bluntly pointed, univeined, without prominently expressed stomatal zones, 8-18 mm long and about 2 mm wide. Cuticle thick. Upper epidermis compound of rectangular shortly elongate smooth cells, longitudinally aligned. Lower epidermis with two stomatal bands. Stomata longitudinally aligned, with roundish crypts with prominent Florin rings. Medial non-stomatal area and stomatal bands strongly papillate. For more information see Kvaček (1976, 1984).

Remarks: It is not a very frequent conifer at Kundratice and very rarely found elsewhere (? Markvartice).

Material studied: NHM Wien: Pb 00011, Pb 00014.
MMG Dresden: Ku 140 a, b, 10 specimens without numbers.
NM Praha: G 2076.
Mus. Litoměřice: ML 7, ML 12.
Charles Univ. Praha: CKU 27, CKU 36, CKU 67A, CKU 69, CKU 120.
Cuticular preparations: PRKU 27, 36, 67A, 69, 120, PRML 7/1, 12/1, G 2076/1, Pb 00011/1.

Tetraclinis salicornioides (UNGER) KVAČEK

Pl. 14, figs 5-6, text-fig. 13/20

1885 *Libocedrus salicornioides* UNGER; Engelhardt, p. 18, pl. 1 (8), figs 27-30
1885 *Callitris brongniartii* ENDLICHER; Engelhardt, p. 18, pl. 1 (8), fig. 32
1901 *Callitris brongniartii* ENDLICHER; Menzel, p. 98, pl. 5, fig. 3
1901 *Libocedrus salicornioides* UNGER; Menzel, p. 101
1978 *Libocedrites salicornioides* (UNGER) ENDLICHER; Bůžek, Kvaček and Walther, p. 356, pl. 3, fig. 3 left, 11
1989 *Tetraclinis salicornioides* (UNGER) KVAČEK, p. 48, pl. 2, figs 3, 10, 12, 14

Description: Foliage shoots plagiotropic, oppositely branched, composed of wide cladode-like leaf segments showing veins of completely fused scale leaves. Cuticle thick. Epidermal structure corresponds exactly with that of other records of this species (see e.g. Knobloch and Kvaček 1976 - as *Libocedrites salicornioides*). Isolated seeds with two equal wings widely open, basally oriented.

Remarks: This taxon attracted attention in recent years (e.g. Kvaček 1989, Mai 1997). The lack of associated typically narrow, alternately branched shoots of *Tetraclinis brachyodon* (BRONGNIART) MAI et WALTHER in all volcanic floras makes the idea of uniting *Tetraclinis salicornioides* and *Tetraclinis brachyodon* into a single species (Mai 1997) improbable.

Material studied: NHM Wien: Pb 00016, Pb 00017, Pb 00018, Pb 00019, PB 00020.
MMG Dresden: Ku 164, Ku 316, Ku 472, 24 specimens without numbers.
NM Praha: G 88-2, G 221-2, G 2099, G 2100, G 2150 a, b, G 2151, G 2152, G 2153, G 2154, G 2155 a, b, G 2157, G 2158, G 2159, G 2160, G 2161, G 2163, G 2164, G 2174, G 2175, G 5099, G 5100.
Mus. Litoměřice: ML 22.2, ML 26, ML 30, ML 172.
Charles Univ. Praha: CKU 8, CKU 28, CKU 29, CKU 30, CKU 31, CKU 67B, CKU 176, 9 specimens without numbers.
Cuticular preparations: PRKU 8, 28-31, 67B, 176.

Tilia gigantea ETTINGSHAUSEN

Pl. 15, figs 1-2

? 1885 *Acer trilobatum* STERNBERG sp.; Engelhardt, p. 52 (pro parte), pl. 6 (13), fig. 10
1885 *Tilia gigantea* ETTINGSHAUSEN; Engelhardt, in sched.

Remarks: The available leaf remains correspond with the type specimens of this species in palmate venation and form of marginal dentation. Typical bracts have not been discovered yet. Remains of *Tilia* L. rarely occur in volcanic floras (Bechlejovice, Seifhennersdorf, Suletice).

Material studied: NHM Wien: Pb 00207, Pb 00208.
Mus. Litoměřice: ? ML 16.

Torreya bilinica SAPORTA et MARION

Pl. 14, figs 7-8, text-fig. 13/18

1885 *Podocarpus eocenica* UNGER; Engelhardt, p. 19, pl. 1 (8), figs 37-38
1978 *Torreya bilinica* SAPORTA et MARION; Bůžek, Kvaček and Walther, p. 356, pl. 3, fig. 4
1984 *Torreya bilinica* SAPORTA et MARION; Kvaček, p. 478, text-figs 5 b, c, i, 6

Description: Isolated needle leaves, cuneate at base and blunt at apex, 20-40 mm long and 2-3 mm wide, with narrow, prominently expressed stomatal bands. Cuticle thick. Upper epidermis compound of prosenchymatous narrow, longitudi-

nally aligned cells. Lower epidermis strongly papillate. Stomata in two stomatal bands, longitudinally aligned, hardly visible, hidden by papillae. Lateral non-stomatal areas partly with low papillae, towards the margin non-papillate, prosenchymatous. For more details see Kvaček (1984).

Remarks: This conifer is an important accessory element of Palaeogene volcanic floras. It deviates from the extant representatives by non-mucronate leaves. According to the epidermal structure it is easily recognizable.

Material studied: NHM Wien: Pb 00015.

NM Praha: G 2088, G 2089, G 3617 - 2, G 65092.

Mus. Litoměřice: ML 2, ML 166-2.

Charles Univ. Praha: CKU 25, CKU 26, CKU 37, CKU 238a, CKU 268.

Cuticular preparations: PRKU 25, 26, 35, 37, 238a, 268.

Toxicodendron herthae (UNGER) comb. n.

Pl. 15, figs 3-8, text-fig. 13/16

1849 *Rhus herthae* UNGER, Blätterabdrücke Schwoszowice, Haidingers Naturwiss. Abh. 3, separatum, p. 6 (non pl. 14, fig. 21) (basionym, Parschlug)
1850a *Rhus herthae* UNGER; Unger, p. 473 (Parschlug)
1861 *Rhus herthae* UNGER; Unger, p. 42, pl. 20, figs 7-9 (Parschlug)
1885 *Rhus herthae* UNGER; Engelhardt, p. 68, pl. 18 (15), fig, 10, fig. 12
1885 *Rhus pyrrhae* UNGER; Engelhardt, p. 68, pl. 17 (24), fig. 19
1885 *Fraxinus deleta* HEER; Engelhardt, p. 37, pl. 8 (15), fig. 23
1885 *Phaseolites orbicularis* UNGER; Engelhardt, p. 76, pl. 19 (26), fig. 48
1885 *Planera ungeri* (KOVATS) ETTINGSHAUSEN; Engelhardt, p. 26, pl. 4 (11), fig. 19
1885 *Zanthoxylon serratum* HEER; Engelhardt, p. 69 (pro parte)

Description: Leaves trifoliate to imparipinnate with two pairs of leaflets, leaflets variable in shape, rounded-oval to longly oval, slightly asymmetric, shortly petiolulate, acuminate, widely cuneate or truncate at base, margin coarsely simple serrate, in basal part entire-margined. Venation semicraspedodrome. Midrib straight, secondaries in basal part at wide angles, united near margin in wide loops, side veinlets from the loops entering the teeth. Epidermal structure poorly preserved. Stomata anomocytic (?), 16-20 μm long, anticlines straight to bent, solitary trichome bases 16 mm across, thin-walled simple papilla-like trichomes 32 μm long observed. Strands, probably remains of secretory channels, on veins.

Remarks: According to leaf morphology and remains of secretory elements on veins these leaves undoubtedly belong to the genus *Toxicodendron* MILLER, as Unger (1850a, p. 473) has already indirectly suggested. Most of the species belonging to this genus are lianas and the same may be true for the fossil species. Unger (1849) described this species for the first time on the basis of the material from Parschlug. With hesitation he identified with this species also a leaf from Swoszowice, which was recognized later as a leaf of *Fagus* L. by Iljinskaja (1962). However, *Rhus herthae* UNGER must be typified by the specimens from Parschlug (Kvaček and Walther 1991).

Material studied: NHM Wien: Pb 00166, Pb 00348 Pb 00349, Pb 00352, Pb 00354, Pb 00399.

MMG Dresden: Ku 142 a, b, Ku 156 a, b, Ku 160, Ku 171, Ku 212 b, Ku 345 a, Ku 346, Ku 464, Ku 465.

NM Praha: G 80, G 81, G 5044.

Mus. Litoměřice: ML 71, Ml 72, ML 73, ML 78, ML 79, ML 83, ML 89.1, ML 222.

Charles Univ. Praha: CKU 72, CKU 179, CKU 180, CKU 181, CKU 184, 8 specimens without numbers.

Cuticular preparations: PRKU 72.

Ulmus fischeri HEER

Pl. 16, figs 1-9, text-fig. 13/39

1885 *Planera ungeri* KOVATS; Engelhardt, p. 26 (pro parte), pl. 4 (11), fig. 14, 16, 20, 28-29
1885 *Ulmus braunii* HEER; Engelhardt, p. 26 (pro parte), pl. 4 (11), fig. 13
1885 *Ulmus bronnii* UNGER; Engelhardt, p. 25 (pro parte), pl. 3 (10), fig. 32
1885 *Ulmus fischeri* HEER, Engelhardt, p. 26, pl. 4 (11), fig. 31

Description: Leaves oval to ovate, 17-80 mm long and 8-50 mm wide, shortly petiolate, petiole up to 15 mm long, margin simple to double serrate, teeth triangular to longly triangular, slightly biconvex, leaf lamina slightly asymmetric at base, acuminate at apex. Venation craspedodrome, midrib thick, secondaries slightly bent, densely spaced, in more than 10 pairs in larger leaves, sometimes forked at one third of their length, entering the teeth.

Remarks: This species has been previously assigned to the closely allied *Ulmus drepanodonta* GRUBOW (Mai and Walther 1991). It occurs in almost all volcanic floras of the studied area. The fruits described below belong undoubtedly to the same plant. Small leaves are difficult to differentiate from the foliage of *Zelkova* SPACH.

Material studied: NHM Wien: Pb 00084, Pb 00091, Pb 00092, Pb 00094a, b, Pb 00100, Pb 00416a.

MMG Dresden: Ku 152 a, b, Ku 193, Ku 194, Ku 260, Ku 262, Ku 303, Ku 485, Ku 486, 10 specimens without numbers.

NM Praha: G 65, G 66, G 67, G 74, G 76 G 77, G 82, G 83, G 124 - 1, G 5075.

Mus. Litoměřice: ML 23, ML 24, ML 27, ML 89-1, ML 161, ML 162, ML 169, ML 225.

Charles Univ. Praha: CKU 139, CKU 140, CKU 141, CKU 208, 20 specimens without numbers.

Ulmus sp. (fructi)

Pl. 16, fig. 6

1885 *Ulmus braunii* HEER; Engelhardt, p. 26, pl. 4 (11), fig. 12

Description: Winged samaras ovate, bicornate, 7 mm long and 6 mm wide, wing incised into narrow triangular tips starting from the nutlet apex, winged rim the same width as the nutlets. Nutlet wide oval, always in the basal part of the fruit, up to 3 mm across, calyx just beneath the fruit on the stalk.

Remarks: The above described fruits recall those of the extant *Ulmus americana* L. (sect. *Blepharocarpus* DUM.), which matches also in leaf morphology the associated *U. fischeri*. Fruit remains of true elms are extremely rare in the volcanic Palaeogene floras. The objects previously assigned to *Ulmus bronnii* UNGER do not belong to this genus (see under *Craigia bronnii*).

Material studied: MMG Dresden: Ku 499 b.

NM Praha: G 81.1.
Mus. Litoměřice : ML 156.
Charles Univ. Praha: 1 specimen without a number

cf. *Vitis stricta* (GOEPPERT) KNOBLOCH

Pl. 14, fig. 9

1885 *Vitis teutonica* A. BRAUN; Engelhardt, p. 46, pl. 10 (17), fig. 12

Remarks: Problematic leaf remains recalling this common type of foliage occur very rarely at Kundratice. They may represent aberrant forms of *Ampelopsis hibschii*.
Material studied: NHM Wien: Pb 00201.
MMG Dresden: 1 specimen without a number.
NM Praha: 1 specimen without a number

Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA

Pl. 15, figs 9-12, text-fig. 13/27

1885 ? *Crataegus pumilifolia* ENGELHARDT, p. 72, pl. 19 (26), fig. 9
1885 *Planera ungeri* (KOVATS) ETTINGSHAUSEN; Engelhardt, p. 26, pl. 4 (11), figs 18-19, 22
1885 *Quercus lonchitis* UNGER; Engelhardt, p. 22, pl. 2 (9), fig. 30

Description: Leaves alternate, ovate, 15-80 mm long and 6-30 mm wide, shortly petiolate, base subcordate to wide cuneate, apex acute, margin simple coarsely, rarely finely serrate, teeth slightly convex or straight on admedial side, convex on abmedial side. Venation craspedodrome, midrib thick, secondaries thin, slightly bent, entering marginal teeth, tertiaries mostly not observable. Rare ultimate foliage shoots, in one case with rounded fruits in leaf axilles.
Remarks: This is the oldest record of *Zelkova* in European Tertiary. This genus is lacking in the Palaeogene of the Weisselster Basin (Haselbach, Thierbach).
Material studied: NHM Wien: Pb 00103.
MMG Dresden: Ku 23 b, Ku 141, Ku 153, Ku 195 a, b, Ku 236, Ku 245, Ku 312, Ku 327, 12 specimens without numbers.
NM Praha: G 56 - 2, G 68, G 79, G 2088.2.
Mus. Litoměřice: ML 18 - 2, ML 19, ML 97.2.
Charles Univ. Praha: CKU 137, CKU 138, CKU 150b, CKU 209, CKU 210, 19 specimens without numbers.

Incertae sedis

1885 *Acacia sotzkiana* UNGER; Engelhardt, p. 81, pl. 20 (27), fig. 35
1898 *Antholithes coronatus* MENZEL, p. 10, pl. 1, fig. 9 a, b
1885 *Carpolithes aceratoides* ENGELHARDT, p. 84, pl. 21 (28), fig. 45
1885 *Carpolithes angulatus* ENGELHARDT, p. 83, pl. 21 (28), fig. 29
1885 *Carpolithes carnosus* ENGELHARDT, p. 84, pl. 21 (28), fig. 29
1898 *Carpolithes coronatus* MENZEL, p. 12, pl. 1, fig. 13
1898 *Carpolithes drupaceus* MENZEL, p. 17, pl. 1, fig. 18
1885 *Carpolithes jugatus* ENGELHARDT, p. 83, pl. 21 (28), figs 26-28
1898 *Carpolithes trimerus* MENZEL, p. 12, pl. 1, figs 15 a, b
1885 *Celastrus protogaeus* ETTINGSHAUSEN; Engelhardt, p. 58, pl. 11 (18), fig. 19
1898 *Cercis antiqua* SAPORTA; Menzel, p. 10, pl. 1, fig. 8
1885 *Chara* sp., Engelhardt, p. 15, pl. 1 (8), fig. 12
1885 *Cinnamomum polymorphum* (A. BRAUN) HEER; Engelhardt, p. 32, pl. 6 (13), figs 13-15
1885 *Cinnamomum scheuchzeri* HEER; Engelhardt, p. 32, pl. 5 (12), fig. 23
1885 *Confervites debilis* HEER; Engelhardt, p. 15, pl. 1 (8), figs 15-16
1885 *Diachaenites ovatus* ENGELHARDT, p. 45, pl. 10 (17), fig. 9
1885 *Diospyros brachysepala* A. BRAUN; Engelhardt, p. 43, pl. 9 (16), fig. 22
1885 *Elaeodendron degener* UNGER; Engelhardt, p. 60 (pro parte), pl. 15 (22), fig. 16
1885 *Embothrium salicinum* UNGER; Engelhardt, p. 36 (pro parte)
1885 *Eucalyptus* sp., Engelhardt, p. 70, pl. 18 (25), figs 26-27
1885 *Kennedija antiqua* ENGELHARDT, p. 74, pl. 17 (24), fig. 15
1885 *Leptomeria flexuosa* ETTINGSHAUSEN; Engelhardt, p. 34, pl. 6 (13), fig. 28
1885 *Lycopodites puberifolius* ENGELHARDT, p. 14, pl. 1 (8), fig. 17
1885 *Menyanthes arctica* HEER; Engelhardt, p. 39, pl. 9 (16), fig. 4
1885 *Myrsine celastroides* ETTINGSHAUSEN; Engelhardt, p. 41, pl. 8 (15), fig. 30
1885 *Myrsine parvifolia* ETTINGSHAUSEN; Engelhardt, p. 41, pl. 8 (15), fig. 28
1885 *Palaeolobium sotzkianum* UNGER; Engelhardt, p. 74, pl. 19 (26), fig. 16
1885 *Pavetta borealis* UNGER; Engelhardt, p. 37, pl. 8 (15), figs 20-21
1885 *Pinus lanceolata* UNGER; Engelhardt, p. 18, pl. 1 (8), fig. 13
1885 *Pirus euphemes* UNGER; Engelhardt, p. 72, pl. 9 (16), fig. 18
1885 *Pisonia eocenica* ETTINGSHAUSEN; Engelhardt, p. 30, pl. 5 (12), fig. 31
1885 *Pittosporum fenzelii* ETTINGSHAUSEN; Engelhardt, p. 60, pl. 14 (21), figs 14-15
1885 *Sapindus falcifolius* (A. BRAUN) HEER; Engelhardt, p. 55, pl. 11 (18), fig. 13
1885 *Terminalia radobojensis* UNGER; Engelhardt, p. 69, pl. 18 (25), fig. 17
1885 *Tetrapteris vetusta* (ETTINGSHAUSEN) SIEBER; Engelhardt, p. 54, pl. 13 (20), figs 28-29
1885 *Vaccinium acheronticum* UNGER; Engelhardt, p. 44, pl. 9 (16), figs 27, 34

Remarks: A considerable part of the taxa described by Engelhardt (1885) and Menzel (1898) represents not identifiable plant fossils, fungal bodies on leaves, impressions of fruits, seeds and flowers and leaves without distinct characters. The examined specimens are listed above in the synonymics in alphabetical order. Also other unpublished specimens of this sort have been found in the collections and left for further studies.
Material studied: NHM Wien: Pb 00013.
MMG Dresden: Ku 13, Ku 120 a, b, Ku 121, Ku 130, Ku 131 a, b (diatomite), Ku 508 a.
NM Praha: G 87, G 89.-2, G 90, G 91, G 92, G 93, G 113, G 114, G 117, G 118, G 119, G 120, G 132, G 133, G 164, G 176, G 178, G 179, G 180, G 181, G 196, G 197, G 201, G 208, G 209, G 218.1, G 247-2, G 263, G 270, G 271, G 272, G 273, G 280, G 281, G 286, G 287, G 298, G 290, G 293, G 297, G 305, G 311, G 312, G 313, G 314.1, G 314.2, G 328, G 330, G 331, G 333, G 334, G 587, G 2975, G 2094, G 5038, G 5073, G 5074.
Mus. Litoměřice: ML 31, ML 114.

Taphnonomy, palaeoecology and palaeoclimatology

The Kudratice flora belongs to the so-called volcanic floras. This term should be used for Tertiary floras which are preserved under conditions of volcanic activity. The sites of deposition are e.g. depressions of fault basins, maar and crater lakes. These localities reflect mostly typical zonal vegetation with characteristic elements. Azonal units of vegetation are usually underrepresented.

These floras are all parautochthonous. Plant remains are preserved in tuffites, diatomites or oil shales (bitumenous shalles). Besides macroclimate, influence of meso- and microclimatic conditions as well as influence of soil fertility from the products of weathered pyroclastics are important. The assemblages reflect the zonal vegetation of a certain time interval. In contrast to the volcanic floras, the basinal floras connected with swamp and fluviatile-lacutrine facies are characterized by typically different azonal units (e.g. aquatic communities, swamp forests and riparian forests). The zonal elements are only partly represented.

Plant-bearing deposits occurring in the outcrop, which have yielded the flora described herein, are built of poorly bedded diatomite, yellowish-brown in colour, in the basal part of the outcrop, and of well-bedded brown diatom oil shale in the upper part. The latter contains much more numerous leaf fossils than the diatomite. The spectrum of the diatom flora of both parts of the site is similar to the upper diatomite layer struck in the core KU-1 (see p. 4). According to Řeháková (1967) this diatom assemblage refers to mesotrophic or eutrophic conditions in the lake.

The oil shale includes droplets of amorphous bitumen, detritus with pollen grains and diatoms in variable quantity, while the diatomite itself is much richer in diatom frustules. The lake, in which the diatomite accumulated, was at first well aerated. After deepening of the water, the regime at the bottom became more anoxic. The lake reached the euxinic phase. Oil shale in weathered state is brownish, but bigger slabs show original dark grey colour, in which dispersed pyrite can be noticed. Anaerobic conditions are also indicated by scarcity of fish fauna and accumulation of leaf compressions with preserved cuticles.

Preservation of complete leaves or even twigs without much deformation demonstrates scarcity of transport by waters from the original stands to the site of burial. Such assemblages can be characterized as parautochthonous (Gastaldo et al. 1992, 1996). As massive wingless fruits are only exceptionally present, a sorting process by stream cannot be expected. Winged disseminules transported by air movement prevail. The oil shale with the same flora was struck also by the core KU-1 several hundreds of meters from the outcrop (see p. 3, text-fig. 2). Hence horizontal extent of at least 500 m can be expected for the lake. However, the fossil-bearing horizon in the core was deposited in deeper parts of the lake in some distance from the lake banks as it contains fewer megafossils. On the other hand, the outcrop, which has yielded also fossil flowers and larger leaves, was situated near the land. It is noteworthy that leaf fossils are not packed together but embedded as scattered and isolated by the thin layers of sediments. The leaf fall occurred not as a sudden event but proceeded for a longer period in pace with slow sedimentation. High representation of sun-leaves (*Alnus gaudinii, Daphnogene*) suggests prevailing wind transport from canopy surface combined with short wash-offs into the lake. According to Obrhelová (1987) these lakes in the volcanic landscape were supplied by mineral springs that influenced the composition of fish fauna.

Banks of the lake emerged well above the water table and did not suit to aquatic - swamp vegetation to grow and to form successional stages of "Verlandung". Also a swamp forest with soft-wood elements (*Populus, Salix*) did not surround the lake. According to autecology of the plants prevailing in the assemblage the reconstructed forests were essentially mesophytic and differentiated as follows:

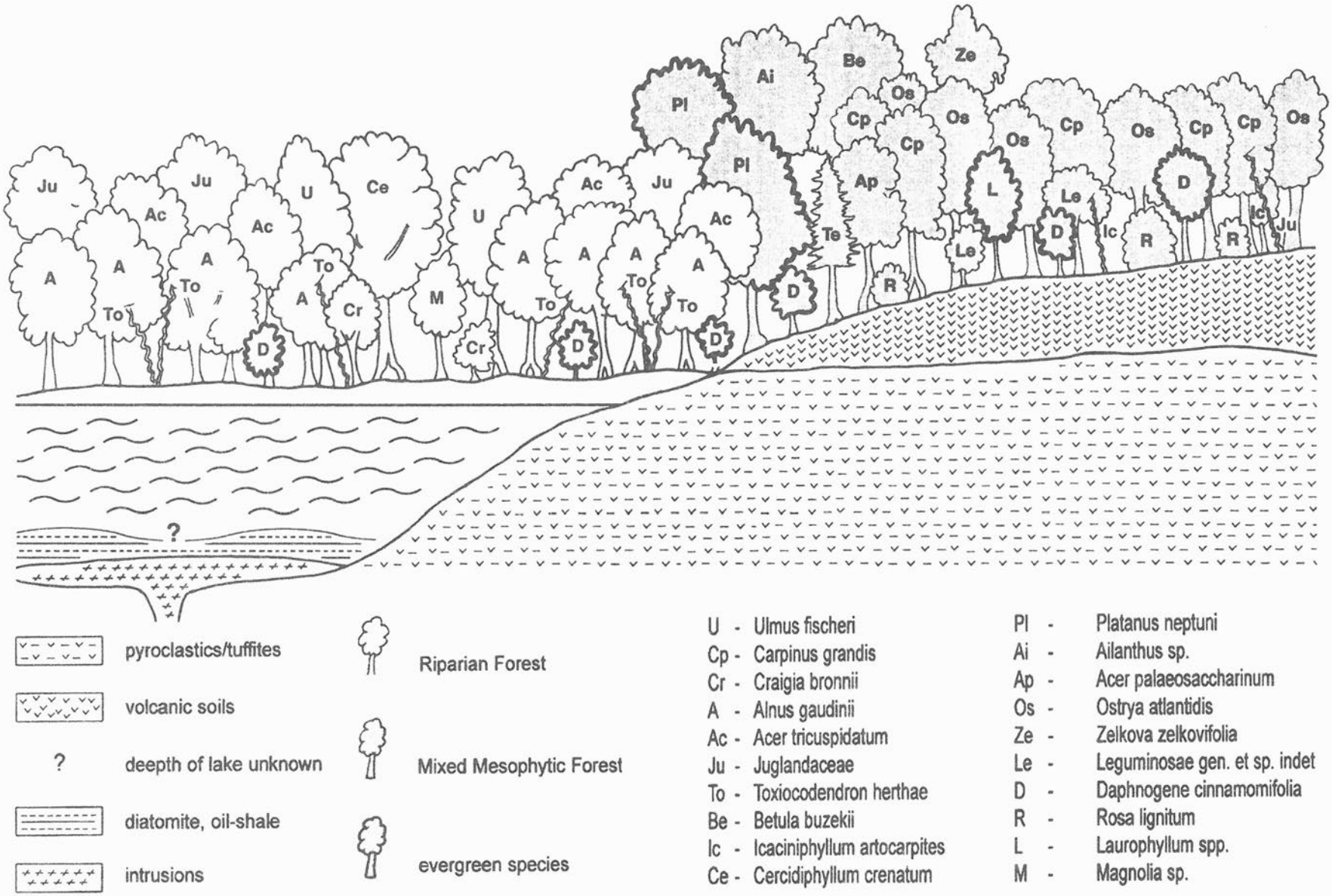
Broad-leaved deciduous forest on humid habitats close to the lake (non-swampy riparian/gallery forest) - table 1.

Most of elements preferred moist soils (e.g. *Alnus, Ulmus, Acer, Craigia, Cercidiphyllum*). Canopy was not well differentiated into storeys and attained a considerable height with the Juglandaceae, *Alnus gaudinii* and *Acer* spp. Lianas and vines were well developed (*Toxicodendron, Vitis, Ampelopsis*) but shrubs occurred rarely. Evergreen elements occasionally penetrated to the lake banks from more mesophytic conditions (*Daphnogene, Platanus neptuni*).

Table 1

Riparian/gallery forest
(frequence classes: I - dominant, II - common, III - rare, *E* - forest storeys: *E4* - trees over 25 m high, *E3* - trees under 25 m high, *E2* - shrubs and lianas, *E1* - herbs)

taxon	forest storeys	frequence classes
Alnus gaudinii	*E4*	I
Acer angustilobum	*E4*	II
Juglandaceae gen. et sp.	*E4*	II
Ulmus fischeri	*E4*	III
Acer cf. *tricuspidatum*	*E4*	III
Cercidiphyllum crenatum	*E4*	III
Craigia bronnii	*E3*	III
Magnolia sp.	*E3*	III
Toxicodendron herthae	*E2*	III
Accessory elements: *Carya serrifolia (E4), Platanus neptuni (E4), Dombeyopsis lobata (E3), Daphnogene (E2-3) Ilex castellii (E2-3), Ampelopsis hibschii (E2),* cf. *Vitis stricta (E2), Osmunda lignitum (E1), Pronephrium stiriacum (E1)*		



Text-fig. 12. Reconstructed Early Oligocene vegetation of Kundratice.

Poorly developed herb storey was represented by extremely rare swamp ferns (*Osmunda, Pronephrium*).

Mixed mesophytic forest with dominating deciduous broad-leaved trees - table 2.

The canopy was differentiated into high trees (*Platanus neptuni, Zelkova zelkovifolia, Betula buzekii* and *Ailanthus* sp.) and smaller trees (*Carpinus grandis, Ostrya atlantidis, Acer palaeosaccharinum*). Frequent evergreen elements either needle-leaf (*Tetraclinis, Cephalotaxus, Taxus, Torreya*) or broad-leaf (*Daphnogene, Laurophyllum*) probably grew as lower trees or shrubs. It is probable that also Leguminosae might have taken part in the understoreys. Shrubs were further represented by *Rosa lignitum,* cf. *Crataegus* and some lianas (Menispermaceae, *Icaciniphyllum*). Unfortunately, the growth form of some common constituents of the assemblage, such as *Dicotylophyllum deichmuelleri* (evergreen), *D. heeri* (deciduous) etc. is doubtful. These may also have taken part in the undergrowth. A possibly smaller density of the mesophytic forest allowed the undergrowth to develop better than it was the case in the riparian forest (text-fig. 12).

According to the leaf physiognomy the following percentage of entire- vs. non-entire-margined broad-leaved woody taxa can be estimated from the total number of species: 37% broad-leaved entire-margined woody elements vs. 63% broad-leaved non-entire-margined woody elements (when also probable arboreal taxa, such as *Dicotylophyllum* spp., are included) and 23% evergreen vs. 77% deciduous trees and shrubs. In terms of Wolfe's classification (Wolfe 1979) the estimated forest formation, which prevailed in the Early Oligocene at Kundratice was very close to the Mixed Mesophytic Forest. Similar comparisons follow from the floristic composition of the assemblage. Such formations indicate warm-temperate humid climatic conditions with mean annual temperature varying between 9-13° C and the mean annual range of temperature (between the coldest and warmest month mean) of 20-30°C. The coldest month mean fluctuated around zero. Total annual precipitations must have attained at least 1200 mm. Compared to the younger assemblage from Suletice (Kvaček and Walther 1995), that of Kundratice includes fewer termophilic elements and in lesser frequency. In volcanic landscapes such differences may have arisen due to the microclimatic and mesoclimatic influence. All the Early Oligocene volcanic floras of the studied area in Central Europe show a distinctly humid (Cfa type) climate. Their floristic/physiognomic differentiation was surely influenced also by soil and slope expositions (Mai and Walther 1997, in preparation). Longer dry periods in the precipitation regime are not to be expected.

Comparison between the flora of Kundratice and other Oligocene floras in Central Europe

The fossil flora of Kundratice with at least 89 taxa of higher plants, i. e. 1 bryophyte, 2 ferns, 4 conifers and 82 angiosperms (table 3, text-fig. 13) belongs to the most diversified in the České středohoří Mts. area including the sites in adjacent regions, e.g. Seifhennersdorf (Saxony), Hrazený/Pirskenberg, Markvartice (Lužice Mts.). All these sites reflect various parts of mesophytic vegetation in the Early Oligocene, which closely surrounded the locality. It is therefore not surprising that the composition of these floras depends more or less on local conditions.

The elements occurring in common at Kundratice as well as in the other volcanic sites are several: *Torreya bilinica, Tetraclinis salicornioides, Carpinus grandis, Ostrya atlantidis, Acer* spp., *Rosa lignitum, Cornus studeri, Craigia bronnii, Platanus neptuni, Laurophyllum acutimontanum, Daphnogene cinnamomifolia, Icaciniphyllum artocarpites,*

Table 2

Mixed Mesophytic Forest
(explanations see table 1)

taxon	forest storeys	frequence classes
Platanus neptuni	*E4*	II
Zelkova zelkovifolia	*E4*	III
Leguminosae gen. et sp. div.	*E2-4*	III
Acer palaeosaccharinum	*E4*	III
Ailanthus sp.	*E4*	III
Daphnogene cinnamomifolia	*E3*	I
Ostrya atlantidis	*E3*	II
Carpinus grandis	*E3*	III
Tetraclinis salicornioides	*E3*	III
Mimosites haeringianus	*E2*	II
Rosa lignitum	*E2*	II
Accessories: cf. *Cyclocarya cyclocarpa (E4), Tilia gigantea (E4), Engelhardia orsbergensis (E4), Betula buzekii (E4), Cephalotaxus parvifolia (E3), Taxus engelhardtii (E3), Torreya bilinica (E3), Laurophyllum acutimontanum (E3), Laurophyllum medimontanum (E3), Laurophyllum* cf. *pseudoprinceps (E3), Celtis* sp. *(E3), Acer integrilobum (E3), Acer rueminianum (E3),* cf. *Crataegus* sp. *(E2), Cornus studeri (E2), Icaciniphyllum artocarpites (E2),* cf. *Matudaea* sp. *(E2)*		

Text-fig. 13. Floral picture of the locality Kundratice. (explanations see p. 33)

Leguminosae etc. On the other hand, some endemic species stress the peculiar character of the Kundratice assemblage: *Taxus engelhardtii, Betula buzekii, Ilex castellii, Dicotylophyllum heeri*. The abundance of *Alnus gaudinii* is also noteworthy. The diversity of this flora can be explained by its age, which is the oldest (32.75 ± 0.82 MA) among the above mentioned sites. Therefore, some of the endemites did not survive and spread over the whole area. The same argument can explain the lack of some plants, e.g. *Comptonia, Liriodendron, Quercus,* which arrived later and were represented in Suletice-Berand, Hrazený, Markvartice etc. The flora of Kundratice can be best compared with that of Seifhennersdorf (Walther 1996) and Hammerunterwiesenthal in the Erzgebirge Mts. (Walther 1998). In the younger floras, such as Suletice-Berand (Kvaček and Walther 1995) and Markvartice (Bůžek et al. 1976) the proportion and diversity of thermophilic elements (*Engelhardia,* Lauraceae, palms) increases.

In the Early Oligocene basinal floras in lowlands of the Leipzig region, several index taxa make connecting links with the upland volcanic terrains (*Rosa lignitum, Ampelopsis hibschii, Icaciniphyllum artocarpites, Laurophyllum acutimontanum, Platanus neptuni, Carpinus mediomontana, Engelhardia orsbergensis* etc.). But in contrast, the lowland floras included *Eotrigonobalanus*, which avoided most of the volcanic sites, such as Kundratice. The floras, which belong to the southern Tethys-Paratethys Province (e.g. the Tard Clay in Hungary) differ from that of Kundratice and most others from the Boreal Province by scarcity of the modern Arcto-Tertiary elements (e.g. *Zelkova, Cercidiphyllum, Acer, Betula, Carpinus* - Hably 1979, Kvaček 1996, Kvaček and Hably, in prep.). The common links are richly represented there among evergreen plants (e.g. *Platanus neptuni, Laurophyllum acutimontanum*). These differences are obviously due to major barriers caused by climatic and palaeogeographic differentiation of Europe during the Early Oligocene.

Mai (1995) ranged the flora of Kundratice into the floristic complex Flörsheim - Nerchau, which is defined as laurophyllous floras with accessory Arcto-Tertiary elements and ancient species: *Eotrigonobalanus furcinervis, Trigonobalanopsis rhamnoides, Sterculia labrusca* (Suletice), *Zizyphus zizyphoides, Myrica longifolia, Comptonia schrankii*. Later (Mai and Walther 1997) a new proposal has been given for the separation of a new floristic complex Seifhennerdorf - Kundratice. Indeed, the flora of Kundratice does not correspond to the original definition of the Flörsheim-Nerchau complex both in the vegetation aspects and the floristic list. The vegetation is prevailingly deciduous and bears aspects of the Mixed Mesophytic Forest. None of the species listed in the characteristic elements of the Flörsheim-Nerchau complex is represented in the Kundratice flora. Radiometric ages date this time interval within the Early Oligocene approximately between 33 - 29 MA, i.e. between the Haselbach and Försheim-Nerchau (sensu stricto) complexes. It is necessary to define this new floristic complex on the basis of new revisions of the type localities (this paper, Walther 1996) and associated floras (Hammerunterwiesenthal - Walther 1998, Hrazený/Knížecí - Knobloch 1961, partly revised, Bechlejovice - Knobloch 1994). All these floras belong to the so-called volcanic floras (see above) so that azonal and coal-forming elements are either underrepresented or lacking. The lower boundary is much more precisely defined by immigration of several Arcto-Tertiary elements while the upper boundary expresses only a shift from cooler to warmer climatic conditions.

Floristic complex Seifhennersdorf - Kundratice

Type localities: Seifhennersdorf near Zittau, Saxony, volcanic serie, diatomite, tuffite and claystone beneath basalt sheet, about 30,7 MA; Kundratice near Litoměřice, North Bohemia, Volcanic Complex of the České středohoří Mts., diatomite, oil shale beneath basaltoid sheet 32.75 ± 0.82 MA

Associated localities: Hammerunterwiesenthal near Annaberg, Erzgebirge Mts., Saxony, tuffite maar lake fill, about 30.5 MA, Hrazený (Pirskenberg)/Knížecí near Šluknov, North Bohemia, diatomite under the basaltoid sheet, 29.49 ±0.74 MA, Bechlejovice near Děčín, North Bohemia, Volcanic Complex of the České středohoří Mts., diatomite under the basalt sheet 24.48 ±0.61 MA.

Vegetation: Mixed Mesophytic Forest (to Broad-leaved Deciduous Forest at Bechlejovice) with high proportion of the Arcto-Tertiary elements.

Flora: First occurrences of *Ostrya atlantidis, Celtis, Zelkova, Liriodendron, Quercus lonchitis, Acer angustilobum, Acer palaeosaccharinum, Carya serrifolia, Cercidiphyllum crenatum, Craigia bronnii, Tilia gigantea, Cornus studeri, Vitis stricta.* Endemites - *Cephalotaxus parvifolia, Betula buzekii, Ilex castellii, Acer engelhardtii, Dicotylophyllum deichmuelleri, D. heeri.* Elements shared with the Haselbach and Flörsheim-Nerchau complexes - *Tetraclinis salicornioides, Platanus neptuni, Laurophyllum acutimontanum, Daphnogene cinnamomifolia, Populus zaddachii, Carpinus mediomontana, Ulmus fischeri, Engelhardia orsbergensis, Rosa lignitum, Nyssa haselbachensis, Palaeohosiea suleticensis/ Icaciniphyllum artocarpites, Ampelopsis hibschii, Sabal major.* Lack of *Eotrigonobalanus* (facial element), Mastixiaceae, *Fagus saxonica/deucalionis, Laurophyllum markvarticense.* Palynological data range this flora in the Calau pollen picture, the zone Pg 20 with *Boehlensipollis* (Konzalová 1996.).

Text-fig. 13. 1. *Betula buzekii* sp. n., 2. *Carpinus grandis* UNGER, 3. *Taxus engelhardtii* KVAČEK, 4-5. *Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK, 6. *Alnus kefersteinii* (GOEPPERT) GOEPPERT, 7. *Magnolia* sp., 8. *Daphnogene cinnamomifolia* (BRONGNIART) UNGER, 9. *Laurophyllum acutimontanum* MAI, 10. *Acer* sp., 11. *Acer angustilobum* HEER, 12-13. *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK, 14. *Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER, 15. *Rosa lignitum* HEER, 16. *Toxicodendron herthae* (UNGER) comb. n., 17. *Ilex castellii* KVAČEK et WALTHER, 18. *Torreya bilinica* SAPORTA et MARION, 19. *Pungiphyllum cruciatum* (A. BRAUN) FRANKENHÄUSER et WILDE, 20. *Tetraclinis salicornioides* (UNGER) KVAČEK, 21. *Acer palaeosaccharinum* STUR, 22. *Acer* cf. *tricuspidatum* BRONN, 23. Leguminosae gen. et sp., 24. "*Palaeolobium*" sp., 25. *Celtis* sp., 26. *Mimosites haeringianus* ETTINGSHAUSEN, 27. *Zelkova zelkovifolia* (UNGER) BŮŽEK et KOTLABA, 28. *Dicotylophyllum heeri* (ENGELHARDT) comb. n., 29. *Cercidiphyllum crenatum* (UNGER) R. BROWN, 30. *Icaciniphyllum artocarpites* (ETTINGSHAUSEN) KVAČEK et BŮŽEK, 31. *Cornus studeri* HEER, 32. *Ampelopsis hibschii* BŮŽEK, KVAČEK et WALTHER, 33. Leguminosae gen. et sp., 34-35. *Ostrya atlantidis* UNGER, 36. Juglandaceae gen. et sp., 37. *Dicotylophyllum deichmuelleri* sp. n., 38. *Ailanthus* sp., 39. *Ulmus fischeri* HEER, 40. *Carya serrifolia* (GOEPPERT) KRÄUSEL.

Table 3

List of the described taxa and their frequencies

(I - more than 300 specimens, II - 100-299, III - 40-99, IV - 10-39, V - 1-9 specimens)

Bryophytes
Bryophyta gen. et sp. (V)
Pteridophytes
Osmundaceae
Osmunda lignitum (V)
Thelypteridaceae
Pronephrium styriacum (V)
Conifers
Cupressaceae
Tetraclinis salicornioides (III)
Cephalotaxaceae
Cephalotaxus parvifolia (V)
Taxaceae
Taxus engelhardtii (IV)
Torreya bilinica (V)
Dicotyledonae
Magnoliaceae
Magnolia sp. (III)
Cabombaceae
cf. *Dusembaya* sp. (V)
Menispermaceae
Menispermaceae gen. et sp. (V)
Lauraceae
Laurophyllum acutimontanum (IV)
Laurophyllum medimontanum (V)
Laurophyllum cf. *pseudoprinceps* (V)
Laurophyllum sp. (III)
Daphnogene cinnamomifolia f. *cinnamomifolia* (IV)
Daphnogene cinnamomifolia f. *lanceolata* (I)
Cercidiphyllaceae
Cercidiphyllum crenatum (III)
Hamamelidaceae
cf. *Matudaea* sp. (V)
Platanaceae
Platanus neptuni (II)
Ulmaceae
Celtis sp. (V)
Ulmus fischeri (III)
Ulmus sp. (fructi) (V)
Zelkova zelkovifolia (III)
Betulaceae
Alnus gaudinii (I)
Alnus kefersteinii (IV)
Alnus sp. (amenta) (V)
Betula buzekii (IV)
Betula sp. (fructi) (V)
Corylaceae
Carpinus grandis (III)
Carpinus mediomontana (V)
Ostrya atlantidis (II)
Juglandaceae
Engelhardia orsbergensis (V)
Carya serrifolia (IV)
cf. *Carya costata* (V)
Carya sp. (amenta) (V)
cf. *Cyclocarya cyclocarpa* (IV)
Juglandaceae gen. et sp. (folia) (III)
Theaceae
cf. *Gordonia* sp. (V)
Salicaceae
Populus zaddachii (V)
Tiliaceae
Tilia gigantea (V)
Craigia bronnii (III)
Dombeyopsis lobata (V)
Leguminosae
Mimosites haeringianus (II)
Leguminosae gen. et sp. forma 1 (IV)
Leguminosae gen. et sp. forma 2 (III)
Leguminosae gen. et sp. forma 3 (III)
Leguminosae gen. et sp. forma 4 (IV)
Leguminosae gen. et sp. forma 5 (IV)
Leguminosae gen. et sp. (fructi) (V)
Rosaceae
Rosa lignitum (III)
cf. *Crataegus* sp. (V)
Simaroubaceae
Ailanthus sp. (III)
Anacardiaceae
Toxicodendron herthae (III)
Aceraceae
Acer angustilobum (II)
Acer integrilobum (V)
Acer palaeosaccharinum (III)
Acer rueminianum (V)
Acer cf. *tricuspidatum* (III)
? *Acer* sp. (flores) (IV)
Acer sp. (fructi) (II)
Cornaceae
Cornus studeri (IV)
Aquifoliaceae
Ilex castelii (V)
Icacinaceae
Icaciniphyllum artocarpites (IV)
Carpolithes sp. (cf. *Palaeohosiea*) (V)
Vitaceae
cf. *Vitis stricta* (V)
Ampelopsis hibschii (IV)
Apocynaceae
Apocynospermum striatum (V)
Oleaceae
Fraxinus sp. (V)
Dicotyledonae fam. indet.
Dicotylophyllum deichmuelleri (II)
Dicotylophyllum heerii (II)
Dicotylophyllum sp. 1 (V)
Dicotylophyllum sp. 2 (V)
Dicotylophyllum sp. 3 (V)
Dicotylophyllum sp. 4 (V)
Dicotylophyllum sp. 5 (V)
Dicotylophyllum sp. 6 (V)
Dicotylophyllum sp. 7 (V)
Dicotylophyllum sp. 8 (V)
Dicotylophyllum sp. 9 (V)
Dicotylophyllum sp. 10 (V)
Dicotylophyllum sp. 11 (V)
Dicotylophyllum sp. 12 (V)
Dicotylophyllum sp. 13 (V)
Dicotylophyllum sp. 14 (V)
Dicotylophyllum sp. 15 (V)
Dicotylophyllum sp. 16 (V)
Dicotylophyllum sp. 17 (V)
"*Palaeolobium*" sp. 1 (II)
"*Palaeolobium*" sp. 2 (IV)
Pungiphyllum cruciatum (V)
Antholithes sp. div.
Amenta sp. div.
Monocotyledonae
Smilacaceae
Smilax sp. (V)
Monocotyledonae fam. indet.
Monocotyledonae gen. et sp. (IV)

Table 4

Comparison of the selected Oligocene floristic complexes of Central Europe

Taxon	Haselbach	Seifhennersdorf-Kundratice	Flörsheim-Nerchau	Thierbach
Sequoia abietina	+	?	-	+
Taxodium balticum	+	+	-	+
Taxodium dubium	-	+	-	+
Athrotaxis couttsiae	+	-	-	+
Cunninghamia miocenica	-	-	-	+
Tetraclinis salicornioides	+	+	+	+
Cephalotaxus parvifolia	-	+	-	-
Taxus engelhardtii	-	+	?	-
Liriodendron	-	+	+	+
Laurophyllum acutimontanum	+	+	+	+
Laurophyllum pseudoprinceps	+	?	+	+
Laurophyllum markvarticense	-	-	+	-
Laurophyllum medimontanum	-	+	?	+
Daphnogene cinnamomifolia	+	+	+	+
Cercidiphyllum	-	+	+	+
Liquidambar	+	-	-	+
Platanus neptuni	+	+	+	+
Ulmus fischeri	+	+	+	+
Ulmus carpinoides	-	-	-	+
Zelkova	-	+	+	-
Celtis	-	+	+	-
Fagus	-	-	-	+
Quercus lonchitis	-	+	?	cf.
Trigonobalanopsis	+	?	+	+
Eotrigonobalanus	+	-	+	-
Alnus kefersteinii	+	+	-	+
Alnus gaudinii	?	+	-	+
Alnus rotshaniana	-	?	-	+
Betula buzekii	-	+	-	-
Carpinus cordataeformis	-	+	+	+
Carpinus mediomontana	+	+	-	-
Ostrya	-	+	+	-
Carya serrifolia	-	+	+	?
Cyclocarya cyclocarpa	-	?	?	+
Engelhardia	+	+	+	-
Salix varians	+	+	-	-
Populus germanica	+	-	-	+
Populus zaddachii	+	+	+	+
Craigia	-	+	+	-
Dombeyopsis lobata	-	+	+	-
Crataegus	-	+	-	-
Pyracatha	+	-	-	-
Rosa lignitum	+	+	+	-
Mimosites haeringianus	-	+	+	-
Palaeohosiea suleticensis	+	+	+	-
Icaciniphyllum	+	+	+	-
Vitis stricta	-	+	-	+
Ampelopsis hibschii	+	+	+	-
Acer haselbachense	+	-	-	+
Acer palaeosaccharinum	-	+	+	-
Acer angustilobum	-	+	+	-
Acer engelhardtii	-	+	-	-

Taxon	Haselbach	Seifhennersdorf-Kundratice	Flörsheim-Nerchau	Thierbach
Acer integerrimum	-	-	-	+
Acer integrilobum	-	+	?	-
Acer decipiens	-	-	+	-
Nyssa altenburgensis	+	+	-	+
Cornus studeri	-	+	+	-
Mastixia amygdalaeformis	-	-	+	+
Tectocarya nerchauensis	-	-	+	-
Ailanthus	-	+	+	-
Ilex castellii	-	+	-	-
Pungiphyllum cruciatum	-	+	+	-
Sabal major	+	+	+	-

Remarks: Main difference to the Försheim-Nerchau complex is in the low representation of *Engelhardia* and other palaeosubtropical elements (except *Daphnogene cinnamomifolia*), an exceptional occurrence of *Comptonia difformis* (Knížecí) and *Liriodendron* (Knížecí, Hammerunterwiesenthal). In the Flörsheim-Nerchau complex rare arboreal elements start to appear - *Calocedrus suleticensis, Acer decipiens*, which help define the upper boundary of the Seifennersdorf-Kundratice complex (table 4). The following corrections should be added to the original definition of the Försheim-Nerchau complex given by Mai (1995): The occurrences of *Acer integerrimum*, *Fagus deucalionis, Paliurus tiliaefolius, Pterocarya paradisiaca, Magnolia kristinae* are doubtful. Revised taxa from Suletice-Berand - "*Sterculia labrusca*" = cf. *Passiflora* sp., "*Gleditschia lyelliana*" = Leguminosae gen. et sp. indet., "*Platanus leucophylla*" = *Acer* spp.

Oligocénní vulkanická flóra Kundratic u Litoměřic, vulkanický komplex Českého středohoří (Česká republika) - přehled

Zlatko Kvaček - Harald Walther

Diatomity a především bituménní jílovce („Brandschiefer") u Kundratic v Českém středohoří jsou od minulého století známou paleontologickou lokalitou flóry, hmyzu a vertebrátní fauny. Basaltoidní lávový příkrov v jejich nadloží byl radiometricky datován K-Ar metodou na 32±0.82 MA (Bellon et al., v tisku), tedy spadá do spodního oligocénu.

V práci podáváme revizi většiny nálezů makroflóry s výjimkou množství květních zbytků, kterým bude věnována samostatná palynologická studie. Studované doklady jsou uloženy ve sbírkách Přírodovědeckého muzea ve Vídni, Státního muzea pro mineralogii a geologii v Drážďanech, Národního muzea v Praze a Okresního muzea v Litoměřicích. Převážná část nových sběrů Č. Bůžka a Z. Kvačka je uložena provizorně na Přírodovědecké fakultě Univerzity Karlovy.

V seznamu taxonů (tab. 3) převažují mezi cévnatými rostlinami krytosemenné (82 taxonů) nad nahosemennými (4 druhy) a kapraďorosty (2 druhy). (Nálezy mechorostů nebyly podrobně prostudovány.) Jako u většiny tzv. vulkanických flór jsou v převaze zastoupeny mezofytní elementy. Teplomilné dřeviny (*Tetraclinis*, Lauraceae, Icacinaceae, *Platanus neptuni*) se méně výrazně podílejí na složení flóry. Většinu druhů tvoří opadavé listnaté stromy a keře (*Alnus, Ostrya, Acer, Cercidiphyllum* aj.). Jako nové druhy byly stanoveny *Betula buzekii* sp. n. a *Dicotylophyllum deichmuelleri* sp. n. Dále byla navržena nová přeřazení taxonů: *Cephalotaxus parvifolia* (WALTHER) comb. n., *Toxicodendron herthae* (UNGER) comb. n., *Daphnogene cinnamomifolia* (BRONGNIART) UNGER forma *lanceolata* (UNGER) stat. n. a *Dicotylophyllum heeri* (ENGELHARDT) comb. n. Přes použití kutikulární analýzy se nepodařilo u řady nálezů stanovit jejich bližší systematické vztahy.

Ve vegetaci byly rozlišeny dvě formace: opadavý listnatý příbřežní les (tab. 1) a smíšený mezofytní les (tab. 2). Klimaticky odpovídá vegetace teplému mírnému pásmu s průměrnou roční teplotou mezi 9-13° C a s rozdílem mezi průměrem nejteplejšího a nejstudenějšího měsíce mezi 20-30° C. Srážkový režim byl humidní s rovnoměrným rozložením srážek v úhrnu nejméně 1200 mm (klima typu Cfa).

Srovnáním oligocénních flór střední Evropy byl definován nový floristický komplex Seifhennersdorf/Kundratice, který paleofloristicky charakterizuje střední část spodního oligocénu (tab. 4).

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Explanations of the plates

PLATE 1

Acer angustilobum HEER
1. CKU 204 (PRC), nat. size.
2. CKU 96 (PRC), nat. size.
3. PRKU 96/1 (PRC), abaxial cuticle of the specimen shown in fig. 2, × 400.

Acer rueminianum HEER
4. ML 32 (Mus. Lit.), nat. size.

Acer palaeosaccharinum STUR
5. Pb 220 (W), nat. size.

Acer integrilobum WEBER
6. Pb 222 (W), nat. size.

Acer cf. *tricuspidatum* BRONN
7. CKU 241 (PRC), nat. size.

Acer sp.
8. fruit, orig. Engelhardt 1885, pl. 13 (20), fig. 15, Pb 235 (W), × 2.

Apocynospermum striatum REID et CHANDLER
9. seed, CKU 285 (PRC), × 2.

Antholites sp.
10. flower, CKU 249 (PRC), × 3.

Ampelopsis hibschii BŮŽEK, KVAČEK et WALTHER
11. Ku 252a (MMG), nat. size.

PLATE 2

Acer angustilobum HEER
1. CKU 102 (PRC), nat. size.
2. abaxial cuticle of the specimen shown in fig. 1, PRKU 102/1 (PRC), × 400.
3. Pb 221 (W), nat. size.
4. orig. Procházka et Bůžek 1975, pl. 27, fig. 7, G 3374 (NM), nat. size.
5. Pb 242 (W), × 2.

Acer palaeosaccharinum STUR [and *Phyllerium kunzei* (A. BRAUN) HEER]
6. orig. Engelhardt 1885, pl. 1(8), fig. 5, Pb 3 (W), × 2.

Acer cf. *tricuspidatum* BRONN
7. Pb 218 (W), × 2.

Acer sp.
8. Pb 226 (W), × 2.

PLATE 3

Alnus gaudinii (HEER) KNOBLOCH et KVAČEK
1. orig. Engelhardt 1885, pl. 16 (23), fig. 14, Pb 316 (W), nat. size.
2. abaxial cuticle, PRKU 219 (PRC), × 400.
3. CKU 222 (PRC), nat. size.

Alnus sp.
4. catkin, CKU 85 (PRC), × 2.

Alnus kefersteinii (GOEPPERT) GOEPPERT
5. infructescence, counterimpression of orig. Engelhardt 1885, pl. 2 (9), fig. 12, Pb 38 (W), nat. size.
6. infructescence, Ku 211 (MMG), nat. size.

Betula sp.
7. fruit, CKU 281 (PRC), × 3.

Betula buzekii sp. n.
8. abaxial cuticle of the holotype, PRKU 143/1 (PRC), × 400.
9. holotype, CKU 143 (PRC), nat. size.
10. CKU 227 (PRC), nat. size.

Bryophyta gen. et sp.
11. CKU 286 (PRC), × 3.

PLATE 4

Cephalotaxus parvifolia (WALTHER) comb. n.
1. G 7576 (NM), × 5.
2. adaxial cuticle of the specimen shown in fig. 1, G 7576/1 (NM), × 200.
3. adaxial cuticle of orig. Kvaček 1984, fig. 9, × 250.

Ailanthus sp.
4. orig. Engelhardt 1885, pl. 2 (9), fig. 31, Pb 43 (W), × 2.

Carya serrifolia (GOEPPERT) KRÄUSEL
5. CKU 158 (PRC), nat. size

cf. *Carya costata* (STERNBERG) BRONGNIART
6. fruit, Ku 296a (MMG), nat. size.

Carya sp.
7. catkin, CKU 87 (PRC), × 2.

Celtis sp.
8. Ku 510 (MMG), nat. size.

Cornus studeri HEER
9. orig. Engelhardt 1885, pl. 16 (23), fig. 17, Pb 320 (W), nat. size.

Cercidiphyllum crenatum (UNGER) R. W. BROWN
10. Pb 205 (W), nat. size.
11. seed, G 177 (NM), × 8.

12. seed, orig. Engelhardt 1885, pl. 6 (13), fig. 8, G 5110 (NM), × 8.
13. fruit, CKU 280 (PRC), × 3.
14. fruit, CKU 279 (PRC), × 3.

Carpinus mediomontana MAI
15. involucre, Ku 416 (MMG), × 2.

Carpinus grandis UNGER
16. CKU 213 (PRC), nat. size.

PLATE 5

Dombeyopsis lobata UNGER
1. CKU 316 (PRC), nat. size.

Craigia bronnii (UNGER) KVAČEK, BŮŽEK et MANCHESTER
2. fruit valve, Pb 106 (W), × 2.

cf. *Crataegus* sp.
3. CKU 229 (PRC), × 1.5.

cf. *Cyclocarya cyclocarpa* (SCHLECHTENDAL) KNOBLOCH
4. Pb 65 (W), × 2.

Daphnogene cinnamomifolia (BONGNIART) UNGER forma *cinnamomifolia*
5. ML 197 (Mus. Lit.), nat. size.

Daphnogene cinnamomifolia (BONGNIART) UNGER forma *lanceolata* (UNGER) stat. n.
6. CKU (PRC), nat. size.
7. abaxial cuticle, PRKU 298/1 (PRC), × 400.

Dicotylophyllum sp. 3
8. orig. Engelhardt 1885, pl. 10 (17), fig. 11, Pb 212 (W), nat. size.

Dicotylophyllum sp. 5
9. Pb 4667 (W), nat. size.

Dicotylophyllum sp. 2
10. orig. Engelhardt 1885, pl. 11 (18), fig. 6, Pb 191 (W), nat. size.

Dicotylophyllum sp. 4
11. Pb 358b (W), nat. size.

Dicotylophyllum sp. 8
12. orig. Engelhardt 1885, pl. 8 (15), fig. 26, G 229 (NM), × 4.

PLATE 6

Dicotylophyllum sp. 1
1. Pb 177 (W), nat. size.

Dicotylophyllum sp. 6
2. Ku 511a (MMG), × 2.

Dicotylophyllum heeri (ENGELHARDT) comb. n.
3. Ku 405 (MMG), nat. size.
4. abaxial cuticle, PRKU 121/1 (PRC), × 400.
5. orig. Engelhardt 1885, pl. 12 (19), fig. 12, G 4648 (NM), nat. size.
6. holotype, orig. Engelhardt 1885, pl. 15 (22), fig. 3, G 2090.2 (NM), × 2.

Dicotylophyllum deichmuelleri sp. n.
7. abaxial cuticle of the holotype, PRKU 191/1 (PRC), × 400.
8. adaxial cuticle of the holotype, PRKU 191/1 (PRC), × 400.
9. CKU 187 (PRC), nat. size.
10. CKU 188 (PRC), nat. size.
11. G 5045 (NM), nat. size.
12. holotype, CKU 191 (PRC), nat. size.

Dicotylophyllum sp. 10
13. CKU 178 (PRC), × 3.

PLATE 7

Dicotylophyllum sp. 7
1. CKU 296 (PRC), × 1.5.
2. detail of the same specimen, × 5.

Dicotylophyllum sp. 11
3. CKU 292 (PRC), × 1.5.
4. detail of the same specimen, × 5.
5. abaxial cuticle of the same specimen, PRKU 292/1 (PRC), × 400.

Dicotylophyllum sp. 12
6. CKU 299 (PRC), × 1.5.
7. detail of the same specimen, × 5.
8. CKU 244 (PRC), nat. size.

Dicotylophyllum sp. 9
9. ML 244 (Mus. Lit.), nat. size.

PLATE 8

Dicotylophyllum sp. 13
1. CKU 260 (PRC), × 1.5.
2. CKU 262 (PRC), × 1.5.
3. abaxial cuticle of the specimen shown in fig. 1, PRKU 260/1 (PRC), × 400.
4. detail of fig. 1, × 5.

Dicotylophyllum sp. 14
5. CKU 201 (PRC), × 1.5.

Dicotylophyllum sp. 16
6. CKU 293.1 (PRC), × 1.4.

Fraxinus sp.
7. fruit, ML 120 (Mus. Lit.), × 2.

Dicotylophyllum sp. 15
8. CKU 126 (PRC), × 1.5.
9. abaxial cuticle of the specimen shown in fig. 8, PRKU 126/1 (PRC), × 400.

PLATE 9

Dicotylophyllum sp. 17
1. CKU 240 (PRC), × 1.5.
2. abaxial cuticle of the same specimen, PRKU 240/1 (PRC), × 400.

Icaciniphyllum artocarpites (ETTINGSHAUSEN) KVAČEK et BŮŽEK
3. ML 109 (Mus. Lit.), nat. size.
4. abaxial cuticle, Pb 52/1 (W) (MMG), × 400.
5. ML 88 (Mus. Lit.), nat. size.

Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER
6. G 7604.1 (NM), × 3.

Carpolithes sp. (cf. *Palaeohosiea* sp.)
7. fruit, ML 114 (Mus. Lit.), × 2.

cf. *Gordonia* sp.
8. seed, Ku 317a (MMG), × 2.
9. seed, Pb 151b (W), × 2.

cf. *Dusembaya* sp.
10. seed, CKU 314 (PRC), × 3.

Juglandaceae gen. et sp.
11. Pb 187 (W), nat. size.

Ilex castellii BŮŽEK, KVAČEK et WALTHER
12. holotype, orig. Engelhardt 1885, pl. 8 (15), fig. 19, Pb 159 (W) nat. size.
13. abaxial cuticle, Ku 175/1 (MMG), × 400.

PLATE 10

Laurophyllum medimontanum BŮŽEK, HOLÝ et KVAČEK
1. CKU 106 (PRC), × 1.5.
2. abaxial cuticle, PRKU 295/1 (PRC), × 400.

Laurophyllum cf. *pseudoprinceps* WEYLAND et KILPPER
3. orig. Engelhardt 1885, pl. 8 (15), fig. 11, Pb 302a (W), nat. size.

Laurophyllum acutimontanum MAI
4. CKU 427 (PRC), nat. size.
5. abaxial cuticle, PRKU 305/1 (PRC), × 400.

Laurophyllum sp.
6. CKU 237 (PRC), nat. size.

Leguminosae gen. et sp. forma 3
7. Pb 410 (W), × 2.

Leguminosae gen. et sp.
8. fruit, Ku 333 (MMG), nat. size.

Leguminosae gen. et sp. forma 1
9. Pb 406a (W), × 2.

Leguminosae gen. et sp. forma 2
10. CKU 199 (PRC), nat. size.

Leguminosae gen. et sp. forma 4
11. ML 167 (Mus. Lit.), nat. size.

PLATE 11

Leguminosae gen. et sp. forma 1
1. Pb 397 (W), × 2.

Leguminosae gen. et sp. forma 3
2. CKU 261.1 (PRC), × 1.5.
3. abaxial cuticle of the specimen shown in fig. 2, PRKU 261.1/1 (PRC), × 400.

Magnolia sp.
4. CKU 171 (PRC), nat. size.
5. CKU 109 (PRC), × 1.4.
6. adaxial cuticle on the midrib of the specimen shown in fig. 5, PRKU 109/1, × 400.

Leguminosae gen. et sp. forma 5
7. Pb 426 (W), nat. size.

Mimosites haeringianus ETTINGSHAUSEN
8. CKU 166 (PRC), nat. size.
9. orig. Engelhardt 1885, pl. 20 (27), fig. 42, Pb 432a (W), × 2.

Osmunda lignitum (GIEBEL) STUR
10. CKU 258 (PRC), × 1.5.

Monocotyledonae gen. et sp.
11. Pb 6b (W), × 2.

PLATE 12

cf. *Matudaea* sp.
1. CKU 112 (PRC), × 1.5.
2. CKU 263 (PRC), × 1.5.
3. abaxial cuticle of the specimen shown in fig. 2, PRKU 263/1 (PRC), × 400.

Ostrya atlantidis UNGER
4. Pb 64 (W), nat. size.
5. detail of the same specimen, × 2.
6. involucre, CKU 273 (PRC), × 2.
7. involucre with a fruit, CKU 272 (PRC), × 2.

Menispermaceae gen. et sp.
8. Ku 509b (MMG), nat. size.

Platanus neptuni (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK
9. CKU 117 (PRC), nat. size.
10. CKU 152 (PRC), × 2.
11. infructescence, CKU 175 (PRC), nat. size.
12. stipule, ML 208.1 (Mus. Lit.), × 2.
13. isolated fruits, CKU 313 (PRC), × 2.
14. male inflorescence, ML 124 (Mus. Lit.), × 2.
15. abaxial cuticle, PRKU 122 (PRC), × 400.

PLATE 13

"*Palaeolobium*" sp. 1
1. Pb 382 (W), nat. size.
2. abaxial cuticle, PRKU 301/1 (PRC), × 400.

Populus zaddachii HEER
3. Ku 299b (MMG), nat. size.

"*Palaeolobium*" sp. 2
4. Pb 163 (W), × 2.

Rosa lignitum HEER
5. thorn, Ku 434b (MMG), × 2.
6. CKU 22 (PRC), × 1.5.
7. Pb 376 (W), × 1.5.
8. Pb 388 (W), × 2.

Pronephrium stiriacum (UNGER) KNOBLOCH et KVAČEK
9. CKU 317 (PRC), nat. size.

Pungiphyllum cruciatum (A. BRAUN) FRANKENHÄUSER et WILDE
10. orig. Engelhardt 1885, pl. 16 (23), fig. 4, Pb 4664 (W), nat. size.

PLATE 14

Smilax sp.
1. Ku 307b (MMG), nat. size.

Taxus engelhardtii KVAČEK
2. ML 12 (Mus. Lit.), × 3.
3. adaxial cuticle of the specimen shown in fig. 2, PRML 12/1 (PRC), × 250.
4. Pb 14 (W), × 2.

Tetraclinis salicornioides (UNGER) KVAČEK
5. Pb 16 (W), × 2.
6. Pb 17 (W), nat. size.

Torreya bilinica SAPORTA et MARION
7. ML 166.2 (Mus. Lit.), × 3.
8. adaxial cuticle, PRKU 268.2/1 (PRC), × 250.

cf. *Vitis stricta* (GOEPPERT) KNOBLOCH
9. orig. Engelhardt 1885, pl. 10 (17), fig. 12, Pb 201b (W), × 2.

PLATE 15

Tilia gigantea ETTINGSHAUSEN
1. Pb 207 (W), nat. size.
2. Pb 208 (W), nat. size.

Toxicodendron herthae (UNGER) comb. n.
3. orig. Engelhardt 1885, pl. 8 (15), fig. 23, Pb 166a (W), × 2.
4. ML 89.1 (Mus. Lit.), × 2.
5. Pb 349b (W), × 2.
6. Ku 262 (MMG), × 2.
7. secretory channels on veins, PRKU 72/1 (PRC), × 250.
8. trichomes on the abaxial cuticle, PRKU 72/1 (PRC), × 400.

PLATE 16

Ulmus fischeri HEER
1. CKU 140 (PRC), × 1.5.
2. Pb 416a (W), × 2.
3. Pb 91 (W), × 2.
4. CKU 141 (PRC), nat. size.
5. Pb 94b (W), × 2.

Ulmus sp.
6. fruit, ML 156 (Mus. Lit.), × 3.

rhizome
7. s. n. (MMG), × 1.5
8. the same specimen, × 1.8

Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA
9. CKU 138 (PRC), × 2.
10. CKU 210 (PRC), nat. size.
11. Ku 23b (MMG), × 2.
12. detail of fig. 9, × 2.


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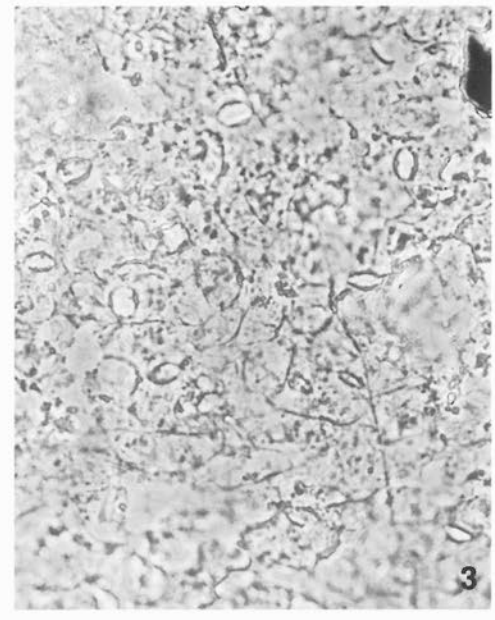
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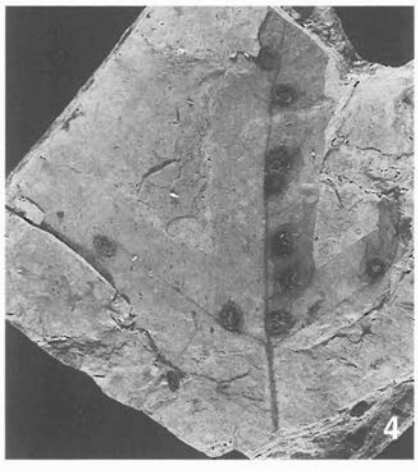
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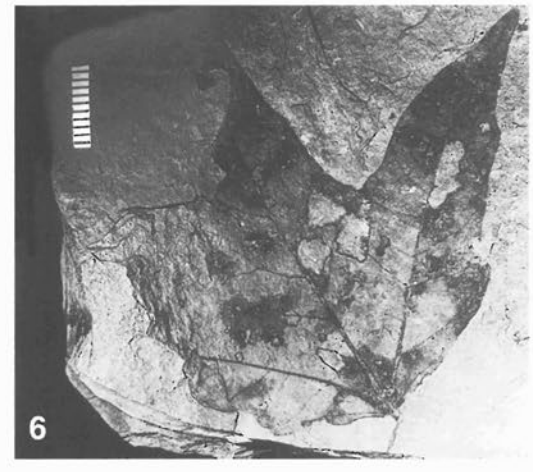
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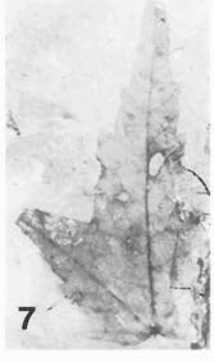
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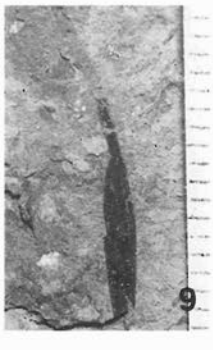
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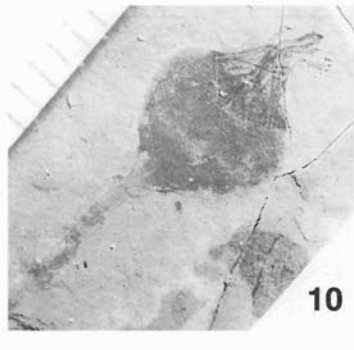
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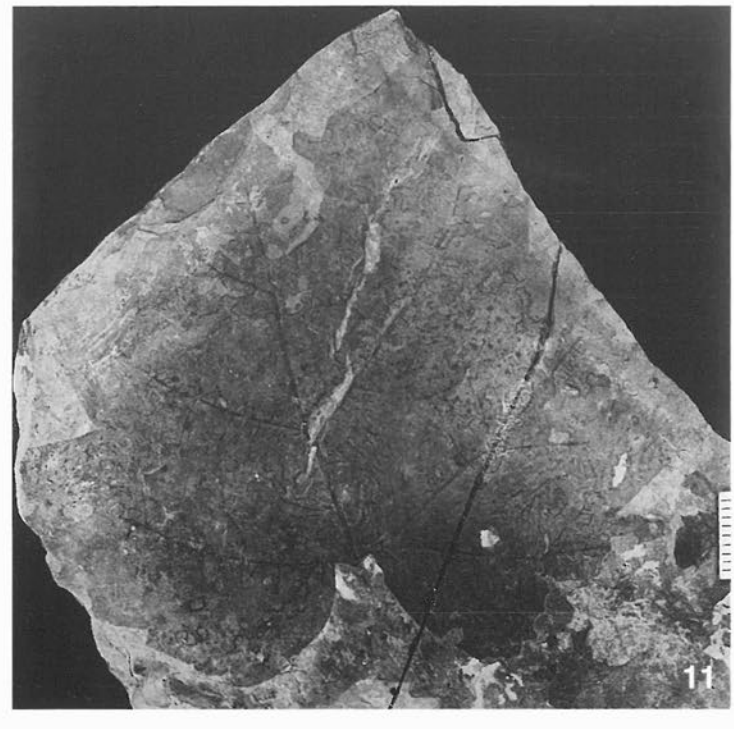
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Plate 2


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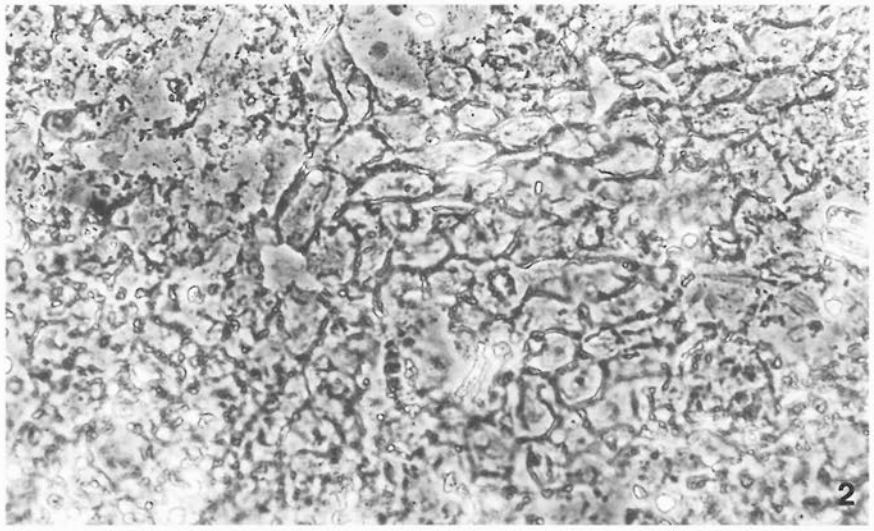
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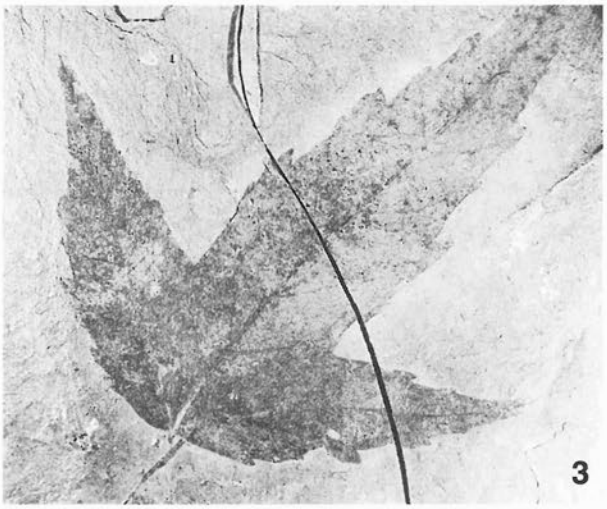
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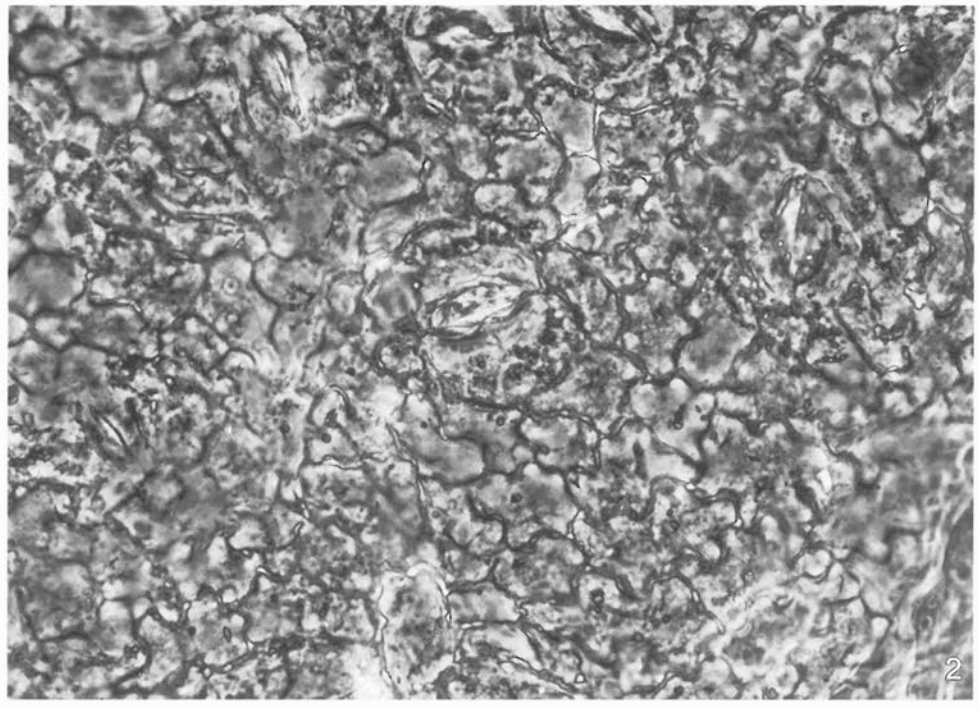
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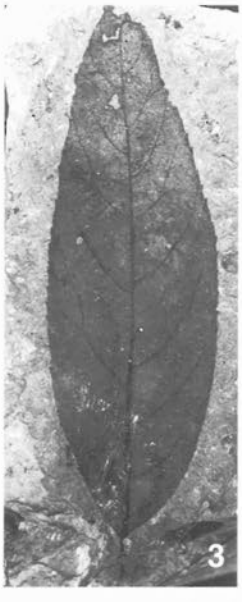
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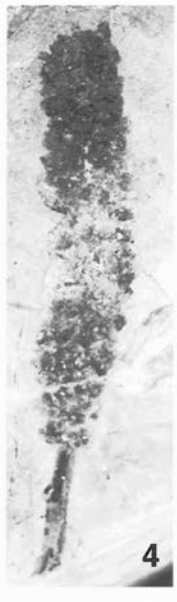
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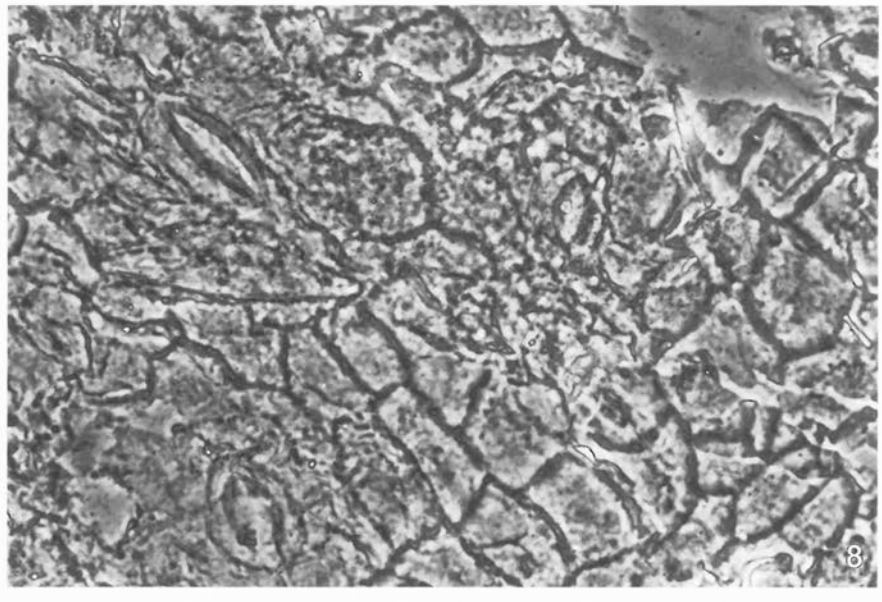
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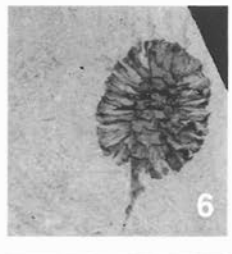
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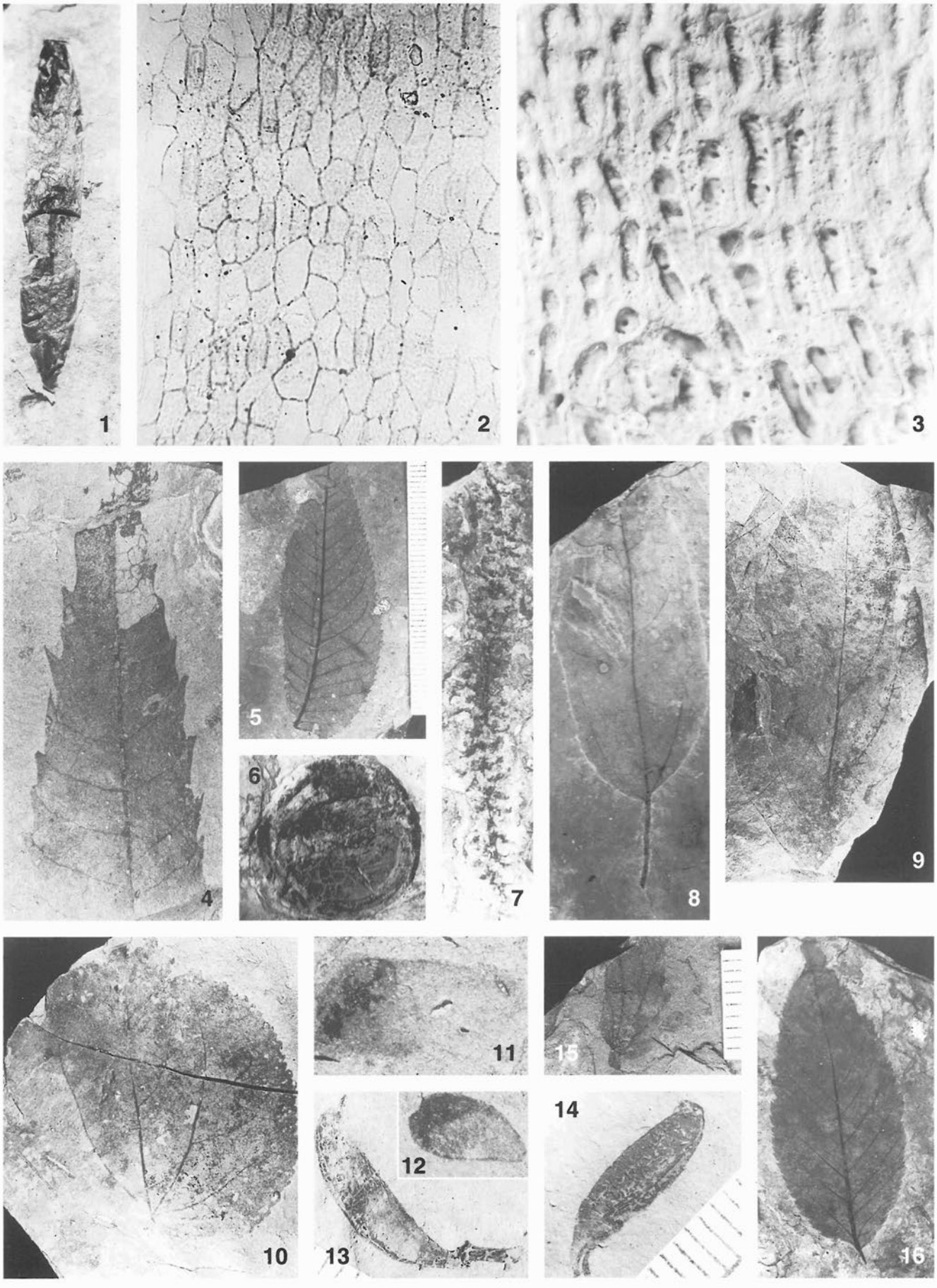
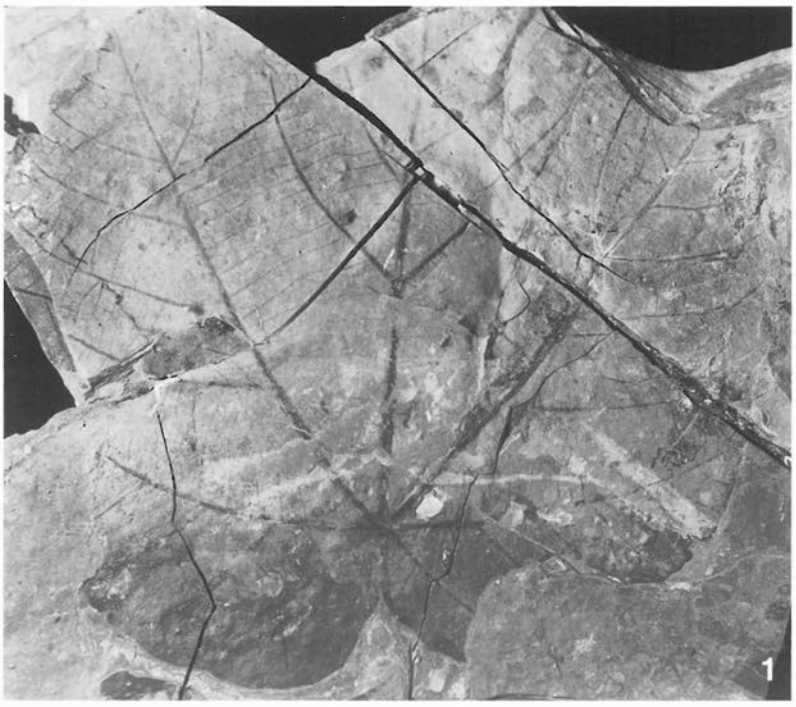
Plate 4

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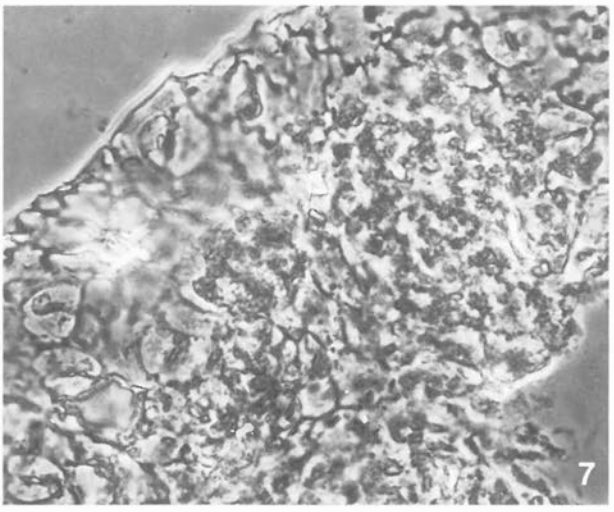
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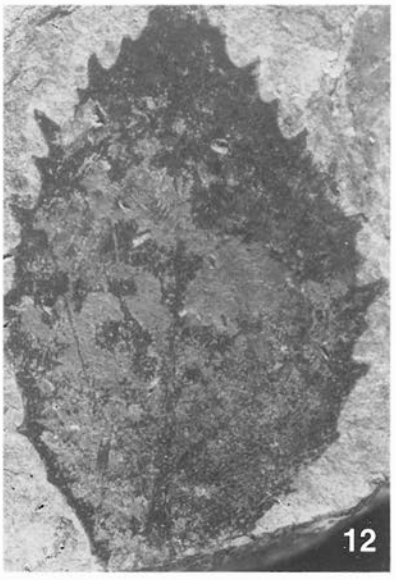
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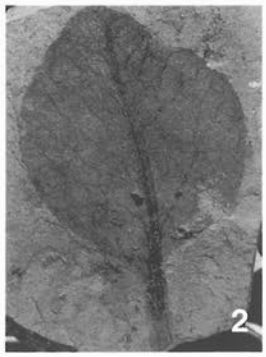

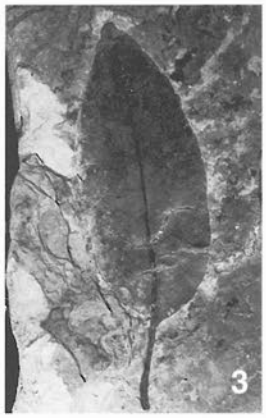

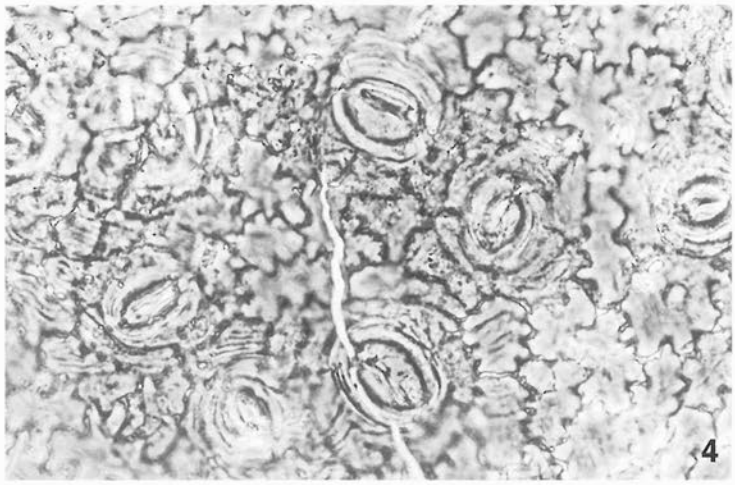

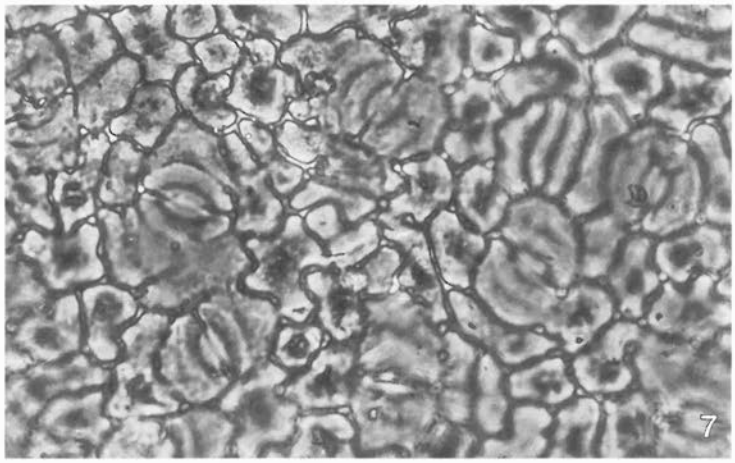

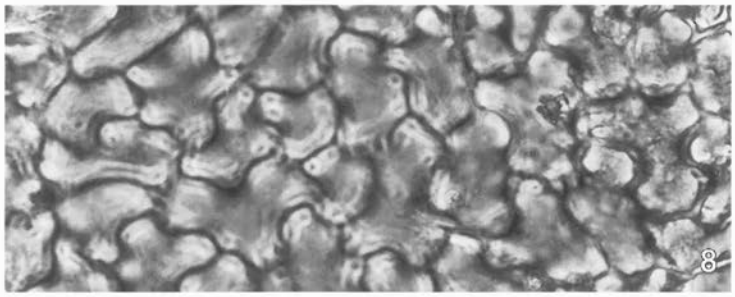

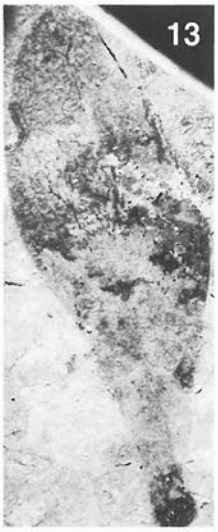

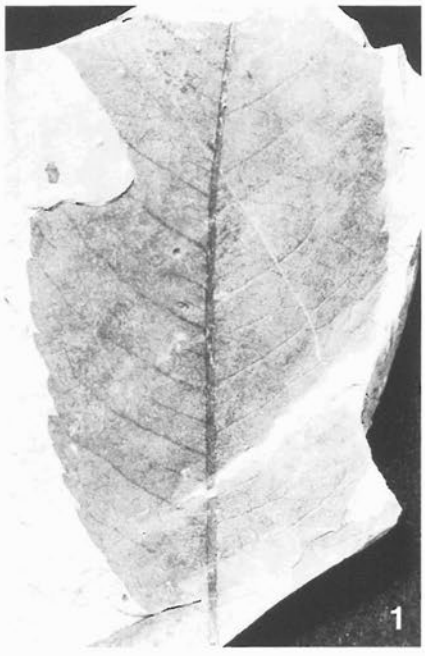
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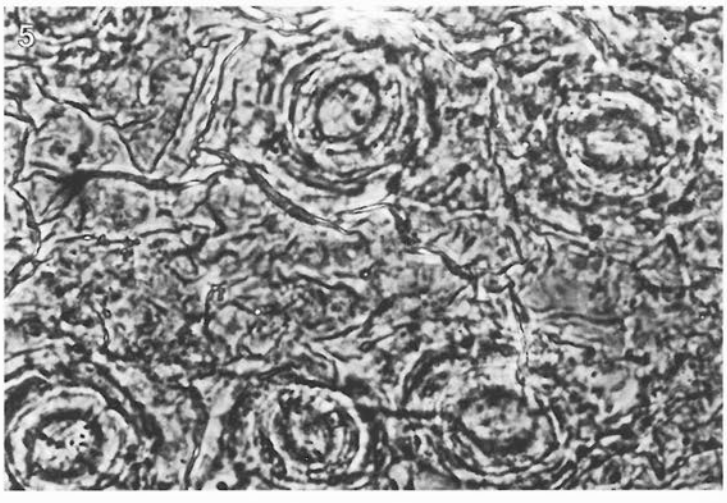
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Plate 8


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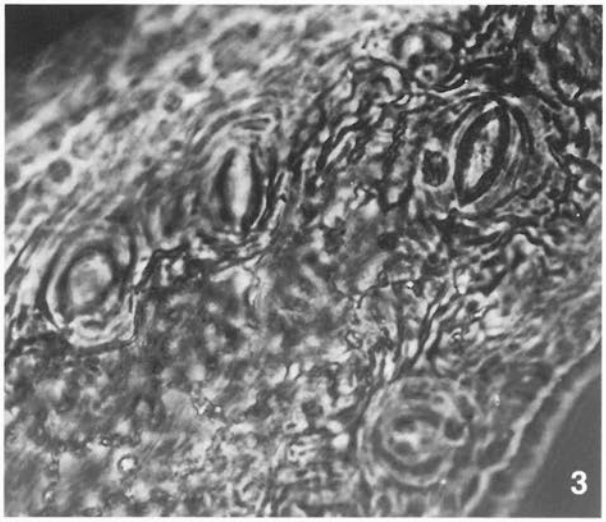
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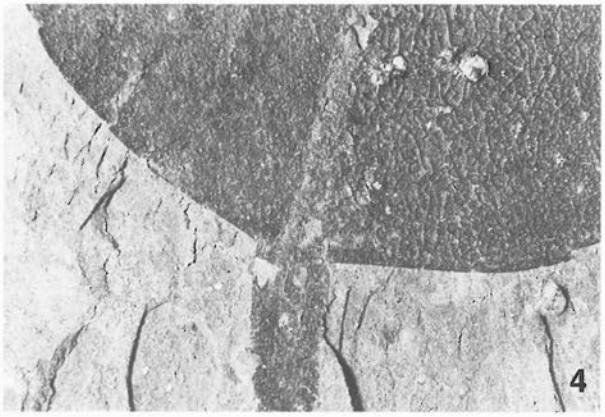
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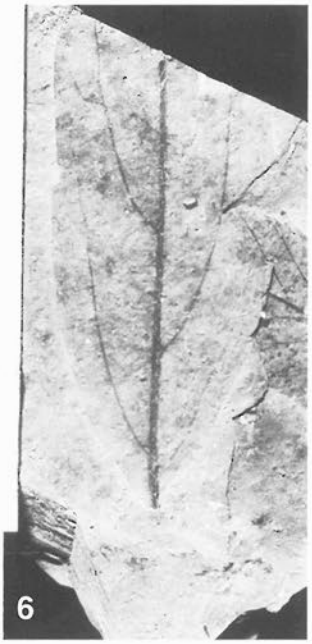
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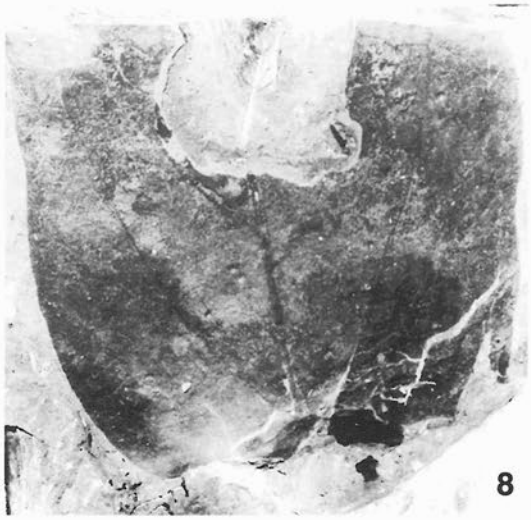
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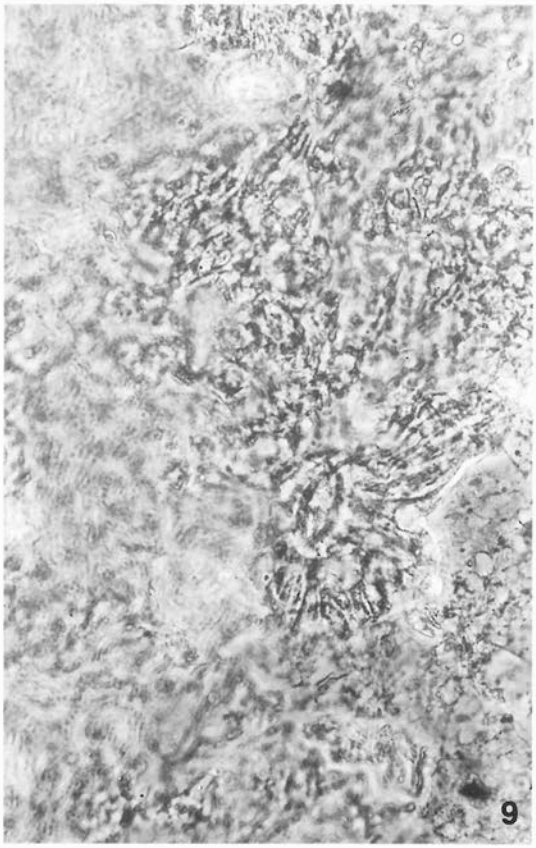
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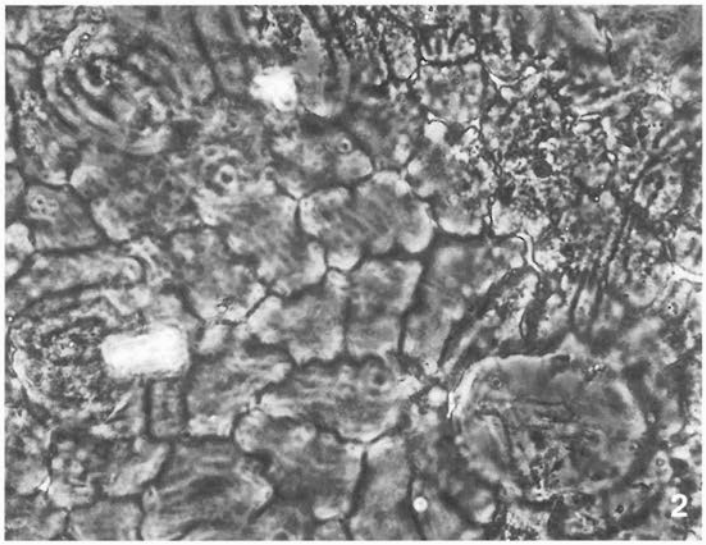
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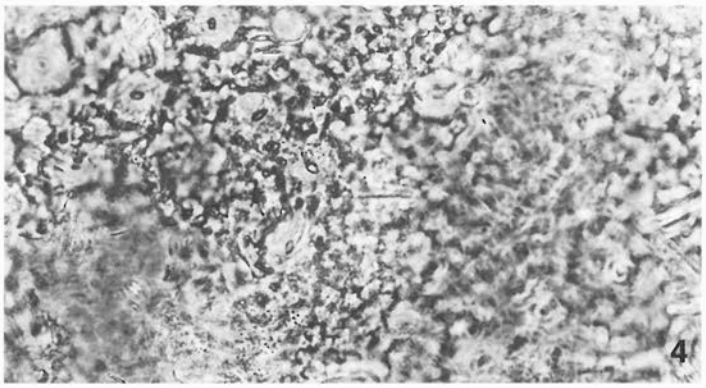
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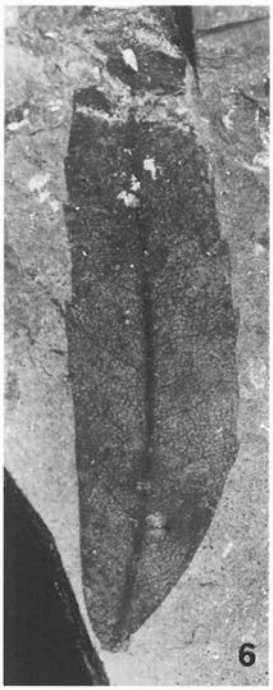
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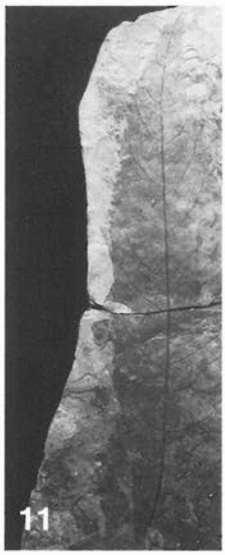
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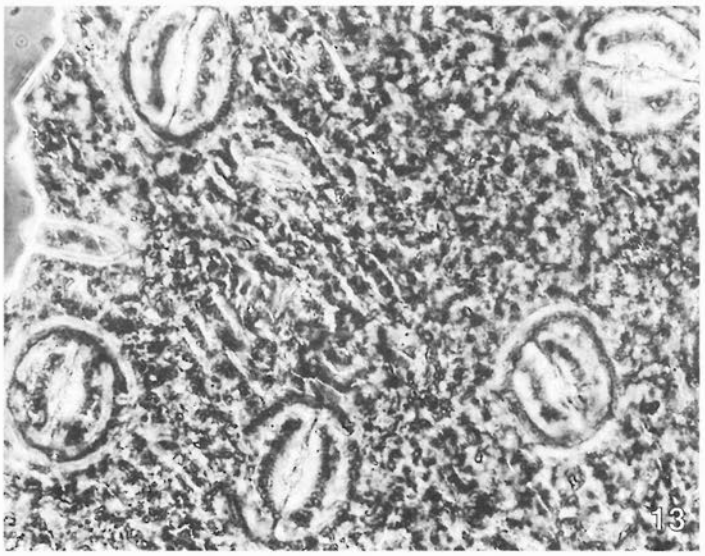
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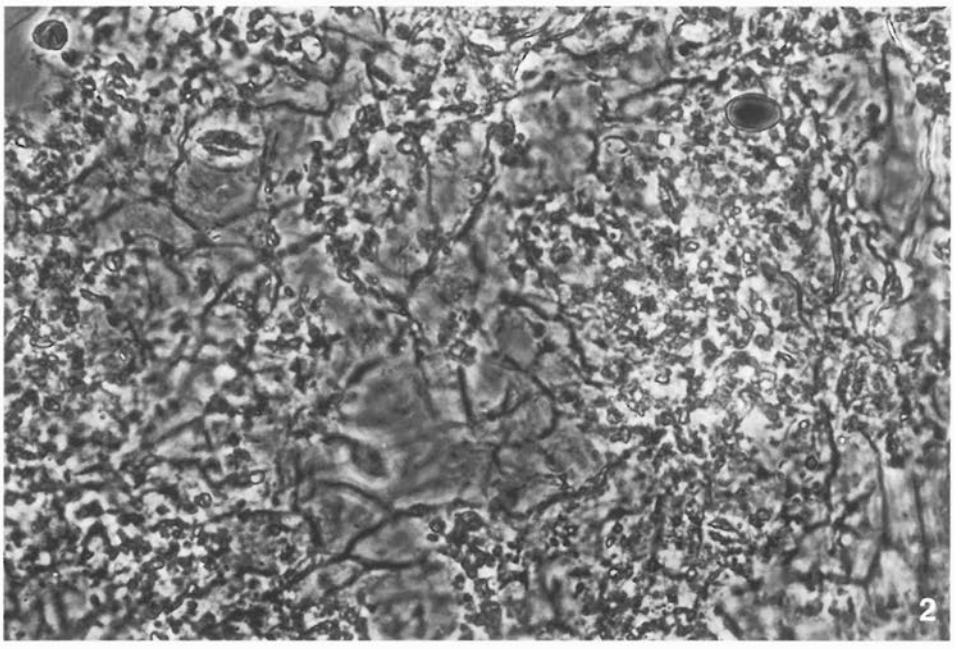

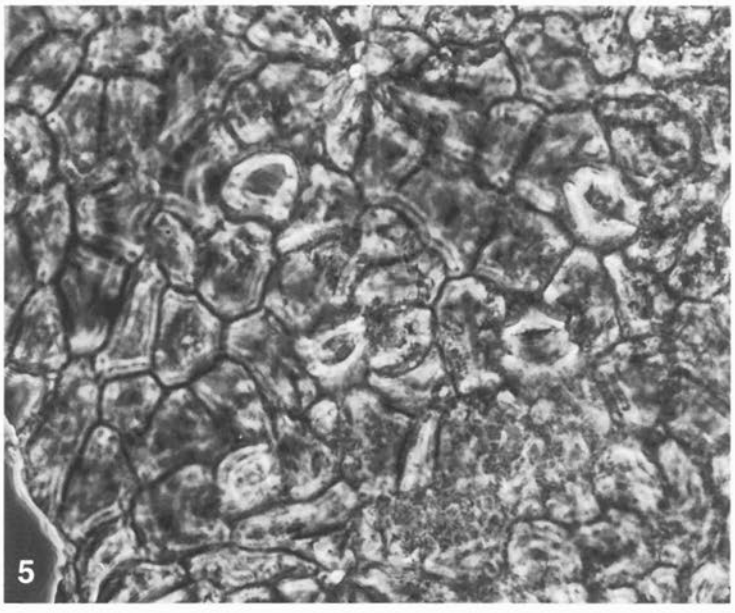

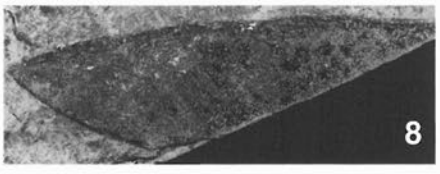

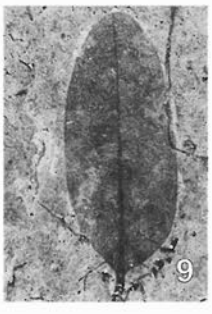

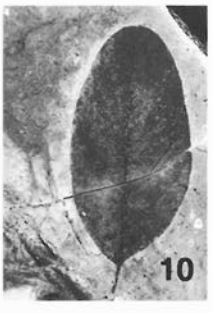

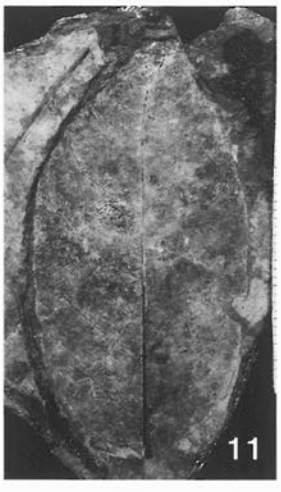


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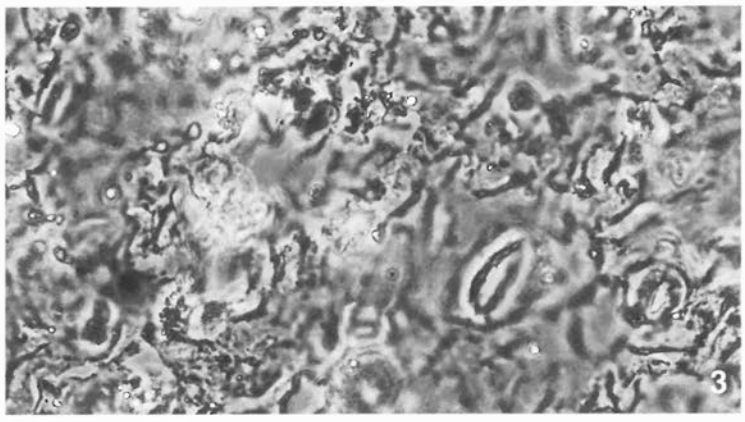
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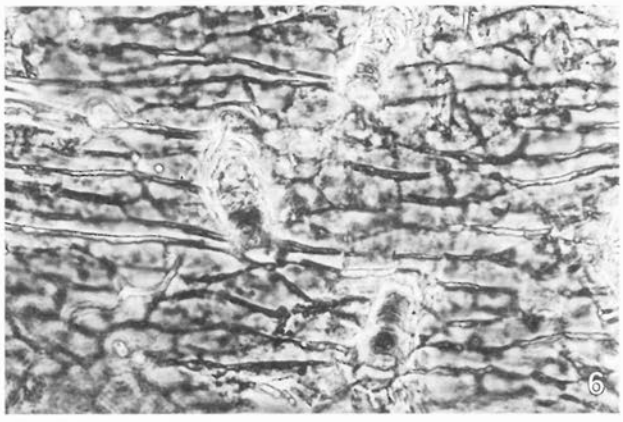
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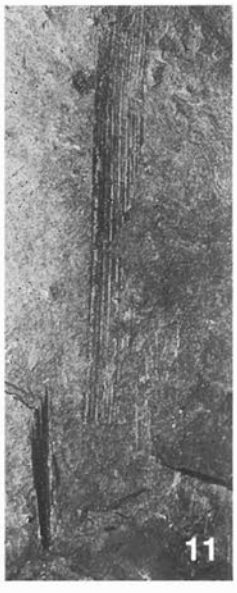
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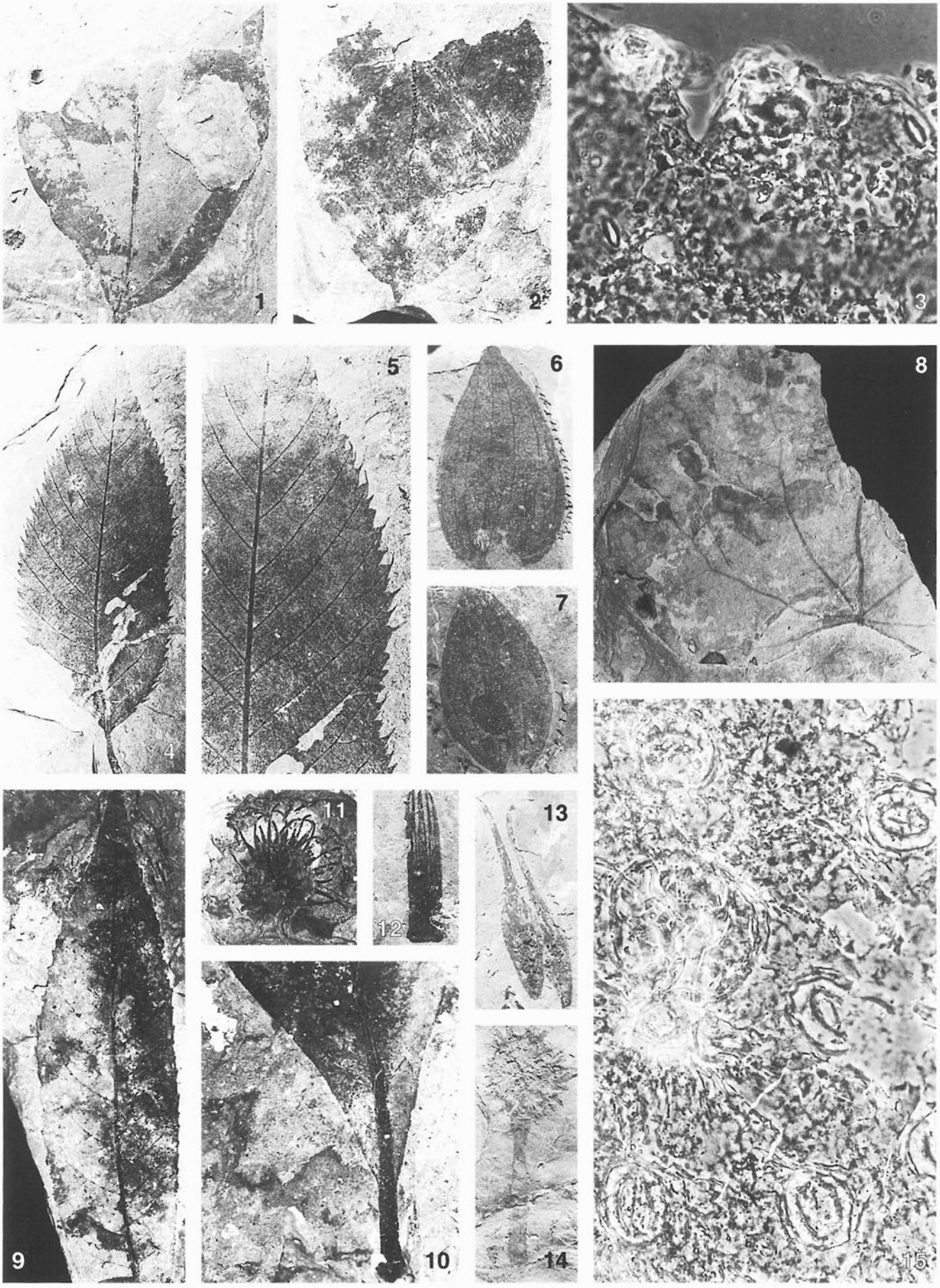

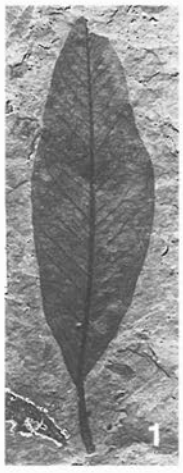
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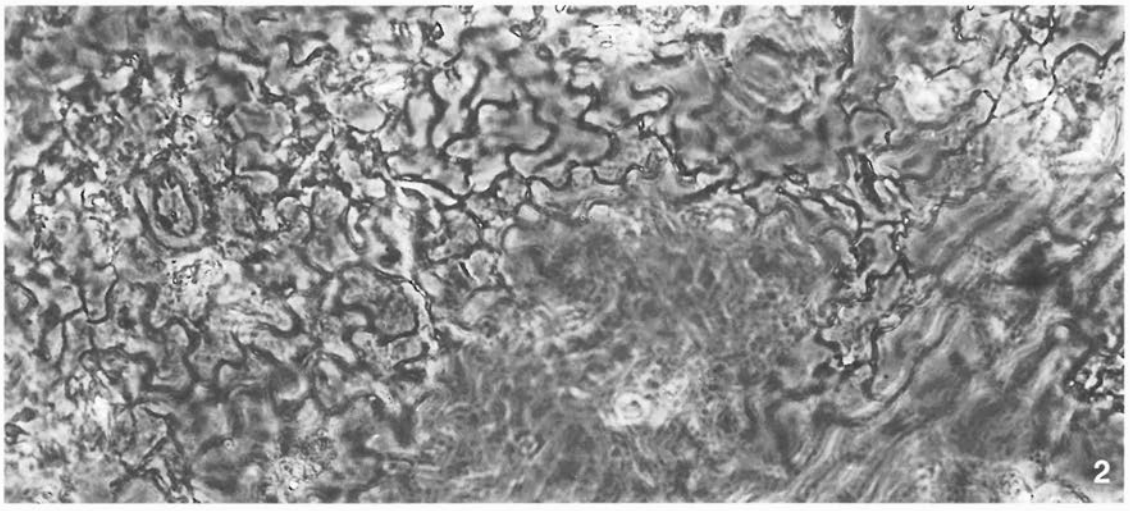
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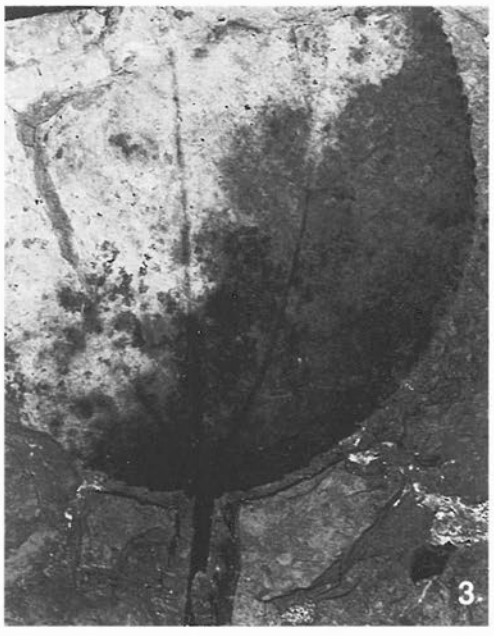
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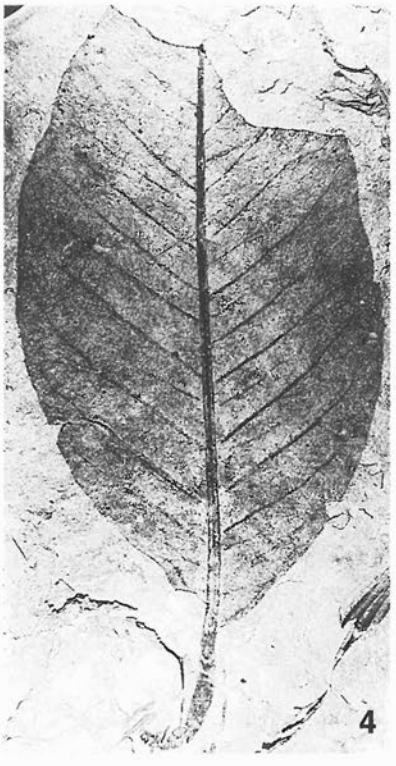
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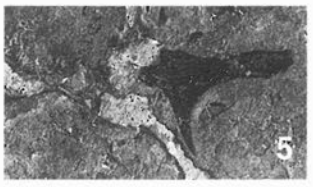
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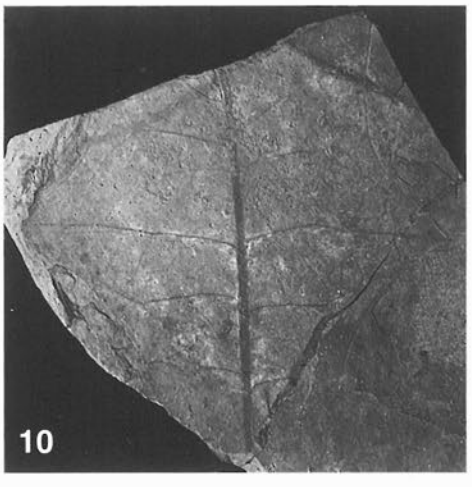
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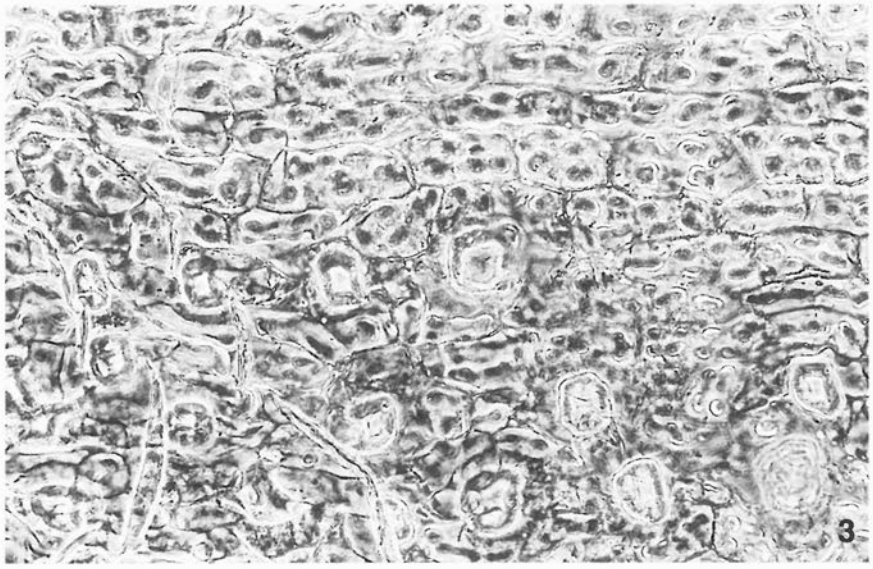

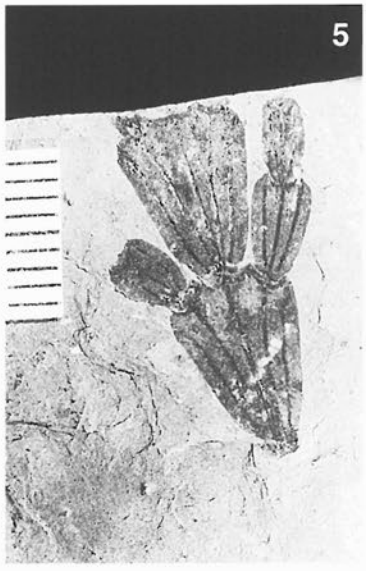

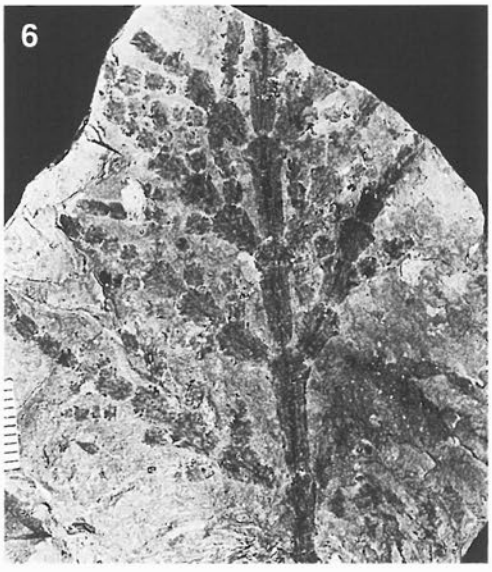

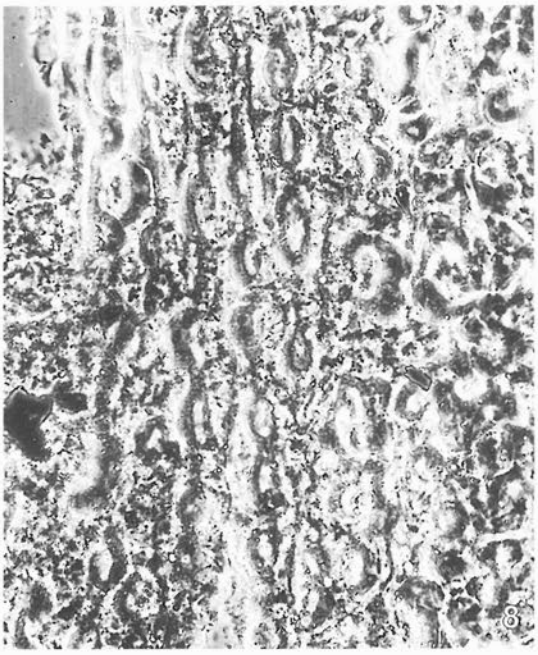


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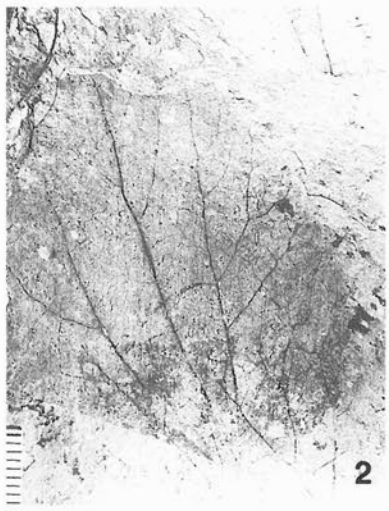
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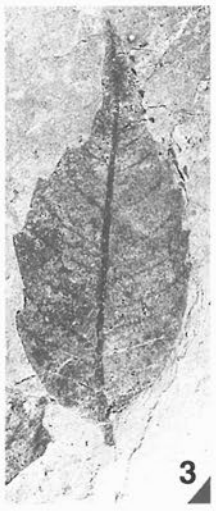
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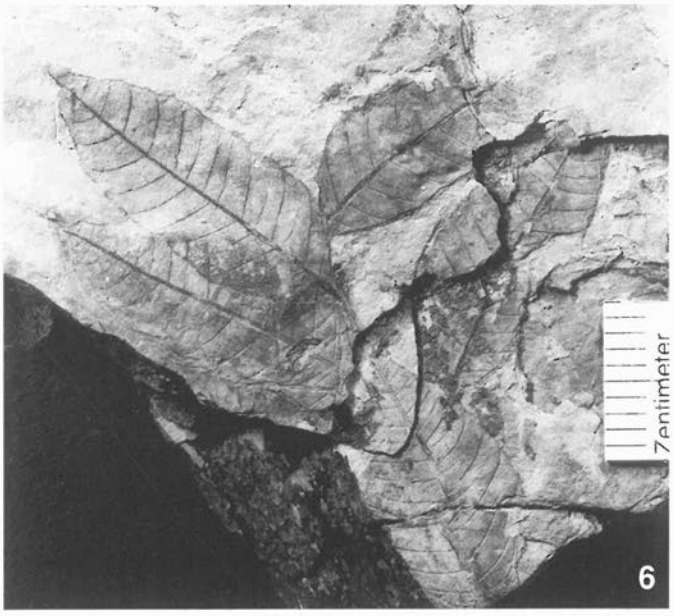
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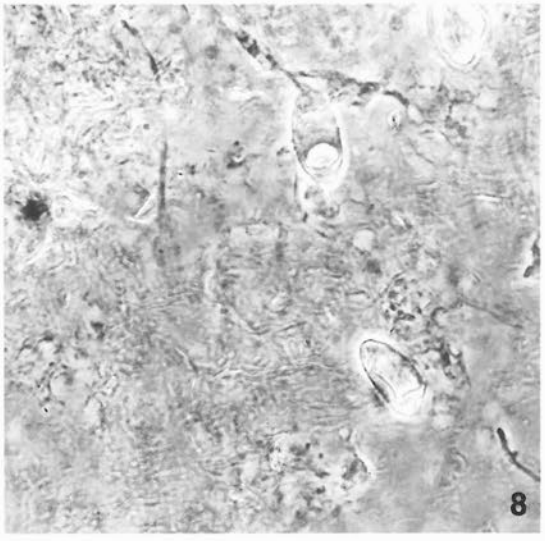
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Plate 16