

## EARLY OLIGOCENE FLORA OF SEIFHENNERSDORF (SAXONY)

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**Abstract.** A synthetic taxonomical study of the Oligocene macroflora from the diatomite of Seifhennersdorf is presented summarizing and correcting previous accounts on foliage, fruits and seeds. It also includes an evaluation of new extensive macrofossil material gathered since by several collectors, but not yet treated in detail. The flora consists of 94 taxa comprising one charophyte, one bryophyte, three ferns, five conifers and 84 angiosperms. Four new morpho-species have been described: *Carpinus roscheri* WALTHER et KVAČEK sp. n., *Laurophyllum meuselii* WALTHER et KVAČEK sp. n., *Magnolia seifhennersdorfensis* WALTHER et KVAČEK sp. n. and *Saportaspermum dieteri* KVAČEK et WALTHER sp. n. as well as five new recombinations and emendations proposed for previously described taxa: *Betula alboides* Engelhardt emend., *Carya fragiliformis* (STERNBERG) KVAČEK et WALTHER comb. n., *Celtis pirskenbergensis* (KNOBLOCH) KVAČEK et WALTHER stat. n., *Rosa saxonica* (ENGELHARDT) WALTHER et KVAČEK comb. n. and *Dicotylophyllum ungeri* (ENGELHARDT) WALTHER et KVAČEK comb. n. The floras from the same geological complex at Varnsdorf and from the nearby volcanogenic sites at the Hrazený Hill near Knížecí, Lipová near Šluknov, Markvartice, Bechlejovice, Sulestice, Berand, Holý Kluk Hill at Proboštov and Kundratice in North Bohemia are also discussed. The age of both diatomite occurrences from Seifhennersdorf and Varnsdorf has been estimated according to the radiometric K-Ar dating as 30.2 to 30.5 Ma. Due to various facies and depositional settings, the fossil vegetation of Seifhennersdorf deviates from roughly contemporaneous plant assemblages from the České středohoří Mountains and its periphery in North Bohemia in having a more pronounced representation of aquatic and riparian (azonal, i.e. intrazonal) elements. Its zonal part corresponds to the warm-temperate Mixed Mesophytic Forest. According to the Co-existence methodology, the following palaeoclimatic proxy data have been estimated: mean annual temperature 15.6° to 15.9° C, mean temperature of the coldest month 5.0° to 5.2° C, mean temperature of the warmest month 25.7° to 25.9° C, mean annual precipitation 897 to 971 mm, precipitation in the wettest month 117 to 133 mm, precipitation in the driest month 43 to 47 mm, precipitation in the warmest month 118 to 131 mm.

■ Flora and vegetation, Early Oligocene, SE Upper Lusatia, volcanic setting

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## Introduction

Seifhennersdorf, a small town in SE Upper Lusatia (“Oberlausitz”) in Saxony, E Germany, which is situated directly on the border with the Czech Republic, belongs to one of the classical areas of Tertiary research activities in Saxony since 1870. A small mine for coal and diatomite started there in 1837. The diatomite and also the coal were used for the distillation of oil for lamps in a chemical factory. In 1856 the mine and the factory were closed.

Hallbauer (1838) was the first who published information about the geology of this coal-bearing locality. Later Geinitz (1840) and Cotta (1868) reported occurrences of fossil fish and frogs there. A description of the corresponding volcanic strata with plant fossils at Varnsdorf was produced by Jokély (1861–1862) in a brief account of the geological mapping in North Bohemia. The mining of coal started at Varnsdorf 10 years later than at Seifhennersdorf, in 1847 (Schlegel 1920). Collections of plant fossils were found in a dump at Varnsdorf later. Much richer collections

of fossils became available from three vast dumps situated close to Seifhennersdorf. In the 1860s, Geinitz advised Engelhardt, a high school teacher from Dresden, to prepare a paper on plant megafossils, mostly leaf impressions and compressions, from various sites in Saxony including Seifhennersdorf. Writing a “Flora der Braunkohlenformation im Königreich Sachsen”, Engelhardt then won the prize given by the Society of Prince Jablonowski, “Fürstliche Jablonowski’sche Gesellschaft in Leipzig” (Engelhardt 1870, pp. 9–28). Until 1930, this publication was the most important paper about this fossil plant-bearing locality. Some information on Seifhennersdorf was published by Friedrich (1871) and Schneider (1901) in local papers. The geological situation with a note on the fossil flora can be found in an explanation accompanying the geological map of the Kingdom of Saxony “Section Seifhennersdorf – Rumburg Blatt 87” (Hazard 1895, Rheinisch 1920). These authors took over the palaeontological data published by Engelhardt (1870) without any changes. The first who wanted a new revision of the Seifhennersdorf fos-

sil flora using modern research methods (i.e. leaf architecture and epidermal structures) was Mädler (1930, 1934). But he never accomplished his plans.

After 1945, a new period of geological research started in Central Europe. The aim of these activities in Germany, like elsewhere, was to find resources for industrial purposes. In the case of the Seifhennersdorf locality it was the investigation of coal and diatomite resources that was carried out by the former State Geological Survey of Saxony ("Staatliche Geologische Kommission"), Freiberg. For this project an underground mine (a 60 m deep shaft with various tunnels) started in 1951. The prospecting shaft penetrated through the basaltoid body to the diatomite seams and pyroclastic rocks and reached granite in the basement. These attempts at prospecting finished in 1957. Results of the geological investigation at Seifhennersdorf were top secret, as was usual at that time for any geological prospecting in the former DDR (Herre 1954).

During the 1950s, several university diploma theses were produced from the Mining University, Freiberg focused on diatoms (Sallum 1956), coal seam diagenesis (Wahlich 1956), and from the Humboldt University, Berlin on stratigraphy and tectonics (Ahrens 1957, 1959). Additional results (Freytag and Rucktäschel 1955) were aimed at using the diatomite ("Polierschiefer") for the production of ceramic ware and insulation material. Walther (1957) first published palaeontological discoveries of fossil frogs from Seifhennersdorf. Hein and Schwab (1958) demonstrated symptoms of silification in the brown coal. The modern palaeobotanical research of the locality started with the studies carried out by Mai (1963) and Walther (1964). Besides revision of the original material of Engelhardt (1870), many new species based on leaves, fruits and seeds were established on gross morphology and epidermal anatomy (i.e. cuticular analysis). Supplements to the Seifhennersdorf flora were included in a series of papers published later by Walther (1965, 1967, 1972, 1974, 1977, 1996 and 2004) and Mai (1988). New results from research on fossil animals were published on fish fauna (Teleostei, Cyprinidae) by Obrhelová (1970), Obrhelová and Obrhel (1987) and Böhme (1996). Jeremias et al. (1998) and Tietz et al. (1998) studied arthropods and Špinar (1972, 1976) worked on frogs (Palaeobatrachidea).

The site of Seifhennersdorf and its surroundings has attracted and still attracts numerous graduate amateurs, teachers, chemists and businessmen, who are interested in collecting fossil remains from the dumps that are still accessible after the previous mining activity. These activities started in the 70s of the 19<sup>th</sup> century. Important at this time was the existence of the Humboldt Club in Seifhennersdorf, an institution that gathered information on natural sciences for the lay population. Later on, a small local museum ("Naturkunde – und Heimatmuseum", now the "Karasek Museum") was founded in Seifhennersdorf and some of the collected fossil remains from the Tertiary of Seifhennersdorf were amassed and stored there. In 1953, large-scale field work on fossil remains was started by the State Museum of Mineralogy and Geology in Dresden. During about 40 years the museum staff were able to organize and managed to obtain fossil remains from Seifhennersdorf from various important private collections by purchase or

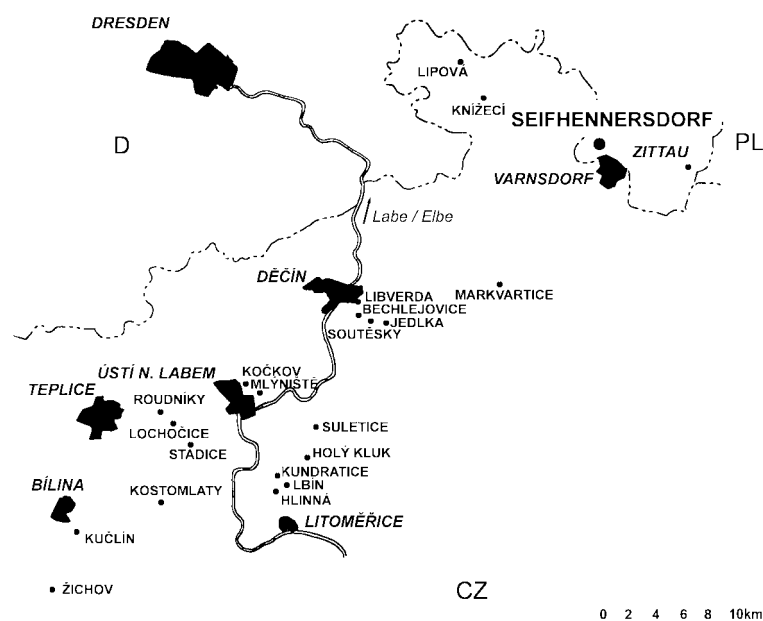
donations (e.g., coll. Andert, Ebersbach, coll. Mai, Berlin, coll. Schmidt, Bautzen, coll. Roscher, Seifhennersdorf, coll. Stilbach, Dresden, coll. Walther, Dresden – see also Walther 1977, 1998). In 1978, a modern exhibition devoted to the Oligocene locality of Seifhennersdorf was opened in a new building called the Karasek Museum (KMS) in Seifhennersdorf, in which the geology with profiles and reconstruction of vegetation, animal fossils and the history of the mine were presented (Walther 1988).

The present paper is focused on a review of the plant megafossils of Seifhennersdorf considering new advances in the systematics of Tertiary plants and floras. An effort has been made to study both earlier published material and new collections mentioned above. Some parts previously published in German language have been translated without any profound changes and references made to the original German text. The geographical and geological terms in German are given in inverted commas. Particular emphasis has been given to proper documentation of the taxa even when a definite solution for the taxonomy has still failed.

## Geological setting, age and environment

The diatomite of Seifhennersdorf, a classical site of Tertiary palaeobotany in Saxony (Engelhardt 1870), is situated in the southeast periphery of the town, about 15 km west of Zittau in southern Upper Lusatia ("Oberlausitz", Saxony, Germany) close to the state boundary with the Czech Republic (Text-fig. 1). The deposit reaches into Bohemia as a small remnant near the Czech town of Varnsdorf ("Varnsdorf") from where plant fossils are also known (Jokély 1861–1862, this paper). In 1837, a small 80m deep underground coal mine "Reichenseggengotteszeche" was opened for about thirty years. In 1920, one gallery was used for the water supply of the town (Schlegel 1920). The geological data given below were derived mainly from the prospecting shaft sunk in 1951.

The sedimentary complex at Seifhennersdorf, which contains diatomite and coal seams, is developed to a maximum of 80 to 100m in thickness on the periphery of a basaltoid lava flow and covers discontinuously an area between the towns and villages of Neugersdorf – Eibau – Oberderwitz – Grossschöna – Seifhennersdorf. The basaltoid body belongs amongst the largest in Germany (Möbius 1956, Pietzsch 1962). Approximately 40–50 m thick pyroclastics rocks of tuff, tuffite, claystone ("Tonstein") with interbeds of diatomite ("Polierschiefer") and thin coal seams remained preserved under the protection of this basaltoid sheet. The diatomite layers include rich plant and animal fossils. Hazard (1896) designated this volcanogenic complex as "basaltoid brown coal formation, whose origin coincides with the beginning of the eruptions and explosions". With the introduction of this term, the boundary with the adjacent Miocene overlying brown coal deposit of Upper Lusatia (Zittau, Olbersdorf, Hirschfelde and Berzdorf) had been established. The brown-coal seams as well as the associated deposits within the Zittau Basin of various quality and thickness are distributed in the Lower Lusatia brown-coal district (Ahrens and Lotsch 1967, Möbius 1956). Berger (1940) already recognized the older age of the Tertiary volcanogenic rocks of the Seifhenners-



**Text-fig. 1. Geographical position of the locality Seifhennersdorf and other sites discussed in comparison.**

dorf – Varnsdorf area. Ahrens (1957) noted a correspondence between the diatomite of Seifhennersdorf and those of the České středohoří Mts. (“Böhmisches Mittelgebirge”). This close relationship was later corroborated by further palaeobotanical studies (see e.g., Hurník and Knobloch 1966, Bůžek et al. 1976, 1978, Konzalová 1981, Kvaček and Walther 1974, 1995, 1998, 2001, 2003, 2004, Kvaček et al. 1989, Mai 1963, 1995, Walther 1964, 1994, 1996, 2004).

The age of the Tertiary strata at Seifhennersdorf was long disputed and doubtful. Neither the diatoms nor the records of faunal and plant megafossils brought evidence to elucidate dating. Only the index sporomorph *Boehlensipollis hohlii* recovered by Krutzsch (in Mai and Walther 1978) and Konzalová (1981) indicated the Early Oligocene. In the last decades, radiometric (K-Ar) dating of the basaltoid lava flow overlying the diatomite has become available, giving an absolute age of  $30.44 \pm 1.52$  MA (Bellon et al. 1998). A core “Bhrg. Seifhennersdorf 1/54” (Text-fig. 2) situated about 200 m north of the former mining area struck two further basaltoid intrusions of 5.9 m and 8.65 m thickness, covered by tuff layers and separated by a tuffaceous breccia 10.9 m in thickness. These intrusions, as Ahrens (1957) anticipated, are much younger, of an age between 28.82 and 24.43 Ma (prof. Gaudan, personal communication 25<sup>th</sup> May, 1994). Such intrusions occur also in the sections at Kundratice and Bechlejovice in the České středohoří Mts. (see Kvaček and Walther 1998, 2004). A record of *Anthracotherium* cited in the literature of Seifhennersdorf (e.g. Hazard 1895) was recognized as a fragment of a Recent animal, hence useless for dating.

After more detailed studies and wider palaeobotanical correlations of the Oligocene floras in Central and West Europe, Kvaček and Walther (1998) arrived at a definition of the Floral Assemblage (“Florenkomplex”) Seifhennersdorf – Kundratice. This phytostatigraphic unit is characterized by the Mixed Mesophytic Forest type of vegetation

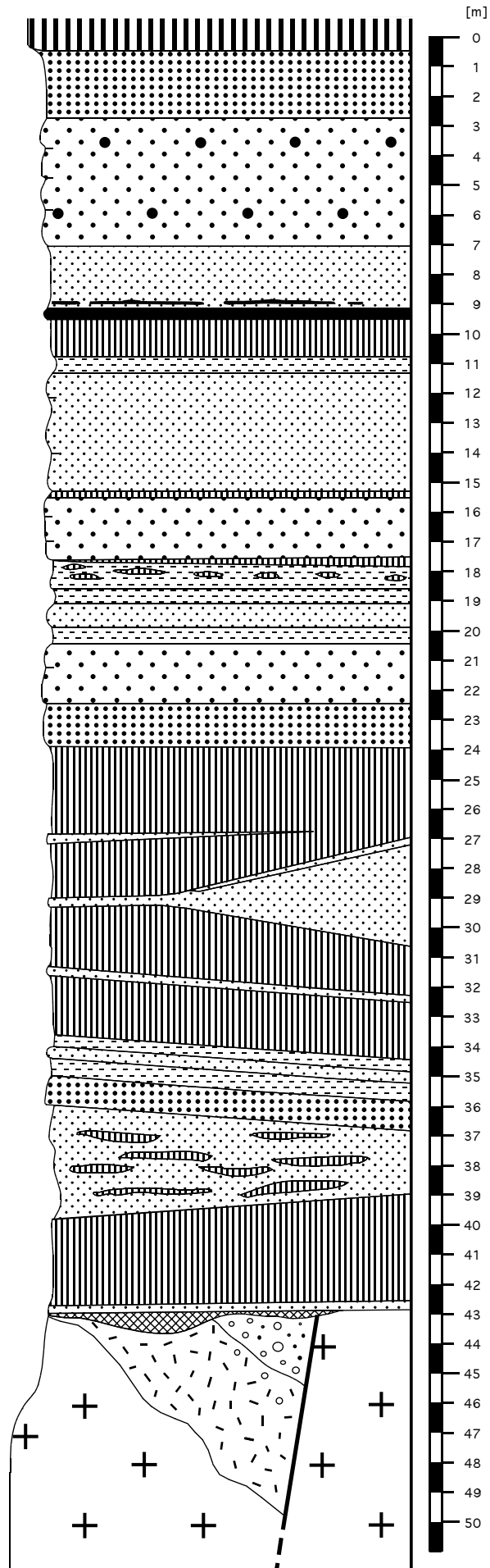
with a higher proportion of the “modern” Arctotertiary elements (*sensu* Kvaček 1994) and is dated as early Early Oligocene (early Rupelian) before the late Rupelin – Eochattian warming phase typical of the evergreen forest vegetation (e.g., at Flörsheim, Markvartice – see Kvaček and Walther 2003). The Tertiary at Seifhennersdorf is underlain by the basement of the Lusatia crystalline rocks (Lusatia granodiorite, Rumburk granite). The granodiorite is deeply weathered and in places fully converted into kaolinite. The age of the kaolin weathering is not yet exactly known. Ahrens (1957) assumed that the weathering would be due to an exposed landscape during the Eocene warm climate phase. The Rumburk granite is represented on the site only as pebbles in the Quaternary debris.

The basaltoid brown coal complex is composed of a sequence of tuff, diatomite, claystone – mudstone (“Tonstein”) layers and coal seams. Five diatomite layers (seams) of various thickness have been distinguished. Among them the lowermost (5th) seam, 2.0–4.0 m thick and the main (4th) seam, 8.0–10.0 m thick, are the richest in fossils. The thin layers (3rd seam 0.20 m thick, 2nd seam 0.30 m thick) have not yielded any useful megafossils. It is probable that the 1st seam (0.85–1.35 m thick) contained those plant fossils which were described by Engelhardt (see text-fig. 2).

The section of the Tertiary volcanogenic rocks below the basaltoid flow is about 50 m thick and consists mostly of the tuff about 25 m thick. In addition, fine-grained tuffaceous deposits (tuffite) about 5 m thick and claystone also 5 m thick are also associated with these rocks. The claystone and tuffite originated from disintegration and re-deposition of the tuff in an aquatic environment. Fossil plant remains (leaves, fruits) are rare but perfectly preserved in the claystone, e.g. *Carpinus grandis*, *Daphnogene cinnamomifolia* f. *lanceolata*, ultimate shoots of *Taxodium* and an infructescence of *Spirematospermum wetzleri*. Plant megafossils are extremely rare and poorly preserved in the tuffite. Ahrens (1957) noticed also rocks with traces of reworked non-vol-

## Basalt, columnar jointing

|                                                                                                                     |             |
|---------------------------------------------------------------------------------------------------------------------|-------------|
| Tuff, medium-grained, banded .....                                                                                  | 2,00-2,50 m |
| Tuff, massive and coarse-grained<br>with volcanic bombs .....                                                       | 4,00-5,00 m |
| Tuff, fine-grained - clayish with a<br>small coal seam and<br>plant remains (rooted bed?) .....                     | 1,50-2,00 m |
| 1. Seam { Coal .....                                                                                                | 0,35-0,50 m |
| { Tripoli .....                                                                                                     | 0,85-1,35 m |
| Mudstone .....                                                                                                      | 0,40-0,50 m |
| Tuff, non-bedded .....                                                                                              | 3,50-4,50 m |
| 2. Seam .....                                                                                                       | 0,00-0,20 m |
| Tuff, massive - thick-bedded .....                                                                                  | -2,00 m     |
| 3. Seam .....                                                                                                       | 0,00-0,30 m |
| Mudstone .....                                                                                                      | 1,00 m      |
| Mudstone, light-coloured .....                                                                                      | 0,50 m      |
| Tuff .....                                                                                                          | 0,75 m      |
| Mudstone, light .....                                                                                               | 0,50 m      |
| Tuff, non-bedded,<br>coarse-grained .....                                                                           | 2,00-2,50 m |
| Tuff, medium - fine-grained<br>fine-banded .....                                                                    | 1,50 m      |
| 4. Seam { Tuff .....                                                                                                | 0,30 m      |
| main seam { Tuff .....                                                                                              | 0,30-4,00 m |
| 8,00-10,00 m { Tuff .....                                                                                           | 0,25-0,40 m |
| Mudstone .....                                                                                                      | 0,40 m      |
| Tuff .....                                                                                                          | 0,40 m      |
| Mudstone .....                                                                                                      | 0,60 m      |
| Tuff, banded .....                                                                                                  | 1,00 m      |
| Transition zone:<br>Tuff and tripoli<br>interbedding .....                                                          | 2,00-4,00 m |
| 5. Seam .....                                                                                                       | 2,00-4,00 m |
| Tuff .....                                                                                                          | 0,30 m      |
| fine-grained clayish tuff<br>with tripoli-streaks .....                                                             | 0,50 m      |
| granitic arkose, up to the roof<br>conglomeratic,<br>on the top tuff with clastic material<br>from the bottom ..... | 0,00-6,00 m |
| Lausitzer Granodiorit<br>partly strongly kaolinized                                                                 |             |



Text-fig. 2. Geological section of the core "Bhrg. Seifhennedorf 1/54" (adapted from Ahrens 1959).

canic material. These are fine- and even-grained with a high proportion of clay particles and include characteristic components of organic remains, namely fossil wood and leaf fragments.

The section starts with the granite arkose and fine-grained tuff (0.50 m thick), which level up the basis of the overlying lowermost diatomite layer (5<sup>th</sup> seam). This diatomite is typically disturbed by subaquatic slide dislocations, which led to a reduction of thickening of the layer. These phenomena were due to destructions or inclinations of the basement. The uneven sedimentation of the 5<sup>th</sup> seam has been explained by its deposition and origin near the shore of a lake (Ahrens 1957) together with the influence of volcano-tectonical phenomena (e. g. cleft tectonics, translocations). The theory of near-shore origin of the 5<sup>th</sup> seam can be supported by the occurrence of fossil frogs (*Palaeobatrachus*) and also its tadpoles that are known only from this deposit of the site. It is in contrast to the next 4<sup>th</sup> seam, where the only animal fossils are fish remains as representatives of the necton (see Böhme, this volume). Also among plant megafossils, higher frequencies of *Taxodium* shoots and aquatic plants, e.g. *Potamogeton seifhennersdorfensis*, fragmentary rootlets of aquatics and rare remains of helophytes, e.g. *Osmunda lignitum*, *Pronephrium stiriacum* and the jungle, *Leersia seifhennersdorfensis* correspond to riparian habitats. Particularly in the part overlying the 5<sup>th</sup> seam, the diatomite is fine-bedded and laminated, rich in fossils. The shale consists of a regular alternation of whitish, non-bituminous diatomite laminae and dark brown-black bituminous laminae. The whitish layers are much thinner (several mm) and consist of pure accumulations of diatoms. Just above the slightly thinner bituminous laminae, the richest fossil-bearing horizons can be found. These can again be densely laminated by whitish diatom-rich intercalations into paper shale (microcycles), in which the bituminous laminae contain often rich remains of frog tadpoles as mummified fossils. The lamination expresses cycles of two to five year events, as is common in freshwater diatom communities today. Such growth booms (so called water bloom “Wasserblüte”) are periods of mass occurrence of diatoms in the spring and the autumn, the seasons of higher precipitation. Attempts have been made to convert the number of cycles within the diatomite to an estimation of speed of sedimentation of the rock. According to the number of whitish layers within the 5<sup>th</sup> 4 m thick seam a period of 8000 to 10000 years has been estimated for the accumulation of this seam (Mädler 1937, Walther 1998, 2004).

Occurrences of freshwater diatomite are generally connected with volcanic activities and volcanic areas in Europe (e.g. Rhön, Vogelsberg, Westerwald and České středohoří Mts. = “Böhmisches Mittelgebirge”). The supply of Si-components is mainly from glass particles of tuff (Schiller, personal communication). Different species of freshwater diatoms thrive in different water depths, as was the case in the deposition of the 5<sup>th</sup> and 4<sup>th</sup> seams. Differences in water depth, particular in small lakes and basins, depend on the distance from the shore. Also short-term periods of intensive volcanic activity profoundly changed the landscape (e.g. formation of small depressions). And particularly the origin of closed water bodies without any aeration, reduced water movements and low supply of clastic particles led to

bituminous sedimentation and accumulation of sapropelite. This environment corresponds to dark, more bituminous layers within the diatomite. The diatoms, in contrast to Chlorophyceae, thrive in pure as well as muddy or mixed ?? water. Hence they cannot be used to indicate either eutrophic or oligotrophic water quality in general.

A transition zone of 2.0–4.0 m thickness is wedged between the basal and main diatomite seams, where the tuff and diatomite layers regularly interchange and where both rock types form more or less huge lenses. These diatomite lenses lack megafossils.

The following 14 m thick strata overlying the main diatomite seam originated under more intensive volcanic activity and in a more limited water table. The change of environment is expressed in the interchanging tuffs of various grain size and thin fine-grained tuffite and claystone layers. Due to reduction of the water body the 2<sup>nd</sup> and 3<sup>rd</sup> diatomite seams are consequently only a few dm thick. Both are barren without any animal and plant megafossils. Greater intensive volcanic activity led to the accumulation of massive, up to 3.5 to 4.5 m thick tuff layers, interrupted by a short calm period, expressed by a thin fine-grained tuffite underlying the uppermost (1<sup>st</sup>) diatomite. According to Walther (1964), the earliest records of plant fossils described from Seifhennersdorf by Engelhardt (1870) must have originated from this seam. This theory cannot be verified without a detailed comparative study of the individual diatomite layers. The 1st diatomite seam is covered by a coal seam 0.30 to 0.55 m thick. The petrological coal type has been classified as firm dull brown coal showing indistinct bedding (Ahrens 1957). According to Hein and Schwab (1958), the coal corresponds to bedded lean coal with up to a 31.3% content of SiO<sub>2</sub>. The silicification phenomena seen in silicified rootlets of monocots and rare permineralized wood have to be explained due to a primary source of SiO<sub>2</sub> from lawns of freshwater sponges in shallow waters, where the coal originated in a subaquatic environment.

The coal-forming process, in which fossil remains of the Cyperaceae, Cabombaceae (*Dusembaya seifhennersdorfensis*) as well as allochthonous pieces of coalified wood took part, terminated the “Verlandung”, i.e. filling-up process of the lake. The sudden interruption of the coal-forming process is represented by a 1.5–2.0 m thick layer of the fine-grained tuff with coal seamlets and coalified plant fragments in the roof of the coal seam (Ahrens 1957). With this horizon the final intense volcanic phase started and formed upwards an about 10 m thick coarse-grained tuff containing up to one ton heavy volcanic bombs. This phase ended by a lava flow of the nepheline basanite, which extends 30–50 m in this area and increases in thickness towards the east. According to Ahrens (1957) either a single sheet or two sheets divided by a tuff layer can be recognized.

## Material and methods

Engelhardt (1870), the first author on the Tertiary flora of Seifhennersdorf, had at his disposal about 97 plant fossils for study. As a result he described 55 morpho-species of leaves, seeds and fruits. In the 20<sup>th</sup> century the next authors Mai (1963) and Walther (1964) collected about 1000 spec-

imens of plants and also some material of lower animals from the dump at the new underground mine (1951–1957). Both authors used new methods for the analysis of the fossil samples, namely carpology and cuticle analysis with success. Mai (1963) published 35 morpho-species while Walther (1964) reported only on 23 species from 164 selected specimens of plant fossils. Later on, more information and new species from this locality became available (e.g. Walther 1967, 1974). Walther (1977) also commented on the continuous collecting activities at Seifhennersdorf during the last 25 years that resulted in 3450 samples which were stored in the former State Museum of Mineralogy and Geology in Dresden. In his monograph on Tertiary maple leaves, Walther (1972) had again examined a lot of leaf samples from different collections of plant bearing diatomites. In the following years, till the 90s of the last century it was possible to accumulate almost all the specimens from private collectors in the museum in Dresden. Some were bought by the museum's administration, others were presented by collectors. In addition, systematic collecting from the dumps continued till 1994. In 2006 the collection of plant fossils included 8700 catalogue numbers with over 10 000 estimated specimens.

The richest fossiliferous deposit of Seifhennersdorf is the laminated diatomite. Rare fossils also occur in the tuff, tuffite and claystone ("Tonstein"). Some seeds (like those of Cabombaceae), cone scales of *Taxodium* and other fructifications are partly three-dimensional and fully coalified. Other plant remains in the diatomite are mostly compressions with carbonized material of different thickness, starting with disintegrated layers of carbonized organic material covering impressions to totally mummified leaves peeling off the matrix, e. g. *Laurophyllum acutimontanum*.

The preservation of the leaf lamina, particularly due to a high degree of coalification and fragmentation, prevents preparation of cuticles in many cases. In leaves of chartaceous texture the cuticle structure was usually fully destroyed by imprints of diatom shells. Only preparation of coriaceous leaf compressions of conifers, evergreen or sclerophyllous broad-leaved elements (*Quercus lonchitis*, *Platanus neptuni*), rarely in other dicotyledons (*Alnus gaudinii*, *Salix varians*, *Carya fragiliformis*, *Ulmus fischeri*) and monocotyledons (*Smilax*) have been successful. The maceration process used Schulze solution and ammonium (see Walther 1972).

The main source of study material of plant megafossils was in the collections of the State Science Collections of Saxony, Museum of Mineralogy and Geology (MMG), a few additional specimens have been found and studied in the Karasek Town Museum in Seifhennersdorf (KM), in the National Museum, Prague (NM), Charles University, Faculty of Science, Prague and the Austrian Geological Survey ("Geologische Bundesanstalt"), Vienna. In total we have had at our disposal at about 8200 specimens.

Photo documentation has been done by the second author using a Coolpix 4500 digital camera and Wild binocular lens. Some megafossil pictures were produced using a professional camera supplied by Mrs. Barbara Bastian, Dresden. The cuticular structures were documented using biological microscopes Leitz Aristoplan and Olympus under phase contrast and interference contrast light using digital technics. The drawings were made directly of fossils

on transparencies, enlarged, retouched and scanned, then produced by Photoshop software.

## Systematic descriptions

(The synonym lists include the basic references with indications of typical sites and age plus all references to the Seifhennersdorf flora without repeating the site and age. The arrangement of angiosperm taxa is according to Takhtajan 1987.)

### Charophyceae

#### Characeae gen. et sp. indet.

Pl. 1, figs 1–2

**Description:** Groups of fully compressed gyrogonites were found on some bedding planes of the diatomite. These originally globular heavily carbonized bodies with occasional indistinct spiral grooves on the surface are less than 0.3 mm in diameter. No details of the coronulla are discernible.

**Remarks:** The gyrogonites were found for the first time in the diatomite of Seifhennersdorf. Their poor preservation prevent us from identifying them more precisely. Gyrogonites from Markvartice (Bůžek et al. 1976) are similar but bigger, matching those of *Nitella* rather than *Chara*.

**Material studied:** MMG, Sf. 5864, Sf. 5865, Sf. 5866, Sf. 5867, Sf. 5869, Sf. 5870, Sf. 5871, Sf. 7493.

### Bryophyta

#### Musci gen. et sp. indet.

Pl. 1, figs 3–5

**Description:** Dichotomously branched stems 14 mm long and 1.5 mm wide, densely covered by narrow lanceolate leaf-like structures with long sharp tips and with a very fine midrib, crowded at the ends of stems.

**Remarks:** Fossils at hand do not show sufficient features to allow a more precise identification. Similar remains of mosses are known from Kundratice (Kvaček and Walther 1998) but a full identification is not possible.

**Material studied:** MMG, Sf. 3287a, b, Sf. 6446, Sf. 6447, Sf. 6448, Sf. 6449, Sf. 6449, Sf. 6451, Sf. 6452, Sf. 6453, Sf. 6454, Sf. 6455, Sf. 6456, Sf. 6457, Sf. 6458, Sf. 6459.

### Pteridophytes

#### Osmundaceae GÉRARDIN et DESF.

##### *Osmunda* L.

#### *Osmunda lignitum* (GIEBEL) STUR

Pl. 1, fig. 6

- 1857 *Pecopteris lignitum* GIEBEL, p. 303, pl. 2, fig. 2a – lectotype and basionym (Rhuntal near Weißenfels, Early Oligocene).  
1870 *Osmunda lignitum* (GIEBEL) STUR, p. 5 (Socka, Late Eocene).

- 1967 *Osmunda lignitum* (GIEBEL) STUR; WALTHER, p. 259, pl. 3, figs 1, 2, text-figs 1, 2.  
 1996 *Osmunda lignitum* (GIEBEL) STUR; WALTHER, p. 16.

**Description:** Fragmentary pinna 18 mm wide and preserved in length of 52 mm, midrib strong, 1 to 1.5 mm thick, pinnules lobe-like, broadly acute at apex, secondary midribs sub-opposite, at an angle of 57 to 69°, forked at the two thirds level, reaching the apex, lateral (tertiary) veinlets also forked shortly above the base, or rarely simple, craspedodromous, not fused; adaxial cuticle reflecting cells 70–120 µm long and 30–40 µm wide, sub-parallel to veinlets, stomata rounded, anomocytic, 29–30 per 1 mm<sup>2</sup>, surrounded with 2–3 non-modified cells, pore ca. 25 µm long, guard cells with thickened stomatal ledges 2 µm thick (Walther 1967, p. 259).

**Remarks:** According to Walther (1967) the epidermal anatomy of *Osmunda lignitum* from Seifhennersdorf corresponds with that found by Kräusel and Weyland (1950, p. 27) in the same fossil morpho-species from Altenburg, Mine Regis, Germany. This easily recognizable fern is a very rare element in the rich flora of Seifhennersdorf. The poorly preserved fragments at hand are compressions found in strongly carbonaceous diatomite from the roof of the 5<sup>th</sup> seam.

**Material studied:** MMG, Sf. 8348, orig. Walther 1967, pl. 3, figs 1–2, pl. 4, figs 1–3, text-figs 2a, b.

### **Thelypteridaceae PIC. SERM.**

#### ***Pronephrium* C. PRESL**

#### ***Pronephrium stiriaceum* (UNGER) KNOBLOCH et KVAČEK**

Pl. 1, figs 8–9

- 1847 *Polypodites stiriaceus* UNGER, p. 121, pl. 36, figs 1–5 (Parschlug, Miocene).  
 1870 *Lastrea dalmatica* A. BRAUN; Engelhardt, p. 9, pl. 1, fig. 3.  
 1967 *Abacopteris* cf. *stiriaca* (UNGER) CHING; Walther, p. 262, pl. 1, figs 1, 2, pl. 6, fig. 4, text-fig. 3.  
 1976 *Pronephrium stiriaceum* (UNGER) KNOBLOCH et KVAČEK, p. 12, pl. 1, fig. 1 (Murnerweiher, Miocene)  
 1996 *Pronephrium stiriaceum* (UNGER) KNOBLOCH et KVAČEK; Walther, p. 16.

**Description:** Fragmentary pinnae, 10 to 15 mm wide, preserved in max. length of 66 mm, midrib (rhachis) strong, 0.5 mm thick, pinnules partly fused, lateral midribs (secondaries) at an angle of 45, 50, 60 and 70°, almost straight, ending in the apex, veinlets very delicate, at narrow angles, simple, fusing with the margin, basal veinlets connected with adjacent pinnule forming a low triangle, epidermal anatomy not preserved (Walther 1967, p. 262); fertile fragmentary pinna 9–14 mm wide, preserved in max. length of 50 mm, midrib (rhachis) strong, 0.9 mm thick, pinnules partly fused, lateral midribs (secondaries) and higher-order venation not preserved, abaxial side of pinnules with sori 12–14 in total, circular – globular, 0.1 to 0.2 mm in size, without indusium.

**Remarks:** This material is fully carbonized and comes from the thinly bedded diatomite of the 1<sup>st</sup> and 5<sup>th</sup> seams. Walther (1967) considered it to be allied to *Abacopteris* FÉE (= *Cyclosorus* LINK). Knobloch and

Kvaček (1976) assigned this fern, widely distributed in the European Tertiary, to *Pronephrium* C. PRESL, a correct name for *Lastrea*, which is often considered a subgenus of *Cyclosorus*. Therefore, the name for this fossil morpho-species varies (Collinson 1996, 2001).

**Material studied:** MMG, Sf. 3726, orig. Walther 1967, pl. 1, fig. 1, pl. 2, figs 1–2, (*Abacopteris* cf. *stiriaca*), Sf. 3737, Sf. 3728, Sf. 6050, Sf. 6051, Sf. 6052, Sf. 6445, Sf. 6465, Sf. 7493.

### **Salviniaceae T. LESTIB.**

#### ***Salvinia* SÉGUIER**

#### ***Salvinia* sp.**

Pl. 1, figs 10–11

**Description:** A young plant with a pair of just protruding leaves and a bunch of ca. 5–7 mm long simple root-like organs beneath; leaves ca. 6 mm long, narrow elliptic, showing vague quadrangular meshes of the venation.

**Remarks:** This single specimen represents an immature individual without details of the venation, not allowing a more detailed comparison. To date there is no good record of *Salvinia* in the volcanic sites in Saxony and Bohemia.

**Material studied:** MMG, Sf. 6450.

### **Conifers**

#### **Cupressaceae RICH. ex BARTL. s. l.**

#### ***Taxodium* RICHARD**

#### ***Taxodium dubium* (STERNBERG) HEER**

Pl. 2, figs 1–10, pl. 22, fig. 1

- 1823 *Phyllites dubius* STERNBERG, tent. p. 39, pl. 36, fig. 3 (Bílina, “Bilin”, Early Miocene).  
 1855 *Taxodium dubium* (STERNBERG) HEER, pp. 49–50, pl. 17, figs 5–15 (Bílina, “Bilin”, Early Miocene).  
 1870 *Taxodium dubium* (STERNBERG) HEER; Engelhardt, p. 10, pl. 1, figs 6–7, pl. 2, figs 1–2.  
 1963 *Taxodium dubium* (STERNBERG) HEER; Mai, p. 43, figs 7–11, text-fig. 1.  
 1963 *Sequoia langsdorfii* (BRONGNIART) HEER; Mai, p. 44, pl. 1, figs 12, 13.  
 1963 *Pinus ornata* (STERNBERG) ENGELHARDT; Mai, p. 45, pl. 1, fig. 14.  
 1963 *Trapa silesiaca* GOEPPERT; Mai, p. 81, pl. 11, figs 6–9.  
 1964 *Taxodium dubium* (STERNBERG) HEER; Walther, p. 10, pl. 2, figs 1–8, pl. 3, figs 2–6, pl. 4, figs 1–3, pl. 5, figs 1–3.  
 1996 *Taxodium dubium* (STERNBERG) HEER vel *Taxodium balticum* SVESHNIKOVA et BUDANTSEV; Walther, pp. 14, 16, text-figs 3/5, 6.

**Description:** Leafy shoots dimorphic, shade shoots long, remarkably elongate, 100–270 mm, needle leaves spirally arranged, distichous, straight or sometimes slightly bent outwards in the basal part of the brachyblast, continuously shortening towards the apex, steeply attached at an angle of 30–45°; sun shoots shorter, about 100 mm or

less, with narrow and strong needle leaves, also distichous, sessile and under wider angles, young shoots with non-distichous, radially disposed leaves; leaves needle-like, univeined, dorsiventrally flattened, narrowing into the acute apex, base mostly curved, cuneate, non-decurrent, lamina delicate; cuticle very thin, in fragments available; ordinary cells mostly rectangular, straight-walled, stomata in rows, obliquely arranged, widely elliptic, amphicyclic, with irregular number of subsidiary cells, guard cells stronger in sub-macerated samples, 38 µm long and 10–26 µm wide; male cones globular, 1.5 to 2 mm across, sessile sub-opposite in about 40 mm long catkin-like aggregates on a simple ca. 1 mm thick stalk, rare; detached seed cone scale complexes variously flattened, triangular, 7 to 13 mm high and 7 to 13 mm wide, basally widely cuneate, distally thickened, on outer surface either smooth and only indistinctly ornamented, or with regular rounded knobs, in extreme cases with stronger spiny projections (“*balticum*” form), seeds 6–10 mm long and 3.5–8 mm wide, wingless, angular, of irregular triangular to ovate form, dorsal edge with two knobs.

**Remarks:** The Oligocene population of bald cypress from Seifhennersdorf is important for understanding the development of this lineage. This site records the transition from the populations with prevailingly strongly ornamented cone scales (“*balticum*” type) to those with smooth scales (“*dubium*” type). Both types of cone scales co-occur and are connected with intermediates. Therefore, we consider only one species to have been present in the European Late Palaeogene and Miocene (see also Kunzmann et al. in prep.). The *Taxodium* twigs are very abundant at Seifhennersdorf, particularly in the 5<sup>th</sup> seam, which is an exception among volcanic floras we have studied so far and demonstrates a near-shore type of riparian forest (see below – section on vegetation).

**Material studied:** shoots – MMG, Sf. 32, orig. Walther 1964, pl. 2, fig. 6, Sf. 51, orig. Walther 1964, pl. 4, figs 1–2, prep. (2) s.n., Sf. 56, orig. Walther 1964, pl. 3, fig. 3, Sf. 138, Sf. 140, Sf. 141, Sf. 142, Sf. 143, Sf. 144, Sf. 145, Sf. 146, Sf. 147, Sf. 148, Sf. 149, Sf. 150, Sf. 152, Sf. 153, Sf. 154, Sf. 155, Sf. 156, Sf. 157, Sf. 158, Sf. 159, Sf. 160, Sf. 161, Sf. 162, Sf. 163, Sf. 164, Sf. 165, Sf. 166, Sf. 167, Sf. 168, Sf. 169, Sf. 170, Sf. 171:1:2 to Sf. 173, Sf. 174:1:2 to Sf. 186, Sf. 188, Sf. 190 to Sf. 199:1:2, Sf. 200, Sf. 201, Sf. 202:1:2 to Sf. 215, Sf. 274, Sf. 275:1:2, Sf. 276 to Sf. 279, Sf. 280:1:2, Sf. 281, Sf. 282, Sf. 283:1:2, Sf. 284 to Sf. 296, Sf. 298 to Sf. 305, Sf. 307 to Sf. 311, Sf. 313 to Sf. 324, Sf. 325:1:2, Sf. 326 to Sf. 335, Sf. 337, Sf. 338, Sf. 339:1:2, Sf. 340, Sf. 341:1:2, Sf. 342, Sf. 343, Sf. 344:1:2, Sf. 345 to Sf. 355, Sf. 357, Sf. 359, Sf. 360, Sf. 361:1:2, Sf. 362 to Sf. 367, Sf. 369 to Sf. 373, Sf. 375 to Sf. 387, Sf. 388:1:2, Sf. 389, Sf. 390:1:2, Sf. 391 to 397. Sf. 399 to Sf. 408, Sf. 410 to Sf. 413, Sf. 414:1:2, Sf. 415 to Sf. 418, Sf. 419:1:2, Sf. 420, Sf. 421:1:2, Sf. 422 to Sf. 437, Sf. 438:1:2, Sf. 439, Sf. 440, Sf. 441:1:2, Sf. 442 to Sf. 444, Sf. 445:1:2, Sf. 446:1:2, Sf. 447:1:2, Sf. 448:1:2, Sf. 449 to Sf. 451, Sf. 452:1:2, Sf. 454:1:2, Sf. 456:1:2, Sf. 457, Sf. 458, Sf. 459:1:2, Sf. 460:1:2, Sf. 461:1:2, Sf. 464 to Sf. 465, Sf. 466:1:2, Sf. 467:1:2, Sf. 468:1:2, Sf. 469:1:2, Sf. 470 to Sf. 485, Sf. 486:1:2, Sf. 487 to Sf. 519, Sf. 520 to Sf. 544, Sf.

546, Sf. 547:1:2, Sf. 548 to Sf. 554, Sf. 555:1:2, Sf. 556, Sf. 557:1:2, Sf. 558 to Sf. 563, Sf. 564:1:2, Sf. 565, Sf. 566:1:2, Sf. 567:1:2, Sf. 568, Sf. 569, Sf. 570:1:2, Sf. 571:1:2, Sf. 573 to Sf. 577, Sf. 578:1:2, Sf. 579 to Sf. 583, Sf. 584:1:2, Sf. 585 to Sf. 588, Sf. 589:1:2, Sf. 590, Sf. 592:1:2, Sf. 593, Sf. 594:1:2, Sf. 595, Sf. 596, Sf. 597:1:2, Sf. 598 to Sf. 601, Sf. 602:1:2, Sf. 603, Sf. 604:1:2, Sf. 605–Sf. 607, Sf. 608:1:2, Sf. 609:1:2, Sf. 610:1:2, Sf. 611:1:2, Sf. 612:1:2, Sf. 613:1:2, Sf. 614 to Sf. 616, Sf. 617:1:2, Sf. 618, Sf. 619:1:2, Sf. 620 to Sf. 624, Sf. 625:1:2, Sf. 626:1:2, Sf. 627:1:2, Sf. 628:1:2, Sf. 629, Sf. 630:1:2, Sf. 631 to Sf. 637, Sf. 638:1:2, Sf. 639, Sf. 640:1:2, Sf. 641 to Sf. 643, Sf. 644:1:2, Sf. 645, Sf. 646, Sf. 647:1:2, Sf. 648 to Sf. 659, Sf. 660:1:2, Sf. 661 to Sf. 664, Sf. 666 to Sf. 698, Sf. 699:1:2, Sf. 700 to Sf. 707, Sf. 708:1:2, Sf. 709 to Sf. 725, Sf. 726:1:2, Sf. 727:1:2, Sf. 728:1:2, Sf. 729 to Sf. 731, Sf. 732:1:2, Sf. 733 to Sf. 742, Sf. 744 to Sf. 747, Sf. 834:1:2, Sf. 835, Sf. 836:1:2, Sf. 1521:1:2, Sf. 2187 to Sf. 2189, Sf. 2813, Sf. 2839:1:2, Sf. 3063:1:2, Sf. 3131, Sf. 3213, Sf. 3258, Sf. 3300, orig. Mai 1963, pl. 1, fig. 13 (*Sequoia abietina*), Sf. 3308a, b, c, orig. Mai 1963, pl. 1, figs 9–11 (seeds), Sf. 3310, orig. Mai 1963, pl. 1, fig. 7, Sf. 3332 to Sf. 3339, Sf. 3361, Sf. 3386, Sf. 3401, Sf. 3525, Sf. 3527, Sf. 3561, Sf. 3571, Sf. 3572:1:2, Sf. 3573:1:2, Sf. 3575:1:2, Sf. 3576:1:2, Sf. 3579:1:2, Sf. 3581:1:2, Sf. 3583:1:2, Sf. 3584:1:2, Sf. 3585:1:2, Sf. 3586:1:2, Sf. 3587:1:2, Sf. 3589:1:2, Sf. 3590:1:2, Sf. 3592:1:2, Sf. 3596:1:2, Sf. 3603:1:2, Sf. 3605, Sf. 3606:1:2, Sf. 3607:1:2, Sf. 3608, Sf. 3609:1:2, Sf. 3611 to Sf. 3626, Sf. 3628 to Sf. 3634, Sf. 3635:1:2, Sf. 3636:1:2, Sf. 3637:1:2, Sf. 3638, Sf. 3639:1:2, Sf. 3640:1:2, Sf. 3641:1:2, Sf. 3642:1:2, Sf. 3643:1:2, Sf. 3644, Sf. 3647 to Sf. 2649, Sf. 3651 to Sf. 3653, Sf. 3654:1:2, Sf. 3655, Sf. 3656, Sf. 3657:1:2, 3658:1:2, Sf. 3659, Sf. 3661, S. 3662, Sf. 3663:1:2, Sf. 3664:1:2, Sf. 3665, Sf. 3666:1:2, Sf. 3667:1:2, Sf. 3668 to Sf. 3670, Sf. 3571:1:2, Sf. 3672:1:2, Sf. 3673:1:2, Sf. 3674, S. 3678, Sf. 3678, Sf. 3679, Sf. 3681:1:2, Sf. 3682, Sf. 3683:1:2, Sf. 3684:1:2, Sf. 3685, Sf. 3686:1:2, Sf. 3687:1:2, Sf. 3690:1:2, Sf. 3691:1:2, Sf. 3695, Sf. 3698, Sf. 3709, Sf. 3721:1:2, Sf. 3722:1:2, Sf. 3752, Sf. 3757, Sf. 3939, Sf. 3981, Sf. 3989, Sf. 3993, Sf. 3995, Sf. 4037, Sf. 4040, Sf. 4042, Sf. 4064:1:2, Sf. 4065, Sf. 4070, Sf. 4074, Sf. 4094, Sf. 4130, Sf. 4137, Sf. 4149, Sf. 4168:1:2, Sf. 4169:1:2, Sf. 4170 to Sf. 4172, Sf. 4173:1:2, Sf. 4178, Sf. 4179, Sf. 4180, Sf. 4181, Sf. 4182:1:2, Sf. 4184, Sf. 4191:1:2, Sf. 4204, Sf. 4232, Sf. 4319, Sf. 4321, Sf. 4322, Sf. 4323, Sf. 4324, Sf. 4325:1:2, Sf. 4389, Sf. 4390:1:2, Sf. 4392, Sf. 4419, Sf. 4420, Sf. 4432, Sf. 6635 to Sf. 6640, Sf. 6642:1:2, Sf. 6643:1:2, Sf. 6644 to Sf. 6652, Sf. 6653:1:2, Sf. 6654 to Sf. 6693, Sf. 6694:1:2, Sf. 6695 to 6734, Sf. 6735:1:2, Sf. 6736 to Sf. 6821, Sf. 6822:1:2, Sf. 6823 to Sf. 6845, Sf. 6846:1:2, Sf. 6847 to Sf. 6866, Sf. 6904 to Sf. 6915, Sf. 6916:1:2, Sf. 6917 to Sf. 6959, Sf. 6961:1:2, Sf. 6962 to Sf. 6999, Sf. 7001 to Sf. 7019, Sf. 7020:1:2, Sf. 7021 to Sf. 7063, Sf. 7064:1:2, Sf. 7065:1:2, Sf. 7066 to Sf. 7113, Sf. 7114:1:2, Sf. 7115:1:2, Sf. 7116:1:2, Sf. 7117:1:2, Sf. 7118 to Sf. 7137, Sf. 7138:1:2, Sf. 7139:1:2, Sf. 7140 to Sf. 7158, Sf. 7159:1:2, Sf. 7828, Sf. 7836, Sf. 7920a, Sf. 7979:1:2, Sf. 7980:1:2, Sf. 7981:1:2, Sf. 7986:1:2, Sf. 7987 to Sf. 7990, Sf. 7992, Sf. 7993:1:2, Sf. 7995, Sf. 7997 to Sf. 8001, Sf. 8002 a b, Sf. 8003, Sf. 8004, Sf. 8005:1:2, Sf. 8006:1:2, Sf.



8007, Sf. 8015, Sf. 8018, Sf. 8021, Sf. 8022:1:2, Sf. 8023:1:2, Sf. 8024:1:2, Sf. 8025:1:2, Sf. 8026:1:2, Sf. 8027:1:2, Sf. 8028:1:2, Sf. 8029:1:2, Sf. 8030, Sf. 8031, Sf. 8034, Sf. 8041:1:2, Sf. 8042:1:2, Sf. 8043:1:2, Sf. 8044:1:2, Sf. 8045:1:2, Sf. 8046, Sf. 8047, Sf. 8048, Sf. 8049:1:2, Sf. 8050 to Sf. 8070, Sf. 8071:1:2, Sf. 8072, Sf. 8073, Sf. 8074:1:2, Sf. 8075 to Sf. 8078, Sf. 8080:1:2, Sf. 8081:1:2, Sf. 8178, Sf. 8186, Sf. 8187, Sf. 8246, Sf. 8257, orig. Engelhardt 1870, pl. 2, fig. 1, Sf. 8259, orig. Walther 1964, pl. 3, fig. 2, Sf. 8372, orig. Walther 1964, pl. 3, fig. 6, Sf. 8374, orig. Walther 1964, pl. 2, fig. 8, Sf. 8375, orig. Walther 1964, pl. 2, fig. 7, Sf. 8423, Sf. 8425, Sf. 8428, Sf. 8430, Sf. 8479, Sf. 8431, Sf. 8428, Sf. 8546 to Sf. 8551, Sf. 8552:1:2:3, Sf. 8553 to Sf. 8557, Sf. 8586, Sf. 8587, Sf. 8598, Sf. 8628, Sf. 8629:1:2, Sf. 8640, Sf. 8641, Sf. 8656, Sf. 8657:1:2 ; KM III, 1202C, 1203C, 1204C, 1207C, orig. Mai 1963, pl.1, fig. 8, 1247C, 3 shoots s.n.

Cone scales and seeds – MMG, Sf. 387, Sf. 3166, Sf. 3172, Sf. 3173, Sf. 3186, Sf. 3191, Sf. 3194, Sf. 3207, Sf. 3212, Sf. 3220, Sf. 3242, Sf. 3254:1:2, Sf. 3271, Sf. 3295a, b, orig. Mai 1963, pl. 1, fig. 14, Sf. 3308a–d, orig. Mai 1963, pl. 1, figs 9–11, Sf. 3347, Sf. 3348, Sf. 3349, Sf. 3350, Sf. 3365a, b, Sf. 3596:1:2, Sf. 4391, Sf. 4401, Sf. 4438, ?Sf. 6766, Sf. 6817, Sf. 6874 to Sf. 6879, Sf. 6881, Sf. 6882, Sf. 6885, Sf. 6888, Sf. 6890, Sf. 6892, Sf. 6893, Sf. 6895, Sf. 6898, Sf. 6901, Sf. 6902, Sf. 7008, Sf. 7011, Sf. 7012, Sf. 7015, Sf. 7018, Sf. 7048:1:2, Sf. 7300, Sf. 7334, Sf. 7337, Sf. 7347 to 7349, Sf. 7351, Sf. 7359, Sf. 7382, Sf. 7387, Sf. 7390, Sf. 7394, Sf. 7396, Sf. 7400, Sf. 7402, Sf. 7403, Sf. 7410, Sf. 7412, Sf. 7413, Sf. 8246, orig. Mai 1963, pl. 11, fig. 6 (*Trapa silesiaca*), Sf. 8426, Sf. 8427.

Male organs – Sf. 28, Sf. 481, Sf. 4392, Sf. 7060.

#### cf. *Quasisequoia* SHRINIVASAN et FRIIS

#### cf. *Quasisequoia couttsiae* (HEER) KUNZMANN

Pl. 2, figs 11–13, pl. 22, fig. 2

cf. 1862 *Sequoia couttsiae* HEER, p. 369, pl. 18 (Hemstead, Oligocene).

cf. 1999 *Quasisequoia couttsiae* (HEER) KUNZMANN, p. 65 (many localities – see there).

1870 *Glyptostrobus ungeri* HEER; Engelhardt, p. 11, pl. 1, fig. 8.

**Description:** Foliage shoots covered with appressed, helically disposed scale leaves; some specimens bear terminal remains of pollen cones; cuticle delicate, only small fragments preserved, non-stomatal areas with straight-walled quadrangular cells (24)–40–(64) µm long, stomatal bands with amphicyclic stomata, parallel to obliquely orientated to the leaf length, 48–68 µm long and 28–44 µm wide, guard cells hardly visible, subsidiary cells about six, quite wide, crystal cavities present but difficult to observe (in phase contrast light).

**Remarks:** Seed cones or seeds have not been available from Seifhennersdorf so that the determination of cupressoid foliage shoots, which occur only very sporadically, has been based on the cuticular structure. This matches the typical pattern of *Quasisequoia couttsiae* in the topography of stomata, distribution of crystal cavities and

other details (Lutz Kunzmann, personal communication 2005).

**Material studied:** MMG, Sf. 20, prep. Sf. 42/93, Sf. 195, Sf. 45/93, Sf. 3362, Sf. 4090a, Sf. 8255, orig. Engelhardt 1870, pl. 1, fig. 8 (*Glyptostrobus ungeri*).

#### *Tetraclinis* MASTERS

#### *Tetraclinis salicornioides* (UNGER) KVAČEK

Pl. 2, figs 14–17, pl. 22, fig. 3

1847 *Thuytes salicornioides* UNGER, p. 11, pl. 2, figs 1–4 (Radoboj, Miocene).

1870 *Libocedrus salicornioides* (UNGER) HEER; Engelhardt, p.10, pl. 1, figs 4–5.

1963 *Hellia salicornioides* UNGER; Mai, p. 41, pl. 1, figs 1–6.

1964 *Libocedrus salicornioides* (UNGER) HEER; Walther, p. 15, pl. 5, figs 7–11, pl. 6, figs 1, 2.

1989 *Tetraclinis salicornioides* (UNGER) KVAČEK, p. 48, pl. 1, fig. 11, pl. 2, figs 2–14, pl. 7, figs 3–4 (Kučlín, Kunderatice, Sulečice, Flörsheim, Bohdanovce, Hrádek/N., Radoboj, Late Eocene to Miocene)

1996 *Tetraclinis salicornioides* (UNGER) KVAČEK; Walther, p. 14, fig. 25.

**Description:** Foliage shoots plagiotropic, oppositely branched, composed of cladode-like leaf segments, showing veins of completely fused scale leaves; cuticle thick, epidermal structure corresponds exactly to that of other records of this morpho-species (see e.g. Knobloch and Kvaček 1976, Walther 1999).

**Remarks:** *Tetraclinis salicornioides* seems to be an important accessory element in most Palaeogene volcanic floras. This conifer was a thermophilic element in the Oligocene Mixed Mesophytic forests.

**Material studied:** MMG, Sf. 123, prep. Sf. 32/7, Sf. 124, Sf. 131, Sf. 132:1:2, Sf. 134, Sf. 136, Sf. 137, Sf. 1458, Sf. 1805, Sf. 3165, Sf. 3169, Sf. 3175, Sf. 3217, Sf. 3247, Sf. 3301, orig. Mai 1963, pl.1, fig. 3 (*Hellia salicornioides*), Sf. 4324, Sf. 5646c, Sf. 5872, Sf. 5876, Sf. 5877, Sf. 5892, Sf. 5893, Sf. 7161 to Sf. 7193, Sf. 7194, Sf. 7195, Sf. 7196, orig. Walther 1964 (*Libocedrus salicornioides*), Sf. 7197, Sf. 7198, Sf. 7199, Sf. 7921:1:2, Sf. 7978:1:2, Sf. 7982, Sf. 7983:1:2, Sf. 8195, Sf. 8321, orig. Mai 1963, pl. 1, fig. 6 (*Hellia salicornioides*), Sf. 8429, Sf. 8356, orig. Engelhardt 1870, pl. 1, fig. 4 (*Libocedrus salicornioides*), Sf. 8666; KM III 1208 C (seed), 1210C.

#### Taxaceae GRAY

#### *Torreya* ARNOTT

#### *Torreya bilinica* SAPORTA et MARION

Pl. 2, figs 20–24, pl. 22, figs 6–7

1876 *Torreya bilinica* SAPORTA et MARION, p. 221 (Žichov, “Schichow”, Oligocene).

cf. 1870 *Podocarpus eocenica* UNGER; Engelhardt, p. 12, pl. 2, figs 4–5.

1963 “*Podocarpus eocenica* ENGELHARDT (non UNGER)”; Mai, p. 83, pl. 12, figs 6–9.

1996 *Torreya bilinica* SAPORTA et MARION, Walther, p. 16.

**Description:** Needle leaves linear, ca. 17–38 mm long and up to 3–4 mm wide, entire-margined, univeined, on the lower side with two narrow stomatal bands, apex blunt, acute to rounded, base cuneate; cuticles thick, adaxial epidermis prosenchymatous, composed of narrow and long cells with smooth anticlinal walls, crosswalls usually very steep; abaxial epidermis heavily papillate over the stomatal bands and a few adjacent cell rows, marginal areas prosenchymatous, similar to the adaxial epidermis, stomata monocyclic, hardly visible among long and dark papillae, 30–40 µm long and about 30–45 µm wide.

**Remarks:** The remains of *Torreya* from Seifhennersdorf match the other records of *Torreya bilinica* from the České středohoří Mts. in all respects (Kvaček 1986). Remains of this conifer are rare. More complete foliage shoots have been recovered only at the type locality Žichov (“Schichow”) in the České středohoří Mts. The needle leaves are morphologically similar to those of *Cephalotaxus parvifolia*. Cuticles, at least on the adaxial side, are needed to distinguish them because in *Cephalotaxus* the cells are not prosenchymatous (see below).

**Material studied:** MMG, Sf. 3304, orig. Mai 1963, pl. 12, fig. 6 (“*Podocarpus eocenica*”), Sf. 3303, orig. Mai 1963, pl. 12, fig. 7 (“*Podocarpus eocenica*”), Sf. 4451, prep. Sf. 46–48/93, Sf. 4109a, Sf. 5872, Sf. 5876, Sf. 5905, Sf. 5908a, b, Sf. 5909d, Sf. 5912, Sf. 5913, Sf. 6372, Sf. 7983:1:2, Sf. 8252, Sf. 8664, Sf. 8666.

## **Cephalotaxaceae DUMORT.**

### ***Cephalotaxus* SIEBOLD et ZUCCARINI**

#### ***Cephalotaxus parvifolia* (WALTHER)**

##### **KVAČEK et WALTHER**

Pl. 2, figs 18–19, pl. 22, figs 4–5

- 1964 *Amentotaxus parvifolia* WALTHER, p. 8, pl. 1, figs 1–5.  
 1986 *Amentotaxus parvifolia* WALTHER; Kvaček, p. 484, fig. 9 (Kundratice, Early Oligocene).  
 1996 *Cephalotaxus* sp. (“*Amentotaxus parvifolia*” WALTHER); Walther, p. 16.  
 1998 *Cephalotaxus parvifolia* (WALTHER) KVAČEK et WALTHER, p. 11, pl. 4, figs 1–3 (Kundratice, Early Oligocene).

**Description:** Needle leaves linear, 2–2.5 mm wide, up to 17 mm long, univeined, without stomatal bands visible on compressions, apex blunt, base cuneate; cuticle thick, adaxial epidermis composed of quadrangular straight-walled cells ca. 25–30 µm wide and 30–60 µm long, abaxial epidermis with one costal and two lateral non-stomatal zones composed of cells similar to adaxial epidermis and two stomatal bands including up to 8–10 irregular rows of stomata and scattered stomatal groups, finely granulate, very rarely with indistinct ridges or papillae on ordinary cells, stomata longitudinally arranged, amphicyclic, outer stomatal pit well demarcated by thickened outline and granular surface (? wax cover), 15–20 µm wide and 25–45 µm long, inner subsidiary cells 4 to 6, polar sometimes shared by two adjacent stomata, lateral similar in shape to outer subsidiary and ordinary cells.

**Remarks:** This species of *Cephalotaxus* differs in small size of needle leaves from most other fossil and extant representatives of the genus. By its gross morphology it differs from the co-occurring leaves of *Torreya bilinica*, which are larger and often show abaxially two very narrow stomatal bands.

**Material studied:** MMG, Sf. 3353, Sf. 3732, orig. Walther 1964, pl. 1, figs 1–5, holotype (*Amentotaxus parvifolia*). Sf. 4453, prep. Sf. 49/93.

## **Magnoliophyta**

### **Dicotyledonae**

#### **Magnoliaceae JUSS.**

##### ***Magnolia* L.**

#### ***Magnolia seifhennersdorfensis***

##### **WALTHER et KVAČEK sp. n.**

Pl. 3, figs 1–2, pl. 2, figs 8–10

cf. 1866 *Magnolia diana* UNGER, p. 44, pl. 14, figs 4–7 (Radoboj, Middle Miocene).

1870 *Quercus desloesii* HEER; Engelhardt, p. 18, pl. 4, fig. 17.

1963 *Magnolia diana* UNGER; Mai, p. 69, pl. 7, figs 1–3.

2003 *Magnolia* sp.; Walther, p. 135, pl. 1, fig. 3, pl. 3, fig. 4.

**Diagnosis:** Leaves simple, entire-margined, oblong ovate, venation brochidodromous; cuticle thin, adaxial compound of polygonal cells with anticlines straight, rarely sinuous, abaxial cuticle consisting of polygonal cells with sinuous anticlines, stomata small, of paracytic to semiparacytic type, bases of serial trichomes rare.

**Holotype designed here:** MMG, Sf. 4441, prep. Sf. 58/94–64/94 – pl. 2, fig. 1.

**Stratum typicum:** Volcanic complex of the Lausitz Mountains, basis of the basaltoid horizon, Early Oligocene.

**Locus typicus:** Seifhennersdorf, Saxony, Germany, Lausitz Mountains.

**Description:** Leaves simple, petiolate, length of petiole up to 10 mm, strong, lamina oblong, oblong ovate to narrow ovate, 21–121 mm long, 21–51 mm wide, base widely cuneate to rounded, symmetrical or rarely slightly asymmetrical, apex long acute, at the tip rounded, margin entire, thickened, venation brochidodromous, midrib strong, upwards thinner, straight, secondaries more delicate, in up to 12 pairs, at acute angles, running straight or slightly bent, intersecondaries simple, in wide angles, tertiaries anastomosing with secondaries by perpendicular veinlets, sometimes forked, higher-order venation not preserved; adaxial cuticle smooth consisting of polygonal cells 24–32 µm across with straight to more or less sinuous anticlines; cells directly in the marginal region rectangular, with strongly cutinised anticlines; abaxial cuticle compound of polygonal cells 16–40 µm across, anticlines sinuous to slightly undulate, stomata mostly paracytic, occasionally incompletely cyclocytic and rarely anomocytic, irregularly distributed, rounded, 14–24 µm long and 14–20 µm wide, cup-like basal fragmentary parts of serial trichomes very rarely visible, about 24 µm across.

**Remarks:** In the Seifhennersdorf flora, *Magnolia seifhennersdorfensis* is represented by more than 30 leaf fragments (Walther 2003, as *Magnolia* sp.). This foliage morpho-type represents a natural entity assignable to the genus *Magnolia*. The seeds described by Mai (1963) as *Magnolia* cf. *denudataeformis* DOROFEEV obviously belong to the same plant. Magnolias are more accessory elements in the volcanic floras (Kundratice – Kvaček and Walther 1998, Bechlejovice – Kvaček and Walther 2004, Suletice-Berand – Kvaček and Walther 1995, Hammerunterwiesenthal – Walther 1998). In Kleinsaubernitz, another species *Magnolia maii* WALTHER was described. It differs in the subcordate base and dense secondary venation (Walther 1999, 2003).

**Material studied:** MMG, Sf. 1433, Sf. 2526, Sf. 2556, Sf. 2632:1:2, Sf. 2632, Sf. 2634, Sf. 2637, Sf. 2638, Sf. 2639, Sf. 2641, Sf. 2647, Sf. 2654, Sf. 2655, Sf. 2658, Sf. 2659, Sf. 2662, Sf. 2665, Sf. 2669, Sf. 2710, Sf. 2711, Sf. 2712, Sf. 2716, Sf. 2719:1:2, Sf. 2721, Sf. 2725, Sf. 3360, Sf. 4200, Sf. 4266, Sf. 4236, Sf. 4441, prep. Sf. 58/94 to Sf. 72/94, Sf. 6314, Sf. 6315:1:2, Sf. 6316:1, Sf. 6317, prep. Sf. 74 to Sf. 76/94, Sf. 6318, Sf. 6319, Sf. 6320, prep. Sf. 65/94 to 73/94, Sf. 6321, Sf. 6322, orig. Walther 2003, pl. 1, fig. 3 (*Magnolia* sp.), Sf. 6323, Sf. 6324, Sf. 6325, Sf. 6326, Sf. 6327, Sf. 6328, Sf. 6329, Sf. 6330, Sf. 6331, Sf. 6332, Sf. 6333:1:2, Sf. 6334:1:2, Sf. 6335:1:2, Sf. 6336, Sf. 6337:1:2, Sf. 6338, Sf. 6339, Sf. 6340, Sf. 6341, Sf. 6342, Sf. 8270, orig. Engelhardt 1870, pl. 4, fig. 8 (*Quercus desloesii*); KM III, 1234C b, one fragment s. n.

### *Magnolia* cf. *denudataeformis* DOROFEEV

Pl. 2, figs 3–4

- cf. 1960 *Magnolia denudataeformis* DOROFEEV, p. 133, text-fig. 1.18 (Kireevskoe, Miocene).  
1963 *Magnolia* cf. *denudataeformis* DOROFEEV; Mai, p. 69, pl. 7, figs 4a–d.  
1996 *Magnolia* cf. *denudataeformis* DOROFEEV; Walther, p. 16.

**Description:** Seeds 12 mm wide and 11 mm long, heart-shaped, depressed on ventral side, smooth, distinct raphe over the whole length as a narrow groove, on dorsal side domed, grooved from chalaza region on, a pit of heteropyle at chalaza lacking; vascular bundle enters through a small opening, micropyle sits on a small point (see Mai 1963, p. 69).

**Remarks:** According to Mai (1963) the nearest fossil record was described as *Magnolia denudataeformis* DOROFEEV and *M. cordata* DOROFEEV from the Miocene of Russia. Most similar seeds of extant species are produced by *M. denudata* DESROUSS., *M. salicifolia* MAXIM. and *M. dawsoniana* REHD. et WILS. from East Asia, which differ in a less bilaterally symmetrical form.

**Material studied:** MMG, Sf. 3325 a, b; KM III 1261c, orig. Mai 1963, pl. 7, fig. 4.

## Lauraceae JUSS.

### *Laurophyllum* GOEPPERT

#### *Laurophyllum acutimontanum* MAI

Pl. 3, fig. 7, pl. 4, figs 1–5, pl. 22, fig. 11

- 1963 *Laurophyllum* (*Tetradenia*) *acutimontanum* MAI, p. 72, pro parte, pl. 8, figs 7–9, 12 (non 10), pl. 9, figs 1–4, text-figs 11f–h.  
1964 *Laurophyllum princeps* (HEER) WEYLAND et KILPPER “sensu stricto”; Walther, p. 45, ex parte, pl. 16, figs 1, 3.  
1971 *Laurophyllum acutimontanum* MAI; Kvaček, p. 53, pl. 2, fig. 5, pl. 6, figs 4–6, pl. 7, figs 2, text-figs 3–4 (Plesná, Markvartice, Bechlejovice).  
1996 *Laurophyllum acutimontanum* MAI; Walther, p. 14, fig. 3/16.

**Description:** Leaves mostly fragmentary, petiole, petiole 5–11 mm long, lamina lanceolate, about 9–20 mm wide and more than 40–145 mm long, entire-margined, margin sometimes thickened, venation brochidodromous, midrib straight, medium thick, secondaries irregularly and alternately arising from the midrib at variable angles, tertiaries and higher-order veins reticulate, texture coriaceous, strong; adaxial cuticle mostly fragmentarily preserved, with ordinary cells isodiametric to polygonal, 12–68 µm across, with straight to bent anticlines, rare simple trichome bases on veinlets or in intercostal fields; hypodermis with straight anticlines often present; abaxial cuticle stronger, excellently preserved, showing ordinary cells similar in size and form to those of adaxial cuticle and with typical brachyparacytic stomata, subsidiary cells overlapped by swollen papillae or the surrounding ordinary cells, 16–20 µm wide and 19–30 µm long.

**Remarks:** This lauroid is very typical in the structure of its abaxial epidermis and in the fragmentary hypodermis located below the adaxial epidermis. It commonly occurs in the Oligocene volcanic floras of the České středohoří Mountains, just as in Seifhennersdorf (type locality) and elsewhere in Central Europe and started in the Late Eocene (Knobloch et al. 1996).

**Material studied:** MMG, Sf. 142, prep. Sf. 1 to 2/05, Sf. 1466, Sf. 2451, prep. Sf. 3 to 5/05, Sf. 2452, prep. Sf. 6 to 7/05, Sf. 2453, prep. Sf. 14/05, Sf. 2493, prep. Sf. 8 to 13/05, Sf. 2502, prep. Sf. 15 to 16/05, Sf. 2503, prep. Sf. s.n., Sf. 2505, prep. Sf. 15/05, Sf. 2565, prep. Sf. 16 to 20/05, Sf. 2566, prep. Sf. 21 to 29/05, Sf. 2275 (*L. cf. acutimontanum*), Sf. 3388, Sf. 3390 to Sf. 3493, prep. Sf. 30 to 32/05, Sf. 4414, Sf. 4436, Sf. 5908a, Sf. 5134:1:2:3:4, Sf. 6108, Sf. 6151, Sf. 6184, Sf. 6198, Sf. 6201, Sf. 6202, Sf. 6209, Sf. 6227:1:2, Sf. 6232, Sf. 6234, Sf. 7914, Sf. 8231, Sf. 8343, orig. Walther 1964, pl. 16, fig. 3 (*Laurophyllum princeps*), Sf. 8373, orig. Walther 1964, pl. 16, fig. 1 (*Laurophyllum princeps*); KM III, 1262 C, 1263 C, 1265 C.

#### *Laurophyllum pseudoprinceps* WEYLAND et KILPPER

Pl. 3, fig. 8, pl. 22, figs 14–15

- 1963 *Laurophyllum pseudoprinceps* WEYLAND et KILPPER, p. 100, pl. 23, figs 14–19, text-fig. 6 (Frimmersdorf, Middle Miocene).

1999 *Laurophyllum pseudoprinceps* WEYLAND et KILPPER; Walther, p. 84, pl. 5, figs 4–6, text-fig. 16/20 (Kleinsaubernitz, Late Oligocene).

Further synonyms see Mai and Walther (1978, p. 39), Knobloch et al. (1996, p. 42).

**Description:** Leaves simple, petiolate, petiole only fragmentarily preserved, lamina lanceolate to narrow ovate, up to 28 mm wide and 79 mm long, entire-margined, venation brochidodromous, secondaries hardly recognizable, leaf compressions strong and mostly split in small fragments; adaxial cuticle not preserved, abaxial cuticle thick, ordinary cells polygonal with straight to sinuous anticlines only partly with bead-like thickenings, 8–32 µm across, stomata brachyparacytic, subsidiary cells completely visible, 25–32 µm wide, 18–32 µm long, pore small, ovate, outer walls of guard cells thickened, mesophyll tissue sometimes with fragments of oil-cells; simple trichome bases rare, more common on veins, 8 to 18 µm in diameter.

**Remarks:** The structure of the abaxial epidermis, particular the stomata, in the rare specimens from Seifhennersdorf indicates *Laurophyllum pseudoprinceps* which is a frequent morpho-species in several warm-temperate floras known mainly from the Early Oligocene and in the Early Miocene of Central Europe (e.g. Kvaček 1988, Kvaček and Walther 2001). The lauroid leaves from Seifhennersdorf which were published by Walther (1964, pp. 45–48, pl. 26) as *Laurophyllum princeps* (HEER) KRÄUSEL et WEYLAND sensu stricto (1950, pl. 26, figs 1–3) do not correspond with *L. pseudoprinceps*, but partly with *L. acutimontanum* and partly are described below as a new species.

**Material studied:** MMG, Sf. 3493, prep. Sf. 30 to 32/05.

### ***Laurophyllum meuselii* WALTHER et KVAČEK sp. n.**

Pl. 3, figs 5–6, pl. 22, figs 12–13

1963 *Laurophyllum princeps* (HEER) sensu stricto KRÄUSEL et WEYLAND; Walther, p. 45, ex parte, pl. 16, fig. 2.

**Holotype designated here:** MMG, Sf. 2451 – pl. 3, fig. 5.

**Stratum typicum:** Basaltoid brown coal complex, Early Oligocene.

**Locus typicus:** Seifhennersdorf, the former diatomite mine “Freundschaft”, Saxony, Germany.

**Etymology:** After the famous botanist and promotor of the Tertiary botany, prof. dr. Herman Meusel (1909 – 1987).

**Diagnose:** Leaf lauroid, similar to *Laurophyllum acutimontanum*, differing in adaxial and abaxial cuticles without hypodermis, stomata paracytic with guard cells only partly sunken, covered by adjacent parts of ordinary cells without papillae.

**Description:** Leaves simple, fragmentarily preserved, lamina lanceolate to oblong ovate, about 35 to 70 mm long, up to 15 mm wide, entire-margined, apex and base not preserved, venation camptodromous to brochidodromous, midrib strong, secondaries more delicate, running to the margin, texture coriaceous; cuticle strong, adaxial

epidermis composed of polygonal ordinary cells 15–25 µm across with straight to sinuous anticlines, mesophyll oil cells distributed mainly on veinlets; abaxial cuticle strong, ordinary cells 12–36 µm across, anticlines straight to sinuous, stomata paracytic, sunken, guard cells sometimes partly covered by adjacent ordinary cells without papillae, stomata (16)–20–(28) µm long and 15–24 µm wide; fragments of mesophyll oil cells distributed along veins; surface sometimes covered by (?) oil cells, isolated or in pairs, 20–40 µm in diameter; no remains of hypodermis visible.

**Remarks:** This morpho-species is distinguished from the similar *Laurophyllum acutimontanum* in the epidermis structure of the abaxial leaf side by the sunken stomata without surrounding papillae and also by the lack of hypodermis on both leaf sides. Otherwise the gross morphology of these lauroid leaves shows no essential differences from other species of *Laurophyllum*.

**Material studied:** MMG, Sf. 2451 (holotype), prep. Sf. 3/05, Sf. 25/05, Sf. 27/05, Sf. 29/05, Sf. 2566, prep. Sf. 21/05 to 29/05, Sf. 8328, orig. Walther 1964, pl. 16, fig. 2 (*Laurophyllum princeps*),

### ***Laurophyllum* sp.**

**Description:** Leaves and leaf fragments entire-margined, mostly lanceolate, with brochidodromous venation, sharing in gross-morphology the characteristics of various species of *Laurophyllum*, cuticles not preserved.

**Remarks:** A lot of specimens listed below and belonging apparently to *Laurophyllum* have not been determined because important traits of the leaf cuticle are not available. It is impossible to assign these samples to any of the leaf morpho-species described above.

**Material studied:** Sf. 17, Sf. 138, Sf. 312, Sf. 955, Sf. 1010, Sf. 1054, Sf. 1072, Sf. 1258, Sf. 1269, Sf. 1316, Sf. 1470, Sf. 2098, Sf. 2275, Sf. 2294, Sf. 2311, Sf. 2312, Sf. 2440 to Sf. 2450, Sf. 2454 to Sf. 2498, Sf. 2500 to Sf. 2504, Sf. 2506 to Sf. 2522, Sf. 2524, Sf. 2525, Sf. 2527 to Sf. 2540, Sf. 2542 to Sf. 2548, Sf. 2550 to Sf. 2558, Sf. 2560 to Sf. 2573, Sf. 2575, Sf. 2576, Sf. 2578 to Sf. 2581, Sf. 2585, Sf. 2600, Sf. 2636, Sf. 2648, Sf. 2650, Sf. 2651, Sf. 2677, Sf. 2686, Sf. 2706, Sf. 2727, Sf. 2741, Sf. 2967, Sf. 3357, Sf. 3381, Sf. 3473, Sf. 3493, Sf. 3496, Sf. 3535:1:2, Sf. 3978:1:2, Sf. 3994, Sf. 3998, Sf. 4000, Sf. 4002, Sf. 4003, Sf. 4021, Sf. 4039, Sf. 4051, Sf. 4057, Sf. 4061, Sf. 4075, Sf. 4082, Sf. 4084, Sf. 4085, Sf. 4087, Sf. 4105, Sf. 4245, Sf. 4246, Sf. 4247, Sf. 4251, Sf. 4263, Sf. 4265, Sf. 4268, Sf. 4277, Sf. 4281, Sf. 4318, Sf. 4319, Sf. 4333, Sf. 4348, Sf. 4369, Sf. 4370, Sf. 4407, Sf. 5305, Sf. 5355, Sf. 5391, Sf. 5478, Sf. 5498, Sf. 5670a, Sf. 5909, Sf. 5911, Sf. 6057, Sf. 6061 to Sf. 6066, Sf. 6067:1:2, Sf. 6068 to Sf. 6087, Sf. 6088:1:2, Sf. 6089 to Sf. 6128, Sf. 6129:1:2, Sf. 6130 to Sf. 6146, Sf. 6147:1:2, Sf. 6148:1:2, Sf. 6149:1:2, Sf. 6150 to Sf. 6157, Sf. 6158:1:2, Sf. 6159 to Sf. 6181, Sf. 6182:1:2, Sf. 6183, Sf. 6185 to Sf. 6224, Sf. 6225:1:2, Sf. 6226:1:2, Sf. 6227:1:2, Sf. 6228 to Sf. 6246, Sf. 6392, Sf. 6600:1:2, Sf. 6601:1:2, Sf. 6002 to Sf. 6614, Sf. 6623, Sf. 7551, Sf. 7562, Sf. 7819a, Sf. 8020:1:2, Sf. 8210, Sf. 8216, Sf. 8218, Sf. 8422, Sf. 8614, Sf. 8617, Sf. 8619, Sf. 8622, Sf. 8651.

## *Daphnogene* UNGER

### *Daphnogene cinnamomifolia* (BRONGNIART)

#### UNGER forma *cinnamomifolia*

Pl. 4, figs 6–8

- 1822 *Phyllites cinnamomifolia* BRONGNIART in CUVIER, p. 359, pl. 11, fig. 12 (Habichtswald, Late Oligocene).  
1850a *Daphnogene cinnamomifolia* (BRONGNIART) UNGER, p. 424 (various localities).  
1974 *Daphnogene* cf. *cinnamomifolia* (BRONGNIART) UNGER; Kvaček and Walther, p. 202, pl. 1, fig. 4, pl. 2, figs 1–5, text-fig. 9.  
1996 *Daphnogene* cf. *cinnamomifolia* (BRONGNIART) UNGER; Walther, pp. 14, 26, text-fig. 3/30.  
1998 *Daphnogene cinnamomifolia* (BRONGNIART) UNGER forma *cinnamomifolia*; Kvaček and Walther, p. 13, pl. 5, fig. 5 (Bechlejovice, Early Oligocene).

**Description:** Leaves typically triveined (venation acrodromous), ovate to broadly elliptic, petiolate, entire-margined, up to 84 mm long and 59 mm wide, incomplete (reconstructed full length of 125 mm probable); secondaries camptodromous to brochidodromous, tertiaries anastomosing at nearly right angles between the primaries and secondaries, outer veinlets running to the margin, connecting together in small loops; cuticle of adaxial epidermis showing polygonal cells 17–24 µm across with wavy anticlines; mesophyll oil cells sometimes frequent, 25–50 µm across, abaxial cuticle more delicate, ordinary cells polygonal, anticlines undulate, stomata paracytic, subsidiary cells sunken, 11–17 µm long, 10–18 µm wide, with a mean of 170/mm<sup>2</sup>; hydathodes (gaps) rare, trichomes on both leaf sides missing.

**Remarks:** The taxonomy of this morpho-species has been resolved several times (Kvaček 1971, Kvaček and Knobloch 1967, Kvaček and Walther 1974, 1998) stressing quite uniform cuticular structure of various leaf forms. According to the variation in some subtle details of epidermal structure (e.g. curved vs. finely undulate anticlines without or with bead-like thickenings in the adaxial epidermis) Kvaček and Walther (1998) separated late Palaeogene populations as *D. cinnamomifolia* from the Neogene *D. polymorpha* (UNG.) ETTINGSH. and *D. pannonica* KNOBLOCH et KVAČEK. They reduced broader and narrow leaf forms previously treated as independent species to the category of the morpho-forms (see Kvaček and Walther 1998).

**Material studied:** MMG, Sf. 20, prep. Sf. 166 to 167/71, Sf. 172/71, orig. Kvaček and Walther 1974, text-fig. 3, pl. 1, fig. 4 (*Daphnogene cinnamomifolia*), Sf. 5954, Sf. 5992.; KM III 1261c, Sf. 1269c, orig. Mai 1963, pl. 8, fig. 11 (*Laurophyllum acutimontanum*).

### *Daphnogene cinnamomifolia* (BRONGNIART) UNGER forma *lanceolata* (UNGER) KVAČEK et WALTHER

Pl. 4, figs 9–10

- 1850a *Daphnogene lanceolata* UNGER, p. 424 pro parte (Socka, Late Eocene).  
1870 *Cinnamomum lanceolatum* UNGER; Engelhardt, p. 20, figs 11, 12.

- 1963 *Cinnamomophyllum* (*Cinnamomum*) *scheuchzeri* (HEER) KRÄUSEL et WEYLAND; Mai, p. 71, pl. 8, figs 4–6.  
1964 *Cinnamomophyllum scheuchzeri* (HEER) KRÄUSEL et WEYLAND; Walther, p. 48, pl. 17, figs. 1–5.  
1974 *Daphnogene lanceolata* UNGER; Kvaček and Walther, p. 207.  
1996 *Daphnogene lanceolata* UNGER; Walther, pp. 14, 16, text-fig. 3/24.  
1998 *Daphnogene cinnamomifolia* (BRONGNIART) UNGER forma *lanceolata* KVAČEK et WALTHER, p. 13, pl. 5, fig. 5 (Bechlejovice, Early Oligocene).

**Description:** Leaves petiolate, petiole preserved in length of ca. 8–10 mm, lamina lanceolate to oblong, entire-margined, triveined, 40–100 mm long and 9–15 mm wide, venation acrodromous (basal imperfect to suprabasal imperfect), higher-order venation as in the above *D. cinnamomifolia* f. *cinnamomifolia*; cuticle of adaxial leaf side strong, cells with straight and strong anticlines, for shape and size see forma *cinnamomifolia*, bases of simple trichomes frequent, abaxial cuticle with polygonal cells, anticlines straight to curved, the type, shape and size of stomata identical with those of forma *cinnamomifolia*, but stomata as well as simple trichome bases more frequent.

**Remarks:** These leaves represent according to Kvaček and Walther (1974) sun leaves of this lauroid. There are also frequent transitions between sun and broader shade leaves (Walther 1998).

**Material studied:** MMG, Sf. 3306, orig. Mai 1963, pl. 8, fig. 10 (*Laurophyllum* (*Tetradenia*) *acutimontanum*), Sf. 5946, Sf. 5947, Sf. 5948, Sf. 5949, Sf. 5950, Sf. 5951, Sf. 5952, Sf. 5953, Sf. 5955, Sf. 5956, Sf. 5957, Sf. 5958, Sf. 5959, Sf. 5960, Sf. 5961, Sf. 5962, Sf. 5963, Sf. 5964, Sf. 5965a, b, Sf. 5966, Sf. 5967, Sf. 5968, Sf. 5969, Sf. 5970, Sf. 5971, Sf. 5972, Sf. 5973, Sf. 5974, Sf. 5975, Sf. 5976, Sf. 5977, Sf. 5978, Sf. 5980, Sf. 5981, Sf. 5982, Sf. 5983, Sf. 5984, Sf. 5985, Sf. 5986, Sf. 5987, Sf. 5988, Sf. 5989, Sf. 5990, Sf. 5991, Sf. 5993, Sf. 5994, Sf. 5995, Sf. 5996, Sf. 5997, Sf. 6263, Sf. 7915, Sf. 8207, Sf. 8208, Sf. 8209, Sf. 8211, Sf. 8273, orig. Engelhardt 1870, pl. 4, fig. 11 (*Cinnamomum lanceolatum*), Sf. 8294, orig. Engelhardt, pl. 4, fig. 12 (*Cinnamomum lanceolatum*), Sf. 8336, orig. Walther 1964, pl. 17, fig. 5 (*Cinnamomophyllum scheuchzeri*), Sf. 8337, orig. Walther 1964, pl. 17, fig. 4 (*Cinnamomophyllum scheuchzeri*), Sf. 8340, orig. Walther 1964, p. 17, fig. 3 (*Cinnamomophyllum scheuchzeri*); KM III 1268 C, orig. Mai 1963, pl. 8, fig. 4 (*Cinnamomophyllum* (*Cinnamomum*) *scheuchzeri*), 1269 C, orig. Mai 1963, pl. 8, fig. 10 (*Laurophyllum* (*Tetradenia*) *acutimontanum*), 1270 C, 1271 C, 1272 C.

## Cabombaceae A. RICH.

### *Dusembaya* DOROFEEV

#### *Dusembaya seifhennersdorfensis* (ENGELHARDT)

##### MAI

Pl. 5, figs 1–3

- 1870 *Carpolithes seifhennersdorfensis* ENGELHARDT, p. 28, pl. 8, figs 4–6 – basionym.  
1963 *Brasenia victoria* (CASP.) WEBER; Mai, p. 68, pl. 6, figs 9–16.

1988 *Dusembaya seifhennersdorfensis* (ENGELHARDT) MAI, p. 88, pl. 1, figs 1–10, text-fig. 1.

**Description:** Seeds variable in size, 2.0–5.0 mm long and 1.8–5.5 mm wide, mostly ovoid, rarely sphaeroidal, strongly compressed, cap (embryotega) apical, 0.5–1 mm in diameter, delimited by a circular groove bearing a circular or columnar hilum adjacent but separate from a small rounded to slit-like micropyle in the centre; surface smooth, rarely faintly striated; surface cells irregularly lobed and approximately in rows; testa in cross-section two-layered; outer columnar testa layer composed of one cell thick layer of V-shaped radially elongate sclereidal cells nearly equiaxial to isodiametric, underlain by a parenchymatous layer of up to eight cells thick, in thickness half of the outer layer, composed of large ovoid, somewhat compressed cells (Mai 1988, p. 88).

**Remarks:** The taxonomy of this species has been solved by Mai (1988). The plant must have been commonly distributed at Seifhennersdorf because seeds occur in some layers of the diatomite and also in the coal seam in masses.

**Material studied:** Sf. 3204a, b, Sf. 3257 (3 seeds), Sf. 3263 (10 seeds), Sf. 3386 a–e (about 32 seeds), Sf. 6003 (45 seeds), Sf. 6004, Sf. 6005 (110 seeds), Sf. 6006, Sf. 6007, Sf. 6008, Sf. 6009, Sf. 6010 (35 seeds), Sf. 6011 (6 seeds), Sf. 6012, Sf. 6013 (3 seeds), Sf. 6014 (31 seeds), Sf. 6015 (7 seeds), Sf. 6016 (20 seeds), Sf. 6017, Sf. 6018 (2 seeds), Sf. 6019, Sf. 6020, Sf. 6021 (99 seeds), Sf. 6022 (2 seeds), Sf. 6023 (3 seeds), Sf. 6024 (10 seeds), Sf. 6025 (13 seeds), Sf. 6026, Sf. 6027, Sf. 6028 (40 seeds), Sf. 6029, Sf. 6030 (2 seeds), Sf. 6031, Sf. 6032 (2 seeds), Sf. 6033 (130 seeds), Sf. 6034:1: 2 (35 seeds), Sf. 6035 (33 seeds), Sf. 6036 (62 seeds), Sf. 6037 (38 seeds), Sf. 6038, Sf. 6039, Sf. 6040 (55 seeds), Sf. 6041 (14 seeds), Sf. 6042 (10 seeds), Sf. 6043 (25 seeds), Sf. 6044 (55 seeds), Sf. 6045 (77 seeds), Sf. 6046 (65 seeds), Sf. 8289, orig. Engelhardt 1870, pl. 8, fig. 4 (lectotype) (*Carpolithes seifhennersdorfensis*), Sf. 8298 (6 seeds), orig. Engelhardt 1870, pl. 8, fig. 5 (*Carpolithes seifhennersdorfensis*), Sf. 8299 (4 seeds), orig. Engelhardt 1870, pl. 8, fig. 6 (*Carpolithes seifhennersdorfensis*), Sf. 8578 (100 seeds), Sf. 8629 (5 seeds), Sf. 8621; KM III, 1258 C.

### Nymphaeales fam. et gen. indet.

Pl. 5, figs 4–5.

**Description:** Leaf roundish, entire-margined, 29 mm long, 32 mm wide, in the centre of lamina probably thickened (darker coalified), base deeply cordate, subpeltate, apex rounded, only a small fragment of petiole preserved, entering the base of the lamina from beneath, margin thickened, venation hardly visible, midvein straight, secondaries admedially bent, subparallel, in more than 7 pairs, very thin, eucamptodromous, higher-order venation in polygonal network.

**Remarks:** The poor preservation prevents us from comparing this unique leaf remain in more detail with similar foliage, which is typical of various Nymphaeales. A similarity to *Brasenia* is noteworthy. The abundant co-

occurrence of the above described seeds of *Dusembaya* suggests that the two organs may belong to the same plant.

**Material studied:** MMG, Sf. 4374.

### Cercidiphyllaceae VAN TIEGH.

#### *Cercidiphyllum* SIEB. et ZUCC.

#### *Cercidiphyllum crenatum* (UNGER) R. BROWN

Pl. 5, figs 6–8

- 1850a *Dombeyopsis crenata* UNGER, p. 448 (Hoher Rhonen, Trofaiaich, ?Bilin, Late Oligocene to Miocene).  
1935 *Cercidiphyllum crenatum* (UNGER) R. BROWN, p. 575, pl. 68, figs 1, 6, 8–10 (John Day Fm., Oregon, Oligocene).  
1963 *Cercidiphyllum crenatum* (UNGER) R. BROWN; Mai, p. 71, pl. 8, figs 1–3.  
1980 *Cercidiphyllum crenatum* (UNGER) R. BROWN; Jähnichen, Mai and Walther, p. 364, pl. 3, fig. 3 (Seifhennersdorf, in addition more documented specimens from other sites in Europe, Oligocene to Miocene).  
1996 *Cercidiphyllum crenatum* (UNGER) R. BROWN; Walther, pp. 14, 16, text-fig. 3/22.

**Description:** Leaves simple, petiolate, lamina roundish to elliptic, 29–41 mm wide and 36–49 mm long, base mostly cordate, apex short bluntly acuminate, margin shallowly crenulate; fruits narrow elliptic, 15 mm long, 5 mm wide, apex only fragmentarily preserved, base cuneate, narrowed into a short stalk, seeds winged, ca. 6.5 mm long, seed body broadly elliptic, with fine striation, wing oblong, veinless, dorsal side bent.

**Remarks:** The complete fertile twig from Bechlejovice (Kvaček and Konzalová 1998) brought evidence that *Cercidiphyllum* fruits and foliage, at least in the volcanic floras of North Bohemia and adjacent Saxony belong to the same species *C. crenatum*. First records from Seifhennersdorf were published by Mai (1963). They do not differ from those from Bechlejovice (Kvaček and Walther 2004) where narrow elliptic leaves of one year old shoots foliage, ordinary leaf forms and fruit remains are much more common. Both foliage and fruit remains are more accessory at Seifhennersdorf.

**Material studied:** MMG, Sf. 2439a, Sf. 3358, Sf. 3429:1:2, Sf. 3439a, Sf. 4080a, Sf. 7556, Sf. 8234, orig. Mai 1963, pl. 8, fig 2, Sf. 8411; KM III, 302.

### Platanaceae LESTIB. ex DUMORT.

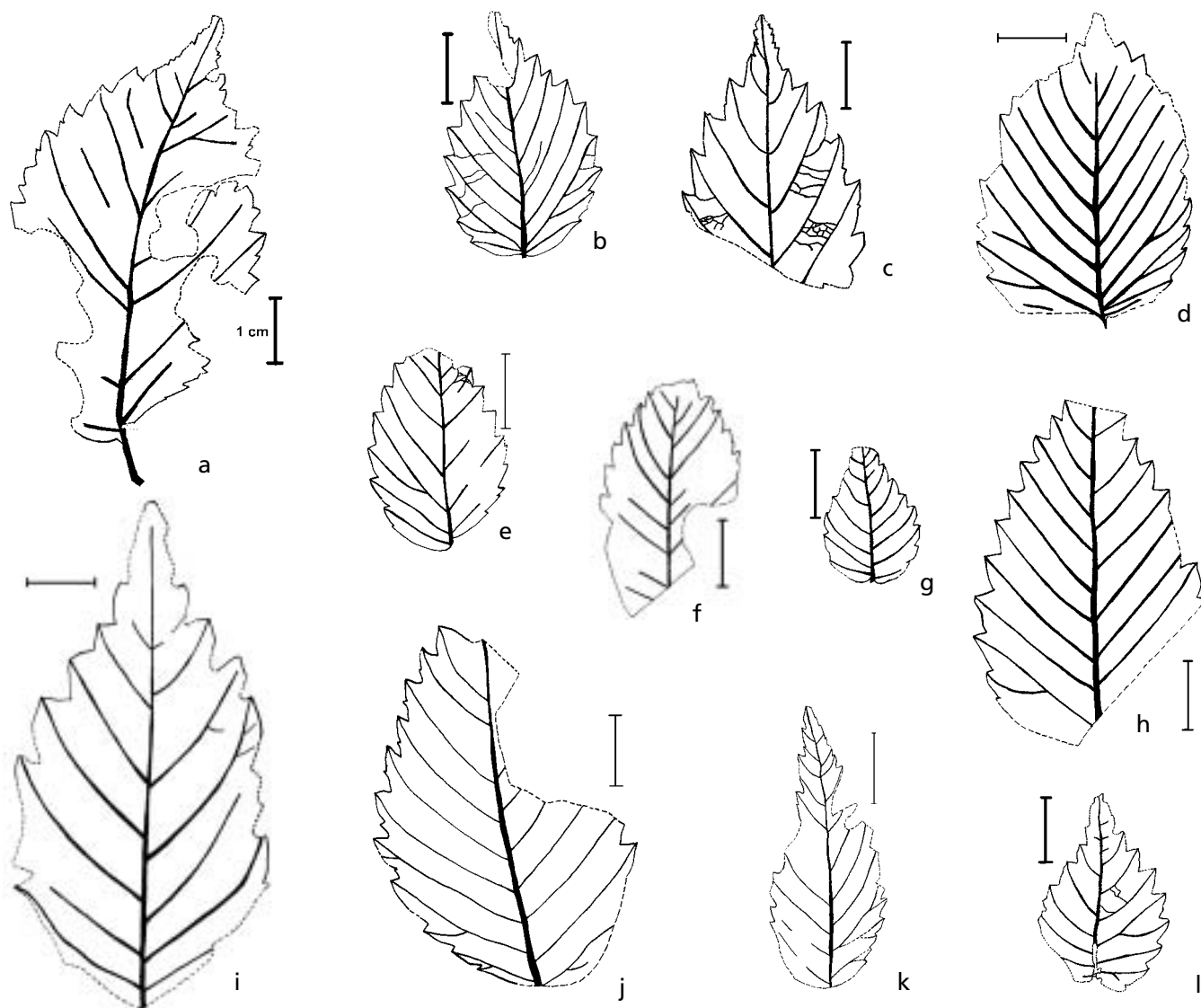
#### *Platanus* L.

#### *Platanus neptuni* (ETTINGSHAUSEN)

#### BŮŽEK, HOLÝ et KVAČEK

Pl. 6, figs 1–6, pl. 23, figs 1–2

- 1866 *Sparganium neptuni* ETTINGSHAUSEN, p. 31, pl. 7, figs 9–15 (Kučlín, “Kutschlin”, Late Eocene).  
1870 *Myrica hakeaefolia* UNGER; Engelhardt, p. 14, pl. 3, figs 5–7.  
1870 *Terminalis radobojensis* UNGER; Engelhardt, p. 23, pl. 5, figs 13–15.  
1963 *Hellia salicornioides* UNG.; Mai, p. 41, pro parte, pl. 1, fig. 5 only.



Text-fig. 3. a – l: *Ulmus fischeri* HEER, a – Sf. 7296, b – Sf. 8338, c – Sf. 7219, d – Sf. 7202, e – Sf. 7227, f – Sf. 7244, g – Sf. 8409, h – Sf. 7221, i – Sf. 7212, j – Sf. 7252, k – Sf. 7258, l – Sf. 7261.

1963 “*Sparganium neptunii* ETT.”; Mai, p. 83, pl. 12, figs 4a, b, 5.

1964 *Myrica lignitum* (UNGER) SAPORTA; Walther, p. 37, pro parte, pl. 12, figs. 1–2 (refigured from Engelhardt 1870, pl. 3, figs 5–7).

1964 *Liquidambar europaea* A. BRAUN; Walther, p. 52, pl. 12, figs 17–18.

1967 *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK; p. 205, pls 1–4 (several sites in Bohemia, Late Eocene to Miocene).

1974 *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK; Walther, p. 149, pl. 7, figs 1–4, pl. 8, figs 1–4.

1996 *Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK; Walther, p. 16.

**Description:** Leaves simple, petiolate, petiole slightly swollen on the base, 4–9 mm long, lamina obovate lanceolate, 40–102 mm long and 13–45 mm wide, apex acuminate, base narrow cuneate, margin simple crenate-dentate, teeth irregularly spaced, absent in the lower leaf half; venation semicraspedodrome, midrib thick and straight, secondaries bent, interspaced with intersecondaries reaching two thirds of the distance towards the margin, tex-

ture thick, coriaceous; cuticles medium thick, adaxial epidermis smooth, medium thick, ordinary cells polygonal, 20 to 34  $\mu\text{m}$  across, anticlines sinuous to broadly undulate, abaxial epidermis smooth, cells similar to the adaxial epidermis, stomata randomly distributed, sometimes in groups of two, anomocytic, broad roundish, with thick stomatal ledges and large outer cavity; aperture slit-like, 24 to 32  $\mu\text{m}$  long and 20 to 24  $\mu\text{m}$  wide, trichome bases polycellular (“platanoid”), about 22  $\mu\text{m}$  across, peltate trichomes rarely preserved, about 52  $\mu\text{m}$  across; stipules incompletely preserved, linear, at the base truncate, at the apex split, venation dense, parallel; immature female infructescences globular to ellipsoidal, long stalked, up to 12 mm across, consisting of uncertain numbers of short fruitlets bluntly pointed apically, with a fruit-free apex ca. 1 mm long, mature infructescence ca. 17 mm across, fruitlets of uncertain number, at the base narrow cuneate, at the apex long pointed with gently curved persistent 5–6 mm long style.

**Remarks:** The foliage and infructescences are rare at Seifhennersdorf, as in the sites of Bechlejovice and Kundratice, where modern Arcto-tertiary elements prevail.

According to the simple leaves, the population of Seifhennersdorf corresponds to those from the Oligocene and Early Miocene in North Bohemia and Germany (for more details of the taxonomy see Kvaček and Manchester 2004).

**Material studied:** MMG, Sf. 9a, b, orig. Walther 1974, pl. 7, figs 1, 2, Sf. 374, Sf. 381, Sf. 382, Sf. 1744, Sf. 2612, Sf. 2619, Sf. 2716, Sf. 2754, Sf. 2755, Sf. 2767, Sf. 2781, Sf. 3062, orig. Engelhardt 1870, pl. 3, fig. 6 (*Myrica hakeaefolia*), Sf. 3281, Sf. 3979, Sf. 4089, Sf. 4329:1:2, Sf. 4449, Sf. 4811, Sf. 6400:1:2, Sf. 6401, Sf. 6402:1:2, Sf. 6403, Sf. 6404 to Sf. 6419, Sf. 6421, Sf. 6422, Sf. 6423, Sf. 6424:1:2, Sf. 6425:1:2, Sf. 6426, Sf. 6428, Sf. 6429 (fructus), Sf. 6430, Sf. 6431: 1:2, Sf. 6432:1:2, Sf. 6433, Sf. 6434, Sf. 6435 (stipule), Sf. 6436 to Sf. 6442, Sf. 6443 (fructus), Sf. 6444, Sf. 6627, orig. Mai 1963, pl. 12, fig. 4a, b, 5 (*Sparganium neptunii*), Sf. 7926, Sf. 8199, Sf. 8202, Sf. 8212, Sf. 8221, Sf. 8223, Sf. 8284, orig. Engelhardt 1870, pl. 5, fig. 14 (*Terminalia radobojensis*), Sf. 8332, orig. Engelhardt 1870, pl. 3, fig. 5 (*Myrica hakeaefolia*), Sf. 8376, orig. Engelhardt 1870, pl. 3, fig. 7 (*Myrica hakeaefolia*), Sf. 8381, orig. Walther 1964, pl. 7, figs 7, 8 (*Liquidambar europaeum*), Sf. 8410, Sf. 8421; KM III, 1211 C (3 specimens), 1211C a, orig. Mai 1963, pl. 1, fig. 5 (*Hellia salicornioides*), 1219 C, 1221 C, 1222 C, 1229 C.

## Ulmaceae MIRB.

### *Ulmus* L.

#### *Ulmus fischeri* HEER

Pl. 6, figs 7–8, text-fig. 3

- 1856 *Ulmus fischeri* HEER, p. 57, pl. 57, figs 1–3 (Eriz-Losenegg near Bern, Late Oligocene).  
 1870 *Planera ungeri* KOVATS; Engelhardt, p. 18, pl. 4, figs 9–10.  
 1963 *Ulmus braunii* HEER; Mai, p. 66, pl. 4, fig. 4.  
 1964 *Ulmus* sp.; Walther, p. 40, pl. 14, figs 2, 4.  
 1964 *Zelkova ungeri* KOVATS; Walther, p. 41, pl. 14, figs 5–7, pl. 15, figs 1–3 (non fig. 4 = *Rosa lignitum*), text-figs 6a, b, 7a.  
 1996 *Ulmus fischeri* HEER; Walther, pp. 14, 16, text-figs 3/4, 23 (refigured from Walther 1964, pl. 14, fig. 2 as *Ulmus* sp.).  
 2004 *Ulmus fischeri* HEER; Walther, pp. 205, 210, text-figs 3/4, 23 (refigured from Walther 1964, pl. 14, fig. 2, as *Ulmus* sp.).

**Description:** Leaves simple, short petiolate, petiole up to 9 mm long, lamina medium sized, 52–70 mm long, 10–38 mm wide, ovate to oval, apex short to long acuminate, at the tip blunt, base rounded to subcordate, slightly to distinctly asymmetrical, margin simple to double serrate, teeth triangular, tooth apex short acuminate, slightly biconvex; venation craspedodromous, midrib thick, running straight in the apex, secondaries slightly bent, in 8–11 pairs, under an angle of 26° to 83°, alternate, sub-opposite to opposite, ending in the main tooth in simple serrate leaves, in double serrate leaves the secondaries forking near the margin; main branch ends in the apex of the main tooth, lateral branchlet ending in the secondary tooth apex; texture medium thick, only abaxial cuticle obtained after numerous attempts, very delicate, ordinary cells polyedric, 16 to 24 µm across, anticlines straight to slightly bent, stomata anomo-

cytic, roundish ovate, 14 to 25 µm long and 13 to 24 µm wide, pore small, elliptic, outer ledges heavily cutinised.

**Remarks:** Foliage of *Ulmus* occurring at Seifhennersdorf varies in the same way as in more numerous records at Bechlejovice (Kvaček and Walther 2004) and can safely be assigned to the same morpho-species, *U. fischeri*. Also in this case, smaller simple-toothed forms resemble leaves of *Zelkova* (for more detailed comments see Kvaček and Walther 2004).

**Material studied:** MMG, Sf. 328, Sf. 909, Sf. 937, Sf. 1028, Sf. 1433, Sf. 1444, Sf. 1516, Sf. 1552, Sf. 1665, Sf. 1692, Sf. 1922, Sf. 1935, Sf. 1973, Sf. 2077, Sf. 2082, Sf. 2182, Sf. 2186, Sf. 2197, Sf. 2193, Sf. 2195, Sf. 2196, Sf. 2199, Sf. 2202 to Sf. 2209, Sf. 2211, Sf. 2212 to Sf. 2214, Sf. 2218 to Sf. 2221, Sf. 2325 to Sf. 2327, Sf. 2232, Sf. 2235, Sf. 2331 to Sf. 2335, Sf. 2337 to Sf. 2339, Sf. 2341 to Sf. 2343, Sf. 2350 to Sf. 2352, Sf. 2355, Sf. 2356, Sf. 2357, Sf. 2267, Sf. 2325 to Sf. 2327, Sf. 2331 to Sf. 2335, Sf. 2337 to Sf. 2339, Sf. 2341 to Sf. 2343, Sf. 2350 to Sf. 2352, Sf. 2355, Sf. 2356, Sf. 2357, Sf. 2360, Sf. 2369, Sf. 2370, Sf. 2373, Sf. 2374, Sf. 2376, Sf. 2379, Sf. 2383, Sf. 2385, Sf. 2387, Sf. 2388, Sf. 2390, Sf. 2392, Sf. 2393, Sf. 2395, Sf. 2398, Sf. 2399, Sf. 3298, orig. Mai 1963, pl. 6, fig. 4 (*Ulmus braunii*), Sf. 3731, orig. Walther 1964, pl. 24, fig. 5 (*Zelkova ungeri*), Sf. 3733, orig. Walther 1964, pl. 14, figs 2, 4 (*Ulmus* sp.), Sf. 3298, orig. Mai 1963, pl. 6, fig. 4 (*Ulmus braunii*), Sf. 3627:1:2, Sf. 3731, orig. Walther 1964, pl. 24, fig. 5 (*Zelkova ungeri*), Sf. 3733, orig. Walther 1964, pl. 14, figs 2, 4 (*Ulmus* sp.), Sf. 3735, orig. Walther 1964, pl. 15, fig. 3, text-fig. 8a (*Zelkova ungeri*), Sf. 3737, orig. Walther 1964, pl. 14, fig. 6, text-fig. 7b (*Zelkova ungeri*), Sf. 3739, orig. Walther 1964, pl. 14, fig. 7, text-fig. 8a (*Zelkova ungeri*), Sf. 3740, orig. Walther, 1964, pl. 15, fig. 1, text-fig. 7a (*Zelkova ungeri*), Sf. 3739, orig. Walther 1964, pl. 14, fig. 7, text-fig. 8a (*Zelkova ungeri*), Sf. 3740, orig. Walther 1964, pl. 15, fig. 1, text-fig. 7a (*Zelkova ungeri*), Sf. 3735, orig. Walther 1964, pl. 15, fig. 3, text-fig. 8a (*Zelkova ungeri*), Sf. 4026, Sf. 4028, Sf. 4029, Sf. 4032, Sf. 4038, Sf. 4043 to Sf. 4045, Sf. 4049, Sf. 4059, Sf. 4062, Sf. 4122, Sf. 4176, Sf. 4295, Sf. 4296, Sf. 4305, Sf. 4310, Sf. 4358, Sf. 4379, Sf. 4787, Sf. 7202:1:2, Sf. 7203:1:2, Sf. 7204:1:2, Sf. 7205:1:2, Sf. 7206:1:2, Sf. 7208:1:2, Sf. 7211 to Sf. 7214, Sf. 7216, Sf. 7217, Sf. 7219, Sf. 7221, Sf. 7224, Sf. 7226, Sf. 7227, Sf. 7229, Sf. 7233:1:2, Sf. 7234:1:2, Sf. 7235:1:2, Sf. 7236, Sf. 7239, Sf. 7241 to Sf. 7246, Sf. 7250:1:2, Sf. 7252, Sf. 7258, Sf. 7259, Sf. 7261, Sf. 7262, Sf. 7263, Sf. 7669, Sf. 7845, Sf. 8268, orig. Engelhardt 1870, pl. 4, fig. 9 (*Planera ungeri*), Sf. 8271, orig. Engelhardt 1870, pl. 4, fig. 10 (*Planera ungeri*), Sf. 8338, Sf. 8409, Sf. 8494, Sf. 8623 to Sf. 8626; KM III, 1251 C, 1252 C, 1253 a, b.

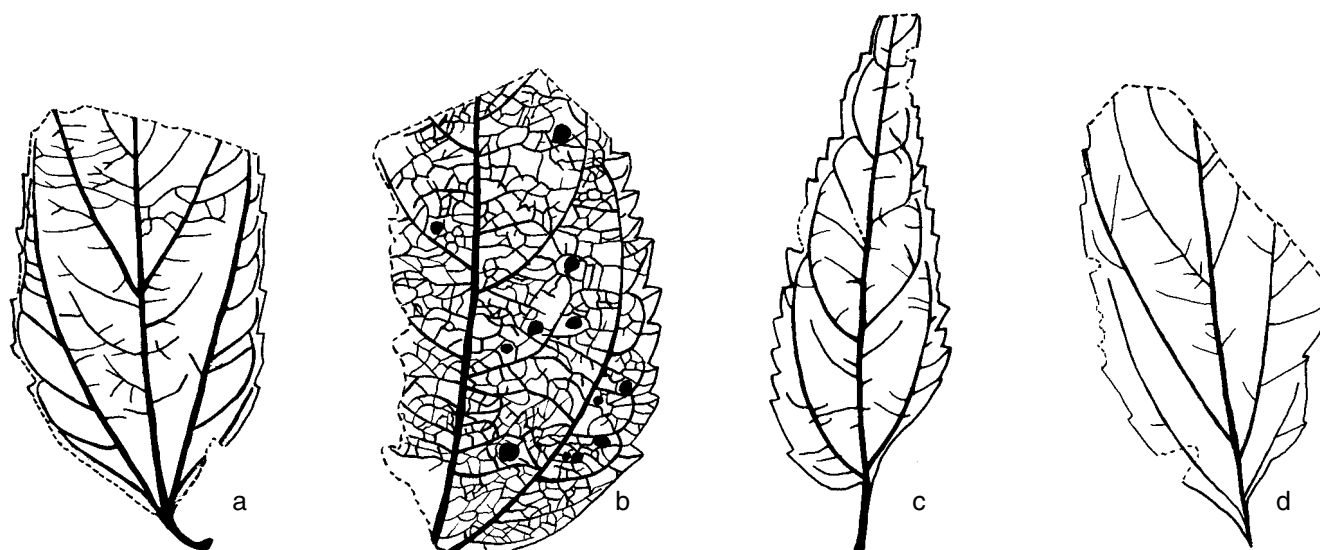
## *Zelkova* SPACH

### *Zelkova zelkovifolia* (UNGER) BŮŽEK et KOTLABA

Pl. 6, figs 9–13

- 1843 *Ulmus zelkovifolia* UNGER, pl. 24, figs 7 right, 9–13 (Parschlug, Early Miocene).  
 1845 *Ulmus zelkovifolia* UNGER, pl. 26, fig. 7 – lectotype (Parschlug, Early Miocene).  
 1847 *Ulmus zelkovifolia* UNGER, p. 94 (Parschlug, Early Miocene).





Text-fig. 4. a – c: *Celtis pirskenbergensis* (KNOBLOCH) WALTHER et KVAČEK stat. n., a – Sf. 2353, b – Sf. 2354, c – epitype, Sf. 2377; d – *Celtis* (?) *bohémica* ENGELHARDT, Sf. 2234:1, all nat. size.

1963 *Zelkova zelkovifolia* (UNGER) BŮŽEK et KOTLABA in Kotlaba, p. 59, pl. 3, figs 7, 8 (Bory, Middle Miocene).

**Description:** Leaves simple, petiolate, petiole up to 6 mm long, lamina ovate, 42 to 30 mm long and 25–30 mm wide, base rounded, distinctly asymmetric, apex acute, rarely long acuminate, margin simple coarsely dentate, sometimes entire in the basal part of the lamina; teeth strong, triangular, of different size, abmedially convex or straight, convex on abmedial side; venation craspedodromous, midrib thick, straight, very slightly curved, secondaries in about 7 pairs, thin, slightly bent, entering marginal teeth at an angle of about 30° to the midrib, tertiaries mostly not observable.

**Remarks:** *Zelkova* is only a rare element in the rich leaf flora of Seifhennersdorf in contrast to other Early Oligocene volcanic floras. *Zelkova* seems to be more common in purely mesophytic vegetation, such as Bechlejovice or Kundratice (e.g., Kvaček and Walther 1998, 2004).

**Material studied:** MMG, Sf. 2382, Sf. 7201, Sf. 7209, Sf. 7210, Sf. 7211, Sf. 7216, Sf. 7225, Sf. 7231, Sf. 7237, Sf. 7240.

## Celtidaceae LINK

### *Celtis* TOURNEFORT

#### *Celtis pirskenbergensis* (KNOBLOCH)

KVAČEK et WALTHER stat. n.

Pl. 7, figs 1–8, text-figs 4.a–c

1961 *Celtis begonioides* GOEPPERT var. *pirskenbergensis* KNOBLOCH, p. 273, pl. 6, figs 3, 5, 8 – basionym (Knížecí, Hrazený hill/Pirskenberg, Early Oligocene).

1961 *Celtis begonioides* GOEPPERT; KNOBLOCH, p. 273, pl. 6, fig. 9, ?pl. 12, fig. 4 (Knížecí, Hrazený hill/Pirskenberg, Early Oligocene).

1963 *Celtis* cf. *begonioides* GOEPPERT; Mai, p. 67, pl. 6, fig. 8.

Holotype: Knobloch 1961, pl. 6, fig. 8, No. G 2850 (NM).

Epitype selected here: No. Sf. 2377, Seifhennersdorf – pl. 7, fig. 5.

**Description:** Leaves simple, more or less asymmetrical, short petiolate, petiole 7–9 mm, long, lamina lanceolate ovate, 35 to more than 90 mm long, 15 to 45 mm wide, base asymmetrical, subcordate to rounded on one side, cuneate on the other, apex long attenuate, margin simple densely serrate, teeth blunt, irregular, sinus acute, venation acrodromous /semicraspedodromous, midrib slightly bent, lateral primaries slightly thinner than the medial, reaching from the base almost up to the middle of the lamina length, looping with the first secondaries, secondaries bent, widely spaced, in ca. 4 pairs, making wide loops near and subparallel to the margin, and sending abmedial veinlets into the teeth, intersecondaries simple, short, only in the lowermost secondaries and lateral primaries, tertiaries ramified, forked, forming with higher-order veins irregular polygonal network.

**Remarks:** This morpho-species is remarkable by its long attenuate apex that causes the upper secondaries to run sub-parallel and near the margin. This feature differentiates it from the previously described species of *Celtis* – *C. begonioides* GOEPPERT (1855, p. 33, pl. 8, fig. 10, Sošnica, Late Miocene), *C. japeti* UNGER (see Kovar-Eder et al. 2005 – Parschlug, Early-Middle Miocene). Incomplete specimens from Kundratice (Kvaček and Walther 1998, p. 11, pl. 4, fig. 5, text-fig. 13/25 – as *Celtis* sp.) and Kleinsaubernitz (Walther 1999, p. 595, pl. 13, figs 5, 6, text-fig. 16/45 – as *Celtis* sp., also with epidermal features) may belong to *C. pirskenbergensis* but due to incomplete preservation, the identification must remain open.

**Material studied:** MMG, Sf. 967, Sf. 1317, Sf. 1356, Sf. 2340, Sf. 2353, Sf. 2354:1:2, Sf. 2377, Sf. 2386, Sf. 2415, Sf. 2419:1:2, Sf. 2646:1:2, Sf. 2672, Sf. 2692, Sf. 4034, Sf. 4409, Sf. 6467, Sf. 7232:1:2, Sf. 7253, Sf. 8416; KM III, 1255 C, orig. Mai 1963, pl. 6, fig. 8 (*Celtis* cf. *begonioides*).

## *Celtis* (?) *bohémica* ENGELHARDT

Pl. 8, fig. 1, text-fig. 4d

- 1898 *Celtis bohémica* ENGELHARDT, p. 16, pl. 1, fig. 55 – holotype (Suleřice-Berařd, Oligocene).  
1995 *Celtis* sp.; Kvaček and Walther 1995, p. 31, pl. 3, fig. 6 (Suleřice-Berařd, Oligocene).

**Description:** Leaves simple, petiolate, petiole 5 mm long, lamina slightly asymmetrical, narrow ovate elongate, more than 45 mm (probably 75 mm) long, 25–28 mm wide, base asymmetrically cuneate, apex missing, margin basally entire, upwards irregularly (? indistinctly double) finely toothed, teeth admedially oriented, sinus acute, venation incompletely acrodromous/semicraspedodromous, midrib straight, basal secondaries of the same thickness, crowded, one lateral running from the very base to the first third of the lamina, the other slightly above the base, under very steep angles, running also straight towards the margin, higher secondaries widely spaced, in two to three pairs preserved, under wider angles, higher-order venation not visible.

**Remarks:** Although Kvaček and Walther (1995) considered this type of leaves as foliage of *Celtis*, Knobloch (1961) already criticized this assignment, particularly because of the position of the lower secondaries, which do not match the common type of venation in *Celtis*. Otherwise the leaf form, higher secondaries and the margin are similar. Up to now, we were unable to resolve the generic position of this morpho-species and decided on the alliance to *Celtis* or another member of the Celtidaceae. *Celtis* (?) *bohémica* is known at present only from Suleřice-Berařd and Seifhennersdorf.

**Material studied:** MMG, Sf. 2234:1:2, Sf. 2389, Sf. 2690, Sf. 7220.

## Fagaceae DUMORT.

### *Quercus* L.

#### *Quercus lonchitis* UNGER

Pl. 8, figs 3–8, pl. 23, fig. 3, text-fig. 5a

- 1850a *Quercus lonchitis* UNGER, p. 403, pro parte (only Socka, Late Eocene).  
1850b *Quercus lonchitis* UNGER, p. 33(163), pl. 9(30), figs 3–8 (Socka, Late Eocene).  
1870 *Laurus primigenia* UNGER; Engelhardt, p. 20, pl. 5, fig. 3.  
1963 *Quercus drymeja* UNGER; Mai, p. 65, pl. 6, figs 1–3.  
1996 *Quercus lonchitis* UNGER; Walther, pp. 14, 16, text-fig. 15.

**Description:** Leaves shortly petiolate, lamina elongate, up to 116 mm long and 24 mm wide, most samples only fragmentarily preserved, often without apex and base, apex long acute, base cuneate, margin simple serrate, venation craspedodromous, midrib strong, mostly straight, secondaries in several pairs according to the teeth, slightly bent, at an angle of 28°–40°, rarely forked, ending in the teeth, intersecondaries very rare, tertiaries percurrent, almost at a right angle to the secondaries, higher-order venation not clearly visible due to strongly carbonised lam-

ina; epidermis thinly cutinized, adaxial cuticle not preserved, abaxial cuticle delicate, ordinary cells polygonal, anticlines straight to sinuous, poorly visible, stomata cyclocytic to incompletely cyclocytic, roundish ovate, 28 to 40 µm wide and 32 to 40 µm long, subsidiary cells narrow, three- to four-rayed trichomes scattered over the abaxial epidermis, bases up to 40 µm in diameter, rays acute, apices rounded, 40 to 50 µm long, stretching outwards, simple roundish ovate bases of glandular trichomes scattered over the abaxial cuticle, 32 to 40 µm diameter.

**Remarks:** The oaks were infrequently distributed in the volcanic floras of North Bohemia and Saxony. The above described population corresponds with the rich occurrence at Stadice and Lochořice and is in our opinion identical with *Q. lonchitis* from Socka. In the cuticular structure it differs decidedly from a similar Neogene sclerophyllous oak *Q. drymeja* UNG. with more sharply toothed leaves (see Kvaček et al. 2002). In the Oligocene floras of the Weißelster Basin (near-shore floras – Kvaček and Walther 2001) it is only known as an accessory element at Bockwitz, floral assemblage Thierbach, Late Oligocene (Mai and Walther 1991, Kvaček and Walther 2001).

**Material studied:** MMG, Sf. 29, Sf. 1425, prep. Sf. 25–26/94, Sf. 2259, prep. Sf. 28 to 32/94, Sf. 2268, Sf. 2274, Sf. 2283, Sf. 2285, Sf. 2289, Sf. 2307, Sf. 3060, Sf. 4444, prep. Sf. 60 to 68/93, Sf. 4450, prep. Sf. 33 to 37/94, Sf. 4463, prep. Sf. 7 to 12/94, Sf. 6227, Sf. 6515:1:2, Sf. 6516, Sf. 6517, Sf. 6518, Sf. 6527, Sf. 8200, Sf. 8253, prep. Sf. 33–34/05, ? Sf. 8281, orig. Engelhardt 1870, pl. 5, fig. 3 (*Laurus primigenia*); KM III, 1247 C.

## *Eotrigonobalanus* WALTHER et KVAČEK

### *Eotrigonobalanus furcinervis* (ROSSMÄSSLER)

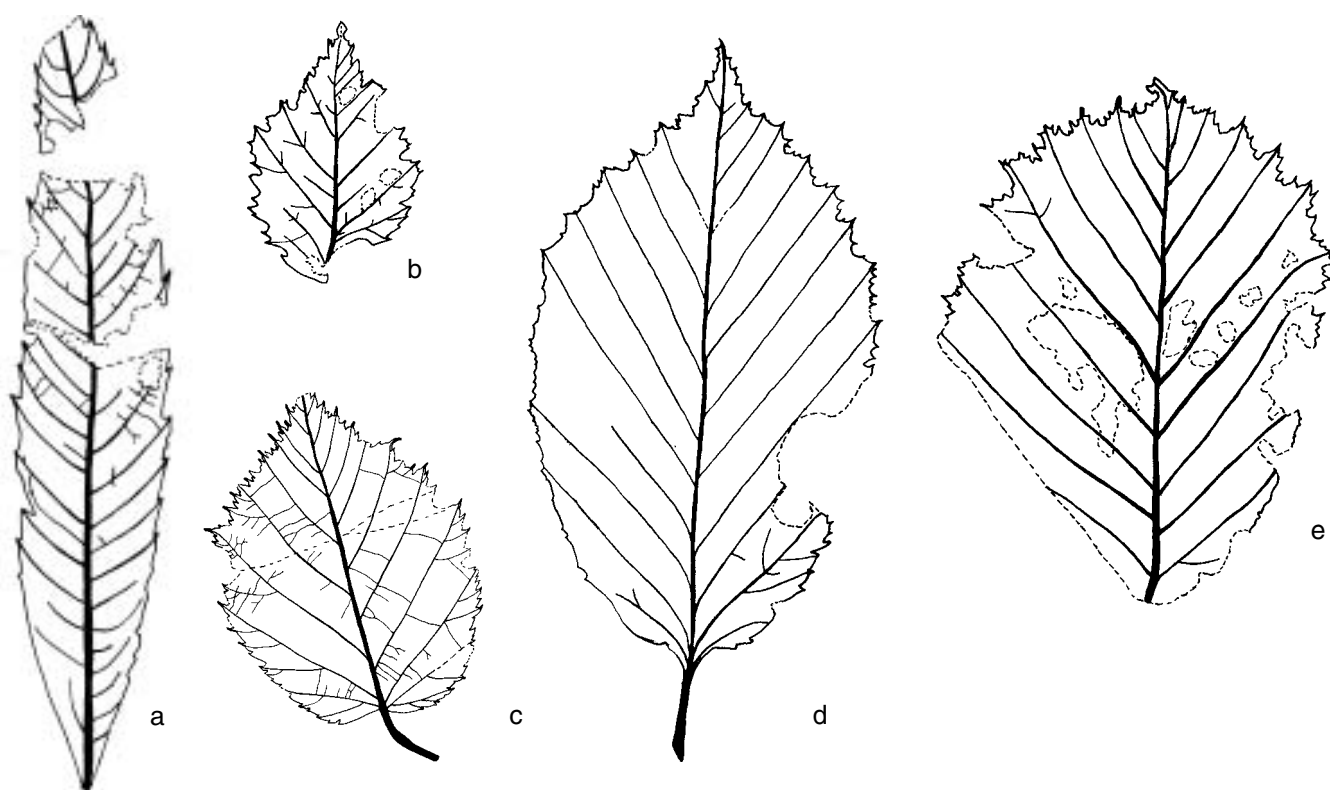
WALTHER et KVAČEK

Pl. 8, fig. 2

- 1840 *Phyllites furcinervis* ROSSMÄSSLER, p. 33, pl. 6, fig. 25, pl. 7, figs 26–31 (Staré Sedlo, “Altsattel”, Late Eocene).  
1989 *Eotrigonobalanus furcinervis* (ROSSMÄSSLER) WALTHER et KVAČEK in Kvaček and Walther, p. 581, pls 33–36, 38–46, pl. 47, figs 1–3, text-figs 3–10 (various sites mostly from NW Bohemia and Saxony, Late Eocene to Oligocene).

**Description:** Leaves simple, incomplete, basal part ovate to lanceolate, lamina up to 30 mm wide, 66 mm long, entire-margined, base narrow cuneate to decurrent into a strong petiole, margin slightly thickened, lamina weakly carbonized; venation eucamptodromous, midrib thick, almost straight, secondaries preserved in 4 to 5 pairs, under an angle up to 40°, slightly bent and looping along the margin, regularly spaced, mostly one intersecondary vein between the secondaries, tertiary veins percurrent, almost at a right angle to the secondaries, higher-order venation visible as a polygonal network.

**Remarks:** The leaves match well with the common Oligocene forms of *Eotrigonobalanus furcinervis*, but the identification is somewhat tentative due to the lack of leaf epidermal anatomy. The occurrence of *Eotrigonobalanus* in the Seifhennersdorf flora is corroborated by the pollen of *Fusipollenites* KEDVES typically associated with the macroremains of this extinct member of the Fagaceae in the



Text-fig. 5. a – *Quercus lonchitis* UNGER, No. Sf. 8253, nat. size; b – *Betula alboides* ENGELHARDT emend., holotype, Sf. 8264, (re-illustrated from Engelhardt 1870, pl. 3, fig. 23); c–e – *Carpinus roscheri* WALTHER et KVAČEK sp. n., c – Sf 1630, d – holotype, Sf. 8408 (re-illustrated from Walther 1964, as *Carpinus grandis* UNGER), e – Sf. 4740:1, all nat. size.

European Tertiary (M. Konzalová, personal communication). It is the first evidence of this genus in the volcanic floras in Central Europe during the Early Oligocene. Up to now this element was only known from the Late Oligocene drilling at Kleinsaubernitz near Bautzen, eastern Germany. In this flora *Eotrigonobalanus* is a dominant element of the mixed mesophytic forest vegetation with a high proportion of *Taxodium* (Walther 1999).

Material studied: MMG, Sf. 957, Sf. 1248, Sf. 1424, Sf. 1613, Sf. 4372:1:2, Sf. 5466, Sf. 8224.

## Betulaceae GRAY

### *Betula* L.

#### *Betula alboides* ENGELHARDT emend.

Pl. 9, figs 2–7, text-fig. 5b

- 1870 *Betula alboides* ENGELHARDT, p. 16, pl. 3, figs 22–23 – lectotype, pl. 3, fig. 23.
- 1870 *Betula prisca* ETTINGSHAUSEN; Engelhardt, p. 16, pl. 3, figs 19–21.
- 1963 *Alnus gracilis* UNGER; Mai, p. 57, pl. 4, fig. 14, text-fig. 10.
- 1963 *Betula dryadum* BRONGNIART; Mai, p. 60, pro parte, pl. 5, fig. 5.
- 1963 *Betula* aff. *subpubescens* GOEPPERT; Mai, p. 64, pl. 5, fig. 14, text-fig. 10.
- 1964 *Betula subpubescens* GOEPPERT; Walther, p. 23, pl. 7, fig. 1.
- 1998 *Betula buzekii* KVAČEK et WALTHER, p. 9, pl. 3, figs 8–10, text-figs 5, 13.1 (Kundratice).

Lectotype selected here: MMG, Sf. 8264 (orig. Engelhardt 1870, pl. 3, fig. 23) – pl. 9, fig. 2 text-fig. 5a.

Description: Leaves simple, petiolate, alternate,

with a large axillary bud, petiole short (2–9 mm), lamina ovate, (15–)20–38(–55) mm long, (12–)14–25(–35) mm wide, base rounded-cuneate, apex acute, margin irregularly double serrate, teeth sharp, with extended tips, sinus acute; venation craspedodromous, midrib straight, secondaries in 5–8 pairs, straight or slightly bent, ending in the main teeth, under medium acute angles, in the basal part of larger specimens at wider angles (25°–50°), tertiaries poorly preserved; texture chartaceous; epidermis structure only available from the abaxial leaf side (according to Mai 1963, the cells vary strongly in shape, at some places small, polygonal and thick-walled, elsewhere, particularly around stomata, larger, thin-walled, so that the outlines of cells disappear); stomata sparsely distributed, in groups, stomatal ledges thickly cutinized, forming spindle-shaped outer cavity, 16–28 µm long.

Remarks: For reasons of priority, the oldest epithet *alboides* (Engelhardt 1870) is to be given preference over *Betula buzekii* KVAČEK et WALTHER (1998). The other synonyms listed above should not be used, being partly based on fragmentary type material (*B. subpubescens* GOEPP. – Zastawniak and Walther 1998, p. 117; *B. prisca* ETTINGSH. – Hummel 1991) or belong to other entities (*Alnus gracilis* UNG. = *A. julianiformis* (STERNB.) KVAČEK et HOLÝ).

Material studied: MMG, Sf. 1323, Sf. 1647, Sf. 1705, Sf. 1832, Sf. 1911, Sf. 2140, Sf. 2171, Sf. 2178, Sf. 2198, Sf. 2200, Sf. 2201, Sf. 2210, Sf. 2215, Sf. 2217, Sf. 2224, Sf. 2229, Sf. 2237, Sf. 2366, Sf. 3066, Sf. 3293, orig. Mai 1963, pl. 4, fig. 10 (*Alnus gracilis*), Sf. 3315, orig. Mai 1963, pl. 5, fig. 5 (*Betula dryadum*), Sf. 3433:1:2, Sf. 3730, orig. Walther 1964, pl. 7, fig. 1 (*Betula subpubescens*), Sf. 4095, Sf. 4255, Sf. 4253:1:2, Sf. 4360, Sf. 4361, Sf. 4680, Sf. 4681, Sf. 4683, Sf. 4685, Sf. 4688, Sf. 4689,

Sf. 4692, Sf. 4695, Sf. 4696, Sf. 4699, Sf. 4701:1:2, Sf. 4703, Sf. 4704, Sf. 4705, Sf. 4706, Sf. 4718a, Sf. 4722, Sf. 4724, Sf. 4726, Sf. 4726, Sf. 4727:1:2, Sf. 4736:1:2, Sf. 8264, orig. Engelhardt 1870, pl. 3, fig. 23, lectotype, Sf. 4864a, Sf. 7609, orig. Engelhardt 1870, pl. 3, fig. 22, Sf. 7611; KM III 1234 C.

### *Betula dryadum* BRONGNIART

Pl. 9, fig. 1

1828 *Betula dryadum* BRONGNIART, p. 49, pl. 3, fig. 5 (Armissan, Oligocene).

1963 *Betula dryadum* BRONGN.; Mai, pp. 60–64, pro parte (excl. foliage), text-figs 8a, b, pl. 5, figs 8, 9.

**Description:** Fruitlets double winged, 3 to 5.5 mm wide and 2 to 3 mm long, fruit body obovoid, with two incompletely preserved styles, wing twice broader than the seed body; bracts ca. 6.5 mm long, at the base 2.5 mm wide, in the upper third wider, trilobate, lobes short, rounded, divergent at a narrow angle, the medial lobe obovate (see Mai 1963, pp. 60–64).

**Remarks:** These fruit remains belong obviously to the foliage of *Betula alboides* ENGELHARDT. Mai (1963) in his detailed comparison came to the conclusion that the population from Seifhennersdorf is identical with that from Armissan, France, the type locality of *Betula dryadum*. He associated the fruits with the foliage called by Saporta (1865) *Betula cuspidens* and stressed the affinity to extant representatives of the East Asiatic sect. *Acuminatae*.

**Material studied:** MMG, Sf. 3299, orig. Mai 1963, pl. 5, fig. 8. Sf. 3317, orig. Mai 1963, pl. 5, fig. 9, Sf. 4406, Sf. 4731.

### *Alnus* MILL.

#### *Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK

Pl. 9, figs 8–10, pl. 23, figs 4–5

1859 *Rhamnus gaudinii* HEER, p. 79, pl. 124, figs 4–15, pl. 125, figs 1, 7, 13 (Lausanne, Monod and other localities, Late Oligocene).

1976 *Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK, p. 33, pl. 6, figs 1, 3, pl. 7, figs 1, 5, pl. 13, fig. 4, pl. 15, figs 1–4, 7–8, 10–11, 10–11, 15, 17, pl. 16, figs 1–5, pl. 19, fig. 15, pl. 20, fig. 10, text-figs 11–12 (Wackersdorf, Early Miocene).

1998 *Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK; Kvaček and Walther, p. 7, pl. 3, figs 51–3, text-figs 13.4–5 (Kundratice, Early Oligocene).

2004 *Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK; Kvaček and Walther, p. 18, pl. 2, figs 5–7, text-fig. 11.6 (Bechlejovice, Early Oligocene).

For full synonymy see Knobloch and Kvaček (1976, p. 33), Kvaček and Walther (1998, p. 7).

**Description:** Leaves simple, petiolate, petiole 3 to 16 mm long, lamina oblong-ovate to narrow elongate, varying in size from 25 to 30 mm in length and 25 to 30 mm in width, base cuneate to rounded, apex tapered to small triangular, margin very finely dentate – serrate, teeth small, sometimes with swollen tips, abmedial side concave to straight, 9 teeth per cm; venation distinctly impressed,

craspedodromous to semicraspedodromous, midrib thick, secondaries in up to 7 pairs, opposite to subopposite, widely spaced, bent, forming an angle of 32° to 50° with the midrib, running towards the margin, entering the teeth by side veinlets, very rarely forked, rarely interspaced by one to three intersecondaries, higher-order venation poorly visible; cuticle medium thick, adaxial epidermis smooth, ordinary cells polygonal (20)–36–(44) µm across with sinuous to U-shaped undulate anticlines; abaxial epidermis thin, ordinary cells of the same kind as in the adaxial epidermis, anticlines more sinuous, stomata anomocytic, irregularly distributed, in form and size strongly variable, oval to broadly oval, 20–40 µm long and 20–30 µm wide; trichome bases 20 to 32 µm across, 4-celled, peltate glands only in fragmentary remains about 50 µm across.

**Remarks:** Typical leaf fossils of this species are in the Seifhennersdorf leaf flora rarer than at Kundratice and Bechlejovice. This element seems to be more zonal. It was distributed outside the riparian vegetation belt, e.g. at Lausanne and other type localities. This morpho-species is not very common there.

**Material studied:** MMG, Sf. 6, prep. s. n., Sf. 2715, Sf. 4443, prep. Sf. 16 to 18/93, Sf. 4465, prep. Sf. 45 to 52/94, Sf. 4555, prep. Sf. 56 to 59/93, Sf. 6058, Sf. 6160, Sf. 6197, Sf. 6226:1:2.

### *Alnus kefersteinii* (GOEPPERT) UNGER

Pl. 9, figs 11–12

1838 *Alnites kefersteinii* GOEPPERT, p. 364, pl. 41, figs 1–19 (Salzhausen, Middle Miocene).

1847 *Alnus kefersteinii* (GOEPPERT) UNGER, p. 115, pro parte, pl. 33, figs 1–3 (Zagorje, Early Oligocene, Bilina, Early Miocene).

1970 *Alnus kefersteinii* (GOEPPERT) UNGER; Engelhardt, p. 15, pl. 3, fig. 17.

1963 *Alnus kefersteinii* (GOEPPERT) UNGER; Mai, p. 58, pro parte, pl. 5, figs 2, 3 (only infructescences).

1964 *Alnus kefersteinii* (GOEPPERT) UNGER; Walther, p. 27, pl. 17, figs 6–10.

**Description:** Infructescences strobile-like, originally ovoid-cylindric, strongly compressed, 10–20 mm long and 7–15 mm across, long stalked, stalk strong, rarely forked, fruitlets and subtending bracts numerous, helically disposed, not well preserved, without morphological detail discernible (Mai 1963, Walther 1964).

**Remarks:** The infructescences of *Alnus kefersteinii* accompany the foliage of *A. gaudinii* at several sites, e.g. Kundratice (Kvaček and Walther 1998) and Bechlejovice (Kvaček and Walther 2004) and probably belong to this type of foliage. It is an important element of both zonal and intrazonal vegetation.

**Material studied:** MMG, Sf. 3184, Sf. 3199, Sf. 3231, Sf. 3233, Sf. 3262, Sf. 3283, Sf. 3521, Sf. 3475:1:2, Sf. 3574, Sf. 3741, orig. Walther 1964, pl. 17, fig. 6, Sf. 3734, orig. Walther 1964, pl. 17, fig. 7, Sf. 3742, orig. Walther 1964, pl. 17, fig. 9, Sf. 3743, orig. Walther 1964, pl. 17, fig. 8, Sf. 4005, orig. Mai 1963, pl. 5, fig. 3, Sf. 4394, Sf. 4395, Sf. 4682, Sf. 4684, Sf. 4690, Sf. 4698, Sf. 4702, Sf. 8250, orig. Mai 1963, pl. 5, fig. 2, Sf. 8415.

## *Carpinus* L.

### *Carpinus roscheri* KVAČEK et WALTHER sp. n.

Pl. 10, figs 1–5, text-figs 5c–e

- 1870 *Carpinus grandis* UNGER; Engelhardt, p. 17, pro parte, pl. 4, figs 1–2.  
1963 *Carpinus* cf. *grandis* UNGER; Mai, p. 56, pro parte, pl. 4, figs 5, 8.  
1964 *Corylus macquarii* (FORBES) MASSALONGO et VISIANI; Walther, p. 25, pl. 8, figs 3, 4.

**Holotype** selected here: MMG Sf. 8408 – pl. 10, fig. 2, text-fig. 5d.

**Stratum typicum**: Basaltoid brown coal complex, Early Oligocene.

**Locus typicus**: Seifhennersdorf, the former diatomite mine “Freundschaft”, Saxony, Germany.

**Etymology**: After the late Arthur Roscher (1902 – 1982), local geologist and famous collector of fossils from the Seifhennersdorf diatomite.

**Dia gnose**: Leaves differing from similar leaves of *Carpinus grandis* in having distinct and sharply double serrate margin.

**Description**: Leaves simple, petiolate, petiole up to 11 mm long, lamina broadly obovate, (36–) 66 (–92) mm long, (11–) 40 (–48) mm wide, base subcordate to truncate, apex acuminate, margin strongly double serrate, main teeth triangular, sharp to mucronate, on both sides with secondary teeth, up to 4 on either tooth side, sinus mostly acute, venation craspedodromous, midrib strong, straight, secondaries in 8 to 14 pairs, close regularly spaced at 5–6 mm, deriving from the midrib at an angle of ca. 30°, at the very base crowded and under wider angle (up to 49°), admedially sometimes forked, tertiaries rarely visible, perpendicular to the secondaries, percurrent.

**Remarks**: The foliage of *Carpinus roscheri* differs from the common *C. grandis* in the more broadly obovate shape of the lamina and the remarkably double serrate margin, where secondary teeth occur on both sides of the main tooth. It is so far known only from the type locality, although we cannot rule out the possibility that some specimens from other sites previously assigned to *C. grandis* may belong to the new morpho-species. The close co-occurrence with also almost endemite *C. cordataeformis* based on fruit remains suggests that these two organs may belong to the same hornbeam of the section *Distegocarpus* (SIEBOLD et ZUCC.) SARGENT. Both leaves and fruits of the *C. roscheri* – *C. cordataeformis* plant match the extant *C. cordata* BL. from NE Asia. However, the foliage of *C. cordata* differs in having a higher number of secondaries (15–20 pairs). In this respect and also in having a double serrate margin, the leaves of *C. turczaninowii* HANCE from NE Asia correspond better (8–12 pairs) in comparison to its fruits, which are more similar to the fossil *C. mediomontana* MAI (sect. *Carpinus*). The reconstruction of *C. roscheri* – *C. cordataeformis* is based more on the co-occurrence rather than on the nearest living relatives. This extinct hornbeam species of the section *Distegocarpus* in our opinion belongs to azonal vegetation because it is absent or much less common at other sites of zonal Early Oligocene vegetation (Bechlejovice, Kundratice, Sulestice-Berand) than the next hornbeam of the *C. grandis* – *C. mediomontana* complex.

**Material studied**: MMG, Sf. 849, Sf. 1365, Sf. 1506:1, 2, Sf. 1511, Sf. 1538, Sf. 1540, Sf. 1542, Sf. 1551, Sf. 1554, Sf. 1563, Sf. 1574, Sf. 1586, Sf. 1614, Sf. 1615:1:2, Sf. 1630, Sf. 1647, Sf. 1663, Sf. 1682, Sf. 1685, Sf. 1721, Sf. 1746, Sf. 1752, Sf. 1764, Sf. 1783, Sf. 1789, Sf. 1791, Sf. 1813, Sf. 1815, Sf. 1829:1:2, Sf. 1838:1:2, Sf. 1842, Sf. 1858, Sf. 1882, Sf. 1943, Sf. 1964, Sf. 1971, Sf. 1976, Sf. 2020, Sf. 2023, Sf. 2059, Sf. 2068, Sf. 2121, Sf. 2156, Sf. 2177, Sf. 2205, Sf. 2279, Sf. 3228, Sf. 3328, Sf. 3276, Sf. 3416, Sf. 3455:1:2, Sf. 3509:1:2, Sf. 3461, Sf. 3530:1:2, Sf. 3550, Sf. 3555, Sf. 3580, Sf. 3398:1:2, Sf. 3460, Sf. 3506:1:2, Sf. 3509:1:2, Sf. 3523, Sf. 3528, Sf. 3568, Sf. 4018, Sf. 4067, Sf. 4098:1:2, Sf. 4099:1:2, Sf. 4104:1:2, Sf. 4107:1:2, Sf. 4154:1:2, Sf. 4190, Sf. 4199, Sf. 4218, Sf. 4220:1:2, Sf. 4242:1:2, Sf. 4249:1:2, Sf. 4250:1:2, Sf. 4256:1:2, Sf. 4308, Sf. 4364:1:2, Sf. 4359, Sf. 4738:1:2, Sf. 4740:1:2, Sf. 4741:1:2, Sf. 4744, Sf. 4745:1:2, Sf. 4747, Sf. 4756, Sf. 4761, Sf. 4779, Sf. 4782, Sf. 4867:1:2, Sf. 4806, Sf. 4807, Sf. 4808, Sf. 4826, Sf. 4827, Sf. 4829, Sf. 4832, Sf. 4836:1:2, Sf. 4841, Sf. 4839, Sf. 4840:1:2, Sf. 4845, Sf. 4846, Sf. 4848, Sf. 4854, Sf. 4855, Sf. 4856, Sf. 4857, Sf. 4863, Sf. 4864, Sf. 4866, Sf. 4868, Sf. 4869, Sf. 4870, Sf. 4871 to Sf. 4879, Sf. 4880:1:2, Sf. 4881 to Sf. 4884, Sf. 4885:1:2, Sf. 4886:1:2, Sf. 4887:1:2, Sf. 4888, Sf. 4889, Sf. 4890, Sf. 4892, Sf. 4893, Sf. 4894, Sf. 4895, Sf. 4896, Sf. 4897, Sf. 4898, Sf. 4900, Sf. 4901, Sf. 4903, Sf. 4904, Sf. 4905, Sf. 4906, Sf. 4907, Sf. 4908, Sf. 4909:1:2, Sf. 4910 to Sf. 4914, Sf. 4917 to Sf. 4924, Sf. 4929, Sf. 4931, Sf. 4933, Sf. 4934, Sf. 4935, Sf. 4948, Sf. 4967, Sf. 4960, Sf. 4961:1:2, Sf. 4962, Sf. 4963, Sf. 4974, Sf. 4982, Sf. 4990, Sf. 4993, Sf. 5010, Sf. 5018, Sf. 5020, Sf. 5028, Sf. 5035, Sf. 5037, Sf. 5041, Sf. 5042:1:2, Sf. 5053, Sf. 5059, Sf. 5060, Sf. 5062, Sf. 5065, Sf. 5067, Sf. 5068, Sf. 5070, Sf. 5071, Sf. 5072:1:2, Sf. 5075, Sf. 5076, Sf. 5079, Sf. 5085:1:2, Sf. 5086:1:2, Sf. 5097, Sf. 5098, Sf. 5113, Sf. 5118, Sf. 5119, Sf. 5124, Sf. 5133, Sf. 5135, Sf. 5145, Sf. 5147, Sf. 5154, Sf. 5160:1:2, Sf. 5169, Sf. 5170, Sf. 5178, Sf. 5192, Sf. 5197, Sf. 5198, Sf. 5201, Sf. 5211:1:2, Sf. 5216, Sf. 5220, Sf. 5225, Sf. 5227:1:2, Sf. 5228:1:2, Sf. 5230, Sf. 5231, Sf. 5256, Sf. 5257, Sf. 5263:1:2, Sf. 5461, Sf. 6621, Sf. 6626, Sf. 7595, Sf. 8272, orig. Engelhardt 1870, pl. 4, fig. 2 (*Carpinus grandis*), Sf. 8115, Sf. 8152, Sf. 8153:1:2, Sf. 8158, Sf. 8160, Sf. 8191, Sf. 8206, Sf. 8345, orig. Walther 1964, pl. 8, fig. 4 (*Corylus macquarii*), Sf. 8345, Sf. 8408 (holotype), Sf. 8411, Sf. 8473:1:2:3, Sf. 8481, Sf. 8486, Sf. 8490, Sf. 8506, Sf. 8519, Sf. 8535:1:2, Sf. 8549, Sf. 8573, Sf. 8593, Sf. 8613, Sf. 8650.

### *Carpinus grandis* UNGER

Pl. 10, figs 6–7, pl. 23, figs 6–7

- 1850a *Carpinus grandis* UNGER, p. 409 (Radoboj, Trofaiaich, Miocene).  
1852 *Carpinus grandis* UNGER, p. 111 (39), pro parte, pl. 20, fig. 4, (?)5 (Radoboj, Middle Miocene).  
1870 *Carpinus grandis* UNGER; Engelhardt, p. 17, pro parte, pl. 4, fig. 3.  
1963 *Carpinus* cf. *grandis* UNGER; Mai, p. 56, pro parte, pl. 4, figs 6–7.

**Description:** Leaves simple, short petiolate, lamina ovate to elliptic, (4.2–) 21–29 (–33) mm long, (1.7) 14–23 (–25) mm wide, base rounded, apex broad acute, margin finely serrate to less distinctly double serrate, venation craspedodromous, midrib medium thick, straight, secondaries dense, slightly bent, varying steepness, in 6–14 pairs, often forked near the margin, with abmedial branches ending in the teeth, tertiaries hardly visible, ? percurrent; cuticles very delicate, adaxial epidermis composed of ordinary cells polyedric, 20–44 µm across, anticlines curved to undulate, simple trichome bases very rare, 13.3 x 11.3 µm in size, fragments of glandular trichomes 25.8 x 21.2 µm across; abaxial epidermis composed of ordinary polyedric cells similar in form and size to those of the abaxial side, anticlines straight to slightly curved, stomata anomocytic, elliptic to rounded, 16–28 µm long, 12–28 µm wide, rare “giant” stomata, very rare bases of glandular trichomes on nervilles and in intercostal areas, 26.2 x 21.6 µm in size.

**Remarks:** As previously noted (Kvaček and Walther 1998) this morpho-species may belong to less natural species (“Sammelart” – see Walther 1999). In the case of the volcanic floras of the České středohoří Mountains and wider surroundings this leaf type may belong to the same plant as the fruits called *C. mediomontana* (sect. *Carpinus*), which often co-occur (Mai and Walther 1978, Kvaček and Walther 1995, 1998, 2004). Mai (1963) compared the fossil fruits with those of *C. turczaninowii* HANCE, China. Walther (Mai and Walther 1978), when comparing the co-occurring foliage, mentioned also *C. japonica* BL. and *C. laxiflora* (SIEB. et ZUCC.) BL., while *C. turczaninowii* seems to differ in the leaf size, the number of the secondaries and the distinctly double serrate margin. Some other species of the section *Carpinus* may also come into the question (e.g. *C. orientalis* MILL.). In contrast to *C. roscheri*, this hornbeam entered probably more mesic vegetation within the hardwood riparian forests.

**Material studied:** MMG, Sf. 2, prep. Sf. 80/71 and Sf. 78/71, Sf. 14a, prep. Sf. 143/71, Sf. 18c, Sf. 35, Sf. 999, Sf. 1169a, Sf. 1196, Sf. 1265, Sf. 1301, Sf. 1305:1:2, Sf. 1361, Sf. 1362, Sf. 1366:1:2, Sf. 1369, Sf. 1370, Sf. 1376, Sf. 1380:1:2, Sf. 1382 to Sf. 1385, Sf. 1445, Sf. 1455, Sf. 1495, Sf. 1496, Sf. 1497, Sf. 1537, Sf. 1539, Sf. 1541, Sf. 1544 to Sf. 1551, Sf. 1553, Sf. 1555 to Sf. 1560, Sf. 1562, Sf. 1564, Sf. 1565, Sf. 1566, Sf. 1567, Sf. 1568, Sf. 1569, Sf. 1570, Sf. 1573 to Sf. 1592, Sf. 1594, Sf. 1595, Sf. 1598, Sf. 1599, Sf. 1600, Sf. 1601, Sf. 1604 to Sf. 1639, Sf. 1641:1:2, Sf. 1642:1:2, Sf. 1643 to Sf. 1646, Sf. 1649 to Sf. 1666, Sf. 1667:1:2, Sf. 1668, Sf. 1669 to Sf. 1671, Sf. 1672, Sf. 1673, Sf. 1676, Sf. 1677, Sf. 1679, Sf. 1680, Sf. 1681, Sf. 1682, Sf. 1683, Sf. 1684, Sf. 1685:1:2, Sf. 1686, Sf. 1687, Sf. 1690, Sf. 1691:1:2, Sf. 1692, Sf. 1693:1:2, Sf. 1694, Sf. 1695 to Sf. 1702, Sf. 1704, Sf. 1707, Sf. 1711:1:2, Sf. 1715, Sf. 1716:1:2, Sf. 1717 to Sf. 1720, Sf. 1722:1:2, Sf. 1723:1:2, Sf. 1724 to Sf. 1726, Sf. 1727:1:2, Sf. 1728 to Sf. 1731, Sf. 1732:1:2, Sf. 1733, Sf. 1734:1:2, Sf. 1735 to Sf. 1742, Sf. 1743:1:2, Sf. 1745, Sf. 1747 to Sf. 1749, Sf. 1753, Sf. 1754:1:2, Sf. 1755 to Sf. 1757, Sf. 1759 to Sf. 1762, Sf. 1765:1:2, Sf. 1766 to Sf. 1775, Sf. 1778:1:2, Sf. 1779 to Sf. 1780, Sf. 1781:1:2, Sf. 1783 to Sf. 1788, 1790:1:2, Sf. 1792 to Sf. 1800, Sf. 1802 to Sf. 1804, Sf. 1806 to Sf. 1812, Sf. 1814 to Sf. 1828, Sf. 1830, Sf. 1831, Sf. 1833 to Sf. 1835,

Sf. 1837, Sf. 1839 to Sf. 1841, Sf. 1843, Sf. 1844, Sf. 1846, Sf. 1848 to Sf. 1851, Sf. 1853 to Sf. 1861, Sf. 1862:1:2, Sf. 1863, Sf. 1864, Sf. 1865 to Sf. 1875, Sf. 1878 to Sf. 1884, Sf. 1900 to Sf. 1905, Sf. 1908, Sf. 1912, Sf. 1913, Sf. 1915, Sf. 1918 to Sf. 1921, Sf. 1923 to 1925, Sf. 1928 to Sf. 1934, Sf. 1937 to Sf. 1942, Sf. 1944, Sf. 1975, Sf. 1978 to Sf. 1988, Sf. 1990 to Sf. 1996, Sf. 1998, Sf. 1999, Sf. 2001, Sf. 2002:1:2, Sf. 2003 to Sf. 2005, Sf. 2007, Sf. 2008:1:2, Sf. 2010:1:2, Sf. 2011:1:2, Sf. 2012:1:2, Sf. 2013:1:2, Sf. 2014:1:2, Sf. 2016, Sf. 2017:1:2, Sf. 2019, Sf. 2021:1:2, Sf. 2022, Sf. 2025 to Sf. 2027, Sf. 2030, Sf. 2032, Sf. 2033, Sf. 2035 to Sf. 2037, Sf. 2038:1:2, Sf. 2039, Sf. 2040, Sf. 2041, Sf. 2043, Sf. 2044, Sf. 2046, Sf. 2048, Sf. 2049, Sf. 2050, Sf. 2051:1:2, Sf. 2052, Sf. 2054, Sf. 2055, Sf. 2057, Sf. 2058, Sf. 2063, Sf. 2064, Sf. 2067, Sf. 2061:1:2, Sf. 2069:1:2, Sf. 2070 to Sf. 2072, Sf. 2073:1:2, Sf. 2074 to Sf. 2076, Sf. 2078:1:2, Sf. 2079, Sf. 2080, Sf. 2081:1:2, Sf. 2084:1:2, Sf. 2085:1:2, Sf. 2086:1:2, Sf. 2089, Sf. 2090:1:2, Sf. 2092, Sf. 2093:1:2, Sf. 2094, Sf. 2100 to Sf. 2104, Sf. 2105:1:2, Sf. 2106, Sf. 2107, Sf. 2109, Sf. 2110, Sf. 2113 to Sf. 2119, Sf. 2120, Sf. 2122, Sf. 2123, Sf. 2124, Sf. 2129, Sf. 2130:1:2, Sf. 2132 to Sf. 2135, Sf. 2138, Sf. 2142 to Sf. 2153, Sf. 2154, Sf. 2155, Sf. 2157 to Sf. 2161, Sf. 2163, Sf. 2165, Sf. 2167, Sf. 2168, Sf. 2169:1:2, Sf. 2170, Sf. 2172, Sf. 2173, Sf. 2175:1:2, Sf. 2176, Sf. 2179, Sf. 2180:1:2, Sf. 2183, Sf. 2184, Sf. 2185, Sf. 2645, Sf. 2707, Sf. 2769, Sf. 2773, Sf. 2881, Sf. 2893, Sf. 2946, Sf. 2947, Sf. 2950, Sf. 2953, Sf. 2958, Sf. 2960, Sf. 2962, Sf. 2966, Sf. 2969, Sf. 2975, Sf. 2980, Sf. 2990, Sf. 2993, Sf. 3067, Sf. 3069, Sf. 3072, Sf. 3073, Sf. 3081, Sf. 3241, Sf. 3314, orig. MAI 1963, pl. 4, fig. 7 (*Carpinus* cf. *grandis*), Sf. 3315, Sf. 3534, Sf. 3376, Sf. 3422:1:2, Sf. 3366, Sf. 3372, Sf. 3435:1:2, Sf. 3497, Sf. 3514:1:2, Sf. 3697, Sf. 3724:1:2, Sf. 3748:1:2, Sf. 3975, Sf. 3987, Sf. 3997, Sf. 3999, Sf. 4026, Sf. 4028, Sf. 4029, Sf. 4032, Sf. 4038, Sf. 4043 to Sf. 4045, Sf. 4049, Sf. 4059, Sf. 4062, Sf. 4012, Sf. 4016, Sf. 4017, Sf. 4027, Sf. 4041, Sf. 4053, Sf. 4066, Sf. 4102, Sf. 4103, Sf. 4106, Sf. 4107, Sf. 4108, Sf. 4110, Sf. 4114, Sf. 4122, Sf. 4131, Sf. 4150, Sf. 4157, Sf. 4176, Sf. 4177, Sf. 4187, Sf. 4190, Sf. 4209, Sf. 4211, Sf. 4215, Sf. 4231, Sf. 4238, Sf. 4240, Sf. 4241, Sf. 4243, Sf. 4244, Sf. 4252, Sf. 4257, Sf. 4258, Sf. 4295, Sf. 4296, Sf. 4305, Sf. 4310, Sf. 4358, Sf. 4379, Sf. 4766, Sf. 4768, Sf. 4810a, b, Sf. 4814, Sf. 4815, Sf. 4300, Sf. 4340, Sf. 4343, Sf. 4344, Sf. 4434, Sf. 4435, Sf. 4363, Sf. 4737:1:2, Sf. 4742:1:2, Sf. 4746:1:2, Sf. 4749, Sf. 4750, Sf. 4752, Sf. 4754, Sf. 4755, Sf. 4757 to Sf. 4760, Sf. 4739:1:2, Sf. 4766, Sf. 4768, Sf. 4769, Sf. 4773, Sf. 4780, Sf. 4810, Sf. 4814, Sf. 4815, Sf. 4823, Sf. 4824, Sf. 4833, Sf. 4835, Sf. 4837, Sf. 4838, Sf. 4852, Sf. 4853, Sf. 4864, Sf. 4866, Sf. 4868, Sf. 4870, Sf. 4874, Sf. 4877 to Sf. 4879, Sf. 4880:1:2, Sf. 4881 to Sf. 4884, Sf. 4885:1:2, Sf. 4890, Sf. 4893, Sf. 4896, Sf. 4897, Sf. 4898, Sf. 4900, Sf. 4903, Sf. 4904, Sf. 4905, Sf. 4907, Sf. 4909:1:2, Sf. 4910 to Sf. 4914, Sf. 4917, Sf. 4920 to Sf. 4924, Sf. 4925 to Sf. 4928, Sf. 4930:1:2, Sf. 4931, Sf. 4932, Sf. 4936 to Sf. 4940, Sf. 4941 to Sf. 4944, Sf. 4947, Sf. 4949, Sf. 4951, Sf. 4953, Sf. 4955 to Sf. 4959, Sf. 4964 to Sf. 4966, Sf. 4968 to Sf. 4970, Sf. 4971:1:2, Sf. 4973, Sf. 4976 to Sf. 4981, Sf. 4983, Sf. 4984, Sf. 4985, Sf. 4987:1:2, Sf. 4988:1:2, Sf. 4989:1:2, Sf. 4991, Sf. 4992, Sf. 4994, Sf. 4995, Sf. 4997, Sf. 4998, Sf. 5061,

Sf. 5062, Sf. 5066, Sf. 5073, Sf. 5074, Sf. 5077, Sf. 5078, Sf. 5081, Sf. 5082, Sf. 5689, Sf. 5000 to Sf. 5007, Sf. 5009, Sf. 5011 to Sf. 5016, Sf. 5019, Sf. 5022 to Sf. 5025, Sf. 5026, Sf. 5027, Sf. 5029, Sf. 5030, Sf. 5032, Sf. 5038, Sf. 5039, Sf. 5040, Sf. 5043, Sf. 5046, Sf. 5047, Sf. 5049, Sf. 5050, Sf. 5052, Sf. 5055, Sf. 5057:1:2, Sf. 5058:1:2, Sf. 5063, Sf. 5064:1:2:3, Sf. 5069, Sf. 5117, Sf. 5120 to Sf. 5123, Sf. 5126 to Sf. 5128, Sf. 5131, Sf. 5137 to Sf. 5139, Sf. 5140, Sf. 5141, Sf. 5142, Sf. 5143, Sf. 5144, Sf. 5145, Sf. 5146, Sf. 5148, Sf. 5149, Sf. 5151, Sf. 5152, Sf. 5155, Sf. 5158, Sf. 5159:1:2, Sf. 5161 to Sf. 5164, Sf. 5167, Sf. 5168, Sf. 5171 to Sf. 5173, Sf. 5174:1:2, Sf. 5175, Sf. 5176, Sf. 5179, Sf. 5181, Sf. 5183, Sf. 5184, Sf. 5186, Sf. 5188 to Sf. 5190, Sf. 5193 to Sf. 5195, Sf. 5200, Sf. 5203:1:2, Sf. 5204 to Sf. 5209, Sf. 5210:1:2, Sf. 5212 to Sf. 5215, Sf. 5217:1:2, Sf. 5218, Sf. 5219, Sf. 5222, Sf. 5224, Sf. 5226, Sf. 5229, Sf. 5232, Sf. 5234 to Sf. 5240, Sf. 5241:1:2, Sf. 5243, Sf. 5244, Sf. 5246 to Sf. 5249, Sf. 5250:1:2, Sf. 5251, Sf. 5253 to Sf. 5255, Sf. 5258 to Sf. 5260, Sf. 5261:1:2, Sf. 5262:1:2, Sf. 5264, Sf. 5266 to Sf. 5271, Sf. 5272:1:2, Sf. 5273 to Sf. 5275, Sf. 5277 to Sf. 5280, Sf. 5282 to Sf. 5293, Sf. 5296, Sf. 5297, Sf. 5298:1:2, Sf. 5299, Sf. 5300 to Sf. 5304, Sf. 5306 to Sf. 5315, Sf. 5397, Sf. 5500, Sf. 5646 b, Sf. 5647, Sf. 5807 a, Sf. 5818a:1:2, Sf. 6641, Sf. 7202:1:2, Sf. 7203:1:2, Sf. 7204:1:2, Sf. 7205:1:2, Sf. 7206:1:2, Sf. 7208:1:2, Sf. 7211, Sf. 7214, Sf. 7217, Sf. 7219, Sf. 7221, Sf. 7224, Sf. 7226, Sf. 7227, Sf. 7229, Sf. 7233:1:2, Sf. 7234:1:2, Sf. 7235:1:2, Sf. 7236, Sf. 7239, Sf. 7241 – Sf. 7246, Sf. 7250:1:2, Sf. 7252, Sf. 7258, Sf. 7259, Sf. 7261, Sf. 7262, Sf. 7263, Sf. 7616, Sf. 7669, Sf. 7831:1:2, Sf. 7843, Sf. 7844, Sf. 7846, Sf. 7920, Sf. 7994, Sf. 8182, Sf. 8183, Sf. 8193, Sf. 8300, Sf. 8338, Sf. 7847, Sf. 8409, Sf. 8412, Sf. 8434, Sf. 8458 to Sf. 8460, Sf. 8461 to Sf. 8463, Sf. 8465:1:2, Sf. 8466, Sf. 8468:1:2, Sf. 8469:1:2, Sf. 8470, Sf. 8472, Sf. 8475 to Sf. 8477, Sf. 8480, Sf. 8482:1:2, Sf. 8483, Sf. 8484, Sf. 8487:1:2, Sf. 8489:1:2, Sf. 8492:1:2, Sf. 8493, Sf. 8495:1:2, Sf. 8496, Sf. 8497, Sf. 8498, Sf. 8500 to Sf. 8503, Sf. 8504:1:2, Sf. 8505, Sf. 8507, Sf. 8508, Sf. 8509:1:2, Sf. 8510, Sf. 8511:1:2, Sf. 8512, Sf. 8513 to Sf. 8527, Sf. 8529:1:2, Sf. 8531, Sf. 8533, Sf. 8534, Sf. 8536 to Sf. 8541, Sf. 8542, Sf. 8564, Sf. 8566 to Sf. 8569, Sf. 8571, Sf. 8572, Sf. 8589, Sf. 8590, Sf. 8591, Sf. 8595, Sf. 5630, Sf. 8638, Sf. 8684 to Sf. 8689.

### *Carpinus cordataeformis* MAI

Pl. 10, figs 10–11

- 1963 *Carpinus cordataeformis* MAI, p. 55, pro parte, pl. 4, figs 1, 2 (non 3, 4), text-figs 6a, b (non c, d).  
 1978 *Carpinus cordataeformis* MAI; Mai and Walther, p. 67, pl. 28, figs 13–15 (Haselbach, Early Oligocene).

**Description:** Involucres elongate trigonal to ovate, irregularly fine toothed to entire-margined, venation actinodromous, with 4–6 almost equally thick, partly forked primaries, basal lobe covering the nutlet (Mai in Mai and Walther 1978).

**Remarks:** One part of the syntypes of *C. cordatae-*

*formis* has been removed and the original extent of the species reduced on the basis of more complete material from Haselbach by Mai (in Mai and Walther 1978). According to him a similar fossil fruit differing in stronger dentation is known only from the Tertiary of southern France (Saporta 1881, as *C. ungeri* ETTINGS.). The closest extant relatives come in question only from sect. *Distegocarpus* (SIEBOLD et ZUCC.) SARGENT, particularly *C. cordata* BL. from Japan and China (Mai in Mai and Walther 1978).

**Material studied:** MMG, Sf. 3188, Sf. 3192, Sf. 3193, Sf. 3218, Sf. 3235, Sf. 3311, orig. Mai 1963, pl. 4, fig. 1 (holotype), Sf. 3309b, orig. Mai 1963, text-fig. 6a, Sf. 3364, Sf. 4375, Sf. 4378:1:2, Sf. 4791, Sf. 4785, Sf. 7383, Sf. 8180, Sf. 8436, Sf. 8437:1:2, Sf. 8438, Sf. 4439, Sf. 8440, Sf. 8441, Sf. 8442.

### *Carpinus mediomontana* MAI

Pl. 10, figs 8–9

- 1963 *Carpinus cordataeformis* MAI, p. 55, pro parte, pl. 4, figs 3, 4, text-fig. 6d.  
 1964 *Carpinus polzeriae* BERGER; Walther, p. 19, pl. 7, fig. 4.  
 1964 *Carpinus vindobonensis* BERGER; Walther, p. 20, pl. 7, fig. 6.  
 1964 *Carpinus* sp. 1; Walther, p. 21, pl. 7, fig. 5.  
 1964 *Carpinus* sp. 2; Walther 1964, p. 21, pl. 7, fig. 3.  
 1878 *Carpinus mediomontana* MAI in Mai and Walther, p. 68, pl. 6, fig. 6, pl. 28, figs 21–27 (Haselbach, Early Oligocene).

**Description:** Involucres oblique oval to asymmetrically triangular, on margin with several coarse lobe-like or simple sharp teeth, without any basal auricle, 13–15 mm long and 8–17 mm wide, venation asymmetrically actinodromous, primaries 5–7, and a few of the secondaries barely forked, craspedodromous, ending in 5–8 (to 9) main teeth, rarely in secondary, 1–3 teeth, in a few cases veins camptodromously bent, nutlet ovoid, small, as a compression, 2.5–3.8 mm long and 1.6–2.5 mm wide (see Mai in Mai and Walther 1978, pp. 68–69).

**Remarks:** According to Mai (in Mai and Walther 1978) such involucres from Seifhennersdorf were assigned to *Carpinus cordataeformis* (Mai 1963, pro parte) or *Carpinus polzeriae* and *Carpinus vindobonensis* (Walther 1964). A closely related species seems to be *C. cuspidata* according to Saporta (1862 – St. Zacharie, Early Oligocene). Such fruits are seen in sect. *Carpinus* and the nearest extant species seems to be *C. turczaninowii* HANCE from China or *C. orientalis* MILL. from the Mediterranean area (Mai 1995).

**Material studied:** MMG, Sf. 839, Sf. 1204, Sf. 1373:1:2, Sf. 1582:1:2, Sf. 2126, Sf. 2127, Sf. 2917, Sf. 3168, Sf. 3174, Sf. 3177, Sf. 3178:1:2 (*Carpinus* cf. *mediomontana*), Sf. 3181, Sf. 3182, Sf. 3185, Sf. 3192, Sf. 3195:1:2, Sf. 3203, Sf. 3206, Sf. 3209, Sf. 3222, Sf. 3237, Sf. 3256:1:2, Sf. 3261:1:2, Sf. 3275, Sf. 3288, Sf. 3539:1:2, Sf. 3594:1:2, Sf. 3744, Sf. 4301, Sf. 4312, Sf. 4376, Sf. 4377, Sf. 4380, Sf. 4381, Sf. 4382, Sf. 4383, Sf. 4384, Sf. 4385:1:2, Sf. 4789, Sf. 4819, Sf. 4820, Sf. 4821, Sf. 5048, Sf. 8205, Sf. 8249a, Sf. 8445, Sf. 8447, Sf. 8448:1:2, Sf. 8449:1:2, Sf. 8450, Sf. 8452, Sf. 8455:1:2, Sf. 8456.

### *Carpinus* sp.

**Description:** Leaves and leaf fragments sharing gross-morphology with the characteristics of *C. grandis* and *C. roscheri*, due to incomplete preservation not determinable, cuticles not preserved.

**Remarks:** About 35 leaves and leaf fragments belonging apparently to *Carpinus* have not been determined because important traits of the leaf margin are only poorly preserved. It is impossible to assign these samples to either of the leaf morpho-species described above.

**Material studied:** MMG, Sf. 1267, Sf. 1371, Sf. 1374, Sf. 1375, Sf. 1378, Sf. 1381, Sf. 1563, Sf. 1648, Sf. 1776, Sf. 2045, Sf. 2053, Sf. 2060, Sf. 2062, Sf. 2111, Sf. 2180, Sf. 2190, Sf. 2420, Sf. 3432:1:2, Sf. 3458, Sf. 3676:1:2, Sf. 3699, Sf. 4205, Sf. 4736, Sf. 4751, Sf. 4762 to Sf. 4765, Sf. 4770 to Sf. 4772, Sf. 4774 to Sf. 4778, Sf. 4781, Sf. 4794, Sf. 4795, Sf. 4798, Sf. 4809, Sf. 4813, Sf. 4816, Sf. 4817, Sf. 4818, Sf. 4822, Sf. 4825, Sf. 4828, Sf. 4830, Sf. 4831, Sf. 4832, Sf. 4834, Sf. 4837, Sf. 4842 to Sf. 4844, Sf. 4847, Sf. 4850, Sf. 4851, Sf. 4853, Sf. 4858, Sf. 4860, Sf. 4861, Sf. 4862, Sf. 4864, Sf. 4874, Sf. 4902, Sf. 4975:1:2, Sf. 5008, Sf. 5447, Sf. 5051, Sf. 5056:1:2, Sf. 5084, Sf. 5129, Sf. 5132, Sf. 5150, Sf. 5166, Sf. 5177, Sf. 5187, Sf. 5199, Sf. 5202, Sf. 5221, Sf. 5276, Sf. 5281, Sf. 5673, Sf. 8412, Sf. 8458, Sf. 8459, Sf. 8461 to Sf. 8463, Sf. 8464:1:2, Sf. 8467:1:2, Sf. 8485, Sf. 8491, Sf. 8494:1:2, Sf. 8497, Sf. 8518, Sf. 8519, Sf. 8532, Sf. 8540, Sf. 8565, Sf. 8575, Sf. 8576, Sf. 8464:1:2, Sf. 8465:1:2, Sf. 8466, Sf. 8467:1:2, Sf. 8468:1:2, Sf. 8469:1:2, Sf. 8470, Sf. 8471:1:2, Sf. 8472, Sf. 8480, Sf. 8482:1:2, Sf. 8483 to Sf. 8485, Sf. 8487:1:2, Sf. 8489:1:2, Sf. 8491, Sf. 8492:1:2, Sf. 8493, Sf. 8494:1:2, Sf. 8495:1:2, Sf. 8496, Sf. 8497, Sf. 8498, Sf. 8500, Sf. 8502, Sf. 8503, Sf. 8504:1:2, Sf. 8507, Sf. 8508, Sf. 8509:1:2, Sf. 8510, Sf. 8511:1:2, Sf. 8512, Sf. 8516:1:2, Sf. 8517 to Sf. 8519, Sf. 8520:1:2, Sf. 8521, Sf. 8522, Sf. 8523, Sf. 8524, Sf. 8525, Sf. 8526, Sf. 8527, Sf. 8529:1:2, Sf. 8531, Sf. 8532, Sf. 8540, Sf. 8542, Sf. 8595, Sf. 8618:1:2, Sf. 8642:1:2, Sf. 8654:1:2.

### *Ostrya* SCOP.

#### *Ostrya atlantidis* UNGER

Pl. 8, fig. 9

- 1850a *Ostrya atlantidis* UNGER, p. 8 (Radoboj, Middle Miocene).  
1852 *Ostrya atlantidis* UNGER; Unger, p. 41, pl. 20, figs 9–11 (Radoboj, Middle Miocene).  
1953 *Ostrya atlantidis* UNGER; Procházka, p. 24, fig. 1a (Bechlejovice, Early Oligocene).  
1998 *Ostrya atlantidis* UNGER; Kvaček and Walther, p. 23, pl. 12, figs 4–7, text-figs 13/34–35 (Kundratice, Early Oligocene).  
2004 *Ostrya atlantidis* UNGER; Kvaček and Walther, p. 32, pl. 15, text-fig. 12/9 (Bechlejovice, Early Oligocene).

**Description:** Leaf fragmentary, simple, petiolate, preserved petiole 9 mm long, preserved lamina 67 mm long and 38 mm wide, ovate, apex not preserved, base cuneate, margin indistinctly double serrate, main teeth long, all with a remarkable mucro, venation craspedodromous, midrib thin, secondaries densely spaced, eight pairs preserved, at

an angle of 23° to 41° with the midrib, sub-opposite to alternate, straight, entering the main teeth, sending side veinlets into the secondary teeth, intersecondaries only in the basal part of the lamina, tertiaries percurrent, rarely forked, nearly perpendicular to secondaries.

**Remarks:** It is the first evidence of this deciduous element in the flora of Seifhennersdorf and therefore we have to correct our opinion that this morpho-species would be missing at this locality (Kvaček and Walther 1998, p. 23). In the extensive collection of about 8 500 samples from Seifhennersdorf, only two leaf fragments have been found that show all characteristics of *Ostrya atlantidis*.

**Material studied:** MMG, Sf. 4036, Sf. 4148, Sf. 4849, Sf. 5045, Sf. 5106, Sf. 5502, Sf. 7925c:3, Sf. 8488.

### Juglandaceae A. RICH. ex KUNTH

#### *Engelhardia* LESCHEN. ex BL.

#### *Engelhardia orsbergensis* (WESSEL et WEBER)

#### JÄHNICHEN, MAI et WALTHER

Pl. 11, fig. 10, text-fig. 6a

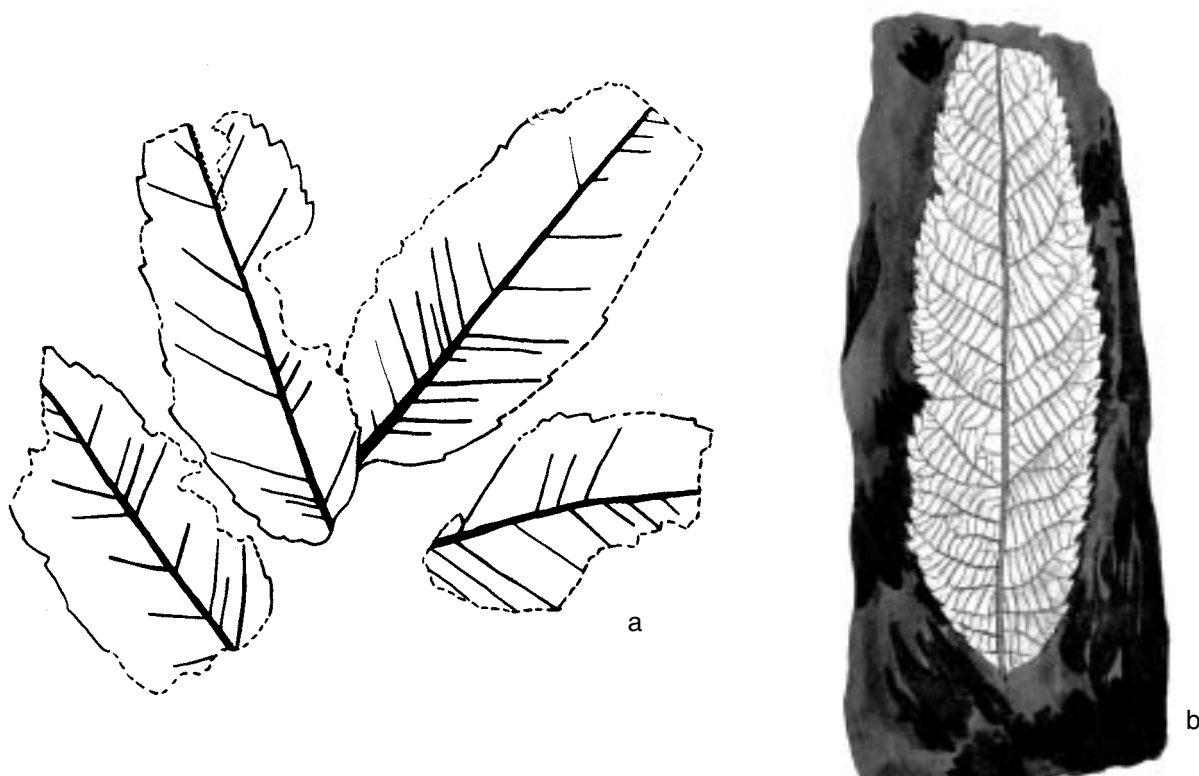
- 1856 *Banksia orsbergensis* WESSEL et WEBER, p. 146, pl. 25, figs 9a–d (Orsberg, Oligocene).  
1977 *Engelhardia orsbergensis* (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER, pp. 326–346, pls. 38–49, text-figs 1–3 (numerous localities and stratigraphy see Jähnichen et al. 1977, pp. 336–337).  
1995 *Engelhardia orsbergensis* (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER; Kvaček and Walther, p. 33, pl. 5, figs 1–2, 7, text-fig. 4/11 (Sulečice-Berand, Early Oligocene).

**Description:** Leaves pinnately compound, leaflets incompletely preserved, sessile, lamina narrow oblong, straight to slightly falcate, 40 and more mm long, and 10–20 mm wide, base asymmetrical, cuneate to rounded, apex acute, margin basally entire, higher up widely minutely serrate, tooth tips bluntly acute, partly abmedially patent, sinus shallow, acute to blunt; venation semicraspedodromous, midrib slightly curved to straight, thick, secondaries delicate, dense, under wide angles, running and looping very near the margin and sending veinlets near the sinus into the tooth, intersecondaries dense, parallel with the secondaries; venation details poorly preserved; cuticular structure has not been obtained in spite of several attempts.

**Remarks:** The foliage of *Engelhardia* is more frequent at Sulečice-Berand (Kvaček and Walther 1995), Holý Kluk hill at Proboštov (Radoň et al. 2006) and Haselbach (Jähnichen et al. 1977, Walther in Mai and Walther 1978) while it is quite rare at Seifhennersdorf, as at Kundratice, Markvartice and Knížecí, Hrazený hill/Pirskenberg (Knobloch 1961, as *Myrica lignitum* pro parte, pl. 1, fig. 8, pl. 2, fig. 10, pl. 3, fig. 3). At Seifhennersdorf, as in other sites, it is accompanied by fruits of *E. macroptera* (see below). It seems to be a thermophilous and mesophytic element.

**Material studied:** MMG, Sf. 2262, Sf. 6049, Sf. 6050, Sf. 7523.





Text-fig. 6. a – *Engelhardia orsbergensis* (Wessel et Weber) Jähnichen, Mai et Walther, Sf. 7523; b – *Carya fragiliformis* (STERNBERG) KVAČEK et WALTHER comb. n., holotype, NM G 6482, Žichov (re-illustrated from Sternberg 1825, pl. 50, fig. 1), both nat. size.

### *Engelhardia macroptera* (BRONGNIART) UNGER

Pl. 11, figs 8–9

- 1828 *Carpinus macroptera* BRONGNIART, p. 48, pl. 3, fig. 6 (Armissan, Late Oligocene).  
 1866 *Engelhardia macroptera* (BRONGNIART) UNGER, p. 52, pl. 16, figs 9–12 (Radoboj, Middle Miocene).  
 1977 *Engelhardia macroptera* (BRONGNIART) UNGER; Jähnichen, Mai and Walther, pp. 346–351, pls 54–56, text-figs 7–9 (numerous localities and stratigraphy see Jähnichen et al. 1977, p. 351).

**Description:** Involucres trilobate, with the nutlet about 6 mm across, basally attached, poorly preserved, medial lobe 30 mm, lateral lobes 25 mm long and about 7 mm wide, widely spread, elongate, at tips rounded, venation not preserved.

**Remarks:** The fruits do not differ from the other records in the volcanic floras (e.g. Kvaček and Walther 1995).

**Material studied:** MMG, Sf. 4399, Sf. 5294, Sf. 6047 (impression) and Sf. 6048 (counter-compression).

### *Cyclocarya* ILJINSKAYA

#### *Cyclocarya* sp.

Pl. 11, figs 5–7, pl. 23, figs 11–12

- 1897 *Pterocarya cyclocarpa* SCHLECHTENDAL, p. 20, pro parte (foliage only), pl. 4, figs 1–3 (Bitterfeld, Early Miocene).  
 1963 *Cyclocarya cyclocarpa* (SCHLECHTENDAL) KNOBLOCH; Mai, p. 50, pl. 3, figs 1–3, text-fig. 4a.

- 1991 *Cyclocarya cycloptera* ILJINSKAYA corr. KNOBLOCH; Mai and Walther, p. 72, pro parte (foliage only), pl. 36, figs 2–4, pl. 37, figs 1, 3–8, text-figs 6/4–8 (Bockwitz, Bitterfeld and other localities, Late Oligocene–Early Miocene).  
 1996 *Cyclocarya cyclocarpa* (SCHLECHTENDAL) KNOBLOCH; Walther, p. 16, text-fig. 3/13.

**Description:** Leaflets narrow ovate to lanceolate, 123 mm long, 20 mm wide, lateral leaflets sessile, margin fine irregularly serrate, teeth not very dense, venation semi-craspedodromous, midrib strong, secondaries in up to 17 to 20 pairs, slightly bent or almost straight, running either directly to the margin or forked near the margin and looping, at an angle of 45°–70° with the midrib, intersecondaries occasionally present, tertiaries widely spaced, irregularly forked, partly areolate, texture firm; cuticle thin, adaxial cuticle not preserved, abaxial cuticle delicate, compound of polygonal cells 15–40 µm across, anticlines straight to sinuous, stomata anomocytic, irregularly dispersed, 16–20 µm long and 10–16 µm wide, trichome bases rounded, 20–32 µm across, rare and sparse, mainly on veinlets, terminal parts of peltate trichomes disc-shaped, occasionally preserved, ca. 40 µm across.

**Remarks:** These remains of oval-lanceolate slightly asymmetric leaflets match well the analogous fossils from the former mine of Bockwitz near Borna, Saxony (Mai and Walther 1991) and in the gross morphology of the leaflets also those from Kundratice and Bechlejovice in the České středohoří Mts. (Kvaček and Walther 1998, 2004). According to Iljinskaya (in Budantsev 1994) the fruits and leaves of *Cyclocarya* from Ashutas belong to a different morpho-species (*C. aschutassica* ILJINSKAYA for foliage, *C.*

*weylandii* STRAUS for fruits). A separate morpho-species for the leaves from Central Europe has not been differentiated so far (Kvaček and Walther 2004) and therefore an open nomenclature is applied here.

**Material studied:** MMG, Sf. 14, orig. Walther 1964, pl. 11, fig. 6, text-fig. 4c (*Cyclocarya cyclocarpa*), Sf. 846, Sf. 870, Sf. 1071, Sf. 1117, Sf. 1168, Sf. 1251, Sf. 1291, Sf. 2705, Sf. 2914, Sf. 3292a, b, orig. Mai 1963, pl. 3, fig. 1 (*Cyclocarya cyclocarpa*), Sf. 3296, orig. Mai 1963, pl. 3, fig. 2 (*Cyclocarya cyclocarpa*), Sf. 4337, Sf. 4449 I, prep. Sf. 15/94 and Sf. 16/94, prep. Sf. 148e and Sf. 239a (Mai 1963), Sf. 8217, Sf. 4693, Sf. 6618a, Sf. 8176, Sf. 5622, Sf. 5707, Sf. 5711, Sf. 5716.

## ***Carya* NUTT.**

### ***Carya fragiliformis* (STERNBERG)**

#### **KVAČEK et WALTHER comb. n.**

Pl. 11, figs 1–3, pl. 23, figs 8–10, text-fig. 6b

- 1825 *Phyllites fragiliformis* STERNBERG, p. 42, index iconum, pl. 50, fig. 1 – basionym (Žichov, “Schichow”, Late Oligocene).  
 ? 1852 *Pterocarya denticulata* WEBER, p. 211, pl. 23, figs 10a, b (Rott, Late Oligocene).  
 ? 1874 *Carya denticulata* (WEBER) W. SCHIMPER, p. 255 (Rott, Late Oligocene).  
 1870 *Salix varians* GOEPPERT; Engelhardt, p. 14, pl. 3, figs 10, 12.  
 1963 *Carya* cf. *serraeifolia* (GOEPPERT) KRÄUSEL; Mai, p. 53, pl. 3, figs 6–11, text-fig. 5a.  
 1964 *Carya serraeifolia* (GOEPPERT) KRÄUSEL; Walther, p. 32, pl. 9, figs 1–8, pl. 10, figs 1–7 (figs 3–4 refigured from Engelhardt 1870, pl. 3, fig. 10, as *Salix varians*).  
 1964 *Myrica lignitum* (UNGER) SAPORTA; Walther, p. 27, ex parte, pl. 27, fig. 2.  
 1974 *Carya* cf. *serraeifolia* (GOEPPERT) KRÄUSEL; Walther, p. 143, pl. 1, figs 1–4, pl. 2, figs 1–4, pl. 3, figs 1–4, pl. 4, figs 1–4, text-figs 1–3.  
 1996 *Carya serrifolia* (GOEPPERT) KRÄUSEL; Walther, pp. 14, 17, text-fig. 3/32.

**Holotype:** NM G 6482 (re-figured in Kvaček J. and Straková 1997, pl. 25, fig. 2), coll. National Museum, Prague – text-fig. 6.2.

**Type locality:** Žichov (former Schichow), České středohoří Mts., Late Oligocene.

**Diagnosis emend.:** Leaflets oblong, slightly asymmetrical, base cuneate to rounded, apex acute to acuminate, venation craspedodromous to semicraspedodromous, midvein almost straight, secondaries opposite to alternate, slightly bent, often forked at margin, rarely near the midvein, at almost right angles to the midvein near the leaflet base, higher up at about 50° or less; tertiaries prominent, at right angles to the secondaries, slightly wavy, percurrent, higher-order venation mostly areolate, ultimate veinlets free, forked.

**Description:** Detached leaflets of compound leaves, terminal leaflets long petiolulate, almost symmetrical, lateral short petiolulate (up to about 3 mm) or sessile, mostly falcate, lamina up to 135 mm long and 35 mm wide,

lanceolate to oblanceolate, apex long acute to acuminate, base rounded to cuneate, often asymmetrical, margin irregularly serrate, teeth triangular, sharp, tooth apex bent admedially, between one main tooth 1 to 2 small secondary teeth; main teeth strong, at the base of the lamina about 1 mm apart, venation craspedodromous, occasionally semicraspedodromous, midvein almost straight, secondaries in 14 to 16 pairs, opposite in the first third of lamina, then alternate, more or less bent admedially, on the very base at an angle of 90°, the others under narrower angles of about 85°–45°, forked in the first third before the margin and entering the teeth, tertiaries percurrent at a right angle, texture chartaceous; cuticles delicate, adaxial showing ordinary cells polyedric, anticlines straight, sometimes curved, 11–13 µm across, circular simple bases of peltate trichomes scattered over the whole surface, abaxial cuticle mostly in fragments, more delicate, ordinary cells difficult to recognize, sometimes covered by fragments of diatoms, 14–30 µm across, anticlines straight to slightly bent, stomata anomocytic, irregularly distributed, distinctly varying in length and width of the guard cells, 12 to 25 µm long and 11 to 19 µm wide, outer stomatal ledges sometimes heavily cutinized, single-celled heavily cutinized bases of peltate trichomes much more common than in adaxial cuticle, bases 20 to 28 µm across, peltate-trichomes rarely preserved, rounded, with slightly thickened entire margin, larger 130–140 µm across, smaller peltate trichomes very rare, about 60 µm across.

**Remarks:** Iljinskaya (in Budantsev 1994) recognized several species of *Carya* on the basis of leaf gross morphology. After comparison, all those assigned to sect. *Apocarya* DC. come into question, because the fruits regularly associated with similar foliage as that described above from Seifhennersdorf belong to the same section (Mai 1981). According to the epidermal anatomy of both leaf sides, comparisons with the living species of *Carya* demonstrate more agreement with the species presently distributed in Asia rather than to those from North America (Walther 1974). We have introduced a new epithet on the priority principle and leave the exact synonymy open. Of particular interest is *C. zaisanica* ILJINSKAYA et AKHMETIEV from the Late Oligocene-Early Miocene of Ashutas that match well the Oligocene fossils from our region. In our opinion, *C. serrifolia*, mostly used previously for the Oligocene-Early Miocene material from Central Europe, may represent a descendent of the same lineage in the late Neogene. Because the genus *Carya* was in the European Tertiary much more differentiated according to the fossil fruits (Mai 1981) in contrast to the foliage morphology, a thorough study reconstructing relationships of fruits and foliage would perhaps solve this problem in the future.

**Material studied:** MMG, Sf. 4, orig. Walther 1964, pl. 9, fig. 1 (*Carya serraeifolia*), Sf. 5, Sf. 7, orig. Walther, pl. 10, fig. 5 (*Carya serraeifolia*), Sf. 14b, Sf. 13, orig. Walther, pl. 10, fig. 4 (*Carya serraeifolia*), Sf. 15, Sf. 16, Sf. 23, orig. Walther, pl. 10, fig. 7 (*Carya serraeifolia*), Sf. 24:1, orig. Engelhardt 1870, pl. 3, fig. 10 (*Salix varians*), orig. Walther 1964, pl. 9, fig. 2 (*Carya serraeifolia*), Sf. 24, orig. Engelhardt 1870, pl. 3, fig. 12 (*Salix varians*), Sf. 25, Sf. 27, orig. Walther 1964 pl. 10, fig. 6 (*Carya serraeifolia*), Sf. 30, orig. Walther 1964, pl. 27, fig. 2 (? *Myrica lignitum*), Sf. 40, orig. Walther 1964, pl. 9, fig. 4, (*Carya*

*serraeifolia*), Sf. 43, orig. Walther, pl. 9, fig. 6 (*Carya serraeifolia*), Sf. 47, orig. Walther 1964, pl. 9, fig. 5 (*Carya serraeifolia*), Sf. 49, orig. Walther, pl. 10, fig. 1 (*Carya serraeifolia*), Sf. 54, orig. Walther, pl. 10, fig. 2 (*Carya serraeifolia*), Sf. 142, prep. Sf. 95/77, Sf. 146, prep. Sf. 22/71, 23/71, 195–6/71, 207/71 and 215–6/71, Sf. 228, Sf. 229, Sf. 462, Sf. 837, Sf. 838, Sf. 840 to Sf. 844, Sf. 847, Sf. 848, Sf. 851, Sf. 852:1:2, Sf. 854, Sf. 855, Sf. 858, Sf. 859, Sf. 860 to Sf. 865, Sf. 867 to Sf. 869, Sf. 871 to Sf. 879, Sf. 881 to Sf. 886, Sf. 888 to Sf. 899, Sf. 901, Sf. 902, Sf. 903, Sf. 904:1:2, Sf. 906, Sf. 907, Sf. 908:1:2, Sf. 910 to Sf. 912, Sf. 913:1:2, Sf. 914:1:2, Sf. 915:1:2, Sf. 916 to Sf. 924, Sf. 925:1:2, Sf. 926 to Sf. 933, Sf. 935, Sf. 936, Sf. 938 to Sf. 942, Sf. 944, Sf. 945, Sf. 946:1:2:3, Sf. 947, Sf. 948, Sf. 950, Sf. 951, Sf. 952:1:2, Sf. 956, Sf. 959 to Sf. 962, Sf. 964, Sf. 966, Sf. 971, Sf. 973 to Sf. 975, Sf. 977 to Sf. 997:1:2, Sf. 998, Sf. 1000 to Sf. 1002, Sf. 1003:1:2, Sf. 1004 to Sf. 1008, Sf. 1009:1:2, Sf. 1011 to Sf. 1017, Sf. 1018:1:2, Sf. 1019, Sf. 1020, Sf. 1021:1:2, Sf. 1022, Sf. 1023, Sf. 1024:1:2, Sf. 1025:1:2, Sf. 1027 to Sf. 1035, Sf. 1036:1:2, Sf. 1037 to Sf. 1040, Sf. 1043:1:2, Sf. 1044 to Sf. 1047:1:2, Sf. 1048 to Sf. 1051, Sf. 1053, Sf. 1055, Sf. 1056, Sf. 1057:1:2, Sf. 1058 to Sf. 1064, Sf. 1066 to Sf. 1069, Sf. 1073, Sf. 1074, Sf. 1077:1:2, Sf. 1078:1:2, Sf. 1079, Sf. 1080:1:2, Sf. 1081, Sf. 1083:1:2, Sf. 1084 to Sf. 1092, Sf. 1094 to Sf. 1096, Sf. 1098 to Sf. 1113, Sf. 1114 :1:2, Sf. 1115, Sf. 1116, Sf. 1118 to Sf. 1124, Sf. 1126, Sf. 1127, Sf. 1129 to Sf. 1132, Sf. 1134, Sf. 1136 to Sf. 1142, Sf. 1143:1:2, Sf. 1144:1:2, Sf. 1145 to Sf. 1147, Sf. 1148:1:2, Sf. 1149:1:2, Sf. 1150, Sf. 1151, Sf. 1152:1:2, Sf. 1153, Sf. 1155, Sf. 1156:1:2, Sf. 1157, Sf. 1158:1:2, Sf. 1159, Sf. 1160:1:2, Sf. 1161, Sf. 1162 to Sf. 1167, Sf. 1170:1:2, Sf. 1171 to Sf. 1175, Sf. 1176:1:2, Sf. 1177 to Sf. 1179, Sf. 1180:1:2, Sf. 1181, Sf. 1182:1:2, Sf. 1183, Sf. 1184, Sf. 1185, Sf. 1187, Sf. 1188, Sf. 1190, Sf. 1191, Sf. 1192:1:2, Sf. 1193 to Sf. 1195, Sf. 1197, Sf. 1198:1:2, Sf. 1199, Sf. 1200 to Sf. 1203, Sf. 1205 to Sf. 1227, Sf. 1228, Sf. 1229, Sf. 1231 to Sf. 1234, Sf. 1236:1:2, Sf. 1237, Sf. 1238, Sf. 1239, Sf. 1240:1:2, Sf. 1241, Sf. 1242, Sf. 1244, Sf. 1245, Sf. 1247, Sf. 1250, Sf. 1252 to Sf. 1254, Sf. 1255:1:2, Sf. 1257, Sf. 1259 to Sf. 1264, Sf. 1266, Sf. 1271, Sf. 1272, Sf. 1274, Sf. 1276 to Sf. 1279, Sf. 1281 to Sf. 1289, Sf. 1292, Sf. 1294, Sf. 1298 to Sf. 1300, Sf. 1302, Sf. 1303, Sf. 1306:1:2 to Sf. 1309:1:2, Sf. 1310, Sf. 1311, Sf. 1312:1:2:3, Sf. 1313:1:2, Sf. 1315, Sf. 1318, Sf. 1319, Sf. 1321, Sf. 1322, Sf. 1324 to Sf. 1326, Sf. 1327:1:2, Sf. 1328:1:2, Sf. 1331:1:2, Sf. 1334 to Sf. 1338, Sf. 1340 to Sf. 1343, Sf. 1345, Sf. 1348 to Sf. 1351, Sf. 1353:1:2, Sf. 1354, Sf. 1355, Sf. 1357 to Sf. 1359, Sf. 1386, Sf. 1388:1:2, Sf. 1390:1:2 to Sf. 1392:1:2, Sf. 1394, Sf. 1395, Sf. 1396:1:2, Sf. 1397, Sf. 1398, Sf. 1399, Sf. 1401, Sf. 1402:1:2, Sf. 1403:1:2, Sf. 1404:1:2, Sf. 1405:1:2, Sf. 1406:1:2, Sf. 1407, Sf. 1408:1:2, Sf. 1409:1:2, Sf. 1410:1:2, Sf. 1411, Sf. 1412:1:2, Sf. 1413:1:2, Sf. 1414:1:2, Sf. 1417, Sf. 1418:1:2, Sf. 1419 to Sf. 1421, Sf. 1426, Sf. 1427, Sf. 1429, Sf. 1430, Sf. 1432, Sf. 1435 to Sf. 1438, Sf. 1440, Sf. 1443, Sf. 1446 to Sf. 1452, Sf. 1454, Sf. 1456, Sf. 1457, Sf. 1459, Sf. 1461, Sf. 1462, Sf. 1464, Sf. 1465, Sf. 1467, Sf. 1469, Sf. 1473, Sf. 1475 to Sf. 1483, Sf. 1484:1:2, Sf. 1485, Sf. 1486, Sf. 1487, Sf. 1489:1:2, Sf. 1490:1:2, Sf. 1491 to Sf. 1494, Sf. 1496, Sf. 1498, Sf. 1522, Sf. 1529, Sf. 1530 to Sf. 1536, Sf. 1552, Sf.

1636, Sf. 1646, Sf. 1674, Sf. 1675, Sf. 1681, Sf. 1703, Sf. 1907, Sf. 1927, Sf. 2006, Sf. 2227, Sf. 2233, Sf. 2239, Sf. 2245, Sf. 2247, Sf. 2249, Sf. 2254, Sf. 2252, Sf. 2256, Sf. 2260, Sf. 2263, Sf. 2269, Sf. 2271, Sf. 2272, Sf. 2273, Sf. 2282, Sf. 2284, Sf. 2287, Sf. 2288, Sf. 2290, Sf. 2295, Sf. 2296, Sf. 2299, Sf. 2300, Sf. 2310, Sf. 2315 to Sf. 2319, Sf. 2321 to Sf. 2323, Sf. 2431, Sf. 2527, Sf. 2549, Sf. 2614, Sf. 2616, Sf. 2623 to Sf. 2625, Sf. 2653, Sf. 2685, Sf. 2687, Sf. 2689, Sf. 2694, Sf. 2696, Sf. 2698, Sf. 2699, Sf. 2700, Sf. 2701:a:b:c, Sf. 2703, Sf. 2708, Sf. 2730, Sf. 2842, Sf. 2914, Sf. 2961, Sf. 3065, Sf. 3079, Sf. 3136, Sf. 3361 to Sf. 3365, Sf. 3404:1:2, Sf. 3407:1:2, Sf. 3410:1:2, Sf. 3412:1:2, Sf. 3413:1:2, Sf. 3414:1:2, Sf. 3415:1:2, Sf. 3427:1:2, Sf. 3428:1:2, Sf. 3431:1:2, Sf. 3439:1:2, Sf. 3441:1:2, Sf. 3442:1:2, Sf. 3443, Sf. 3444, Sf. 3446, Sf. 3453 to Sf. 3457, Sf. 3459, Sf. 3465, Sf. 3474, Sf. 3481, Sf. 3482, Sf. 3491, Sf. 3495, Sf. 3512:1:2, Sf. 3513:1:2, Sf. 3515:1:2, Sf. 3516:1:2, Sf. 3526, Sf. 3532:1:2, Sf. 3533, Sf. 3536:1:2, Sf. 3542:1:2, Sf. 3552, Sf. 3556, Sf. 3557, Sf. 3559, Sf. 3560, Sf. 3564, Sf. 3565, Sf. 3567, Sf. 3569, Sf. 3578, Sf. 3602, Sf. 3675:1:2, Sf. 3680, Sf. 3689, Sf. 3694, Sf. 3700:1:2, Sf. 3703:1:2, Sf. 3704:1:2, Sf. 3705:1:2, Sf. 3706:1:2, Sf. 3711:1:2, Sf. 3713:1:2, Sf. 3725:1:2, Sf. 3753, Sf. 3759, Sf. 3779, Sf. 3772, Sf. 3773, Sf. 3982, Sf. 3988, Sf. 3990, Sf. 3992, Sf. 3996, Sf. 4004, Sf. 4006, Sf. 4013, Sf. 4055, Sf. 4076, Sf. 4078, Sf. 4092, Sf. 4093, Sf. 4100, Sf. 4112, Sf. 4116, Sf. 4135, Sf. 4151, Sf. 4152, Sf. 4153, Sf. 4155, Sf. 4165, Sf. 4166, Sf. 4174, Sf. 4183, Sf. 4185, Sf. 4188, Sf. 4192 to Sf. 4194, Sf. 4197, Sf. 4198, Sf. 4201, Sf. 4206, Sf. 4207, Sf. 4212, Sf. 4219, Sf. 4221, Sf. 4222, Sf. 4226, Sf. 4234, Sf. 4235, Sf. 4248, Sf. 4254, Sf. 4270, Sf. 4271, Sf. 4274, Sf. 4280, Sf. 4282, Sf. 4284, Sf. 4294, Sf. 4288, Sf. 4326 to Sf. 4328, Sf. 4330 to Sf. 4332, Sf. 4334, Sf. 4335, Sf. 4337, Sf. 4352, Sf. 4353, Sf. 4354, Sf. 4356, Sf. 4362, Sf. 4365, Sf. 4366, Sf. 4367, Sf. 4368, Sf. 4371, Sf. 4509, Sf. 4812, Sf. 4999, Sf. 5087 to Sf. 5089, Sf. 5125, Sf. 5136, Sf. 5153, Sf. 5191, Sf. 5316 to Sf. 5318, Sf. 5320 to Sf. 5327, Sf. 5330, Sf. 5331:1:2, Sf. 5332:1:2, Sf. 5333 to Sf. 5354, Sf. 5356 to Sf. 5362, Sf. 5364 to Sf. 5371, Sf. 5373 to Sf. 5383, Sf. 5384:1:2, Sf. 5385:1:2, Sf. 5388, Sf. 5390, Sf. 5392 to Sf. 5396, Sf. 5398, Sf. 5399, Sf. 5412 to Sf. 5431, Sf. 5432:1:2, Sf. 5433 to Sf. 5439, Sf. 5441 to Sf. 5444, Sf. 5446, Sf. 5448 to Sf. 5460, Sf. 5472 to Sf. 5477, Sf. 5479 to Sf. 5493, Sf. 5495, Sf. 5496, Sf. 5499, Sf. 5515 to Sf. 5518, Sf. 5520 to Sf. 5525, Sf. 5528 to Sf. 5533, Sf. 5535 to Sf. 5542, Sf. 5543:a:b, Sf. 5544:1:2, Sf. 5545 to Sf. 5553, Sf. 5555 to Sf. 5561, Sf. 5562:1:2, Sf. 5563 to Sf. 5567, Sf. 5569, Sf. 5574, Sf. 5575, Sf. 5576:1:2, Sf. 5577 to Sf. 5587, Sf. 5589 to Sf. 5591, Sf. 5593, Sf. 5594, Sf. 5596 to Sf. 5599, Sf. 5675 to Sf. 5688, Sf. 5690 to Sf. 5706, Sf. 5708 to Sf. 5710, Sf. 5712 to Sf. 5715, Sf. 5800 to Sf. 5806, Sf. 5808 to Sf. 5817, Sf. 5819:1:2, Sf. 5820:1:2, Sf. 5821, Sf. 5822 to Sf. 5830, Sf. 5832 to Sf. 5842, Sf. 5843:1:2, Sf. 5800 to Sf. 5806, Sf. 5808 to Sf. 5817, Sf. 5819:1:2, Sf. 5820:1:2, Sf. 5821, Sf. 5822 to Sf. 5830, Sf. 5832 to Sf. 5842, Sf. 5843:1:2, Sf. 5909b, Sf. 6054, Sf. 6622, Sf. 7251, Sf. 7824, Sf. 7984:1:2, Sf. 8329, orig. Walther 1964, pl. 10, fig. 1, Sf. 8335, orig. Walther 1964, pl. 9, fig. 8 (*Carya serraeifolia*), Sf. 8083, Sf. 8085:1:2, Sf. 8086:1:2, Sf. 8130:1:2, Sf. 8189, Sf. 8201, Sf. 8214, Sf. 8215, Sf. 8346, Sf. 8349, orig. Walther 1964, pl. 9, fig. 5 (*Carya serraeifolia*), Sf.

8414, Sf. 8649, Sf. 86724b, prep. Sf. 22/71, 23/71, Sf. 195 to 208/71 and Sf. 215/71, Sf. 8677, Sf. 8681.

### ***Carya cf. quadrangula* (KIRCHHEIMER) LEROY**

Pl. 11, fig. 4

- 1870 *Carya bilinica* UNG.; Engelhardt, pp. 23–24, pl. 6, figs 4–6.  
? 1936 *Caryojuglans quadrangula* KIRCHHEIMER, p. 82, pl. 12, figs 36a–l, text-fig. 13 (Meuselwitz, Early Oligocene).  
? 1955 *Carya quadrangula* (KIRCHHEIMER) LEROY, p. 162, fig. 81 (Borna, Regis mine, Early Oligocene).  
1963 *Carya cf. costata* (C. PRESL) UNGER; Mai, p. 51, pl. 3, figs 4–5.  
? 1978 *Carya quadrangula* (KIRCHHEIMER) LEROY; Mai, p. 80 (various localities of the Haselbach floral assemblage, Early Oligocene).

**Description:** Fruits 3-dimensionally preserved, carbonized, slightly compressed, 25 to 31 mm long, 27–29 mm across, ovoid, slightly acuminate on apex, rounded at base, smooth to fine striate on surface, with 4 longitudinal ridges, wall perhaps ca. 2 mm thick, inner structure not apparent due to compression (Mai 1963, p. 52).

**Remarks:** The original determination of the fruits as *Carya bilinica* (Engelhardt 1970) or *C. cf. costata* (Mai 1963, p. 51, pl. 3, figs 4–5) was corrected in a detailed revision of similar fruits of the group of East Asiatic *C. poilanei* (CHEV.) LEROY (Mai and Walther 1978, Mai 1981) and compared with *Carya quadrangula* typically occurring in the European Paleogene.

**Material studied:** MMG, Sf. 3170, Sf. 8243, orig. Mai 1963, pl. 3, figs 4–5 (*Carya cf. costata*), Sf. 8665 (impression).

## **Salicaceae MIRBEL**

### ***Salix varians* GOEPPERT**

Pl. 12, figs 1–2, pl. 23, figs 14–15, pl. 24, fig. 1

- 1855 *Salix varians* GOEPPERT, p. 26, pl. 19, figs 17, 18, pl. 20, figs 1, 2 (Sośnica “Schossnitz”, Late Miocene).  
1954 *Salix varians* GOEPPERT; Kräusel and Weyland, p. 124, pl. 17, fig. 3, pl. 25, figs. 5–7, pl. 26, fig. 1, text-fig. 1, 8 (Liblar, Miocene).  
1974 *Salix varians* GOEPPERT; Walther, p. 151, pl. 9, figs 3–4, pl. 10, figs 1–4, text-fig. 4.  
1978 *Salix varians* GOEPPERT; Walther in Mai and Walther, p. 85, pl. 3, figs 6–10, pl. 34, figs 1–13 (Haselbach, Early Oligocene).  
1996 *Salix varians* GOEPPERT; Walther, p. 17.

**Description:** Leaves simple, petiolate, petiole not preserved, lamina ovate lanceolate, about 59 to 100 mm long, 24 to 26 mm wide, apex acuminate, base rounded to cuneate, only fragments present, margin fine serrate, teeth small, more or less adhering to the margin, sometimes with roundish glands on the tips, about 7–10 teeth per 10 mm, venation semicraspedodromous, midrib strong, running straight to the apex, secondaries alternate, at angles of 45 to 63° to the midrib, running slightly bent to the margin, forked, the apical branch forming with the next secondary vein a wide loop, the basal branch forking again directly on

the margin in two branches which end in the teeth, intersecondaries 1–3, at angles wider than those of the secondaries, tertiaries forming vertical slightly bent, dense anastomoses between the secondaries and intersecondaries, lamina medium thick; adaxial cuticle showing ordinary cells polyedric, 8–10 µm across, anticlines straight to slightly bent, single-celled trichome bases sporadically distributed, roundish, heavily cutinised, 5 to 8 µm across, rare small paracytic stomata visible close to the margin; abaxial cuticle reflecting ordinary cells in form and size similar to those of adaxial leaf side, but more delicate, stomata paracytic, irregularly arranged, sometimes in dense groups, 15 to 25 µm long, 10 to 20 µm wide, stomata ledges strongly cutinised, lateral subsidiary cells hard to see, simple trichome bases irregularly distributed.

**Remarks:** Foliage of *Salix varians* GOEPPERT is known from various Early Oligocene sites (Haselbach; Mai and Walther 1978; Seifhennersdorf), but also from the Early Miocene (Čermnůky; Bůžek 1971, Oder 2d; Knobloch and Kvaček 1976), Middle Miocene (Kreuzau; Ferguson 1971) and Late Miocene sites (Sośnica; Goeppert 1855, Walther in prep.). In the gross morphology only small differences in the serration of the margin and in the epidermis structure exist between the populations from the Early Oligocene and Early Miocene (Walther in Mai and Walther 1978). Up to now we are not certain, if these examples are indicating an evolutionary lineage of this Tertiary willow, or they represent separated species, based on the Early Oligocene and the Late Miocene specimens. *Salix varians* is only an accessory element in the Oligocene and Miocene floras studied. It is very difficult to compare this morpho-species with any living willow (e.g. Kräusel and Weyland 1954, Bůžek 1971, Ferguson 1971, Knobloch and Kvaček 1976). By comparison with various species of *Salix* we have found only relations to *Salix bonplandiana* KUNTH in the type of venation, serration of margin and also in the epidermis structure (Walther in Mai and Walther 1978). This neotropical willow is distributed together with *Taxodium mucronatum*, *Populus arizonica*, *Platanus chiapensis*, *Ulmus mexicana* in the riverside riparian forests of the Tierra Templada in eastern Mexico and Guatemala (Knapp 1965, p. 297).

**Material studied:** MMG, Sf. 16, Sf. 17a, orig. Walther 1974, pl. 3, 4, text-fig. 4, Sf. 17 b, prep. Sf. 31 to 66/71 and Sf. 71 to 74/71, Sf. 18b, prep. Sf. 121–129/71, Sf. 853, Sf. 1065, Sf. 1133, Sf. 1230, Sf. 1290, Sf. 1389, Sf. 2266, Sf. 2324:1:2, Sf. 2409 (*Salix cf. varians*), Sf. 2666, Sf. 2682 (*Salix cf. varians*), Sf. 2714 (*Salix cf. varians*), Sf. 2806, Sf. 2865, Sf. 3086, Sf. 3531, Sf. 4228:1:2, Sf. 4233:1:2, Sf. 4299, Sf. 5095, Sf. 6420:1:2 (*Salix cf. varians*), Sf. 6615:1, Sf. 6616, Sf. 6619 (*Salix cf. varians*), Sf. 6624 (*Salix cf. varians*), Sf. 6628, Sf. 6633, Sf. 8181 (*Salix cf. varians*), Sf. 8678.

### ***Populus zaddachii* HEER**

Pl. 12, fig. 3, text-fig. 7

- 1859 *Populus zaddachii* HEER, p. 307 (Svetlogorsk, “Rauschen”, Russia, Early Oligocene).  
1996 *Populus zaddachii* HEER; Walther, pp. 14, 17, text-fig. 3/21.  
2006 *Populus zaddachii* HEER; Reuschel and Walther, p. 13.

**Description:** Leaves simple, petiolate, petiole 11 to 18 mm in preserved length, fragments of lamina ovate, 72 to 99 mm long, 32 to 57 mm wide, apex acuminate, sometimes long acuminate, base cuneate, rounded, rarely subcordate, margin finely crenulate to finely toothed, teeth difficult to observe; venation craspedodromous, midrib strong, secondaries in ca. 5 pairs, basal pair acrodromous, at an angle of 22° to 45° to the midrib, running straight to the upper half of lamina, higher-order venation poorly preserved; texture delicate, hence cuticle analysis impossible.

**Remarks:** This morpho-species was originally described from the Early Oligocene strata of the Baltic region (Heer 1869), then firstly recorded in Central Europe in the nearshore or lowland floras sensu Kvaček and Walther (2001) of the Haselbach floral assemblage (Mai and Walther 1978) and later, much more often in the nearshore sites of the Rott-Thierbach floral assemblage (Mai and Walther 1991). It is also present as a very accessory element in the volcanic floras of Bechlejovice, Kundratice, Hrazený and Sulečice-Berand (Kvaček and Walther 2004, 1998, 1995). Walther (in Mai and Walther 1991) recognized this poplar as mesophytic rather than a riparian element. This statement needs to be expanded in such a way to accommodate that *Populus zaddachii* was growing in the transitional region between the intrazonal riparian forest and the zonal Mixed Mesophytic forest (as can be observed in the case of the extant *Carpinus betulus*).

**Material studied:** MMG, Sf. 44, Sf. 2722, Sf. 3494, Sf. 3753, Sf. 4129 (*Populus* cf. *zaddachii*), Sf. 4409, Sf. 4452, Sf. 4454 (*Populus* cf. *zaddachii*), Sf. 4459, Sf.

4460:1:2, Sf. 6460:1:2, Sf. 6461:1:2, Sf. 6462:1:2, Sf. 6463, Sf. 6464 (*Populus* cf. *zaddachii*), Sf. 6465, Sf. 6466, Sf. 7472, Sf. 7841.

## **Elaeocarpaceae DC.**

### ***Sloanea* L.**

#### ***Sloanea artocarpites* (ETTINGSHAUSEN)**

**KVAČEK et HABLY**

Pl. 12, figs 4–5

1869 *Quercus artocarpites* ETTINGSHAUSEN, p. 63, pl. 55, figs 19–19a (Žichov, “Schichow”, Late Oligocene).

2001 *Sloanea artocarpites* (ETTINGSHAUSEN) KVAČEK et HABLY in Kvaček et al., p. 117 (Žichov, “Schichow”, Late Oligocene).

**Description:** Leaf incomplete, without petiole, lamina narrow elliptic, ca. 35 mm wide, preserved in length of 80 mm, base widely cuneate, apex missing, margin subentire, with widely spaced minute teeth; venation semi-craspedodromous, midrib straight, stout, secondaries subopposite, gently bent, at an angle of 30°–45°, looping very near margin, with abmedial veinlets entering teeth, tertiaries percurrent (?), rarely visible.

**Remarks:** The single specimen shows characteristic features of the marginal venation that allow identification of this mesophytic and thermophilous element. *Sloanea* was widely spread in most sites of the České středohoří Mountains and particularly frequent in the floras of Sulečice-Berand and the Holý Kluk Hill (Kvaček and Walther 1995, Radoň et al. 2006).

**Material:** MMG, Sf. 6053:1:2.

## **Malvaceae JUSSIEU**

### ***Tilia* L.**

#### ***Tilia gigantea* ETTINGSHAUSEN**

Pl. 12, fig. 6

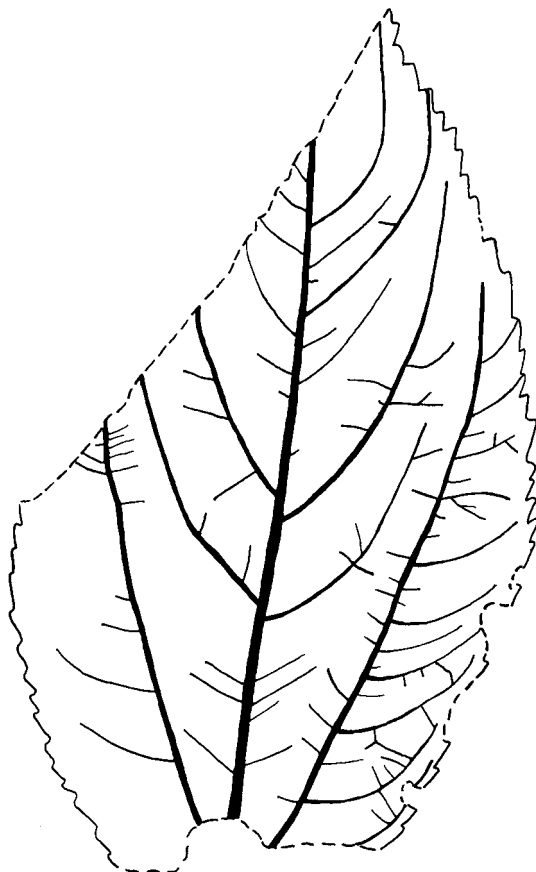
1869 *Tilia gigantea* ETTINGSHAUSEN, p. 16, pl. 43, fig. 12 – holotype (Žichov, “Schichow”, Late Oligocene).

1964 *Tilia* cf. *irtyschensis* (SHAPARENKO) GRUBOV; Walther, p. 65, pl. 24, figs 1–3.

1996 *Tilia irtyschensis* (SHAPARENKO) GRUBOV; Walther, pp. 14, 19, text-fig. 3/27.

**Description:** Leaves simple, incompletely preserved, long petiolate, preserved petiole 37 mm long, lamina ca. 12.5 cm wide, more than 10 mm long, apex missing, base cordate, asymmetrical, margin irregularly dentate, teeth triangular to widely triangular, acute, in the upper part of the lamina more prominent, lobe-like, venation actinodromous – craspedodromous, with 5 basal primaries, midrib strong and more or less wavy, left lateral primaries at an angle of 70° and 30°, right lateral primaries 85° and 40°, secondaries in 4 sub-opposite pairs at an angle of 55° to 44°, 5 abmedial veinlets from the lateral primaries running along the margin; cuticle delicate, without preserved cell structure, on abaxial side scattered stellate trichomes.

**Remarks:** The fossil foliage of *Tilia* from Seifenhensdorf is not distinguishable from the other more com-



**Text-fig. 7. *Populus zaddachii* HEER, Sf. 4452, nat. size.**

plete records of linden in the North Bohemian Oligocene, particularly Bechlejovice (Kvaček and Walther 2004). In the latter site the associated bracts corroborate affinities to an extinct group of linden first recorded in North America (Manchester 1994, Hably et al. 2000).

**Material studied:** MMG, Sf. s. n., orig. Walther 1964, pl. 24, fig. 1, pl. 25, figs. 1–3 (*Tilia* cf. *irtyschensis*), Sf. 4357, Sf. 7200.

***Craigia* W. W. SM. et W. E. EVANS**

***Craigia bronnii* (UNGER)**

**KVAČEK, BŮŽEK et MANCHESTER**

Pl. 13, figs 3–6

- 1845 *Ulmus bronnii* UNGER, p. 79, pro parte, pl. 25, figs 2–4 (non fig. 1) (Bílina, “Bilin”, Early Miocene).  
 1948 *Ptelea carpum bronnii* (UNGER) WEYLAND, p. 130, pl. 21, fig. 5, text-figs 5–9 (Rott, Late Oligocene).  
 1963 *Ptelea carpum bronnii* (UNGER) WEYLAND; Mai, p. 79, pl. 10, figs 10, 11.  
 1991 *Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER, p. 522 (Bílina, Early Miocene).  
 1996 *Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER; Walther, pp. 14, 17, text-fig. 3/26.

**Description:** Capsule valves elliptical, 11–18 mm long and 8–13 mm wide if flat compressed, with peripheral wing, sometimes folded, half-moon in shape, in such cases only 6–8 mm wide, in the medial part with broadly spindle-shaped to elliptical locular cavity and medial septum, rarely remains of elliptical seeds; venation reticulate, over the locule irregular, on the wing radially disposed in rows.

**Remarks:** Similar fruit remains of *Craigia* known previously as *Ptelea carpum* (Weyland 1948, Bůžek et al. 1989) occur in most sites of volcanic floras in North Bohemia and Saxony except Kučlín. They do not differ from the other European occurrences of *Craigia*, where they are usually associated with the trilobate symmetrical leaves of *Dombeyopsis lobata* described below. In contrast, the North American and Asiatic fossil populations differ in foliage to the *Plafkeria* – type (Kvaček et al. 2005). *Craigia bronnii* is closely related to the extant relict of *C. yunnanensis* W.W. SM. et W.E. EVANS known from SE Asia (E Himalayas, Tonkin, S China).

**Material studied:** MMG, Sf. 2839, Sf. 2981, Sf. 3163, Sf. 3201, Sf. 3214, Sf. 3215, Sf. 3238, Sf. 3230, Sf. 3240, Sf. 3259, Sf. 3280, Sf. 3389, Sf. 3600:1:2, Sf. 3660, Sf. 3985, Sf. 5915:1:2, Sf. 5916 to Sf. 5944, Sf. 5945:1:2, Sf. 6427, Sf. 8206, Sf. 8318, orig. Mai 1963 figs 10, 11 (*Ptelea carpum bronnii*); KM III 1278 C a, b, one fruit s.n.

***Dombeyopsis* UNGER**

***Dombeyopsis lobata* UNGER**

Pl. 13, fig 1, pl. 24, figs 2–3

- 1850a *Dombeyopsis lobata* UNGER, p. 447 (Bílina, “Bilin”, Early Miocene).  
 1870 *Ficus tiliacifolia* (*grandifolia*) AL. BRAUN; Engelhardt, p. 19, pl. 5, fig. 1.

1963 *Dicotyledonae* gen. et sp. indet.; Walther, p. 65, pl. 24, fig. 2.

1996 *Dombeyopsis dechenii* WEBER; Walther, p. 17.

**Description:** Leaves simple, incomplete, long petiolate, lamina trilobate, sub-circular, up to more than 200 mm across, base widely rounded to cordate, symmetrical, apices of lobes blunt, margin entire (? to fine dentate), venation palmate, 5–7 basal primaries radiate from the very base of lamina, lateral primaries giving off subparallel abmedial veinlets, secondaries widely spaced, particularly the first pair from the base, at an angle of ca. 60°, tertiaries in a spider-like pattern between the primaries and secondaries, almost perpendicular, mostly percurrent; cuticle delicate, adaxial epidermis compound of polygonal cells 12 to 34 µm across, anticlines straight to slightly curved, cells with fine epicuticular granulation, simple trichomes common, up to 68 µm long and about 8 µm wide, apex of trichomes attenuate; abaxial epidermis full of fungal hyphae, cell structures poorly visible, stomata anomocytic, narrow elliptic, large rounded compound bases of stellate trichomes common, smaller simple rounded bases of glandular trichomes rare.

**Remarks:** This large type of foliage morphologically matches rare records from Bechlejovice and Kundratice, where it also accompanies *Craigia* fruits. The poor preservation of the cuticles prevented us from assessing affinities to the Neogene records from Europe more accurately, which seem not to differ morphologically (see also Worobiec et al., in prep.).

**Material studied:** MMG, Sf. 21, prep. Sf. 225/71, Sf. 1672, Sf. 2652, Sf. 2654, Sf. 2674, Sf. 2731, Sf. 2737, Sf. 3540:1:2, Sf. 4314, Sf. 4342a, b, Sf. 4456, Sf. 5935, Sf. 5941, Sf. 6001:1:2:3:4, Sf. 6002, prep. Sf. 225/71, Sf. 7822, Sf. 7823:1:2, prep. Sf. 221 to 234/71, Sf. 8331, orig. Engelhardt 1870, pl. 5, fig. 1 (*Ficus tiliacifolia*); KM III, 286 (old No.).

***Dombeyopsis* sp.**

Pl. 13, fig 2, text-fig. 8

**Description:** Leaf simple, slightly asymmetrical, lamina more than 100 mm wide and ca. 140 mm long, base truncate, apex acuminate, margin entire, venation eucamptodromous to sub-actinodromous, midrib slightly curved, secondaries crowded at the leaf base, at first almost at right angle, higher secondaries under narrower angles to the midrib, widely spaced, alternate, in about 6 pairs, three lowest forked near the margin, giving off abmedial veinlets looping together, tertiaries percurrent, slightly oblique to the secondaries, interspaced with thinner sub-parallel intertertiaries and higher-order areolate veinlets.

**Remarks:** This leaf resembles some kind of *Dombeyopsis* foliage but differs in the basal sub-actinodromous – eucamptodromous venation. Similar truncate leaves with the acuminate apex but ordinary actinodromous venation are developed in the Miocene “*Ficus*” *truncata* sensu Bůžek (1971), recently interpreted as belonging to *Reevesia* (Kvaček 2006). Unlike most other recent species, *Reevesia clarkii* from Mexico also produces large leaves with sub-actinodromous venation. Therefore, we are inclined to

believe that the above described leaf may belong in fact to the seeds of the *Reevesia* – type described below as *Saportaspermum dieteri* sp. n. Unfortunately, no fruit remains are available to support our theory.

**Material studied:** MMG, Sf. 6000:1:2:3.



**Text-fig. 8.** *Dombeyopsis* sp., Sf. 6000:1:2, nat. size.

## **Hydrangeaceae DUMORTIER**

### ***Hydrangea* L.**

#### ***Hydrangea microcalyx* SIEBER**

Pl. 13, figs 7–8

- 1880 *Hydrangea microcalyx* SIEBER, p. 16, pro parte, only figs 26, 27, 31 (Kučlín, Late Eocene).  
 1870 *Caesalpinia micromera* HEER; Engelhardt, p. 23, pl. 5, fig. 17.  
 1963 *Hydrangea microcalyx* SIEBER; Mai, p. 77, pl. 10, figs 7–9, text-fig. 13.

**Description:** Enlarged quadrimerous petaloid calyces 17–31 mm across and separate sessile sepals, max. 12 mm long, broadly obovate to elliptical, margin entire, venation reticulate, camptodromous-brochidodromous, 3 stronger primaries and 2–3 pairs of secondaries running from the basal part, wavy, the midrib reaching almost to the apex, higher-order veins forming large elongate meshes.

**Remarks:** Flower remains of *Hydrangea* from Seifhenndorf match well the other records from the

Palaeogene of North Bohemia (e.g. Holý Kluk – Radoň et al. 2006) and are assigned to the same species (Mai 1963). So far the corresponding foliage has not been determined. According to Mai (1963) the flowers of East Asiatic *H. paniculata* SIEBOLD et ZUCC., *H. petiolaris* SIEBOLD et ZUCC. and North American *H. quercifolia* BARTR. are well comparable with the fossils.

**Material studied:** MMG, Sf. 3198, Sf. 7918, Sf. 8213, Sf. 8280, orig. Engelhardt 1870, pl. 5, fig. 17 (*Caesalpinia micromera*); KM III, 1275C, orig. Mai 1963, pl. 10, fig. 8 (*Hydrangea microcalyx*), one specimen s. n.

## **Rosaceae JUSS.**

### ***Rosa* L.**

#### ***Rosa lignitum* HEER**

Pl. 14, figs 3–7

- 1869 *Rosa lignitum* HEER, p. 99, pl. 30, fig. 33 (Chlapovo, “Rixhof”, Early Oligocene).  
 1870 *Myrsine celastroides* ETTINGSHAUSEN; Engelhardt, p. 22, pl. 5, fig. 12.

**Description:** Rarely complete imparipinnately compound leaves with two leaflet pairs, mostly isolated leaflets, ovate to longly ovate, rarely obovate, 10–40 mm long, 6–20 mm wide; apex slightly acuminate or acute forming a wide triangle, base rounded to widely cuneate, margin finely simple serrate to crenulate-serrate, teeth irregular, small, triangular to widely triangular, acute to blunt at the apex, sinuses sharp, up to 13 teeth on 10 mm, the very base of the leaflets sometimes entire; venation semi-craspedodromous, midrib strong straight, secondaries fine, almost alternate to subopposite, under narrow angles, in about 7–9 pairs, slightly bent, and near the margin fine loops with side veinlets directed into the teeth; higher-order venation fine areolate; one sample of a rare compound leaf shows the terminal leaflet long petiolulate, subcordate, 23 mm long and 15 mm wide, and the lateral leaflets which are slightly asymmetric, subsessile, the first leaflet pair 20 x 13 mm and 21 x 12 mm, the second 13 x 6 mm and 15 x 6 mm in size.

**Remarks:** These specimens correspond to isolated leaflets described by Walther (in Mai and Walther 1978) from the Haselbach flora and known from other Oligocene sites in Central Europe (e.g. Kvaček and Walther 1998).

**Material studied:** MMG, Sf. 140, Sf. 160, Sf. 905, Sf. 949, Sf. 1052, Sf. 1154, Sf. 2009, Sf. 2042a, Sf. 2078, Sf. 2225, Sf. 2258, Sf. 2278, Sf. 2336, Sf. 2362, Sf. 2365, Sf. 2367, Sf. 2371, Sf. 2380, Sf. 2384, Sf. 2429, Sf. 2744, Sf. 2752, Sf. 2757, Sf. 2770, Sf. 2779, Sf. 2780, Sf. 2783, Sf. 2785, Sf. 2787, Sf. 2795:1:2, Sf. 2797, Sf. 2798, Sf. 2800 (leaf with 5 leaflets), Sf. 2810, Sf. 2812, Sf. 2815, Sf. 2818, Sf. 2822, Sf. 2823, Sf. 2827, Sf. 2836, Sf. 3837, Sf. 2838, Sf. 2840, Sf. 2841, Sf. 2846, Sf. 2848, Sf. 2849, Sf. 2852, Sf. 2861, Sf. 2864, Sf. 2872, Sf. 2873, Sf. 2877, Sf. 2878, Sf. 2800, Sf. 2882, Sf. 2888, Sf. 2890, Sf. 2898, Sf. 2900, Sf. 2901, Sf. 2903, Sf. 2904, Sf. 2905, Sf. 2908, Sf. 2909, Sf. 2911:1:2, Sf. 2913, Sf. 2918, Sf. 2926, Sf. 2933, Sf. 2937, Sf. 2938, Sf. 2939, Sf. 2944, Sf. 2945, Sf.

2952:1:2, Sf. 2954, Sf. 2955, Sf. 2956, Sf. 2957, Sf. 2959, Sf. 2963, Sf. 2983, Sf. 2986, Sf. 3080, Sf. 3202, Sf. 3368, Sf. 3369, Sf. 3370, Sf. 3371, Sf. 3378, Sf. 3379, Sf. 3380, Sf. 3382, Sf. 3408:1:2, Sf. 3417:1:2, Sf. 3469, Sf. 3470, Sf. 3499, Sf. 3520, Sf. 3560, Sf. 3702:1:2, Sf. 3750, Sf. 3972, Sf. 3974, Sf. 4047, Sf. 4067, Sf. 4128, Sf. 4162, Sf. 4275, Sf. 4283, Sf. 4287, Sf. 4293, Sf. 4304, Sf. 4427, Sf. 4691, Sf. 4697, Sf. 5372, Sf. 5764, Sf. 6059, Sf. 6267, Sf. 6535:1:2, Sf. 6536:1:2, Sf. 6538 to Sf. 6557, Sf. 6559, Sf. 6561 to Sf. 6576, Sf. 6579 to Sf. 6586, Sf. 6588, Sf. 6589, Sf. 6590, Sf. 6593, Sf. 6595 to Sf. 6599, Sf. 7207, Sf. 7215, Sf. 7222, Sf. 7223, Sf. 7238, Sf. 7247, Sf. 7249, Sf. 7254, Sf. 7256, Sf. 7257, Sf. 7260, Sf. 7264, Sf. 7266, Sf. 8197, Sf. 8279, orig. Engelhardt 1870, p. 22, fig. 12 (*Myrsine celastroides*), Sf. 8566, Sf. 8633:1:2.

### ***Rosa saxonica* (ENGELHARDT)**

**KVAČEK et WALTHER comb. n.**

Pl. 14, figs 1–2

1870 *Diospyros saxonica* ENGELHARDT, p. 22, pl. 5, fig. 17 – basionym and holotype.

? 2004 *Rosa milosii* KVAČEK et WALTHER, p. 38, pl. 17, figs 4–8 (Bechlejovice, Early Oligocene).

**Description:** Obliquely compressed fruit – hip on an unarmed stalk, preserved sepals max. 20 mm long, entire, inside the hip numerous impressions of ovoid fruitlets ca. 3 mm long, slightly wrinkled longitudinally.

**Remarks:** This fruit remain belongs undoubtedly to the co-occurring foliage described above. The poor preservation prevents us from comparing it more precisely to the abundant record of roses at Bechlejovice, described as *Rosa milosii* (Kvaček and Walther 2004), which differs by the partly toothed sepals and thorny stalks of the hips.

**Material studied:** MMG, Sf. 8283, orig. Engelhardt 1870, pl. 5, fig. 11 (*Diospyros saxonica*) – holotype.

### **cf. *Crataegus* L.**

### **cf. *Crataegus* sp.**

Pl. 15, fig. 1

**Description:** Leaf fragment of upper part of lamina, 15 mm wide, incomplete length 19 mm, lamina pinately dissected, margin lobed (5 lobes preserved), fine double serrate, teeth widely spaced, solitary, secondary teeth present on the base of the abmedial side of the main tooth, venation craspedrodromous, midrib slightly bent at the end, secondaries alternate, straight, in two to three pairs preserved, ending in the lobe, on both sides sending very fine tertiaries, which partly loop (camptodromous) or end in the primary teeth, 2–3 intersecondaries partly forming narrow loops at the sinus and sending a veinlet into the lobe and another veinlet into the sinus; higher-order venation visible as fine polygonal network.

**Remarks:** Due to incomplete preservation the identification is only tentative. More complete leaf impressions

have been known from Bechlejovice (Kvaček and Walther 2004, as *Crataegus pirskenbergensis* KNOBLOCH).

**Material studied:** MMG, Sf. 3287.

### ***Prunus* L.**

### ***Prunus langsdorfii* KIRCHHEIMER**

Pl. 15, figs 2–4

1935 *Prunus langsdorfii* KIRCHHEIMER, pp. 717, 721, fig. 9 (Salzhausen, Middle Miocene).

1963 *Prunus langsdorfii* KIRCHHEIMER; Mai, p. 76, pl. 10, fig. 4, text-fig. 12.

**Description:** Endocarps 10 mm long and 7 mm wide, ovoid, funicular canal seen on the counterimpression bent from the middle of the locule, the dehiscence scar without ornamentation, surface smooth, the wall ca. 500 µm thick, coalified, in cross section the inner layer compound of tangential elongate sclereids, the outer much thicker layer showing rounded, strongly pitted sclereids, pitting poorly observable (Mai 1963, pp. 76–77).

**Remarks:** According to Mai (1963), the anatomical structure of the fossils corresponds to the Prunoideae. Besides the Neogene sites (Salzhausen, Wiesa), specimens of *Prunus langsdorfii* similar to those from Seifhennersdorf were also recovered in the Oligocene of the České středohoří Mountains (Bůžek, Holý and Kvaček 1976, Markvartice).

**Material studied:** MMG, Sf. 8245, orig. Mai 1963, pl. 10, figs 4a, b, c (*Prunus langsdorfii*), Sf. 8236.

### **? Rosaceae JUSS.**

### ***Dicotyphyllum* SAPORTA**

### ***Dicotyphyllum ungeri* (ENGELHARDT)**

**KVAČEK et WALTHER comb. n.**

Pl. 15, figs 5–7

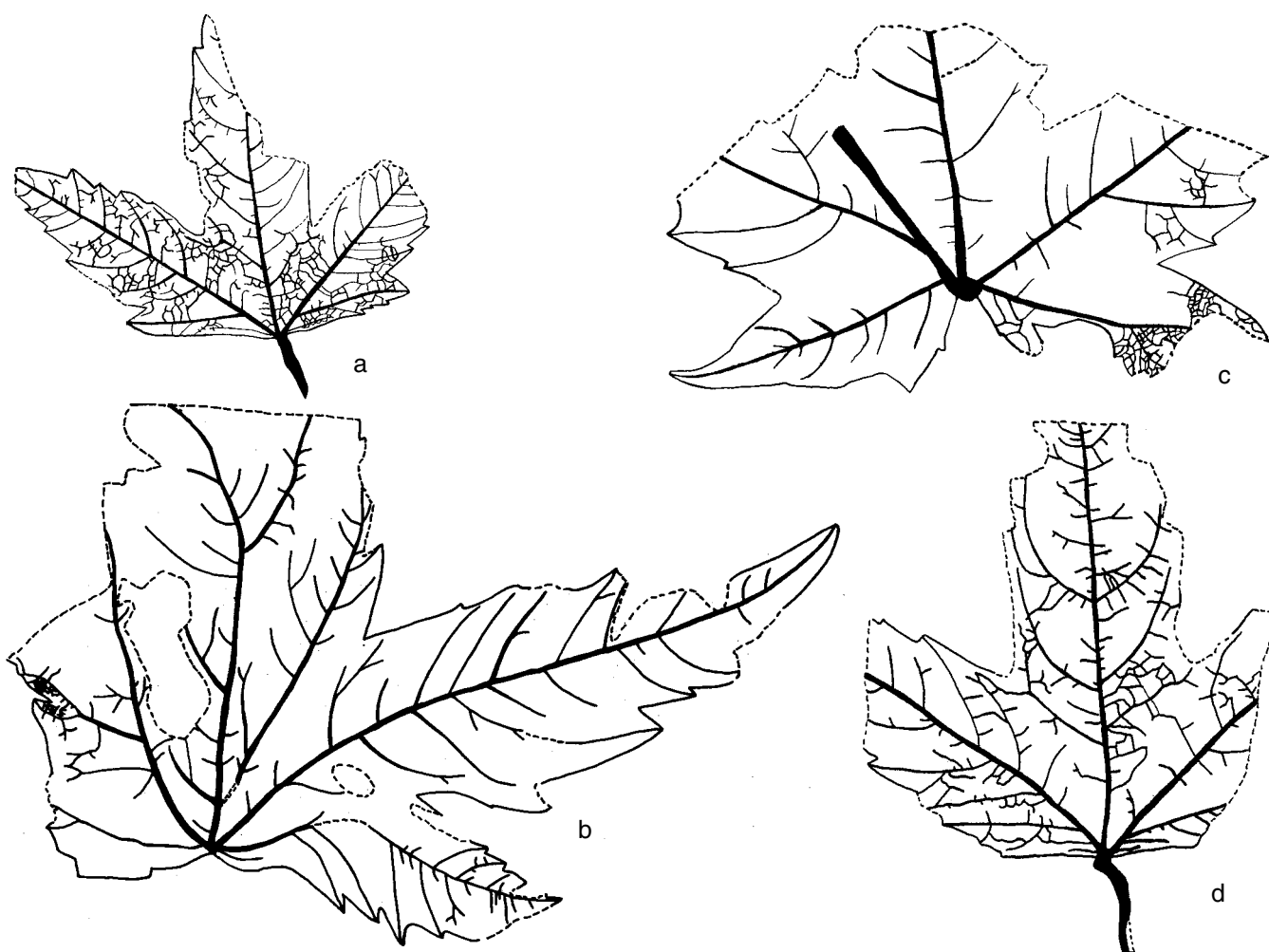
1870 *Celastrus ungeri* ENGELHARDT, p. 26, pl. 6, fig. 13 left (lectotype) and right (paratype) – basionym.

**Lectotype selected here:** MMG, Sf. 8286a (orig. Engelhardt 1870, pl. 6, fig. 13 left) – pl. 15, fig. 5.

**Description:** Leaves fragmentary, lamina probably lanceolate, preserved length 30–37 mm (probably ca. 60 mm long), 14–16 mm wide, base missing, apex narrow acute, margin densely and finely crenulate, 4 teeth per cm, tip rounded, sinus narrow acute, venation indistinct, ? semicraspedodromous, midrib straight, medium thick, secondaries under medium narrow angles, straight, only rarely visible in the apex region.

**Remarks:** The crenulate margin resembles the leaves of *Dicotyphyllum heerii* (ENGELHARDT) KVAČEK et WALTHER from Kundratice (Kvaček and Walther 1998), which differs in the bluntly acute apex. We separate both entities, although the very incomplete record from Seifhennersdorf would have the priority if both species are merged. The relationships still remains ambiguous. Similar crenulate leaves can be found but rarely among the Rosaceae (e.g. *Prunus simonii* CARR., northern China).





Text-fig. 9. a – *Acer angustilobum* HEER, Sf. 4404, nat. size; b – *Acer* cf. *dasycarpoides* HEER, Sf. 4599, nat. size; c – *Acer* cf. *dasycarpoides* HEER, Sf. 8247, nat. size; d – *Acer* cf. *tricuspidatum* BRONN, Sf. 3015:2, nat. size.

Material studied: MMG, Sf. 8286a, orig. Engelhardt 1870, pl. 6, fig. 13 left (lectotype), 8286b, orig. Engelhardt 1870, pl. 6, fig. 13 right (*Celastrus ungeri*).

## Sapindaceae JUSS. s.l.

### *Acer* L.

#### *Acer angustilobum* HEER sensu HANTKE

Pl. 15, figs 9–10, text-fig. 9a

- 1859 *Acer angustilobum* HEER, p. 57, pl. 117, fig. 25 a, pl. 118, figs 4–9 (Höhronen, St. Gallen, Wangen etc., Early Miocene).
- 1870 *Acer angustilobum* HEER; Engelhardt, p. 27, pl. 7, fig. 6.
- 1956 *Acer trilobatum* A. BRAUN; Walther, p. 88, fig. 2.
- 1963 *Acer angustilobum* HEER; Mai, p. 80, pro parte, only pl. 10, fig. 17 (leaf) (non figs 16–18, fruits).
- 1964 *Acer angustilobum* HEER; Walther, p. 54, pro parte, pl. 19, figs. 1, 4, 5, 6 (non figs 2, 3, 7, nec pl. 20).
- 1965 *Acer angustilobum* HEER; Hantke, p. 86, p. 15, fig. 3 (Höhronen, Early Miocene), figs 6, 7, 8, 10 (Wangen, Schrotzburg, Middle Miocene).
- 1972 *Acer angustilobum* HEER; Walther, pp. 41–49, pl. 4, figs 1–7, pl. 35, figs 1–5, pl. 36, figs 1–4.
- 1995 *Acer angustilobum* HEER; Walther, p. 17, text-fig. 3.3.
- 2002 *Acer angustilobum* HEER; Ströbitzer-Hermann, p. 17.
- 2004 *Acer angustilobum* HEER; Walther, p. 206, fig. 3/3.

**Description:** Leaves trilobate, rarely with small basal lobes 9 mm long, petiolate, petiole up to 40 mm long, leaf lobes slender, margin shallowly irregularly dentate, the medial lobe slightly narrowing towards the base, frequently with two characteristic blunt teeth, lamina 53 to 103 mm long, 52 to 130 mm wide (for more details of gross-morphology see Walther 1972, Procházka and Bůžek 1975, as *Acer dasycarpoides* f. *angustilobum*, Ströbitzer-Hermann 2002); adaxial cuticle thin, showing polygonal cells 15 to 37  $\mu$ m across with straight to curved anticlines, abaxial cuticle papillate showing domed polygonal cells with curved anticlines, smaller than the cells of the adaxial cuticle, stomata anomocytic, deeply sunken about 12.5  $\mu$ m long and 12.5 to 15  $\mu$ m wide, surrounded by small papillate cells, pore widely oval, pairs of guard cells partially covered by the papillae of adjacent cells.

**Remarks:** This species predominates among maples in the Early Oligocene flora of Seifhennersdorf and is connected with *A. palaeosaccharinum* described below by transitional morpho-types, like in Kundratice and Bechlejovice (Kvaček and Walther 1998, 2004). Therefore, it is not certain, whether all specimens, principally those with smaller leaves, in fact belong to this morpho-species. A definite solution would be possible if we know the differences between the gross-morphology and epidermal anat-

my of the Oligocene populations of *Acer palaeosaccharinum* and those from the higher Miocene (see remarks on *Acer palaeosaccharinum* below). The nearest living relatives can be found in members of the section *Spicata*, e. g. *A. heldreichii* ORPHANIDES ex BOISSIER, particularly in the structure of the abaxial cuticle. A search for an extant species that would fully match in gross-morphology was so far without any success (see Walther 1972).

**Material studied:** MMG, Sf. 1, orig. Walther 1972, pl. 4, fig. 6, sl. 35, fig. 2, Sf. 3, orig. Walther 1972, pl. 4, fig. 1, pl. 35, fig. 1, pl. 36, figs 1–4, Sf. 6:a:b, Sf. 10, orig. Walther, 1972, pl. 4, fig. 6, pl. 35, fig. 2, Sf. 25:a:b, Sf. 26, orig. Walther 1972, pl. 4, fig. 7, pl. 35, fig. 4, Sf. 35, orig. Walther 1964, pl. 19, fig. 3, orig. Walther 1972, pl. 4, fig. 2, Sf. 58, Sf. 59, Sf. 61, orig. Walther 1964, pl. 19, fig. 1, orig. Walther 1972, pl. 4, fig. 1, pl. 35, fig. 5, Sf. 68, Sf. 69, Sf. 71, orig. Walther 1972, pl. 4, fig. 4, pl. 35, fig. 3, Sf. 73, orig. Walther 1964, pl. 20, fig. 4, orig. Walther 1972, pl. 4, fig. 73, Sf. 80, Sf. 845, Sf. 953, Sf. 1680, Sf. 2991, Sf. 2994, Sf. 2995, Sf. 2996, Sf. 2998:1:2, Sf. 3002, Sf. 3005:1:2, Sf. 3006, Sf. 3007, Sf. 3008, Sf. 3011, Sf. 3014, Sf. 3026, Sf. 3030, Sf. 3031:1:2, Sf. 3034:1:2, Sf. 3038, Sf. 3039, Sf. 3040, Sf. 3041:1:2, Sf. 3045:1:2, Sf. 3047:1:2, Sf. 3052, Sf. 3053, Sf. 3056, Sf. 3505, Sf. 3524, Sf. 3714:1:2, Sf. 3746:1:2, Sf. 3755:1:2, Sf. 3766, Sf. 3768, Sf. 4050:1:2, Sf. 4072, Sf. 4120, Sf. 4132, Sf. 4189:1:2, Sf. 4203, Sf. 4225, Sf. 4404, Sf. 4418, Sf. 4461, Sf. 4514, Sf. 4468, Sf. 4478, Sf. 4480:1:2, Sf. 4484, Sf. 4487, Sf. 4492, Sf. 4495, Sf. 4497, Sf. 4503, Sf. 4504, Sf. 4511:1:2, Sf. 4514, (A. cf. *angustilobum*), Sf. 4518, Sf. 4519, (A. cf. *angustilobum*), Sf. 4522, Sf. 4523, orig. Walther 1972, pl. 15, fig. 1, pl. 41, fig. 3, Sf. 4532, Sf. 4536, Sf. 4538, Sf. 4559, Sf. 4561, Sf. 4564, Sf. 4565, Sf. 4566, Sf. 4567, Sf. 4571, Sf. 4572, Sf. 4673, Sf. 4574, Sf. 4675, Sf. 4578, Sf. 4679, Sf. 4581, Sf. 4582:1:2, Sf. 4584, Sf. 4585, Sf. 4586, Sf. 4589, Sf. 4595, Sf. 4598, Sf. 4600, Sf. 4601, Sf. 4602, Sf. 4603, Sf. 4606, Sf. 4611:1:2, Sf. 4612, Sf. 4613, Sf. 4624, Sf. 4627, Sf. 4628, Sf. 4630, Sf. 4635, Sf. 4641, Sf. 4646, Sf. 4647, Sf. 4656, Sf. 4660, Sf. 4662, Sf. 7833:1:2, Sf. 8138:1:2, Sf. 8140 to Sf. 8143, Sf. 8162, Sf. 8164, Sf. 8165, Sf. 8168 to Sf. 8174, Sf. 8183, Sf. 8184, Sf. 8194, Sf. 8203, Sf. 8350:1:2, Sf. 8351, Sf. 8352, Sf. 8353, Sf. 8358, Sf. 8359, Sf. 8360, Sf. 8361, Sf. 8364, Sf. 8365, Sf. 8384, Sf. 8417, Sf. 8419, Sf. 8597, Sf. 8658, Sf. 8661:1:2, Sf. 8662:1:2; KM III, 2 leaf fragments s. n.

### *Acer cf. dasycarpoides* HEER sensu HANTKE

Text—figs 9b, c

- ? 1859 *Acer dasycarpoides* HEER, p. 198, pro parte, only pl. 155, fig. 8 – lectotype selected by Hantke (1965) (Greit at Höhrnen, Late Oligocene).
  - ? 1965 *Acer dasycarpoides* HEER sensu HANTKE; Hantke, p. 66, pl. 5, figs 9, 10, pl. 14, figs 2–5, 7 (Greit at Höhrnen, Late Oligocene).
  - 1963 *Acer dasycarpoides* HEER; Mai, p. 80, pl. 11, fig. 1.
  - ? 2002 *Acer dasycarpoides* HEER sensu HANTKE; Ströbitzer-Herman, p. 18, pl. 2, figs 4–6, 10, 11 (non figs 8, 9, 12) (only Greit at Höhrnen, Late Oligocene).
- Further synonyms see Ströbitzer-Herman (2002, p. 18).

**Description:** Fragments of large palmate, five-lobed, petiolate leaves, petiole 30 mm preserved, both basal lobes up to 22 mm long, narrowed on the sides or base, base of lamina cordate.

**Remarks:** Up to now only seven specimens in the extremely rich leaf flora of Seifhennersdorf are available. Two of them are anomalously large leaves and demonstrate a wide gross-morphological variation in the leaves. Such a leaf architecture is known in extreme large leaves of *A. saccharinum* L., particularly on regenerating juvenile shoots coming from the base of stems or dead stumps of trees growing in floodplains (Sigafos 1964, Gastaldo et al. 1996). Hantke (1965) interpreted sharply toothed leaves as the Aquitanian (Early Miocene) forms of “*Acer trilobatum*” (= *Acer tricuspidatum* BRONN). Ströbitzer-Herman (2002, p. 18) was able for the first time to prepare the adaxial and abaxial cuticles from the type material of *A. dasycarpoides* from Greit/Höhrnen. But these are poorly preserved and not convincing enough to separate this *Acer* species from the other. The pattern can be compared perhaps with the cuticles of *Acer tricuspidatum* BRONN sensu WALTHER (1972). The cuticles from similar leaf fragments from Kleinsaubernitz described as *A. haselbachense* (Walther 1999, pl. 16, figs. 1, 3,) and *A. cf. tricuspidatum* (Walther 1999, pl. 16, figs 6–7, text-figs 12/1, 3) need further discussion. The question, if *A. dasycarpoides* is a real morpho-species or belongs to an anomalous foliage form of the *A. tricuspidatum* group, will be solved in a future study (see Kvaček and Walther 2004). Many authors compare *A. dasycarpoides* with the living North American maple *Acer saccharinum* L. (e.g. Heer 1859, Mai 1963, Hantke 1965, Ströbitzer-Hermann 2002).

**Material studied:** MMG, Sf. 3028:1:2, Sf. 3693:1:2, Sf. 4071, Sf. 4118, Sf. 4121, Sf. 4599, Sf. 7641, Sf. 8247.

### *Acer engelhardtii* WALTHER

Pl. 15, fig. 8, pl. 24, figs 4–5

- 1964 *Acer angustilobum* HEER; Walther, p. 54, pro parte, pl. 19, figs 2, 6 (non figs 1, 3–5, 7).
- 1972 *Acer engelhardtii* WALTHER, p. 37, pl. 6, figs 6–8, 11, pl. 37, figs 1, 3, 5, 6–8 (pl. 37, figs 1, 7, 8 – holotype).
- 2000 *Acer engelhardtii* WALTHER; Walther, p. 100, text-fig. 3.
- 2002 *Acer engelhardtii* WALTHER; Ströbitzer-Hermann, p. 23 ex parte (only Seifhennersdorf, Early Oligocene).

**Description:** Leaves trilobate, lamina about 60 to 75 mm long and 35 to 45 mm wide, lobes ovate-lanceolate, medial lobe longer and wider in comparison to the lateral triangular lobes, base rounded to subcordate, margin irregularly toothed; adaxial cuticle thin, cells polygonal, 25 to 57 µm across, with nearly straight anticlines, sometimes with fine cuticle striation, unicellular trichome bases on veinlets and also in intercostals areas, abaxial cuticle showing cells covered by papillae, stomata irregularly distributed, surrounded by domed cell papillae (10 to 25 µm across), stomata reflected only as 7.5 to 10 µm long pores, rarely also as fragmentary guard cell pairs.

**Remarks:** This morpho-species resembles *A. angustilobum*, but the main differences are in the size and

form of the median lobe and also in the characteristics of the abaxial cuticle (Walther 1972, p. 35). Up to now it is impossible to compare this fossil maple with any living taxon. Therefore we share the opinion of Walther (1972) that this maple leaf species is an extinct *Acer*. Oterdoom (1994) also discussed this fossil maple of Walther (1972), but he probably misunderstood or confused it with *A. angustilobum*.

The comparison with members of a living section is difficult. It seems that *A. engelhardtii* represents an extinct maple from the section *Acer*, series *Acer* (van Geldern et al. 1994) with a more regional importance in the Lower Oligocene of Central Europe (Walther 1972, Ströbitzer-Hermann 2002).

**Material studied:** MMG, Sf. 33, Sf. 43, orig. Walther 1972, pl. 6, fig. 7 (syntype), Sf. 55a, b, Sf. 67, orig. Walther 1972, pl. 6, fig. 8, pl. 37, fig. 3 (syntype), Sf. 74, orig. Walther 1975, pl. 37, fig. 5 (syntype), Sf. 75, orig. Walther 1972, pl. 6, fig. 6, pl. 37, figs 1, 7–8 (holotype), Sf. 76 (*A. cf. engelhardtii*), Sf. 8371 (*A. cf. engelhardtii*).

### *Acer palaeosaccharinum* STUR s. l.

Pl. 15, fig. 11

- 1867 *Acer palaeosaccharinum* STUR, p. 177, pl. 5, fig. 8 (Tállya, Middle Miocene).  
 1952 *Acer palaeosaccharinum* STUR; Procházka, p. 24, pl. 5, fig. 2a (holotype of forma *subdasycaroides* PROCHÁZKA et BŮŽEK), pl. 6, fig. 1 (Bechlejovice, Early Oligocene).  
 1972 *Acer palaeosaccharinum* STUR; Walther, p. 97, pl. 19, figs 1–3 (Bechlejovice), figs 4–6 (Kundratice), pl. 20, figs 1–4 (Bechlejovice), fig. 5 (Kundratice), pl. 21, figs. 1–3 (Sulestice-Berand), figs 4–5 (Seifhennersdorf), figs 5, 6, 8, (Bechlejovice), fig. 9 (Kundratice) pl. 52, figs 1–4 (Kundratice), 2–3 (Sulestice-Berand), 5–7 (Bechlejovice), pl. 52, figs 1–4 (Kundratice), 2–3 (Sulestice-Berand), 5–7 (Bechlejovice), pl. 53 (Kundratice).  
 1975 *Acer palaeosaccharinum* STUR; Procházka and Bůžek, pp. 48, 51, pro parte, pl. 20, figs 1–6 (?), pl. 21, figs 1, 3–5, ?2, text-figs 16–17, 20 (Bechlejovice, Sulestice, Early Oligocene).  
 2002 *Acer palaeosaccharinum* STUR; Ströbitzer-Hermann, p. 41, pl. 4, figs 10, 15, 16 (Kundratice), figs 11, 14 (Bechlejovice), fig. 13 (Gérce, Pliocene), pl. 19, figs 1–3 (Gérce, Pliocene).  
 2004 *Acer palaeosaccharinum* STUR; Kvaček and Walther, p. 16, pl. 1, fig. 1, text-figs 4.8–11, 5.1–7, 13.23 (Bechlejovice).  
 For the full synonymy see Ströbitzer-Herman (2002, p. 18).

**Description:** Leaves tri- to quinquelobate, lamina about 55 mm long, 62 mm wide, coarsely and sharply dentate, medial lobe with two characteristic coarse teeth, lobe narrowing towards its base, base of lamina cordate, leaf size and form in general variable (see Walther 1972, Procházka and Bůžek 1975, Ströbitzer-Herman 2002, Kvaček and Walther 2004).

**Remarks:** The frequency of *Acer palaeosaccharinum* in the flora of Seifhennersdorf seems essential lower than in the volcanic floras of Bechlejovice, Sulestice-Berand and Kundratice (see Kvaček and Walther 1995, 1998, 2004).

The leaves of *Acer palaeosaccharinum* show similarity in gross-morphological architecture to *A. haselbachense*

WALTHER (1972), in particular with the record from Kleinsaubernitz (Walther 1999). Both taxa of maples are important members of the Oligocene lowland floras (*A. haselbachense*) and of the volcanic floras (*A. palaeosaccharinum*) of Central Europa (see Mai and Walther 1978, 1991, Kvaček and Walther 2001, 2004). The main difference is in the micro-morphological characteristics. While *A. palaeosaccharinum* shows smooth abaxial cuticle with non-papillate cells around anomocytic stomata, *A. haselbachense* exhibits a papillate leaf underside with distinctly domed cells around anomocytic stomata. Both species were interpreted as parallel in gross morphology to the type populations of *A. palaeosaccharinum*, originally known from the Miocene of Hungary (Stur 1867). Because the cuticle structure has not been obtained so far from the type locality, it is difficult to decide if the Miocene record belongs to the same taxon as leaves from the Oligocene volcanic floras. This problem again needs further detailed research work (e.g. Radoň et al. 2006).

**Material studied:** MMG, Sf. 66, orig. Walther 1972, pl. 21, fig. 7, Sf. 1223, Sf. 2999, Sf. 3001, Sf. 3004, Sf. 3009, Sf. 3018, Sf. 3019, Sf. 3048, Sf. 3688, Sf. 3710:1a:2a, Sf. 3867, Sf. 4023, Sf. 4117, Sf. 4124, Sf. 4145:1:2, Sf. 4472, Sf. 4474, Sf. 4475, Sf. 4477, Sf. 4481:1:2, Sf. 4512, Sf. 4542, Sf. 4608, Sf. 4619, Sf. 4623, Sf. 4633, Sf. 4645, Sf. 4659, Sf. 8366, ? Sf. 8367 (*Acer cf. palaeosaccharinum*), Sf. 8418; KM III, 1286C.

### *Acer pseudomonspessulanum* UNGER emend.

STRÖBITZER-HERMANN

Pl. 16, fig. 1

- 1847 *Acer pseudomonspessulanum* UNGER, p. 132, pl. 43, fig. 2 (non fig. 1) (Parschlug, Miocene).  
 1967 *Acer loclense* HANTKE; Walther, p. 266, pl. 5, figs 1–2, text-fig. 5.  
 1972 *Acer decipiens* AL. BRAUN *sensu novo*; Walther, p. 121, pl. 2, figs 5–9, pl. 54, figs 5–7 (Parschlug, Břešťany, Čermníky, Miocene).  
 1995 *Acer cf. decipiens* A. BRAUN; Kvaček and Walther, p. 29, pl. 10, fig. 2, text-fig. 4/15 (Sulestice-Berand, Oligocene).

**Description:** Leaves trilobate, petiolate, petiole preserved in length of up to 2 mm, lamina 26 to 40 mm long, 39 mm wide, middle lobe 10 to 25 mm long and 10 to 13 mm wide, lateral lobes slightly asymmetrical, 8 to 15 mm long, base subcordate, apices acute, tips rounded, entire-margined, margin slightly wavy, rarely one small tooth at the apex region on the margin of the middle lobes, angle between main lobe and lateral lobes 40°–78°, primaries strong, straight to slightly bent running into the tips of the lobes, secondaries camptodromous, forming right angles with the primaries, and directly on the margin looping up with the next secondary, between the secondaries a network of tertiaries and higher-order venation, texture thick to delicate (depending on the type of preservation); cuticles delicate, adaxial missing, abaxial cuticle only in small fragments preserved, ordinary cells polygonal, 12 to 17 µm across, anticlines straight to bent, strong, stomata anomocytic, poorly visible (Walther 1967).

**Remarks:** Only a few specimens from Seifhennersdorf according to their gross morphology belong to *Acer pseudomonspessulanum*. These small maple leaves are only accessory in the flora of Seifhennersdorf. The species seems to be a more xeromorphic maple that grew in the hilly region outside near-shore vegetation (Ströbitzer–Hermann 2002).

**Material studied:** MMG, Sf. 4490, Sf. 7471, Sf. 8347; KM, III 298.

### *Acer rueminianum* HEER sensu HANTKE

Pl. 16, figs 4–5

- 1859 *Acer rueminianum* HEER, p. 59, pl. 118, figs 11–12 – lectotype pl. 118, fig. 2 selected by Hantke (1965) (Monod, Late Oligocene).
- 1965 *Acer rueminianum* HEER; Hantke, p. 88, pl. 15, figs 1, 2 (Monod, Late Oligocene), 4 (Rinderwaidhorn, Late Oligocene), 5 (Wädenswil, Late Oligocene).
- 1972 *Acer rueminianum* HEER sensu HANTKE 1965; Walther, p. 132, pl. 28, figs 1–2, 4a, b, 5a, b, 6 (Seifhennersdorf, Early Oligocene), fig. 3 (Kundratice, Early Oligocene), pl. 57, figs 1–3, 5, 6 (Seifhennersdorf, Early Oligocene), figs 4, 7–9 (Kundratice, Early Oligocene).
- 1998 *Acer rueminianum* HEER sensu HANTKE 1965; Kvaček and Walther, p. 5, pl. 1, fig. 4 (Kundratice, Early Oligocene).
- 2000 *Acer rueminianum* HEER sensu HANTKE 1965; Walther, p. 102, pl. 8, figs 1–2, 4a, b, 5a, b, 6 (Seifhennersdorf, Early Oligocene), fig. 3 (Kundratice, Early Oligocene).
- 2002 *Acer rueminianum* HEER sensu HANTKE 1965; Ströbitzer–Hermann, p. 45, pl. 5, figs 7 (Rinderwaidhorn, Late Oligocene), 9 (Steinrütli, Late Oligocene).

**Description:** Leaves trilobate, petiolate, petiole up to 22 mm, lamina about 67 mm long and up to 110 mm wide, lobes nearly entire-margined, medial lobe sometimes only with very solitary small teeth, lateral lobes asymmetrically arranged to the median one, sinuse between lateral lobes 40°–65°; both leaf sides with very delicate cuticles, adaxial epidermis without distinguishing characteristics, cells isodiametric, 15.5 to 25 µm large, anticlines straight to curved, rare simple trichome bases, cuticle with thin striation; abaxial epidermis composed of same size and shape cells as the adaxial epidermis, stomata anomocytic, elliptic to rounded, 22.5 to 25 µm long and 17.5 to 25 µm wide.

**Remarks:** This morpho-species occurs only sporadically in Palaeogene floras of Europa (e.g. Walther 1972, Ströbitzer–Hermann 2002, Mai 1997). Hantke (1965) believed this species to be an ancestor of *A. angustilobum*. Walther (1972) disagreed with him after the results of cuticular analysis of both morpho-species. He considered this taxon as extinct during the Tertiary without any extant analogon, while De Jong (1976) found similarity with *A. pilosum* MAXIM. [sect. *Pubescentia* (POJARKOVA) OGATA], a small tree distributed throughout western Asia and China. Up to now there is little information available about this taxon (van Gelderen et al. 1994).

**Material studied:** MMG, Sf. 1, orig. Walther 1972, pl. 28, fig. 1, pl. 57, fig. 1, Sf. 5:a:b, orig. Walther 1972, pl. 28, fig. 4, pl. 57, figs 5–6, Sf. 9a:b, Sf. 22a:b, prep.

Sf. 1 to 5/67, 8/67 and 45/67, Sf. 64, Sf. 358, Sf. 1249, Sf. 3017, Sf. 3044, Sf. 4164, Sf. 4339, Sf. 4341, Sf. 4514, Sf. 4525, Sf. 4540, Sf. 4587, Sf. 4588, Sf. 4610, Sf. 4622, Sf. 4636, Sf. 4663, Sf. 4665:1:2, Sf. 4676, Sf. 4677, Sf. 8163 (*Acer* cf. *rueminianum*), Sf. 8355, orig. Walther 1972, pl. 28, fig. 2, Sf. 8356, Sf. 8660; KM III, 3 leaf fragments s. n.

### *Acer* cf. *tricuspidatum* BRONN

Pl. 16, figs 2–3, text-fig. 9d

- 1823 *Phyllites trilobatus* STERNBERG, p. 37, pl. 50, fig. 2 (Žichov, “Schichow”, Oligocene).
- ? 1838 *Acer tricuspidatum* BRONN, p. 865, pl. 35, figs 10a, b – missing holotype (Salzhausen, Middle Miocene).
- ? 1845 *Acer trilobatum* AL. BRAUN, p. 172 (Öhningen, Middle Miocene).
- ? 1855 *Acer tricuspidatum* AL. BRAUN; Heer, p. 14, pl. 2, fig. 3 (Öhningen, Middle Miocene).
- 1870 *Acer trilobatum* AL. BRAUN; Engelhardt, p. 28, pl. 8, figs 1–2.
- 1963 *Acer trilobatum* (STERNBERG) AL. BRAUN; Mai, p. 79, pl. 11, fig. 2.
- 1964 *Acer trilobatum* (STERNBERG) AL. BRAUN; Walther, p. 59, pl. 21, pl. 22, figs 1–6, pl. 23, figs 2, 5, 8.
- ? 1968 *Acer tricuspidatum* BRONN; Walther, p. 363, pl. 2, fig. 1 – neotype (Salzhausen, Middle Miocene).
- 1972 *Acer tricuspidatum* BRONN; Walther, p. 78, pl. 15, figs 1–12, pl. 45, figs 2–10.
- 1996 *Acer tricuspidatum* BRONN; Walther, p. 14, fig. 3/28. For full synonymy see Walther (1972), Ströbitzer–Hermann (2002).

**Description:** Leaves trilobate, petiolate, petiole up to 23 mm, lamina about 25 to 80 mm long and 15 to 71 mm wide, base cuneate to rounded, rarely subcordate, lobes triangular, central lobe distinctly longer and wider than the lateral ones; apex of central lobe acute to acuminate, apices of lateral lobes acute, very slightly rounded at the tip, margin irregularly coarsely serrate to fine serrate, teeth of uneven size, more or less with acute apex; venation actinodromous, primary veins of lateral lobes under an acute angle with the primary vein of the main lobe, secondaries craspedodromous, alternate to opposite, departing from the primaries at acute angles, running straight to slightly curved to the marginal teeth; cuticle not preserved.

**Remarks:** According to the gross morphology, these specimens are of the same type of maple leaves published previously from volcanic floras of Central Europe, e.g. from Seifhennersdorf (Engelhardt 1870, Mai 1963, Walther 1964, 1972); Suleitice-Berand (Kvaček and Walther 1995), Kundratice (Kvaček and Walther 1998), Bechlejovice (Kvaček and Walther 2004), Holý Kluk Hill (Radoň et al. 2006). The variation in gross morphology of this morpho-species is very wide. Therefore, it is difficult to determine such leaves without cuticular structure and a misidentification with other fossil maple species is possible. This problem was repeatedly discussed without any practical answer (e.g. Walther 1972, Procházka and Bůžek 1975, Kvaček and Walther 2004, Radoň et al. 2006). The populations of Palaeogene *A. tricuspidatum* with cuticular structure preserved differ from the type specimen and other occurrences from the Miocene in the absence of trichomes

(see Walther 1972, Ströbitzer-Hermann 2002). The leaves from the volcanic floras seem to represent an independent taxon (subspecies ?). This idea can only be proved by a detailed study of better preserved material with a characteristic cuticular structure and is planned for the future.

**Material studied:** MMG, Sf. 8, Sf. 14, Sf. 16:1:2, orig. Walther 1972, pl. 41, fig. 6 (*Acer tricuspidatum*), Sf. 18, orig. Walther 1972, pl. 15, fig. 2, pl. 41, fig. 4 (*Acer tricuspidatum*), Sf. 21, orig. Walther 1972, pl. 15, fig. 5, pl. 41, fig. 9 (*Acer tricuspidatum*), Sf. 37a, b, Sf. 46, Sf. 48, Sf. 60, Sf. 1372:1:2, Sf. 3000, Sf. 3015:1:2, Sf. 3022, Sf. 3027:1:2, Sf. 3029, Sf. 3032, Sf. 3033, Sf. 3042, Sf. 3050, Sf. 3123, Sf. 3696:1:2, Sf. 3712:1:2, Sf. 3717:1:2, Sf. 3718:1:2, Sf. 3760:1:2, Sf. 3761, Sf. 3763, Sf. 4069, Sf. 4086, Sf. 4142, Sf. 4402, Sf. 4403, Sf. 4591, Sf. 4604, Sf. 4605, Sf. 4625 (impression) and Sf. 4626 (counter-compression), Sf. 4629, Sf. 4631, Sf. 4632, Sf. 4651, Sf. 4653, Sf. 8163, Sf. 8291, orig. Engelhardt 1870, pl. 8, fig. 2 (*Acer trilobatum*), Sf. 8344, Sf. 8368:1:2, Sf. 8369, Sf. 8370, Sf. 8653; KM III, 1285 C, 1287 C, one leaf fragment s. n.

### *Acer* spp. (fructus)

Pl. 15, figs 12–15

1963 *Acer angustilobum* HEER; Mai, p. 80, pro parte, pl. 10, fig. 14 (fruit only).

**Description:** Impressions and compressions of winged fruits, rarely composed of two one-sided mericarps, forming a wide angle, mostly only isolated mericarps preserved, 17 to 24 mm long, seed part heavily carbonized, rounded to wide ovate, 3 to 7 mm across, details of the nutlets (endocarps) fragmentarily preserved or not visible, attachment scar as well as both partial fruits at an angle of about 19 to 58° to the wing, attachment area between the seed part and the wing slightly to medium narrowed, wings elliptic to ovate, 12 to 24 mm long and 3.5 to 7 mm wide, the dorsal line straight, slightly to distinctly curved.

**Remarks:** By 1859, Heer had already reported on the difficulties of determining maple fruits. And paleobotanists who have studied fossil maples still agree with this statement, e.g. Walther (1964, 1972), Procházka (1952), Procházka and Bůžek (1975). Later, Mai (1974, 1983, 1984) found a new method using main characteristics of the endocarp of the winged fruits for a reliable determination of fruits from sandy, silty and clayish sediments (e.g., Mai 1995). Unfortunately, fossil fruits in diatomites from the volcanic localities lack such endocarp details. De Jong (1976), van Gelderen et al. (1994) discussed the problems and difficulties in determination of living maple fructifications as well. Tanai (1983), Wolfe and Tanai (1987) also knew this problem and used a special morphological analysis for the winged fruits. We are nevertheless at the moment unable to determine with certainty the maple fruits from Seifhennersdorf, and for this reason we use the open nomenclature (see also Kvaček and Walther 2004). Further studies are planned by the authors in this respect.

**Material studied:** MMG, Sf. 44, orig. Walther 1964, pl. 20, fig. 4 (*Acer angustilobum*), Sf. 47, orig. Walther 1964, pl. 20, fig. 3 (*Acer angustilobum*), Sf.

53, orig. Walther 1964, pl. 20, fig. 2 (*Acer angustilobum*), Sf. 63, orig. Walther 1964, pl. 20, fig. 5, Sf. 73, orig. Walther 1964, pl. 20, fig. 4 (*Acer angustilobum*), Sf. 2065, Sf. 3012, Sf. 3176, Sf. 3179, Sf. 3200, Sf. 3223, Sf. 3227, Sf. 3228, Sf. 3246, Sf. 3251, Sf. 3253, Sf. 3260, Sf. 3262, Sf. 3264, Sf. 3286, Sf. 3531, Sf. 3534, Sf. 3708, Sf. 4337, Sf. 4396, Sf. 4397, Sf. 4411, Sf. 4412, Sf. 4415, Sf. 4486, Sf. 4489, Sf. 4493, Sf. 4516, Sf. 4517, Sf. 4520, Sf. 4521, 4527, Sf. 4524, Sf. 4526, Sf. 4528, Sf. 4529, Sf. 4530, Sf. 4535, Sf. 4536, Sf. 4537, Sf. 4541:1:2, Sf. 4544 to Sf. 4556, Sf. 4558, Sf. 4569, Sf. 4575, Sf. 4590, Sf. 4616, Sf. 4617, Sf. 4620, Sf. 4621, Sf. 4648, Sf. 4666, Sf. 4667, Sf. 4668, Sf. 4790, Sf. 5031, Sf. 7916, Sf. 7917, Sf. 7922, Sf. 8179, Sf. 8196, Sf. 8251, orig. Mai 1963, pl. 10, fig. 14 (*Acer angustilobum*), Sf. 8262, Sf. 8296, Sf. 8313, Sf. 8326, orig. Walther 1964, pl. 23, fig. 1 (*Acer trilobatum*), Sf. 8330, orig. Walther 1964, pl. 20, fig. 6 (*Acer angustilobum*); Sf. 8333, orig. Walther 1964, pl. 23, fig. 3 (*Acer trilobatum*), Sf. 8339, Sf. 8396, Sf. 8400:1:2, Sf. 8401:1:2, Sf. 8402:1:2, Sf. 8403:1:2, Sf. 8405, Sf. 8420, Sf. 8561, Sf. 8562, Sf. 8643; KMS III, 1239 C, 1284 C, 1290 C, one specimen s. n.

### Nyssaceae JUSS.

#### *Nyssa* GRONOV. ex L.

#### *Nyssa altenburgensis* WALTHER et KVAČEK

Pl. 17, figs 2–4, pl. 24, figs 6–7

1870 *Lomatia pseudoilex* UNGER; Engelhardt, p. 21, pl. 5, fig. 5.  
1870 *Quercus gmelini* A. BRAUN; Engelhardt, p. 18, pl. 4, fig. 7.  
1981 *Nyssa altenburgensis* WALTHER et KVAČEK in Kvaček and Walther, p. 78, pl. 1, figs 1–4, pl. 2, figs 1–5, pl. 3, figs 1–2 (cf.), text-figs 1–2 (Haselbach, Seifhennersdorf, Early Oligocene).

**Description:** Leaves simple, short petiolate, lamina lanceolate to slender obovate, 80 to 130 mm long and 25 to 45 mm wide, apex bluntly acuminate, base narrow cuneate, margin coarsely simple toothed, teeth irregularly distributed, sharp, triangular, one to several on either leaf margin, sinuses rounded, venation craspedodromous and camptodromous, midrib thick, almost straight, secondaries partly forked, in up to 10 pairs, sub-opposite to alternate, at an angle of 30°–40°, irregularly spaced, alternating with about 3 intersecondaries, higher-order venation not visible, texture medium thick; cuticles preserved in fragments, adaxial missing, abaxial cuticle with ordinary cells hardly visible, anticlines slightly bent, stomata narrow oval, stomatal ledges heavily cutinized, irregular in size, 16–40 µm long, 16–20 µm wide, trichome bases frequent, rounded, heavily cutinized, 8 µm across.

**Remarks:** The leaves have been recognized as belonging to *Nyssa* on account of epidermal features (spatulate glandular trichomes) preserved on the material from Haselbach (Walther in Mai and Walther 1978, Kvaček and Walther 1981). The newly obtained cuticles and also the co-occurrence of *Nyssa* endocarps corroborate that also the material from Seifhennersdorf can safely be assigned to the same species.

**Material studied:** MMG, Sf. 4146 (*Nyssa* cf. *altenburgensis*), Sf. 4445, prep. Sf. 14 to 76/93, Sf. 6389, Sf. 6395, Sf. 6396 (*Nyssa* cf. *altenburgensis*), Sf. 6398 (*Nyssa* cf. *altenburgensis*), Sf. 6399, orig. Kvaček and Walther 1981, pl. 3, fig. 1 and counterimpression, Sf. 8233:1:2, Sf. 8269, orig. Engelhardt 1870, pl. 4, fig. 7 (*Quercus gmelini*), Sf. 8278, orig. Engelhardt 1870, pl. 5, fig. 5 (*Lomatia pseudoilex*).

### ***Nyssa disseminata* (LUDWIG) KIRCHHEIMER**

Pl. 17, fig. 1

- 1857 *Pinus disseminata* LUDWIG, p. 89, pl. 20, figs a–g (Dorheim, Pliocene).  
 1937 *Nyssa disseminata* (LUDWIG) KIRCHHEIMER, p. 916 (Dorheim, Pliocene).  
 1963 *Nyssa disseminata* (LUDWIG) KIRCHHEIMER; Mai, p. 82, pl. 12, figs 1–3.

**Description:** Endocarps strongly compressed, 1.2 mm wide and 1.7 mm long, ovoid, acuminate at apex, angular, longitudinally striated. Germination valve not observed. A fine inner structure seen on the cross section matching that of the *Nyssa* fruits from the Miocene (Mai 1963, p. 82).

**Remarks:** According to Mai (1963), the above described endocarps match best those of extant *Nyssa sylvatica* MARSH. from the Atlantic part of the U.S.A.

**Material studied:** MMG, Sf. 3307, orig. Mai 1963, pl. 12, fig. 2, Sf. 4408, Sf. 5494.

## **Simaroubaceae DC.**

### ***Ailanthus* DESF.**

#### ***Ailanthus prescheri* WALTHER**

Pl. 17, figs 5–7

- 1870 *Cupania neptuni* UNGER; Engelhardt 1870, p. 25, pl. 7, fig. 1.  
 1964 *Myrica lignitum* UNGER; Walther, p. 37, pro parte, pl. 12, figs 4–6.  
 1999 *Ailanthus prescheri* WALTHER, p. 125, pl. 15, figs 1–4, text-fig. 10.1, 16.40 (Kleinsaubernitz, Late Oligocene).  
 2004 *Ailanthus prescheri* WALTHER; Kvaček and Walther, p. 18, pl. 2, figs 1–2 (Bechlejovice, Early Oligocene).

**Description:** Leaflets fragmentary, petiolulate, petiolule ca. 20 mm long, lamina oblong, 140 mm long (preserved length), 18 to 80 mm wide, base slightly asymmetrical, rounded to truncate, apex acuminate, margin with widely spaced simple sharp teeth, sinuses rounded, venation semicraspedodromous, midrib straight, thick, secondaries densely spaced, under wide angles of about 60°, in more than 10 pairs, straight, forked, looping near the margin and sending abmedial veinlets near the sinus into the teeth, higher-order venation not preserved.

**Remarks:** This morpho-species is an important accessory element in most volcanic floras of Central Europe, mainly in the zonal vegetation. It was variously named, e.g., *Myrica lignitum* (Knobloch 1961, p. 256, pro

parte, pl. 3, fig. 1 – Knížecí, Hrazený Hill /Pirskenberg), *Ailanthus* sp. (Kvaček and Walther 1998, p. 6, pl. 4, fig. 4, text-fig. 13/28, Kunderatice). According to the characters of the gross-morphology only, misidentifications with leaves of *Oleinites hallbaueri* (MAI) SACHSE are possible. *Ailanthus* foliage from the Miocene (Hably 2001, Kovar-Eder et al. 2004) differs in less coarsely toothed margin and strongly asymmetric leaflets.

**Material studied:** MMG, Sf. 8, orig. Walther 1964, pl. 12, fig. 4 (*Myrica lignitum*), Sf. 968, Sf. 1341, Sf. 1415, Sf. 2244, Sf. 2265, Sf. 2286, Sf. 2302, Sf. 2304, Sf. 2308, Sf. 2519, Sf. 6232, Sf. 6519, Sf. 6520, Sf. 6523, Sf. 6524, Sf. 6525, Sf. 6526, Sf. 6528, Sf. 6529, Sf. 6533, Sf. 8287, orig. Engelhardt 1870, pl. 7, fig. 1 (*Cupania neptuni*), Sf. 8407, orig. Walther 1964, pl. 12, fig. 6 (*Myrica lignitum*).

## **Oleaceae HOFFM. et LINK**

### ***Oleinites* COOKSON**

#### ***Oleinites hallbaueri* (MAI) SACHSE**

Pl. 17, figs 8–9, pl. 24, figs 8–9

- 1963 *Myrica hallbaueri* MAI, p. 46, pl. 2, figs 4–6, text-figs 3a, 3c – holotype.  
 1976 *Myrica hallbaueri* MAI; Bůžek, Holý and Kvaček, p. 114, text-fig. 11.  
 2001 *Oleinites hallbaueri* (MAI) SACHSE, p. 319, pl. 2, figs 8–9.

**Description:** Leaf incomplete, short petiolate, lamina elongate, ca. 30 mm wide, length not preserved, base truncate to cuneate, strongly asymmetrical, apex not preserved, margin simple dentate, teeth coarse, sharp, abmedially patent, sinus either sharp or rounded, texture thin, venation craspedodromous to semicraspedodromous, midrib strong, straight, secondaries at a wide angle somewhat sinuous, sometimes forked, looping well within the margin or partly entering the teeth, intersecondaries occasional, tertiaries reticulate; adaxial cuticle smooth, reflecting polyedric isometric to elongate cells ca. 16–40 µm across, solitary simple trichome bases rounded, rare; abaxial cuticle finely striate, cells polygonal, 16–36 µm across, with straight to wavy anticlines; stomata irregularly distributed, ovate to narrow ovate, type not always distinctly recognizable, mostly anomocytic, 11–20 µm wide and 16–28 µm long, pore small, ovate, inner sides of guard cells heavily cutinised, lateral sides of guard cells covered by fine cutin striations, trichomes peltate, fairly frequent, ca. 40–50 µm across, heads rarely preserved, basal cell rounded, ca. 12–20 µm across, with a double outline, inner pore 4–6 µm across, head radially divided into 10 triangular or narrow triangular or polygonal, radially disposed segments.

**Remarks:** Bůžek et al. (1976, text-fig. 11) reproduced again the peltate trichome from the type slide No. 121a ascribed to *Myrica hallbaueri*, which has the simple-celled base, not bicellular (myrocoid), as Mai (1963) stated in the original description. They assigned similar leaves from Markvartice and other sites in the České středohoří Mountains to *Myrica hakeaefolia* following Engelhardt (1876, 1885) and noted similarities between *Myrica hall-*

*baueri* to leaflets of *Ailanthus*. Sachse (2001) found the same type of trichomes particularly among various Oleaceae. The holotype of *Myrica hallbaueri* (MMG, Sf. 3294) is covered by varnish and new preparations of cuticle failed so that it cannot be verified for certain that the described cuticle structure really originates from this leaf. Otherwise, *Myrica hallbaueri* is in gross morphology indistinguishable from *Ailanthus prescheri*. The other specimens identified by Mai (in sched.) as *Myrica hallbaueri* belong partly to *Nyssa altenburgensis*, or in the cases of entire-margined coriaceous leaves described below, to *Oleinites maii*. The entity in the original sense of Mai (1963) is obviously heterogeneous.

**Material studied:** MMG, Sf. 3294 (old No. 121), holotype, orig. Mai 1963, pl. 2, fig. 4 (*Myrica hallbaueri*), prep. Sf. 121a.

***Oleinites maii* (BŮŽEK, HOLÝ et KVAČEK) SACHSE**

Pl. 17, fig. 10, pl. 24, figs 10–11

1976 *Dicotylophyllum maii* BŮŽEK, HOLÝ et KVAČEK, p. 111, pl. 13, figs 1–5, pl. 22, figs 1–6 (Markvartice, Oligocene).

2001 *Oleinites maii* (BŮŽEK, HOLÝ et KVAČEK) SACHSE, p. 221 (Markvartice, Oligocene).

**Description:** Leaves fragmentary, entire-margined, lamina elliptic, the preserved fragment 43 mm long and 18 mm wide, venation brochidodromous, midrib thick, straight, secondaries regularly widely spaced, at an angle of 45° to 50°, texture coriaceous; adaxial cuticle delicate, cells 16–40 µm across, anticlines straight, wavy to shallow undulate, abaxial cuticle partly with fine striation, cells in size and shape like those of adaxial leaf side, stomata irregularly distributed, type not distinctly recognizable, mostly anomocytic, 16–20 µm wide and 20–36 µm, pore narrow ovate, inner sides of guard cells heavily cutinized, peltate trichomes with disk-shaped heads, mostly fragmentary, ca. 40 to 60 µm across, basal cell simple, rounded, ca. 12–20 µm across, with double outline, the inner pore 4–6 µm across, details of head only indistinctly visible.

**Remarks:** The present specimens were originally assigned by Mai (1963) to *Myrica hallbaueri*, but, as noted above, they deviate decidedly in gross morphology from the type specimen of this species and match perfectly the abundant material from Markvartice described as *Dicotylophyllum maii* by Bůžek, Holý and Kvaček (1976). Sachse (2001) recognized the affinity to Oleaceae according to the characteristic peltate trichomes and stressed the similarity to extant genera, e.g. *Chionanthus*, *Fraxinus* or *Osmanthus*.

**Material studied:** MMG, Sf. 3352 (old No. 148), prep. Sf. 148 a–c, Sf. 3354 (old No. 227).

**Araliaceae JUSS.**

***Schefflera* J. R. FORST. et G. FORST.**

***Schefflera dorofeevii* ŁAŃCUCKA-ŚRODONIOWA**

Pl. 18, fig. 1

1975 *Schefflera dorofeevii* ŁAŃCUCKA-ŚRODONIOWA, p. 107, pl. 1, figs 10–13 (Novy Sącz, Middle Miocene).

**Description:** Endocarp 3 mm long and 2 mm wide, obliquely ellipsoidal, rounded at the base and the apex, dorsally concave, ventrally straight, walls thin, smooth on the surface.

**Remarks:** This single specimen was identified by D. H. Mai as *Schefflera dorofeevii* (in sched.) but never published. According to him (Mai, personal communication 2005), other Oligocene records of this plant known from the Weissenster Basin (Mai and Walther 1991) are similar.

**Material studied:** MMG, Sf. 3189.

**Aquifoliaceae BARTLING.**

***Ilex* L.**

***Ilex tenuiputamenta* MAI**

Pl. 18, fig. 2

1970 *Ilex tenuiputamenta* MAI, p. 457, pl. 62, figs 4–5.

**Description:** Endocarps, 3.5–4 mm long, 0.8–1 mm wide, lateral surfaces diverging from base at narrow angles, wall of the endocarps very delicate, without ornamentation, by tangential strands slightly striate across (Mai 1970, p. 457).

**Remarks:** According to Mai (1970) the fossils compare well with those of the North American *Ilex coriacea* CHAPM. More distant similarities have been found in *Ilex glabra* GRAY from the same region.

**Material studied:** MMG, Sf. 8242, orig. Mai 1970, pl. 62, fig. 5.

**Icacinaceae (BENTH.) MIERS**

***Palaeohosiea* KVAČEK et BŮŽEK**

***Palaeohosiea sulleticensis* KVAČEK et BŮŽEK**

Pl. 18, figs 3–4

1963 *Prunus bilinica* (ETTINGSHAUSEN) MAI, p. 75, pl. 10, figs 1, 2.

1978 *Hosiea bilinica* (ETTINGSHAUSEN) HOLÝ in Mai and Walther, p. 125, pl. 45, figs 4–6 (Haselbach, Peres, Early Oligocene).

1995 *Palaeohosiea sulleticensis* KVAČEK et BŮŽEK, p. 123, pl. 1, figs 1–14, pl. 2, figs 8, 9 (Suleice, Early Oligocene).

**Description:** Impressions of endocarps broadly ellipsoidal, 16 mm wide and 14–19.5 mm long, with strongly impressed reticulate pattern of ribs and cavities, dehiscence line partly visible on the side (Mai 1963).

**Remarks:** Similar endocarps were sporadically recovered in other sites of the volcanic floras of North Bohemia. Holý (in Mai and Walther 1978) recognized the affinity to Icacinaceae and believed that they belong to *Hosiea*, probably influenced by the view by Chandler (1925, as *Natsiatum eocenicum*) and Takhtajan (1966). Kvaček and Bůžek (1995) in studying in detail similar endocarps from the Palaeogene of Europe and in particular the rich occurrence from Suleice, recognized subtle differences between the fossil remains and the endocarps of extant *Hosiea* and among various fossil populations in

Europe. They created a new morpho-genus *Palaeohosiea* similar to *Iodes* and separated the populations from the Oligocene as an independent species *P. suleticensis* from the smaller Eocene endocarps of *P. bilinica* (England, Kučlín). Radoň et al. (2006) commented in more detail on the status of this species. Due to poor preservation, the material from Seifhennersdorf does not bring additional information to resolve more accurately the affinities of this thermophilous element.

**Material studied:** MMG, Sf. 7458, Sf. 8235, orig. Mai 1963, pl. 10, figs 2a, b (*Prunus bilinica*), Sf. 8244.

## **Vitaceae JUSS.**

### ***Ampelopsis* MICHX.**

#### ***Ampelopsis hibschi* BŮŽEK, KVAČEK et WALTHER**

Pl. 18, fig. 7

1981 *Ampelopsis hibschi* BŮŽEK, KVAČEK et WALTHER, p. 127, pls 1–6, text-figs 1–7 (Haselbach, Kunderatice, Bechlejo-vice, Seifhennersdorf, Early Oligocene).

**Description:** Leaves fragmentary, a larger preserved fragment 58 mm long, 50 mm wide, lamina broad ovate, apex separated, oval, margin lobed to coarsely dentate, venation actinodromous and mainly craspedodromous, midrib straight, strong, secondaries in a number of the lobes or teeth, straight, tertiaries not well preserved; texture firm (compression); cuticles not preserved.

**Remarks:** This vine left only infrequent foliage remains at Seifhennersdorf, while it occurs more commonly only at Bechlejo-vice and Kunderatice. Otherwise it is widely spread in the volcanic areas but also in the lowland of the Weissester Basin at Haselbach (Mai and Walther 1978, as *Ampelopsis* sp.). The seeds listed below as *Ampelopsis* cf. *rotundata* may belong to the same mother plant.

**Material studied:** MMG, Sf. 2693, orig. Bůžek, Kvaček and Walther 1981, pl. 5, fig. 2, Sf. 3545, Sf. 8547 (cf. *Ampelopsis hibschi*).

#### ***Ampelopsis* cf. *rotundata* CHANDLER**

Pl. 18, figs 5–6

cf. 1926 *Ampelopsis rotundata* CHANDLER, p. 33, pl. 5, figs 5a–c (Hordle, Late Eocene).

1963 *Vitis teutonica* A. BR.; Mai, p. 81, pl. 11, figs 5a, b.

**Description:** Seed impressions, elongate ovoid, 3.8 mm long and 2.8 mm wide, dorsally domed, smooth, with an oval chalaza in the upper third; raphe starting from the chalaza and reaching over the apex to two thirds of the ventral keel, on either side accompanied with two pits of the same shape, surface not striated, base with conus-shaped micropyle (Mai 1963, p. 81).

**Remarks:** Due to poor preservation it is difficult to imagine the original shape of the seed. Similar fossils finely striated on the surface were studied on artificial molds and ascribed to *Vitis teutonica* from Markvartice (Bůžek et al. 1976). According to Mai (1963), the extant *V. rotundifolia* MCHX. (swamp forests in the Atlantic part of North

America) produces similar seeds. On account of the rounded form and the association with the leaves of *Ampelopsis* we consider this seed type to also belong to *Ampelopsis*. The same form of seeds have been recovered at Holý Kluk Hill (Radoň et al. 2006) and described under the same name.

**Material studied:** MMG, Sf. 3318 a:b, orig. Mai 1963, pl. 11, figs 5a, b (*Vitis teutonica*).

## **Leguminosae JUSS.**

### ***Leguminosites* BOWERBANK emend. SCHIMPER**

#### ***Leguminosites* sp. 1**

Pl. 18, figs 8–10

cf. 1870 *Cassia gersheimii* ENGELHARDT, p. 23, pl. 4, fig. 16.

**Description:** Leaflets sessile, lamina narrow elliptic, entire-margined, 21 to 40 mm wide, apex rounded, base cuneate to rounded, partly asymmetric rounded; venation eucamptodromous, midrib straight to slightly curved, secondaries delicate, with intersecondaries at an angle of about 40° to the midrib, tertiaries reticulate, texture of lamina coriaceous.

**Remarks:** These leaflets resemble *Podocarpium* in the texture and leaflet forms but differ in symmetrical basal venation. A similar form was described by Engelhardt (1885) under numerous legume species (see Kvaček and Walther 1998, p. 20, as Leguminosae gen. et sp. forma 1).

**Material studied:** MMG, Sf. 6248, Sf. 6253, Sf. 6256, Sf. 6258, Sf. 6260, Sf. 6261, Sf. 6275, Sf. 6309, Sf. 6310, Sf. 6312.

#### ***Leguminosites* sp. 2**

Pl. 18, fig. 11

**Description:** Leaflets incomplete, lamina entire-margined, widely ovate, 40–42 mm long and 30–33 mm wide, base rounded, asymmetrical, apex not preserved, venation eucamptodromous, a stronger basal vein arising from the larger half of the base, curved, running to the margin, accompanied by a thin basal veinlet; secondaries subopposite, rarely opposite, widely spaced at an angle of 22° to 30°, tertiary veins very fine, rarely visible.

**Remarks:** Similar legume leaflets were described by Engelhardt (1885) from Kunderatice under various morpho-species and as Leguminosae gen. et sp. forma 3 by Kvaček and Walther (1998).

**Material studied:** MMG, Sf. 6203, Sf. 6299.

#### ***Leguminosites* sp. 3**

Pl. 18, fig. 12

cf. 1870 *Leguminosites cassioides* ENGELHARDT, p. 28, pl. 8, fig. 3.  
cf. 1964 *Juglans acuminata* A. BRAUN; Walther, p. 30, pro parte, pl. 11, fig. 2.

**Description:** Leaflets narrow elliptic, entire margined, partly minutely petiolulate, lamina 28–60 mm long



and 19–25 mm wide, base rounded, slightly asymmetric, midrib straight, thick, secondaries eucamptodromous, widely spaced, curved, at an angle of 30° to the midrib, tertiaries not well preserved, probably reticulate.

**Remarks:** A similar legume leaflet was described by Engelhardt (1870) as *Leguminosites cassioides* and similar forms were encountered also at Kundratice and assigned by Engelhardt (1885) to numerous formal species (see Kvaček and Walther 1998, p. 20, as *Leguminosae* gen. et sp. forma 2).

**Material studied:** Sf. 6247, Sf. 6266, Sf. 6278, Sf. 6282, Sf. 6308.

#### ***Leguminosites* sp. 4**

Pl. 18, figs 13–14

**Description:** Leaflets sessile or minutely petiolulate, lamina elliptic, entire-margined, 24–35 mm long, 12–17 mm wide, base rounded, slightly asymmetric, apex blunt, venation eucamptodromous, midrib straight, thick, secondaries widely spaced, curved, at an angle of 30° to the midrib, tertiaries poorly preserved, probably reticulate.

**Remarks:** The above described legume leaflets differ from those previously described by having a broader form. Its independent status is based on only very formal criteria, like all previously mentioned legume forms.

**Material studied:** MMG, Sf. 6251:1:2, Sf. 6252, Sf. 6259.

#### ***Leguminosites* sp. 5**

Pl. 18, fig. 15

**Description:** Leaflet ovate, entire-margined, 60 mm long, 38 mm wide, base rounded, slightly asymmetrical, apex rounded to slightly emarginate, venation eucamptodromous, midrib almost straight, thick, secondaries densely spaced, subparallel, in about 9 pairs at an angle of 45 to 60°, tertiaries very thin, irregularly directed, intersecondaries occasionally present.

**Remarks:** Similar large legume leaflets were described from Parschlug (Middle Miocene) as *Phaseolites securidacus* UNGER and *Juglans parschlugiana* UNGER (see Kovar-Eder et al. 2004).

**Material studied:** MMG, Sf. 7558.

#### ***Leguminosites* spp.**

**Description:** Leaflets and leaf fragments sharing in gross morphology the general characteristics of *Leguminosites* sp. 1 to 5, due to incomplete preservation not determinable, cuticles not preserved.

**Remarks:** About 48 leaflets and leaf fragments belonging apparently to *Leguminosites* have not been determined because important traits of the leaf venation and margin region are only poorly preserved. It is impossible to assign these samples to the above described *Leguminosites* sp. 1 to 5.

**Material studied:** Sf. 1246, Sf. 1471, Sf. 1967, Sf. 2626, Sf. 2643, Sf. 2742, Sf. 2747, Sf. 2748, Sf. 2750 to Sf. 2752, Sf. 2766, Sf. 2790, Sf. 2793, Sf. 2801, Sf. 2816, Sf. 2830, Sf. 2855, Sf. 2867, Sf. 2869, Sf. 2880, Sf. 2883 to Sf. 2886, Sf. 2896, Sf. 2907, Sf. 2909, Sf. 2915, Sf. 2930 to Sf. 2932, Sf. 2938, Sf. 2941, Sf. 2942, Sf. 2977, Sf. 2979, Sf. 3277, Sf. 3423:1:2, Sf. 3488, Sf. 3534:1:2, Sf. 3551, Sf. 3719:1:2, Sf. 4011, Sf. 4088, Sf. 4094, Sf. 4239, Sf. 4278, Sf. 4298, Sf. 5351, Sf. 6056, Sf. 7830, Sf. 8111, Sf. 8118, Sf. 8145, Sf. 8146, Sf. 8667, Sf. 8668, Sf. 8686.

#### **Anacardiaceae LINDL.**

##### ***Toxicodendron* MILLER**

##### ***Toxicodendron herthae* (UNGER)**

##### **KVAČEK et WALTHER**

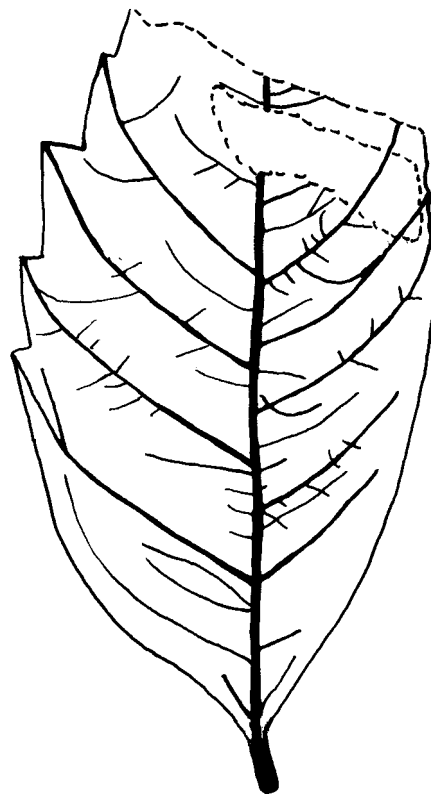
Pl. 20, fig. 1, text-fig. 10

1850a *Rhus herthae* UNGER, p. 473 (Parschlug, Middle Miocene).

1860 *Rhus herthae* UNGER; Unger, p. 42, pl. 20, figs 7–9 (Parschlug, Middle Miocene).

1998 *Toxicodendron herthae* (UNGER) KVAČEK et WALTHER, p. 27, pl. 15, figs 3–8, text-fig. 13.16 (Kundratice, Early Oligocene).

**Description:** Leaflet incomplete, 55 mm long, 27 mm wide, oblong elliptic, apex missing, base cuneate, asymmetric, petiolulate, margin on one side entire, on the opposite side coarsely serrate, teeth triangular, blunt, sinuses sharp, lamina thin, venation eucamptodromous and craspedodromous, midrib thick, straight, secondaries regularly spaced, at an angle of 55° to the midrib, single intersec-



**Text-fig. 10.** *Toxicodendron herthae* (UNGER) KVAČEK et WALTHER, Sf. 7476, nat. size.

ondaries short, tertiaries oblique to the secondaries, densely spaced.

**Remarks:** Leaflets of this form are rare but occur in several Oligocene floras of the České středohoří Mts. (Kvaček and Walther 1998, 2004).

**Material studied:** MMG, Sf. 2246, Sf. 2276, Sf. 2253, Sf. 7476, Sf. 7555, Sf. 7561.

## **Ebenaceae GÜRKE**

### ***Diospyros* L.**

#### ***Diospyros brachysepala* A. BRAUN**

Pl. 19, figs 1–3

1845 *Diospyros brachysepala* A. BRAUN, p. 170 (Oehningen, Middle Miocene).

1870 *Diospyros brachysepala* A. BRAUN; Engelhardt, p. 20, pl. 5, figs 8–9.

**Description:** Calyces deeply clefted, quadrisepalous, sepals broadly triangular, 7 mm long and 6 mm wide, shortly fused; central scar left by the fruit rounded, 3 mm across.

**Remarks:** Similar fossil remains have been newly described from Bechlejovice, where they are accompanied by foliage of the *Diospyros* type (Kvaček and Walther 2004, pp. 28–29).

**Material studied:** MMG, Sf. 3321, Sf. 7388, Sf. 8276, orig. Engelhardt 1870, pl. 5, fig. 8, Sf. 8297, orig. Engelhardt 1870, pl. 5, fig. 9, Sf. 8665.

### ***Diospyros* sp.**

Pl. 19, figs 4–5

1870 *Juglans acuminata* A. BRAUN; Engelhardt, p. 24, pl. 6, fig. 7.

1964 *Juglans acuminata* ENGELHARDT; Walther, p. 30, pro parte, pl. 11, figs 1 (refigured orig. Engelhardt 1870, pl. 6, fig. 7) and 3.

**Description:** Leaves simple, petiolate, petiole up to 5 mm long, about 2 mm thick, lamina ovate, 45 to 70 mm long and 16 to 30 mm wide, entire-margined, venation camptodromous, midrib almost straight, secondaries in more than 8 pairs, alternate, intersecondaries (1 per cm) occasionally present, tertiaries percurrent, oblique to the secondaries, thin, not always visible.

**Remarks:** Similar leaves have been described together with the calyces of *Diospyros brachysepala* from Bechlejovice (Kvaček and Walther 2004). We have separated the leaves from the fruit remains to keep two organs under independent taxa, like in most other cases of detached fossil organs.

**Material studied:** MMG, Sf. 6292, Sf. 6317, Sf. 6521, Sf. 6522, Sf. 6530, Sf. 6531.

## **? Lythraceae St. HILL**

### ***Apocynophyllum* HEER**

#### ***Apocynophyllum neriifolium* HEER**

Pl. 19, figs 6–7, text-fig. 11

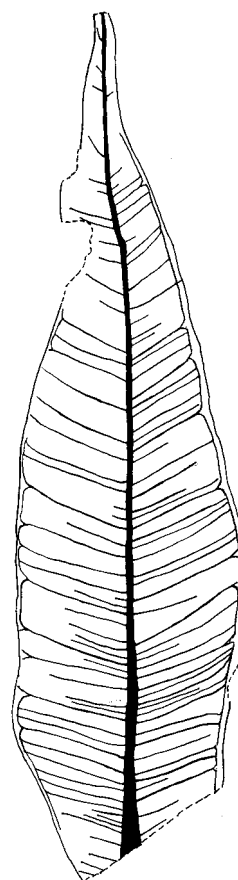
1861 *Apocynophyllum neriifolium* HEER, p. 419, pl. 8, figs 1–8 (Skopau, Late Eocene).

1870 *Ficus multinervis* HEER; Engelhardt, p. 19, pl. 5, fig. 2.

1978 *Apocynophyllum helveticum* HEER; Mai and Walther, p. 128, pl. 4, figs 1–5, pl. 46, figs 7–13, pl. 47, figs 1–3 (Haselbach, Early Oligocene).

**Description:** Leaf simple, incomplete, lamina lanceolate, more than 118 mm long, 31 mm wide, base missing, apex acuminate, tip narrow rounded, margin entire, venation camptodromous with intramarginal vein near the margin, midrib straight, strong, secondaries delicate, straight, under wide angles, merged into an intramarginal vein together with dense composite intersecondaries, 4–5 per cm.

**Remarks:** This morpho-species is very common in the so-called “Knollenstein” floras of the Late Eocene in central Germany (Heer 1861, Rüffle et al. 1976). It is also known in the Early Oligocene Haselbach floral assemblage (Mai and Walther 1978, p. 128, pl. 4, figs 1–5, pl. 46, figs 7–13, pl. 47, figs 1–3, as *Apocynophyllum helveticum* Heer). According to the co-occurrence with the Lythraceae seeds, mostly belonging to *Microdiptera*, this type of



**Text-fig. 11.** *Apocynophyllum neriifolium* HEER (re-illustrated from Engelhardt 1870, pl. 5, fig. 2, as *Ficus multinervis* HEER), Sf. 8277, nat. size.

foliage may belong to an extinct member of this family. It is obviously an intrazonal element, exceptional in the volcanic floras in general.

**Material studied:** MMG, Sf. 1352 (*Apocynophyllum* cf. *neriifolium*), Sf. 2740, Sf. 2874, Sf. 7547, Sf. 8277, orig. Engelhardt 1870, pl. 5, fig. 2.

### **Dicotyledonae fam. inc.**

#### ***Dicotylphyllum* SAPORTA**

#### ***Dicotylphyllum deichmuelleri***

**KVAČEK et WALTHER**

Pl. 18, figs 16–17, pl. 24, figs 12–13

1998 *Dicotylphyllum deichmuelleri* KVAČEK et WALTHER, p. 14, pl. 6, figs 7–12, text-figs 13.7, 13.30 (Kundratice, Early Oligocene).

**Description:** Leaf simple, short petiolate, lamina ovate, 67 mm long, 35 mm wide, apex ? acute, incompletely preserved, base cuneate, margin with widely spread blunt teeth, teeth probably glandular, venation semicraspedodromous, midrib straight, thick, secondaries in ca. 5 pairs at a wide angle, interspaced with sub-parallel intersecondaries, looping well within the marginal area, forming additional smaller, narrow loops and sending abmedial fine partly forked veinlets towards marginal teeth, tertiaries very oblique to the secondaries, dense; adaxial cuticle thick, smooth, reflecting isodiametric almost straight-walled polygonal cells 15–25 µm across, abaxial cuticle thick, papillate (distinctly under phase contrast light), non-modified cells mostly isodiametric, 10–15 (–25) µm across, thick-walled, with one broad papilla in the centre, anticlines straight, rarely bent, stomata paracytic, guard cell pairs broadly oval to almost circular, 15–18 µm wide and 18–20 µm long, with thicker stomatal ledges, pore narrow to broadly oval, slit linear, two subsidiary cells parallel to the slit, broadly halfmoon-shaped or narrow polygonal, sometimes an additional third cell present or one subsidiary cell subdivided into two perpendicularly to the stoma, no trichome bases noted.

**Remarks:** The specimens available correspond with the other occurrences at Markvartice (Bůžek et al. 1976, as “*Viburnum*” *atlanticum*), Kundratice (type locality, Kvaček and Walther 1998) and Bechlejovice (Kvaček and Walther 2004) in gross morphology and in two former cases also in the epidermal anatomy. The affinities are still vague; the epidermal pattern resembles that of evergreen species of *Symplocos* (Kvaček and Walther 2004). Pollen of *Symplocos* has been recovered in the pollen flora of Seifhennersdorf (M. Konzalová, personal communication 2007).

**Material studied:** MMG, Sf. 2240, Sf. 2989, Sf. 5914, Sf. 6558, 2 prep. s.n., Sf. 7265, Sf. 7267 to 7276, Sf. 7869, Sf. 7870.

#### ***Dicotylphyllum* sp. 1**

Pl. 18, fig. 18

**Description:** Leaf simple, shortly petiolate, petiole 6 mm, slightly curved, lamina asymmetrically ovate,

incompletely preserved, fragment 46.5 mm long (reconstructed length at least 50 mm), 28 mm wide, base unevenly developed, on one side the base 3 mm higher than on the other side, subcordate to rounded, apex narrow acute, margin entire except for one side lobe with acute tip and wide rounded sinus, venation brochidodromous and semicraspedodromous, midrib straight, strong, secondaries in 6–7 pairs, almost opposite, straight, forked and looping along the margin, under medium narrow angles, simple intersecondaries occasionally present, tertiaries and higher-order venation reticulate, forming irregular isometrical network.

**Remarks:** This complex of gross-morphological features is rather characteristic. Still we are unable up to now to suggest any modern plant that would be an analogous taxon.

**Material studied:** MMG, Sf. 7475.

#### ***Saportaspermum* MEYER et MANCHESTER**

#### ***Saportaspermum dieteri* KVAČEK et WALTHER sp. n.**

Pl. 19, figs 8–12

**Holotype** designated here: MMG, Sf. 8237b – pl. 19, fig. 8.

**Stratum typicum:** Basaltoid brown coal complex, Early Oligocene.

**Locus typicus:** Seifhennersdorf, former diatomite mine “Freundschaft”, Saxony, Germany.

**Etymology:** After the surname of prof. Dieter Hans Mai, our colleague and friend, who undertook detailed studies on volcanic floras including Seifhennersdorf.

**Diagnose:** Large winged seeds with almost straight and not thickened ventral and dorsal margin and elliptic seed body slightly oblique to the wing axis.

**Description:** Winged seeds, 23–25 mm long and 6–8 mm wide, seed body elliptic, 8 mm long and 5 mm wide, attached slightly obliquely to wing axis, wing straight, rarely bent, elongate to narrow elliptic, rounded at distal end, venation hardly visible, consisting of fine elongate reticulation, particularly expressed at the boundary to the seed body.

**Remarks:** This type of seed differs from similar pine seeds by attachment of the seed body, which is in pines and other Pinaceae attached to one side of the wing surface. Their seeds at maturity are usually detached or free from the wing that sometimes overlaps on the other side of the seed body by small extensions (*Keteleeria*), in *Pinus* with fine undulate striation (Wolfe and Schorn 1990). The dorsal margin of the so far described winged seeds of this sort (e.g. Meyer and Manchester 1997) is usually thickened dorsally at the seed body. Mai (in sched.) believed at first that the described seeds from Seifhennersdorf might belong to *Reevesia* (Malvaceae s.l.). However, the dorsal thickening is typical of this genus (Kvaček 2006) and is lacking in the seeds at hand. The fine wing venation rules out an affinity to the Pinaceae. The true systematic position of *Saportaspermum dieteri* could be solved in the future, when some correlation with the corresponding fruits, foliage or pollen can accurately be made. An affinity to *Reevesia* suggested by Mai (in sched.) may come into question, when we

consider the co-occurrence of the leaf type described above as *Dombeyopsis* sp.

**Material studied:** MMG, Sf. 8237a, Sf. 8237b (holotype), Sf. 8238, Sf. 8239, Sf. 8240, Sf. 8241:1:2.

### *Saportaspermum cf. occidentale*

**MEYER et MANCHESTER**

Pl. 19, fig. 13

? 1997 *Saportaspermum occidentale* MEYER et MANCHESTER, p. 161, pl. 74, figs. 14–20 (Fossil, Oregon, Oligocene).

**Description:** Seed winged, laterally strongly compressed, seed body elliptical, 3 mm long, 3 mm wide, wing attached to the distal end of seed body, elongate, 10 mm long and 4 mm wide, obliquely oriented to the axis of the seed, which continues dorsally by a short thickened extension of the margin of the wing; wing margins gently bent, almost straight, abruptly curved into the rounded end.

**Remarks:** This type of winged seed has been sporadically recorded at various Oligocene sites of the České středohoří Mts. (Kvaček and Walther 2004) and elsewhere in Europe. They are remarkably similar to those described from the Oligocene of the John Day Basin in Oregon, U.S.A. (Meyer and Manchester 1997, Hably et al. 2000) and differ from the above described co-occurring *Saportaspermum dieteri* in smaller size, slender form of the seed body and dorsally thickened extension of the seed into the wing. The seeds ascribed to the fossil fruits of *Reevesia* (Malvaceae s.l.) and the foliage of the “*Ficus*” *truncata* type from the Lower Miocene of North Bohemia (Kvaček 2006) are also quite similar, while those from the Eocene (e.g. Látatlan – Kovács 1959, as *Cedrelospermum* spp. 1, 2) are bigger, with rounded seed body, matching the extant representatives of *Pterospermum* from the same family (Z. K. – own observation). The taxonomy of the presently described winged seed requires more comparative study, particularly with the material described by Saporta (1867), as noted already by Meyer and Manchester (1997).

**Material studied:** MMG, Sf. 7370.

## **Monocotyledonae**

### **Potamogetonaceae DUMORT.**

#### ***Potamogeton* L.**

##### ***Potamogeton seifhennersdorfensis* ENGELHARDT**

Pl. 20, figs 2–5

1870 *Potamogeton seifhennersdorfensis* ENGELHARDT, p. 12, pl. 2, figs 6–9.

1963 *Potamogeton seifhennersdorfensis* ENGELHARDT; Mai, p. 45, pl. 2, figs 1–3, text-fig. 2.

**Description:** Fragments of herbaceous plants up to 100 mm long, axes very narrow, 0.2 mm thick, leaves sub-opposite, sessile, linear, up to 45 mm long and up to 3 mm wide, usually much shorter and slender, abmedially

curved, entire-margined, parallel-veined, base truncate, apex rounded to mucronate, stipules not fused, obliquely appressed to the axis, densely parallel-veined; venation of leaves consisting of the midrib and one to three pairs of lateral veins of one order, distance between the midrib and the first parallel vein twice wider than between the rest of the parallel veins; cross-veins very thin, hardly visible, irregularly spaced, bent or straight oblique; the outermost lateral parallel veins getting thinner and ending before the apex but mostly joining the margin; phyllotaxis resembling taxodioid leaves, typically abmedially bent, almost at a right angle to about 40° to the axis; detached endocarp 1.8 mm long and 1.1 mm wide, oblique and acuminate, germinal valve quite wide, without any keel, sides smooth, with indistinct longitudinal small pits.

**Remarks:** As noted by Mai (1963), this species of *Potamogeton*, which is more completely characterized (plants and a detached fruitlet), belongs to the cosmopolitan *Potamogeton pussilus* group. Its fossil remains are more common together with other aquatic plants in the 4<sup>th</sup> diatomite seam.

**Material studied:** MMG, Sf. 57:1:2, Sf. 59, Sf. 61, Sf. 63:1:2, Sf. 64:1:2, Sf. 66:1:2, Sf. 67, Sf. 68:1:2, Sf. 70, Sf. 71, Sf. 72:1:2, Sf. 73, Sf. 74, Sf. 75, Sf. 78 to Sf. 81, Sf. 83, Sf. 84:1:2, Sf. 85, Sf. 86, Sf. 88, Sf. 91:1:2, Sf. 92, Sf. 93, Sf. 94, Sf. 97 to Sf. 101, Sf. 103, Sf. 106 to Sf. 112, Sf. 113:1:2, Sf. 114, Sf. 115, Sf. 116:1:2, Sf. 117, Sf. 118, Sf. 119, Sf. 120, Sf. 127, Sf. 239:1:2, Sf. 562:1:2, Sf. 3309a, orig. Mai 1963, pl. 2, fig. 3 (neotype selected here), Sf. 3302, orig. Mai 1963, pl. 2, fig. 1 (and counter-impression), Sf. 3563, Sf. 3366, Sf. 4323:1:2, Sf. 5663a, Sf. 5882, Sf. 5886, Sf. 5906:1:2, Sf. 6468, Sf. 6469, Sf. 6470, Sf. 6471, Sf. 6472 part 1 to 4, Sf. 6473, Sf. 6474 to Sf. 6485, Sf. 6486:1:2, Sf. 6487, Sf. 6488 to Sf. 6503, Sf. 6504:1:2, Sf. 6505:1:2, Sf. 6506, Sf. 6507 to Sf. 6514, Sf. 7985:1:2, Sf. 7991:1:2, Sf. 8177, Sf. 8637; KM III, 1213 C.

#### ***Potamogeton* sp.**

Pl. 20, fig. 6

**Description:** Leaf incomplete, entire-margined, narrow elliptic, 35 mm long and 8 mm wide, attached to a partially decayed axis, sessile, apex rounded, (?) long mucronate, probably decayed; venation parallel, midrib slightly wavy, lateral parallel veins in two to three ranks, those of the first rank four on either side of the midrib, outermost very thin and close to the margin; the second vein from the midrib thicker than the others, cross veins widely and irregularly spaced, straight or wavy, variously oriented to the parallel veins.

**Remarks:** The venation is similar to that of *Potamogeton seifhennersdorfensis*, but lateral veins are differentiated into two ranks and the innermost veins next to the midrib are closer than the others.

**Material studied:** MMG, Sf. 3151.

## Smilacaceae VENT.

### *Smilax* L.

#### *Smilax weberi* WESSEL

Pl. 20, figs 7–8, pl. 24, figs 14–15

- 1856 *Smilax weberi* WESSEL in Wessel and Weber, p. 17, pl. 2, fig. 1 (Rott, Late Oligocene).  
1964 *Smilax* sp.; Walther, p. 68, pl. 11, fig. 7.  
1996 *Smilax* cf. *weberi* WESSEL et WEBER; Walther, p. 18.

**Description:** Leaves sub-triangular elongate, hastate, preserved maximum length 50 mm without apical part, 34 to 100 mm wide, entire-margined, base truncate to subcordate, apex not preserved, margin thickened, venation actinodromous – acrodromous, midrib straight, lateral primaries 3–5 on either side, bent towards the apex, outer lateral veins sending curved abmedial side veinlets, secondaries thin, forming large meshes with tertiaries, lamina medium thick; only fragments of cuticles preserved showing paracytic (?) stomata with narrow ovate to ovate outer cavities 22 to 70 µm long and about up to 35 µm wide.

**Remarks:** Walther (1964) hesitated to assign this foliage to a species, but several other occurrences in České středohoří Mountains, e.g. at Kundratice (Kvaček and Walther 1998), Bechlejovice (Kvaček and Walther 2004) and in Saxony at Kleinsaubernitz (Walther 1999) do not differ morphologically and in our opinion were correctly identified as *S. weberi*. At Seifhennersdorf as well as at the other sites, the leaves of *Smilax* are extremely rare.

**Material studied:** MMG, Sf. 3094, Sf. 3736, orig. Walther 1964, pl. 11, fig. 7 (*Smilax* sp.), Sf. 4447, Sf. 4458, Sf. 4467.

## Zingiberaceae LINDL.

### *Spirematospermum* CHANDLER

#### *Spirematospermum wetzleri* (HEER) CHANDLER

Pl. 20, figs 9–10

- 1859 *Gardenia wetzleri* HEER, p. 192, pl. 141, figs 81–103 (Günzburg, Late Miocene).  
1825 *Spirematospermum wetzleri* (HEER) CHANDLER, pp. 19–20, pl. 1, fig. 8, text-fig. 8 (Hordle, Late Eocene).  
1965 *Spirematospermum wetzleri* (HEER) CHANDLER; Walther, pp. 425–426, text-figs 1–3.

**Description:** Fruit impression incomplete, 23 mm long, 18 mm across, narrowed into a bent stalk 15 mm long, inside numerous narrow ovoid seeds in two rows, obliquely oriented, with fine spiral striation, well visible on artificial molds.

**Remarks:** Although incompletely preserved, this fossil fruit proves the existence of *Spirematospermum* in the flora of Seifhennersdorf (Walther 1965). The affinities of this swamp plant of the Zingiberales has not been satisfactorily elucidated so far. It is widely spread in Tertiary swampy vegetation all over the Northern Hemisphere (Koch and Friedrich 1871).

**Material studied:** MMG, Sf. 196, Sf. 3180 (*Spirematospermum* cf. *wetzleri*), Sf. 3190, Sf. 8379, orig. Walther 1965, figs 1–3.

## Palmae JUSS.

### *Sabal* ADANS.

#### *Sabal* cf. *lamanonis* (BRONGNIART) HEER

Pl. 21, fig. 1

- ? 1822 *Palmacites lamanonis* BRONGNIART, p. 210, pl. 3, fig. 1 (Aix-en-Provence, Oligocene)  
? 1855 *Sabal lamanonis* (BRONGNIART) HEER, p. 86 (Mornex, Eriz, Develier, Oligocene)

**Description:** Fragment of a sabaloid leaf, 25 mm long, 105 mm wide, segments dense and slightly bent, attached to short remains of the rachis.

**Remarks:** This very incomplete fragment of a sabaloid palm is the only evidence of palms at Seifhennersdorf. The generic affinities of similar remains are very uncertain even in cases of more complete fossils (see Knobloch et al. 1996).

**Material studied:** MMG, Sf. 4446.

## Gramineae JUSS.

### *Leersia* Sw.

#### *Leersia seifhennersdorfensis* WALTHER

Pl. 21, figs 2–3

- 1974 *Leersia seifhennersdorfensis* WALTHER, p. 153, pls 11, 12, pl. 13, figs 1–2, pl. 14, figs 1–2.

**Description:** Apical part of a fertile grass, preserved in length of 163 mm, inflorescence terminal, paniculate, incompletely preserved, 121 mm long, with partly bent branchlets, spikelets with a single flower, 1.4 to 2.5 mm large, without grains, more or less racemously arranged, glumes indistinctly seen, leaf blades 2.5–4 mm wide, partly at an almost right angle from the main axis, leaf ribbed, midrib evident, accompanied on either side with 4–5 distinct lateral secondary veins, between them up to 3 tertiary thinner veins; cuticle of the glume showing cells with strongly undulate anticlines, fruit wall of the caryopse with outer parenchymous cell layer (Walther 1974, pp. 153–154, adapted).

**Remarks:** According to Walther (1974) the unique specimen from Seifhennersdorf shows features similar to a grass-like fossil from Oehningen assigned to *Oryza* (Heer 1855). But without the study of the type material of this *O. exasperatus* HEER, he preferred to create a new species for the specimen at hand. After consultation with several specialists he recognized in this fossil a representative of *Leersia*, particularly similar to extant *L. oryzoides* (L.) Sw. This grass is widely spread in Europe and in the eastern part of North America in riparian settings together with *Phragmites*.

**Material studied:** MMG, Sf. 12a, orig. Walther 1974, pls 11–13 (holotype), prep. Sf. 154/71 and Sf. 156/71.

## Monocotyledonae gen. et sp.

Pl. 21, fig. 4

**Description:** Ribbon-shaped to linear monocotyledonous leaf fragments with parallel venation, entire-margined without any other characters useful for identification; laminae mostly compressions; attempts at obtaining cuticle failed.

**Remarks:** Such remains were mainly found in the bedded diatomite of the 4<sup>th</sup> seam within the Seifhennersdorf mine.

**Material studied:** MMG, Sf. 125, Sf. 126, Sf. 128, Sf. 2499, Sf. 2590, Sf. 2591, Sf. 3020, Sf. 3074, Sf. 3083, Sf. 3088, Sf. 3089, Sf. 3091, Sf. 3092, Sf. 3093, Sf. 3095, Sf. 3096, Sf. 3097, Sf. 3098, Sf. 3099, Sf. 3100, Sf. 3101, Sf. 3102, Sf. 3103, Sf. 3105, Sf. 3106, Sf. 3107, Sf. 3108, Sf. 3109, Sf. 3111 to Sf. 3122, Sf. 3124 to Sf. 3133, Sf. 3135, Sf. 3136, Sf. 3138, Sf. 3140, Sf. 3141, Sf. 3143 to Sf. 3146, Sf. 3148, Sf. 3149, Sf. 3153 to Sf. 3157, Sf. 3159, Sf. 3546, Sf. 3562, Sf. 3577, Sf. 3582, Sf. 3984, Sf. 3591, Sf. 4009, Sf. 4063, Sf. 5874, Sf. 5889, Sf. 5901, Sf. 6342:1:2, Sf. 6343:1:2, Sf. 6344 to Sf. 6357, Sf. 6358:1:2:3, Sf. 6359:1:2, Sf. 6360:1:2, Sf. 6361, Sf. 6362, Sf. 6363:1:2, Sf. 6364, Sf. 6365 to Sf. 6371, Sf. 6373 to Sf. 6390, 6391:1:2, Sf. 7832, Sf. 7924, Sf. 8019, Sf. 8032, Sf. 8034:1:2, Sf. 8074, Sf. 8228, Sf. 8616, Sf. 8663:1:2.

## Incertae sedis

### Rhizomes and roots

Pl. 21, figs 5–6

**Description:** Two kinds of root-like structures have been recovered: straight roots, diverging from a stronger medial rhizome resembling a conifer twigs, and thin, wavy and loosely forked, variously oriented filaments, densely covering some bedding planes (‘‘*Ceratophyllum*’’ according to Walther 1977, pp. 23–25).

**Remarks:** Such root-like fossils often occur in near-shore settings and cannot be assigned to a definite plant group. Heer (1855) ascribed some similar fossils to algae (‘‘*Confervites debilis*’’).

**Material studied:** Sf. 58, Sf. 60, Sf. 65, Sf. 69, Sf. 76, Sf. 77, Sf. 82, Sf. 87, Sf. 90, Sf. 95, Sf. 96, Sf. 102, Sf. 104, Sf. 105, Sf. 121, Sf. 3566, Sf. 3983, Sf. 4056, Sf. 4079, Sf. 4416, Sf. 4417, Sf. 5844:1:2, Sf. 5845, Sf. 5846, Sf. 5847, Sf. 5848, Sf. 5849:1:2, Sf. 5854, Sf. 5855, Sf. 5856, Sf. 5857, Sf. 5858, Sf. 5859, Sf. 5860, Sf. 5861, Sf. 5862, Sf. 5863; KM III, fragments s. n.

## Excluded taxa

### *Juniperus naumanii* ENGELHARDT

1870 *Juniperus naumanii* ENGELHARDT, p. 11, pl. 2, fig. 3.

**Remarks:** According to Mai (1963) the fossil represents the skeleton of a fish.

## *Potamogetonaceacarpum* WALTHER

### *Potamogetonaceacarpum magnum* WALTHER

1967 *Potamogetonaceacarpum magnum* WALTHER, p. 264, pl. 2, figs 4–5 (holotype).

**Remarks:** In the authors’ opinion, this enigmatic fossil represents probably the remains of a beetle.

**Material studied:** MMG, Sf. 42, orig. Walther 1967, pl. 2, figs 4–5.

## Taphonomy, vegetation, palaeoecology and palaeoclimatology

### Taphonomy

The taphonomic bias that influenced the assemblages at Seifhennersdorf resembles similar situations valid for all examined volcanic floras, e.g. Sulejce-Berand, Kundratice and Bechlejovice (Kvaček and Walther 1995, 1998, 2004). The difference at Seifhennersdorf is demonstrated by the fossiliferous content of the 4<sup>th</sup> and 5<sup>th</sup> diatomite seams. The 5<sup>th</sup> seam consists of laminated and also sometimes heavily bituminous paper shale layers. Besides abundant leaves of *Potamogeton seifhennersdorfensis*, also fronds of swampy ferns of *Pronephrium* and *Osmunda*, a high quantity of *Taxodium* shoots together with tadpoles, fragments of frogs (*Palaeobatrachus*) and salamanders (*Palaeotriton*) co-occurring there reflect a more near-shore region. In the 4<sup>th</sup> seam, the diatomite is for the most part not bedded, and the laminated sequences of diatomite are without carbonaceous or bituminous horizons. Plant megafossils in the not bedded diatomite are missing or occurring in a conspicuously low quantity. For example, fragments of *Taxodium* are rare and ferns and seeds of water lilies are missing. Of the faunal remains only fragments of carp fishes are preserved. This taphocoenosis characterized an environment more distant from the shore. The fossil remains of plants and also animals are excellently preserved. The leaf impressions and compressions are without destruction, affected by insect damage or water currents. One can assume that the assemblage mostly consists of remains from the very nearby vegetation. There is no sure indication of transport from the wider surroundings. The presence of compound leaves (*Rosa*, *Engelhardia*), large leaves (*Tilia*, *Dombeyopsis*) and complete herbs (*Leersia seifhennersdorfensis*) underlines the assumption of a parautochthonous taphocoenosis. The common mixture of sun-leaves (small leaves) and shade-leaves (large leaves) for example recognized in *Carpinus roscheri*, *C. grandis*, *Rosa lignitum* and *Acer angustilobum*, promotes the idea of very nearby vegetation (Gastaldo et al. 1996, 1998, Kvaček and Walther 2004). Also leaves of Lauraceae (e.g. *Laurphyllum acutimontanum*) are preserved as mummified fossils, which are not known from the other volcanic floras examined by the authors. Another difference was demonstrated by the possibility to obtain relatively excellent cuticles not only from evergreen species but also from leaves of deciduous trees (pls 22–24). Fossilisation in calm freshwater is reflected in excellently pre-

served leaf impressions in the fine-grained pyroclastics (tuffites, claystone) which interrupted the normal sedimentary process in the 4<sup>th</sup> diatomite seam (see p. 91).

### **Vegetation reconstructions and palaeoecology**

The first attempt at reconstructing fossil vegetation at Seifhennersdorf (Walther 1977) is fully acceptable and after adding taxonomic novelties and corrections it is as presented here. In general, several associations have been recognized based on autecologies of the plant elements represented.

#### **1. The water-lily association**

It belongs to the plant cover of the diatom lake. The most characteristic component is *Dusembaya seifhennersdorfensis* represented by numerous seeds. The single leaf obviously belonging to the same plant (Nymphaeales fam. et gen. indet.) reveals that it was most probably a shallow rooted aquatic herb with floating leaves on the water table like the nearest living relative *Brasenia schreberi* from North and Middle America, Africa, India, temperate E Asia and Australia. The second component was *Potamogeton seifhennersdorfensis*, another aquatic herb, but with submerged foliage axes. Very rare was the heterosporous aquatic floating fern *Salvinia*. Parts of the lake were certainly overgrown by underwater lawns of charophytes. The association can be well compared with similar Recent water-lily associations from lakes, pools and oxbow lakes in North America (Knapp 1965, p. 46 – Water lily association).

#### **2. Taxodium – Nyssa swamp forest**

This consists of two main components – *Taxodium dubium* and *Nyssa altenburgensis*. An additional arboreal rare component appears cf. *Quasisequoia couttsiae*. The abundant representation of bold cypress at Seifhennersdorf is an exception among volcanic plant assemblages in North Bohemia and Saxony. The association is well comparable with similar swamp forests of *Taxodium distichum* and *Nyssa sylvatica* (incl. *N. biflora*) where it is bound to riparian and swampy settings on acid substrates (Knapp 1965, p. 63 – *Taxodium – Nyssa* swamp forests).

#### **3. Monocot – fern swamp undergrowth**

It represented herbaceous undergrowth that consisted of swampy ferns (*Osmunda lignitum*, *Pronephrium stiriacum*) and monocots (*Spirematospermum wetzleri*, Monocotyledonae gen. et sp. indet.). The undergrowth penetrated under the canopy of the bold cypress forest along water courses. Mosses can also have been part of this vegetation. Rare components were bushy *Ilex tenuiputamenta* and *Sabal* cf. *lamanonis* and the sub-shrubby *Decodon*-like *Apocynophyllum*. Analogies can be found in the Atlantic part of the U.S.A., which are much more diversified (Knapp 1965, p. 64, more or less analogous to Evergreen swamp forests, “Pocosin-Gehölze”).

#### **4. Diversified mixed mesophytic forest**

Most of the woody plants found at the Seifhennersdorf site belong here. The two-storied canopy consisted of giant deciduous trees of *Carya fragiliformis*, *Platanus neptuni*, tilioids (*Tilia gigantea*, *Craigia bronnii*, *Dombeyopsis lobata*) and Ulmaceae (*Ulmus fischeri*, *Zelkova zelkovifolia*) and more numerous medium trees. Dominated were hornbeams (*Carpinus roscheri*, *C. grandis*, *C. cordatae-*

*formis*, *C. mediomontana*), birches (*Betula dryadum*, *B. alboides*), *Celtis pirskenbergensis*, lauroids (*Laurophyllum acutimontanum*, *L. pseudoprinceps*, *L. meuselii*, *Daphnogene cinnamomifolia*), many maple trees (*Acer angustilobum*, *A. engelhardtii*, *A. ruemianum*, *A. cf. dasy-carpoides*, *A. pseudomonspessulanum*), *Magnolia seifhennersdorfensis*, *M. cf. denudataeformis*, *Diospyros*, *Cyclocarya*, *Cercidiphyllum*, *Sloanea* and various conifers (*Tetraclinis salicornioides*, *Torreya bilinica*, *Cephalotaxus parvifolia*). The undergrowth consisted of various shrubs and lianas (*Rosa lignitum*, *R. saxonica*, *Prunus langsdorfii*, *Palaeohosiea suleticensis*, *Hydrangea microcalyx*). Most similar vegetation can be found in central and east China at higher elevations (Wang 1961, p. 108). Best comparable are the Deciduous Broad-leaved Forests of the Upper Yangtze, with a high richness of species at an elevation of about 1200 to 1400 m.

#### **5. Alder flat-water riparian forest and large sedges**

It consisted mainly of alder (*Alnus gaudinii*, *A. kefersteinii*) and monocots (*Leersia seifhennersdorfensis*, monocot leaf fossils) in the undergrowth.

#### **6. Willow bushes**

Willow bushes (*Salix varians*) can be expected along streams that disembogued into the lake (Knapp 1965, p. 297, Riparian forests and other woody plants in marshy localities in the Tierra Templada of Central America).

#### **7. Hickory-oak flooded riparian forest**

This forest was bound to partly flooded fertile soils and can roughly be compared with the Oak-Ash-Hickory forest of the SE United States, which is more diversified and typical of the association of *Quercus lyrata* – *Carya aquatica*. The higher tree components at Seifhennersdorf were *Quercus lonchitis*, *Eotrigonobalanus furcinervis*, *Carya fragiliformis* and *Acer* cf. *tricuspidatum*, probably *Cephalotaxus parvifolia*, *Carpinus grandis*, *Ulmus fischeri*, *Populus* and *Leguminosites* spp. of lower trees, and various lianas and vines (*Ampelopsis hibschi*, *A. cf. rotundata*, *Toxicodendron herthae*, *Smilax weberi*). A nice Recent example was given by Knapp (1965, p. 33) with the Western *Quercus – Hickory* Forests.

The above selected associations were obviously not strictly delimited and infiltrated each other according to changing substrate conditions. They were reconstructed intuitively, chiefly on the basis of autecologies of the nearest living relatives. The individual diatomite seams differ in the content of plant taxa and show some kind of succession in the vegetation development.

The leaf and fruit / seed assemblages correspond well with the pollen record. Preliminary palynological data (courtesy M. Konzalová) include pollen and spores of *Osmunda*, Polypodiaceae s.l., Taxodiaceae vel Cupressaceae, Magnoliaceae, *Cercidiphyllum*, *Alnus*, *Engelhardia*, *Carya*, cf. *Carpinus*, *Quercus*, Fagaceae – *Fususpollenites*-type, Salicaceae, Platanaceae, *Acer*, *Ampelopsis*, Araliaceae, *Ulmus* vel *Zelkova*, *Symplocos*, Tiliaceae and Poaceae. In addition, a few taxa not encountered as megafossils are to be added – *Castanea* vel *Castanopsis* and Pinaceae – *Picea*, *Abies* and *Pinus* types. Either they have not been recognized as such in cases where the foliage was not suitable for cuticle analyses to allow sure identification (Fagaceae) or the elements grew far from the diatomite lake and the

pollen arrived due to long-distance transport by wind (Pinaceae). In general, the pollen spectra are in agreement with the general characteristics of vegetation given above on the basis of macrofossils.

#### **Palaeoclimatic proxies**

Palaeoclimatic proxies have been derived by matching the zonal forest vegetation with recent analogues by the Co-existence methodology (courtesy D. Uhl, personal communication) and the margin analysis of arboreal dicots.

The floristic composition of the Seifhennersdorf diatomite indicates a good correlation with the fossil assemblage of the Mixed Mesophytic Forest of the East Asiatic type, as defined by Wolfe (1979). This forest community is limited today to humid areas of SE China with the mean annual temperature about 10° to 15°C and the mean of the coldest month 1° to –2° C. It is in contrast to the situation in eastern North America, where the mean temperature of the coldest month for such forest vegetation is much higher. In this respect the proxy data derived from East Asian analogues seem to be too cold.

The Co-existence proxy data with the aid of all nearest living relatives have been calculated as follows: mean annual temperature 15.6° to 15.9° C, mean temperature of the coldest month 5.0° to 5.2° C, mean temperature of the warmest month 25.7° to 25.9° C; mean annual precipitation 897 to 971 mm, precipitation of the wettest month 117 to 133 mm, precipitation of the driest month 43 to 47 mm, precipitation of the warmest month 118 to 131 mm. From the data set evaluated for the Seifhennersdorf flora, some of the extreme elements have been excluded, e.g. *Reevesia* and *Sabal*, because these taxa are less reliably documented in the fossil flora of Seifhennersdorf. The sum of mean annual precipitations seems to be calculated a little too low in comparison with that for the volcanic flora of Bechlejovice (Kvaček and Walther 2004).

One methodology independent from the systematic position and also employed here is the proportion of dentate vs. entire-margined non-herbaceous dicots. However, this simple correlation does not give reliable proxies in our case. The Seifhennersdorf assemblage consists of probably some more morpho-types, which may have been overlooked. However, of the woody dicots (52 morphotypes) established so far those with entire-margined foliage are in the minority (16 species, slightly more than 30%) versus those with dentate margin (36 species, slightly less than 70%). This proportion indicates far more severe climatic conditions than one would expect from the individual autecologies of thermophilous components (*Sabal*, *Engelhardia*, *Sloanea*, *Craigia*). Comparing with the East Asian forests (Wolfe 1979) the forest vegetation of Seifhennersdorf would, according to the leaf margin analysis, correspond to the Mixed Broad-leaved Deciduous Forest, which is confined to the middle latitude East Asia with the Mean Annual Temperature 10° to 13° C and the Coldest Month Mean lower than –2° C.

The palaeoclimatic proxies of Seifhennersdorf derived from the CA methodology seem to be most realistic and are an important addition to the reconstruction of the continental climate evolution in the Palaeogene of Central Europe. They are in close agreement with the data previously published (see Mosbrugger et al. 2005).

## **Comparison with adjacent volcanic sites in North Bohemia**

### **Varnsdorf (former Warnsdorf and Alt-Warnsdorf)**

Fossil plants at Varnsdorf were recovered by Jokély (1861–1862), who included the floral list into his report on the geological research and mapping of this part of North Bohemia. The fossil plants were recovered from an underground mine at Alt-Warnsdorf (today a part of the town of Varnsdorf) and listed in this paper (identifications by D. Stur). The waste heap left after this mining is still accessible in close vicinity to the town and is only a few hundred meters from the waste heaps of Seifhennersdorf across the state boundary between the Czech Republic and Germany. The incompletely documented material of Jokély is housed in the Austrian Geological Survey (Geologische Bundesanstalt), Vienna. Those specimens that survived have been re-identified as *Taxodium dubium*, *Platanus neptuni* and *Laurophyllum* sp. Some additional elements have also been re-identified (det. Z. K.): cf. *Quasisequoia couttsiae*, *Acer* cf. *tricuspidatum*, *Carya fragiliformis*, *Engelhardia orsbergensis*, and cf. *Sloanea artocarpites*. Engelhardt (1870) in his work focused on Seifhennersdorf mentioned a few species that he considered to occur also at Varnsdorf. Only later, Wentzel (1881) published another short paper on the Varnsdorf flora, where he summarized the so far known species and added his own collection. This poorly preserved material has recently been accessed from the Faculty of Science, Charles University, Prague, where Wentzel worked under the guidance of Gustav Laube from the Geological Institute of the German university. The specimens allowing identifications have been recognized as remains of *Taxodium dubium*, *Platanus neptuni* (including a stipule), Betulaceae indet., *Daphnogene cinnamomifolia* f. *lanceolata*, *Laurophyllum* sp. and *Dusembaya seifhennersdorfensis*. Procházka (in Procházka and Bůžek 1975) also accepted *Acer tricuspidatum* and *Acer dasycarpoides* s. l. to be present at Varnsdorf and indeed, one poorly preserved specimen from Wentzel's collection can be assigned to the latter species.

In a review of the Czech Tertiary flora, Brabenec (1909) lists occurrences at Varnsdorf (also as Warnsdorf, or Alt Warnsdorf) under the following taxa: *Podocarpus eocenica* UNG., *Taxodium dubium* (STERNB.) HEER, *Glyptostrobus europaeus* (BRONGN.) HEER, *Phragmites oeningensis* A. BRAUN, *Juglans bilinica* UNG., *Carpinus grandis* HEER, *Dryandroides hakeaefolia* UNG., *Cinnamomum polymorphum* A. BRAUN sp., *Acer trilobatum* (STERNB.) A. BRAUN, *Acer crenatifolium* ETTINGSH., *Sapindus falcifolius* A. BRAUN (det. Velenovský) and *Ziziphus ungeri* HEER. Brabenec obviously accepted uncritically all the so far published plants for Varnsdorf but also studied at least some additional specimens housed in the collections of the National Museum, Prague. Unfortunately, no specimens have been found at the National Museum that would extend the already revised floral list for Varnsdorf.

The assemblage from Varnsdorf matches well the flora of Seifhennersdorf, although the proportions of elements may not be the same. Importantly, the most significant elements of the Seifhennersdorf flora, i.e. *Taxodium* and *Dusembaya* are also present there. However, the source lay-



ers are probably not exactly the same as those that yielded plant fossils in the much deeper section at Seifhennersdorf.

#### **Hrazený hill (former Pirskenberg) at Knížecí**

This site is the closest from the Varnsdorf – Seifhennersdorf area, about 14 km NWW at Šluknov. The flora was collected and identified by Knobloch (1961). The collection housed at the National Museum in Prague requires revision as recent attempts to recover cuticle structures have been partly successful (Z. K. own observation). Remarkably, the assemblage of the Hrazený hill shares many important elements with Seifhennersdorf: *Taxodium dubium*, *Tetraclinis salicornioides*, *Cercidiphyllum*, *Engelhardia*, *Cyclocayra*, *Carya*, *Betulaceae*, *Daphnogene*, *Platanus neptuni*, *Ailanthus prescheri* (as *Myrica lignitum*), *Populus zaddachii*, *Rosa*, *Celtis*, *Ulmus fischeri*, *Toxicodendron* (as *Rhus*) *herthae*, *Ampelopsis hibschi* (as *Vitis* and *Platanus*), *Craigia* (as *Pteleaecarpum*), *Smilax* and perhaps some more that may come out after the revision (see Kvaček and Walther 2001, table 3). Two elements, *Liriodendron* and *Comptonia*, are not known at Seifhennersdorf. Otherwise the whole aspect of the assemblage from Hrazený is more mesophytic (the lack of water and swamp plants, like *Dusembaya*, *Nyssa*, *Potamogeton*) but by the floristic composition it fits well within the Floral Assemblage Seifhennersdorf – Kundratice, as defined by Kvaček and Walther (2001).

#### **Lipová (former Hainspach)**

The diatomite occurring at Lipová on the Farský Les (“Breiten Busch”) hill about 5 km west from Hrazený has been lately re-visited by amateur collectors (Jeremies 2006). Besides samples for the diatomological research, already reported by Řeháková (1958), several leaf impressions, partly with cuticles preserved, have been collected and are at our disposal (courtesy M. Jeremies, Weigsdorf-Köblitz). The flora includes *Taxodium dubium*, *Tetraclinis salicornioides*, *Engelhardia orsbergensis*, *Liriodendron procaccinii*, cf. *Dombeyopsis lobata*, *Laurophyllum markvarticense* (cuticles), *Daphnogene cinnamomifolia* f. *lanceolata* and some more fragments of leaves. The assemblage is similar to that from Hrazený.

#### **Markvartice (former Markersdorf) and Veselíčko (former Freudensheim)**

The sites are situated on the slopes of a hill called Veselka (or Vysoký Les) about 23 km southwest from Seifhennersdorf. The flora has many species in common with Seifhennersdorf, e.g. *Tetraclinis* (as *Libocedrites*), *Torreya*, *Ailanthus prescheri* (as *Myrica hakeaefolia sensu* Engelhardt), *Daphnogene*, *Laurophyllum pseudoprinceps*, *L. acutimontanum*, *Platanus neptuni*, *Prunus langsdorfii*, *Ampelopsis*, *Acer*, *Betula alboides* (as *Betula dryadum*), *Sloanea* (as *Dicotylophyllum sparsidentatum*), *Saportaspermum* cf. *occidentale* (as “*Embothrium*” cf. *salicinum*), *Oleinites maii* (as *Dicotylophyllum maii*), *Dicotylophyllum deichmuelleri* (as “*Viburnum*” *atlanticum*), *Rosa*, *Craigia* (as *Pteleaecarpum*) according to Bůžek et al. (1976) and *Sabal* cf. *lamanonis* (Z. K. own observation 2007 in coll. Austrian Geological Survey). However, it differs by the overwhelming proportion of lauroids and *Platanus neptuni* while deciduous taxa occur rarely and far less diversified than at Seifhennersdorf. As at Hrazený, *Liriodendron* is present, while *Engelhardia* and *Taxodium* are lacking.

Some intrazonal elements, e.g. *Taxodium* (as cf. *Glyptostrobus europaeus*) and *Nyssa* are shared with the swampy part of the Seifhennersdorf assemblage. Due to a more thermophilous aspect of the assemblage, the level of Markvartice and Veselíčko is considered younger, approaching the Late Rupelian climatic optimum (Kvaček and Walther 2001).

#### **Kundratice (former Kundratitz)**

This site called also “Jesuitengraben” lies in the heart of the České středohoří Mountains between Litoměřice and Ústí nad Labem more than 50 km SW from the Seifhennersdorf – Varnsdorf area, i.e. far from the discussed volcanic assemblages. The first monograph of the fossil flora by Engelhardt (1885) has recently been revised (Kvaček and Walther 1998). Considering its composition the plant assemblage of Kundratice matches well that from Seifhennersdorf in respect of zonal elements. Conifers are represented by the same species except endemic *Taxus engelhardtii*. Angiosperms are mostly shared with Seifhennersdorf (50 %) and also the proportion of deciduous vs. evergreen taxa corresponds, giving this assemblage an aspect of the Mixed Mesophytic Forest with a dominant deciduous broad-leaved component. This was also the reason why it has been included into the same floral assemblage Seifhennersdorf – Kundratice (Kvaček and Walther 1991). The age of Kundratice is  $32.75 \pm 0.82$  Ma (Bellon et al. 1998) and stresses a somewhat colder period before the Late Rupelian climatic optimum. It is true that any signs of swamp vegetation (*Taxodium* – *Nyssa* community) are lacking at Kundratice and aquatic plants are rare (cf. *Dusembaya* sp.). This difference is obviously due to another landscape setting within the volcanic area not suitable for the development of flat-land swampy environment.

#### **Bechlejovice (former Bachlsdorf)**

This site now falls into the administrative district of the town of Děčín (former Teschen), and is situated at a distance of 30 km SW from Seifhennersdorf – Varnsdorf area. The recently worked out flora of Bechlejovice (Kvaček and Walther 2004) is similar to that of Kundratice and Seifhennersdorf, but differs by the presence of some ancient Eocene elements (*Platanus schimperi*, *Sterculia crassineria*) and endemic *Mahonia* and *Ziziphus ziziphoides* f. *bilinica*. It is predominantly deciduous and almost lacks conifers, otherwise sharing most of the zonal components (*Juglandaceae*, *Betulaceae*, *Cercidiphyllum*, *Diospyros*, *Ampelopsis*, *Tilia*, *Craigia*, *Ailanthus prescheri*) with Seifhennersdorf. The radiometric dating published by Bellon et al. (1998) cannot be applied to the fossiliferous diatomite of Bechlejovice because they concern tephritic intrusions belonging to a much younger phase of volcanism (Cajz 2000). Considering more Eocene surviving elements, the Bechlejovice flora appears to be older than that of Seifhennersdorf and may start the succession of volcanic floras in the České středohoří Mountains after the Grand-Coupure event on the Eocene-Oligocene boundary (Kvaček and Walther 2003).

#### **Suletice area and Holý Kluk hill (former Sulloditz, Holaykluk) at Proboštov**

Both sites are situated near Ústí nad Labem across the Labe (Elbe) river valley within the České středohoří Mountains about 45 km SW from Seifhennersdorf. The so

far revised assemblages (Kvaček and Walther 1995, Radoň et al. 2006) appear similar to each other within this area. They are characterized by a pronounced representation of thermophilous elements (*Engelhardia*, *Platanus neptuni*, *Sloanea*, *Palaeohosiea*) and a new conifer *Calocedrus suleticensis* (also represented in the Late Oligocene sites Krumvíř in Moravia and Evros in Greece – Kvaček in Radoň et al. 2006). The radiometric age of the Holý Kluk site varies between 29 and 30 Ma (Radoň et al. 2006). The floras of Suledice and Holý Kluk were assigned to the floral assemblage Flörsheim – Nerchau because of warmer aspects and differences in the composition, although again, many taxa are shared with the zonal part of the Seifhennersdorf assemblage (Kvaček and Walther 1991). The swampy vegetation is lacking both at Suledice and at Holý Kluk.

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## Appendix

**Table 1.** List of taxa, frequencies and revisions of Engelhardt (1870) (frequency categories: I – over 100 specimens, II – 40 to 100, III – 10 to 39, IV – 1 to 9).

| family             | species                                               | frequency | Engelhardt (1870)                                         |
|--------------------|-------------------------------------------------------|-----------|-----------------------------------------------------------|
| Characeae          | Characeae gen. et sp. indet.                          | IV        |                                                           |
| Musci fam. inc.    | Musci gen. et sp. indet                               | III       |                                                           |
| Osmundaceae        | <i>Osmunda lignitum</i>                               | IV        |                                                           |
| Thelypteridaceae   | <i>Pronephrium styriacum</i>                          | IV        | <i>Lastraea dalmatica</i>                                 |
| Salviniaceae       | <i>Salvinia</i> sp.                                   | IV        |                                                           |
| Cupressaceae s. l. | <i>Taxodium dubium</i>                                | I         | <i>Taxodium dubium</i>                                    |
| Cupressaceae s. l. | cf. <i>Quasisequoia couttsiae</i>                     | IV        | <i>Glyptostrobus ungeri</i>                               |
| Cupressaceae s. l. | <i>Tetraclinis salicornioides</i>                     | II        |                                                           |
| Taxaceae s.l.      | <i>Torreya bilinica</i>                               | III       | <i>Podocarpus eocenica</i>                                |
| Taxaceae s.l.      | <i>Cephalotaxus parvifolia</i>                        | IV        |                                                           |
| Magnoliaceae       | <i>Magnolia seifhennersdorfensis</i>                  | II        | <i>Quercus desloesii</i>                                  |
| Magnoliaceae       | <i>Magnolia</i> cf. <i>denudataeformis</i>            | IV        |                                                           |
| Lauraceae          | <i>Laurophyllum acutimontanum</i>                     | II        |                                                           |
| Lauraceae          | <i>Laurophyllum pseudoprinceps</i>                    | IV        |                                                           |
| Lauraceae          | <i>Laurophyllum meuselii</i>                          | IV        |                                                           |
| Lauraceae          | <i>Laurophyllum</i> sp.                               | I         |                                                           |
| Lauraceae          | <i>Daphnogene cinnamomifolia</i>                      | IV        |                                                           |
| Lauraceae          | <i>Daphnogene cinnamomifolia</i> f. <i>lanceolata</i> | II        | <i>Cinnamomum lanceolatum</i>                             |
| Cabombaceae        | <i>Dusembaya seifhennersdorfensis</i>                 | I         | <i>Carpolithes seifhennersdorfensis</i>                   |
| Nymphaeales        | Nymphaeales fam. et gen. indet.                       | IV        |                                                           |
| Cercidiphyllaceae  | <i>Cercidiphyllum crenatum</i>                        | IV        |                                                           |
| Platanaceae        | <i>Platanus neptuni</i>                               | II        | <i>Myrica hakeaefolia</i> , <i>Terminalis radoboensis</i> |
| Ulmaceae           | <i>Ulmus fischeri</i>                                 | II        | <i>Planera ungeri</i> p.p.                                |
| Ulmaceae           | <i>Zelkova zelkovifolia</i>                           | IV        |                                                           |
| Celtidaceae        | <i>Celtis pirskenbergensis</i>                        | III       | ? <i>Ziziphus ungeri</i>                                  |
| ? Celtidaceae      | <i>Celtis</i> (?) <i>bohemica</i>                     | IV        |                                                           |
| Fagaceae           | <i>Quercus lonchitis</i>                              | III       | <i>Laurus primigenia</i>                                  |
| Fagaceae           | cf. <i>Eotrigonobalanus furcinervis</i>               | IV        |                                                           |
| Betulaceae         | <i>Betula alboides</i>                                | II        | <i>Betula alboides</i> , <i>Betula prisca</i>             |
| Betulaceae         | <i>Betula dryadum</i>                                 | IV        |                                                           |
| Betulaceae         | <i>Alnus gaudinii</i>                                 | IV        |                                                           |
| Betulaceae         | <i>Alnus kefersteinii</i>                             | III       | <i>Alnus kefersteinii</i>                                 |
| Betulaceae         | <i>Carpinus roscheri</i>                              | I         | <i>Carpinus grandis</i> p.p.                              |
| Betulaceae         | <i>Carpinus grandis</i>                               | I         | <i>Carpinus grandis</i> p.p.                              |
| Betulaceae         | <i>Carpinus cordataeformis</i>                        | IV        |                                                           |
| Betulaceae         | <i>Carpinus mediomontana</i>                          | II        |                                                           |
| Betulaceae         | <i>Carpinus</i> sp.                                   | III       |                                                           |
| Betulaceae         | <i>Ostrya atlantidis</i>                              | IV        |                                                           |
| Juglandaceae       | <i>Engelhardia orsbergensis</i>                       | IV        |                                                           |
| Juglandaceae       | <i>Engelhardia macroptera</i>                         | IV        |                                                           |
| Juglandaceae       | <i>Cyclocarya</i> sp.                                 | III       |                                                           |
| Juglandaceae       | <i>Carya fragiliformis</i>                            | I         | <i>Salix varians</i>                                      |
| Juglandaceae       | <i>Carya</i> cf. <i>quadrangula</i>                   | IV        | <i>Carya bilinica</i>                                     |
| Salicaceae         | <i>Salix varians</i>                                  | III       |                                                           |
| Salicaceae         | <i>Populus zaddachii</i>                              | III       |                                                           |



| family              | species                                      | frequency | Engelhardt (1870)                          |
|---------------------|----------------------------------------------|-----------|--------------------------------------------|
| Malvaceae s.l.      | <i>Tilia gigantea</i>                        | IV        |                                            |
| Malvaceae s.l.      | <i>Craigia bronnii</i>                       | II        |                                            |
| Malvaceae s.l.      | <i>Dombeyopsis lobata</i>                    | III       | <i>Ficus tiliaefolia (grandifolia)</i>     |
| Malvaceae s.l.      | <i>Dombeyopsis</i> sp.                       | IV        |                                            |
| Hydrangeaceae       | <i>Hydrangea microcalyx</i>                  | IV        | <i>Caesalpina micromera</i>                |
| Rosaceae            | <i>Rosa lignitum</i>                         | I         | <i>Myrsine celastroides</i>                |
| Rosaceae            | <i>Rosa saxonica</i>                         | IV        | <i>Diospyros saxonica</i>                  |
| Rosaceae            | cf. <i>Crataegus</i> sp.                     | IV        |                                            |
| Rosaceae            | <i>Prunus langsдорфii</i>                    | IV        |                                            |
| ? Rosaceae          | <i>Dicotylophyllum ungeri</i>                | IV        | <i>Celastrus ungeri</i>                    |
| Sapindaceae s.l.    | <i>Acer angustilobum</i>                     | I         | <i>Acer angustilobum</i>                   |
| Sapindaceae s.l.    | <i>Acer</i> cf. <i>dasy carpoides</i>        | IV        |                                            |
| Sapindaceae s.l.    | <i>Acer engelhardtii</i>                     | IV        |                                            |
| Sapindaceae s.l.    | <i>Acer palaeosaccharinum</i>                | III       |                                            |
| Sapindaceae s.l.    | <i>Acer pseudomonspessulanum</i>             | IV        |                                            |
| Sapindaceae s.l.    | <i>Acer rueminianum</i>                      | III       |                                            |
| Sapindaceae s.l.    | <i>Acer</i> cf. <i>tricuspidatum</i>         | II        | <i>Acer trilobatum</i>                     |
| Sapindaceae s.l.    | <i>Acer</i> spp. ( <i>fructus</i> )          | II        |                                            |
| Nyssaceae           | <i>Nyssa altenburgensis</i>                  | III       | <i>Lomatia pseudoilex, Quercus gmelini</i> |
| Nyssaceae           | <i>Nyssa disseminata</i>                     | IV        |                                            |
| Simaroubaceae       | <i>Ailanthus prescheri</i>                   | III       | <i>Cupania neptuni</i>                     |
| Oleaceae            | <i>Oleinites hallbaueri</i>                  | IV        |                                            |
| Oleaceae            | <i>Oleinites maii</i>                        | IV        |                                            |
| Araliaceae          | <i>Schefflera dorofeevii</i>                 | IV        |                                            |
| Aquifoliaceae       | <i>Ilex tenuiputamenta</i>                   | IV        |                                            |
| Icacinaceae         | <i>Palaeohosiea suleticensis</i>             | IV        |                                            |
| Vitaceae            | <i>Ampelopsis hibschi</i>                    | IV        |                                            |
| Vitaceae            | AMPELOPSIS cf. ROTUNDATA                     | IV        |                                            |
| Leguminosae         | <i>Leguminosites</i> sp. 1                   | III       |                                            |
| Leguminosae         | <i>Leguminosites</i> sp. 2                   | IV        |                                            |
| Leguminosae         | <i>Leguminosites</i> sp. 3                   | IV        |                                            |
| Leguminosae         | <i>Leguminosites</i> sp. 4                   | IV        |                                            |
| Leguminosae         | <i>Leguminosites</i> sp. 5                   | IV        |                                            |
| Leguminosae         | <i>Leguminosites</i> spp.                    | II        |                                            |
| Anacardiaceae       | <i>Toxicodendron herthae</i>                 | IV        |                                            |
| Ebenaceae           | <i>Diospyros brachysepala</i>                | IV        | <i>Diospyros brachysepala</i>              |
| Ebenaceae           | <i>Diospyros</i> sp.                         | IV        | <i>Juglans acuminata</i>                   |
| ? Lythraceae        | <i>Apocynophyllum neriifolium</i>            | IV        | <i>Ficus multinervis</i>                   |
| Dicotyledonae fam.  | <i>Dicotylophyllum deichmuelleri</i>         | IV        |                                            |
| Dicotyledonae fam.  | <i>Dicotylophyllum</i> sp. 1                 | IV        |                                            |
| Dicotyledonae fam.  | <i>Saportaspermum dieteri</i>                | IV        |                                            |
| Dicotyledonae fam.  | <i>Saportaspermum</i> cf. <i>occidentale</i> | IV        |                                            |
| Potamogetonaceae    | <i>Potamogeton seifhennersdorfensis</i>      | II        | <i>Potamogeton seifhennersdorfensis</i>    |
| Potamogetonaceae    | <i>Potamogeton</i> sp.                       | IV        |                                            |
| Smilacaceae         | <i>Smilax weberi</i>                         | IV        |                                            |
| Zingiberaceae       | <i>Spirematospermum wetzleri</i>             | IV        |                                            |
| Aracaceae           | <i>Sabal</i> cf. <i>lamanonis</i>            | IV        |                                            |
| Poaceae             | <i>Leersia seifhennersdorfensis</i>          | IV        |                                            |
| Liliopsida fam.     | Monocotyledonae gen. et sp. indet.           | I         |                                            |
| ? Angiospermae fam. | Rhizomes and roots                           | III       |                                            |

**Table 2. Nearest living relatives of fossil taxa.**

| Fossil taxa                                           | Comparison with living taxa                                                                               |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Characeae gen. et sp. indet.                          | cosmopolitan                                                                                              |
| Musci gen. et sp. indet                               | cosmopolitan                                                                                              |
| <i>Salvinia</i> sp.                                   | cosmopolitan.                                                                                             |
| <i>Taxodium dubium</i>                                | <i>Taxodium distichum</i> , <i>T. distichum</i> var. <i>imbricatum</i> , SE N America                     |
| cf. <i>Quasisequoia couttsiae</i>                     | extinct                                                                                                   |
| <i>Tetraclinis salicornioides</i>                     | extinct (? <i>Tetraclinis articulata</i> , SE Spain, Atlas Mts.)                                          |
| <i>Torreya bilinica</i>                               | <i>Torreya nucifera</i> , Japan                                                                           |
| <i>Cephalotaxus parvifolia</i>                        | extinct                                                                                                   |
| <i>Magnolia seifhennersdorfensis</i>                  | <i>Magnolia yulan</i> , <i>M. parviflora</i> , E Asia                                                     |
| <i>Magnolia</i> cf. <i>denudataeformis</i>            | <i>Magnolia denudata</i> , E Asia                                                                         |
| <i>Laurophyllum acutimontanum</i>                     | E Asia, hilly regions                                                                                     |
| <i>Laurophyllum pseudoprinceps</i>                    | E Asia, hilly regions                                                                                     |
| <i>Laurophyllum meuselii</i>                          | extinct                                                                                                   |
| <i>Daphnogene cinnamomifolia</i>                      | E Asia, hilly regions                                                                                     |
| <i>Daphnogene cinnamomifolia</i> f. <i>lanceolata</i> | E Asia, hilly regions                                                                                     |
| <i>Dusembaya seifhennersdorfensis</i>                 | <i>Brasenia purpurea</i> , tropical and extratropical waters, e.g. Japan, India, Australia, North America |
| <i>Platanus neptuni</i>                               | extinct (? <i>Platanus kerrii</i> , Laos)                                                                 |
| <i>Ulmus fischeri</i>                                 | <i>Ulmus americana</i> , NE North America                                                                 |
| <i>Zelkova zelkovifolia</i>                           | <i>Zelkova carpinifolia</i> , Caucasus, <i>Zelkova serrata</i> , China, Japan, Korea                      |
| <i>Celtis pirskenbergensis</i>                        | <i>Celtis occidentalis</i> , North America                                                                |
| <i>Celtis</i> (?) <i>bohemica</i>                     | ?                                                                                                         |
| <i>Quercus lonchitis</i>                              | <i>Quercus acutissima</i> , China, lower Yang-tze                                                         |
| cf. <i>Eotrigonobalanus furcinervis</i>               | extinct                                                                                                   |
| <i>Betula dryadum</i> , <i>B. alboides</i>            | <i>Betula maximowicziana</i> , Japan                                                                      |
| <i>Alnus gaudinii</i>                                 | <i>Alnus nitida</i> , India, Himalayas                                                                    |
| <i>Alnus kefersteinii</i>                             | <i>Alnus serrulata</i> , <i>A. rugosa</i> , eastern North America                                         |
| <i>Carpinus roscheri</i>                              | e.g. <i>Carpinus turczaninowii</i> , China                                                                |
| <i>Carpinus grandis</i>                               | e.g. <i>Carpinus cordata</i> , Japan                                                                      |
| <i>Carpinus cordataeformis</i>                        | e.g. <i>Carpinus cordata</i> , Japan .                                                                    |
| <i>Carpinus medimontana</i>                           | e.g. <i>Carpinus turczaninowii</i> , China                                                                |
| <i>Engelhardia orsbergensis</i>                       | <i>Engelhardia roxburghiana</i> , E Asia, <i>E. (Oreomunnea) mexicana</i> , Central America               |
| <i>Engelhardia macroptera</i>                         | <i>Engelhardia roxburghiana</i> , E Asia                                                                  |
| <i>Cyclocarya</i> sp.                                 | <i>Cyclocarya paliurus</i> , Central China, mountains                                                     |
| <i>Carya fragiliformis</i>                            | <i>Carya poilanei</i> group, E Asia                                                                       |
| <i>Carya</i> cf. <i>quadrangula</i>                   | <i>Carya poilanei</i> group, E Asia                                                                       |
| <i>Salix varians</i>                                  | <i>Salix bonplandiana</i> , eastern Mexico and Guatemala                                                  |
| <i>Populus zaddachii</i>                              | <i>Populus lasiocarpa</i> , China, E Szechuan, 1200 – 2400 m                                              |
| <i>Tilia gigantea</i>                                 | extinct (? <i>Tilia americana</i> , E North America)                                                      |
| <i>Craigia bronnii</i>                                | <i>Craigia yunnanensis</i> , S China, Tonkin                                                              |
| <i>Dombeyopsis lobata</i>                             | <i>Craigia yunnanensis</i> , S China, Tonkin                                                              |
| <i>Dombeyopsis</i> sp.                                | ? <i>Reevesia</i> spp., SE Asia, Central America                                                          |
| <i>Hydrangea microcalyx</i>                           | <i>Hydrangea paniculata</i> , E Asia, <i>H. petiolaris</i> North America                                  |
| <i>Rosa lignitum</i>                                  | <i>Rosa</i> spp., Central Asia                                                                            |
| <i>Rosa saxonica</i>                                  | extinct                                                                                                   |
| cf. <i>Crataegus</i> sp.                              | ?                                                                                                         |
| <i>Prunus langsdorfii</i>                             | <i>Prunus humilis</i> , China, <i>Prunus japonica</i> , Japan, China, Manchuria                           |

| Fossil taxa                                  | Comparison with living taxa                                                         |
|----------------------------------------------|-------------------------------------------------------------------------------------|
| <i>Dicotylophyllum ungeri</i>                | ? Prunoideae, E Asia                                                                |
| <i>Acer angustilobum</i>                     | <i>Acer heidreichii</i> , <i>A. pseudoplatanus</i> , Central and S Europe, Caucasus |
| <i>Acer</i> cf. <i>dasycarpoides</i>         | <i>Acer saccharinum</i> , E North America                                           |
| <i>Acer engelhardtii</i>                     | extinct                                                                             |
| <i>Acer pseudomonspessulanum</i>             | <i>Acer monspessulanum</i> W and S Europe                                           |
| <i>Acer palaeosaccharinum</i>                | <i>Acer saccharum</i> , E North America, Canada                                     |
| <i>Acer ruemianum</i>                        | <i>A. pilosum</i> , W Asia, China                                                   |
| <i>Acer</i> cf. <i>tricuspidatum</i>         | <i>Acer saccharinum</i> , <i>A. rubrum</i> , E North America                        |
| <i>Acer</i> spp. (fructus)                   | ?                                                                                   |
| <i>Nyssa altenburgensis</i>                  | <i>Nyssa aquatica</i> , <i>N. biflora</i> , SE North America                        |
| <i>Nyssa disseminata</i>                     | <i>Nyssa sylvatica</i> , E North America                                            |
| <i>Ailanthus prescheri</i>                   | <i>Ailanthus excelsa</i> , India, Himalayas                                         |
| <i>Oleinites hallbaueri</i>                  | extinct Oleaceae                                                                    |
| <i>Oleinites maii</i>                        | evergreen Oleaceae, E Asia                                                          |
| <i>Schefflera dorofeewii</i>                 | subtropical humid forests, e.g. Ecuador                                             |
| <i>Ilex tenuiputamenta</i>                   | <i>Ilex coriacea</i> , <i>I. glabra</i> , North America                             |
| <i>Palaeohosiea suleticensis</i>             | extinct (? <i>Hosiea</i> , W and C China, Japan)                                    |
| <i>Ampelopsis hibschi</i>                    | <i>A. japonica</i> , Japan                                                          |
| <i>Ampelopsis</i> cf. <i>rotundata</i>       | <i>A. heterophylla</i> , <i>A. fargesii</i> , E Asia                                |
| <i>Leguminosites</i> 1–5, spp.               | ?                                                                                   |
| <i>Dicotylophyllum deichmuelleri</i>         | ? evergreen Symplocaceae, E Asia                                                    |
| <i>Dicotylophyllum</i> sp. 1                 | ?                                                                                   |
| <i>Diospyros brachysepala</i>                | North America and E Asia, Asa Gray disjunction                                      |
| <i>Diospyros</i> sp.                         | ?                                                                                   |
| <i>Apocynophyllum neriifolium</i>            | extinct                                                                             |
| <i>Saportaspermum dieteri</i>                | ?                                                                                   |
| <i>Saportaspermum</i> cf. <i>occidentale</i> | ?                                                                                   |
| <i>Toxicodendron herthae</i>                 | <i>Toxicodendron</i> spp., E North America                                          |
| <i>Potamogeton seifhennersdorfensis</i>      | <i>Potamogeton pusillus</i> , cosmopolitan                                          |
| <i>Potamogeton</i> sp.                       | ?                                                                                   |
| <i>Smilax weberi</i>                         | <i>Smilax macrophylla</i> , India, E Himalayas                                      |
| <i>Spirematospermum wetzleri</i>             | extinct (? <i>Cenolophon oxymitrum</i> , Thailand)                                  |
| <i>Sabal</i> cf. <i>lamanonis</i>            | <i>Sabal minor</i> , <i>S. palmetto</i> , SE North America                          |
| <i>Leersia seifhennersdorfensis</i>          | <i>Leersia hexandra</i> , E Asia, Java, <i>L. virginiana</i> , North America        |
| <i>Monocotyledonae</i> gen. et sp. indet.    | ?                                                                                   |

## Spodnooligocénní flóra ze Seifhennersdorfu (Sasko)

Harald Walther – Zlatko Kvaček

V této syntetickém studii o oligocénní makroflóře z diatomitu od Seifhennersdorfu jsou shrnuta a zpřesněna všechna dosavadní pojednání týkající se olistění, plodů a semen. Práce zahrnuje i zpracování rozsáhlého nově získaného materiálu, který byl shromážděn různými sběrateli a doposud nebyl detailně zhodnocen. Flóra obsahuje 94 morfologických druhů, jež náležejí jednomu ze skupiny parožnatek (Charophyceae), jednomu ze skupiny mechorostů (Musci), třem kapradinám, pěti jehličnanům a 84 krytosemenným rostlinám. Jsou popsány tři nové druhy *Carpinus roscheri* WALTHER et KVAČEK sp. n., *Laurophyllum meuselii* WALTHER et KVAČEK sp. n., *Magnolia seifhennersdorfensis* WALTHER et KVAČEK sp. n. a *Saportaspermum dieteri* KVAČEK et WALTHER sp. n. a navrženo pět nových kombinací a emendací: *Betula alboides* ENGELHARDT emend., *Carya fragiliformis* (STERNBERG) KVAČEK et WALTHER comb. n., *Celtis pirskenbergensis* (KNOBLOCH) KVAČEK et WALTHER stat. n., *Rosa saxonica* (ENGELHARDT) WALTHER et KVAČEK comb. n. a *Dicotylophyllum ungeri* (ENGELHARDT) WALTHER et KVAČEK comb. n.

## Die Unteroligozäne Flora von Seifhennersdorf (Sachsen)

Harald Walther – Zlatko Kvaček

Es wird eine umfassende taxonomische Bearbeitung der unteroligozänen Makroflora aus den Diatomiten (Polierschiefer) von Seifhennersdorf vorgestellt, die die bisherigen Kenntnisse über Blätter, Früchte und Samen zusammenfasst, erweitert und revidiert. Bei der Auswertung werden die umfangreichen, bisher nicht im Detail bearbeiteten Belege (ca. 10 000 Stück), die von verschiedenen Sammlern zusammengetragen wurden, mit einbezogen. Die Flora setzt sich aus 94 Formarten (Morpho-Spezies) zusammen die sich aus einer Charophyceae (Armeleuchteralge), einer Bryophyta (Moospflanze); drei Farnarten, fünf Koniferen-Arten und 84 Arten von Angiospermen zusammen. Es werden vier neue Formarten (Morpho-species) beschrieben: *Carpinus roscheri* WALTHER et KVAČEK sp. n., *Laurophyllum meuselii* WALTHER et KVAČEK sp. n. *Magnolia seifhennersdorfensis* WALTHER et KVAČEK sp. n. und *Saportaspermum dieteri* KVAČEK et WALTHER sp. n. sowie fünf Neukombinationen und Emendationen (Berichtigungen) vorgeschlagen: *Betula alboides* ENGELHARDT emend., *Celtis pirskenbergensis* (KNOBLOCH) KVAČEK et WALTHER stat. n. *Rosa saxonica* (ENGELHARDT) WALTHER et KVAČEK comb. n. und *Dicotylophyllum ungeri* (ENGELHARDT) WALTHER et KVAČEK comb. n. Die Floren vom gleichen geologischen Komplex wie Varnsdorf (Altvarnsdorf, Varnsdorf) und von den nahen vulkanischen Gebieten vom Hrazený (Pirskenberg)

Dále jsou diskutovány vztahy k flóře ze stejného vulkanického komplexu od Varnsdorfu a z dalších blízkých nalezišť vulkanického původu z vrchu Hrazený u Knížecí, od Lipové u Šluknova, od Markvartic a od Kundratic v severních Čechách. Stáří diatomitu od Seifhennersdorfu a Varnsdorfu je odhadováno podle radiometrického K-Ar datování nadložního bazaltoidu na 30,2 až 30,5 Ma. Různý faciální vývoj způsobil, že vegetace Seifhennersdorfu se výrazněji liší od ostatních přibližně stejně starých nalezišť Českého středohoří a jeho periferie v severních Čechách vyšším zastoupením vodní a příbřežní (azonální, tj. intrazonální) složky. Zonální část vegetace odpovídá smíšeném mezofytinému lesu teplého mírného pásma. Podle koexistenční metody lze odhadnout střední roční teplotu 15,6° až 15,9° C, střední teplotu nejstudenějšího měsíce 5,0° až 5,2° C, střední teplotu nejteplejšího měsíce 25,7° až 25,9° C; průměr úhrnu ročních srážek 897 až 971 mm, úhrn srážek v nejvlhčím měsíci 117 až 133 mm, srážek v nejsušším měsíci 43 až 47 mm a úhrn srážek v nejteplejším měsíci 118 až 131 mm.

bei Knížecí (Fürstenwalde), Lipová (Hainspach) bei Šluknov (Schlukenau), Markvartice (Markersdorf) und Veselíčko (Freudensheim), Bechlejovice (Bachlsdorf), Sulečice (Sulloditz), Berand, Holý Kluk bei Proboštov (Holaykluk) und Kundratice (Kundratitz) in Nordböhmen ebenfalls diskutiert. Das Alter der beiden Diatomit-Vorkommen von Seifhennersdorf und Varnsdorf beträgt nach radiometrischen Untersuchungen, K – Ar Datierung, 30, 2 bis 30, 5 Ma. Nach der verschiedenen Fazies und den Schichtenfolgen lässt sich die fossile Vegetation von Seifhennersdorf deutlich von Pflanzengesellschaften aus dem Böhmischem Mittelgebirge und seiner Umgebung in Nordböhmen durch das stärker betonte Auftreten azonaler Elementen von Wasserpflanzen- und Auenwald-Gesellschaften unterscheiden. Der zonale Teil der Vegetation entspricht einem warmtemperierten Mixed Mesophytic Forest (Mischwald aus immergrünen und sommergrünen Taxa). Nach der Ko-existenz-Methode wurden die folgenden paläoklimatischen Daten abgeleitet: Mittlere jährliche Temperatur 15,6° bis 15,9° C, mittlere Temperatur des kältesten Monats 5,0° bis 5,2° C, mittlere Temperatur des wärmsten Monats 25,7° bis 25,9° C, jährliche Niederschläge 897 bis 971 mm, mittlere Niederschläge des wettesten Monats 117 bis 133 mm, mittlere Niederschläge des trockensten Monats 43 bis 47 mm, mittlere Niederschläge des wärmsten Monats 118 bis 131 mm.

## Explanation of the plates

### PLATE 1

#### **Characeae gen. et sp. indet.**

1. Fully flattened gyrogonites scattered on a bedding plane, Sf. 7493 (scale bar 2 mm).
2. Detail of gyrogonites, same specimen (scale bar 0.8 mm).

#### **Musci gen. et sp. indet.**

3. Fragment of a branched gametophyte, Sf. 3287b (scale bar 5 mm).
4. Detail of a leafy branch, Sf. 6458 (scale bar 2 mm).
5. Gametophytes covering a bedding plane, the same specimen (scale bar 5 mm).

#### **Osmunda lignitum (GIEBEL) STUR**

6. Fragmentary pinna showing venation, Sf. 8348, orig. Walther 1967, pl. 3, figs 1–2, text-figs 1, 2 (scale bar 10 mm).

#### **Pronephrium stiriacum (UNGER) KNOBLOCH et KVAČEK**

7. Fragmentary pinna with almost fused pinnules, Sf. 6445 (scale bar 10 mm).
8. Fertile pinna with almost free pinnules, Sf. 6052 (scale bar 5 mm).
9. Detail of sori within a pinnule, the same specimen (scale bar 2 mm).

#### **Salvinia sp.**

10. Fragmentary young plant with submerged frond dissected into segments, Sf. 6450 (scale bar 3 mm).
11. Detail of quadrangular areoles, the same specimen (scale bar 0.5 mm).

### PLATE 2

#### **Taxodium dubium (STERNBERG) HEER**

1. Deciduous ultimate shoot, Sf. 593 (scale bar 10 mm).
2. Similar shoot in compression – impression mode of preservation, Sf. 294 (scale bar 10 mm).
3. Fertile branch with male cones, Sf. 7060 (scale bar 10 mm).
4. Seed, Sf. 3308c, orig. Mai 1963, pl. 1, fig. 11 (scale bar 3 mm).
5. Branch with broader needles, Sf. 3300, orig. Mai 1963, pl. 1, fig. 3, as “*Sequoia langsdorfii*” (scale bar 5 mm).
6. Detail of the same specimen (scale bar 3 mm).
7. Seed cone scale compressed from outside, with a few blunt tubercles, Sf. 8246, orig. Mai 1963, pl. 11, fig. 6, as “*Trapa silesiaca*” (scale bar 3 mm).
8. Cone scale compressed longitudinally showing blunt apex and thickened terminal part, Sf. 3361 (scale bar 3 mm).
9. Seed cone scale compressed from outside, with sharp tubercles (“*balticum*” – type), Sf. 7387 (scale bar 3 mm).
10. Obliquely compressed cone scale with almost smooth terminal part, Sf. 3295a, orig. Mai 1963, pl. 1, fig. 14, as “*Pinus ornata*” (scale bar 3 mm).

#### **cf. Quasisequoia couttsiae (HEER) KUNZMANN**

11. Fertile shoot with terminal male cones, Sf. 8255, orig. Engelhardt 1870, pl. 1, fig. 8, as “*Glyptostrobus Ungerii*” (scale bar 10 mm).
12. Detail of male cones, the same specimen (scale bar 5 mm).
13. Sterile leafy branches, Sf. 195 (scale bar 10 mm).

#### **Tetraclinis salicornioides (UNGER) KVAČEK**

14. Ultimate fragmentary branch, Sf. 7196, orig. Walther 1964, pl. 5, fig. 9, as *Libocedrus salicornioides* (scale bar 5 mm).
15. Branch with broadened medial leaf segments, Sf. 7194 (scale bar 10 mm).
16. Fragment of ultimate branch with incompletely fused scale leaves, Sf. 3217 (scale bar 3 mm).
17. Basally 2-winged seed, KM III 1208c (scale bar 3 mm).

#### **Cephalotaxus parvifolia (WALTHER) KVAČEK et WALTHER**

18. Fragmentary needle from below with broad indistinct stomatal bands, Sf. 4453 (scale bar 5 mm).
19. Isolated compression of a needle, holotype, Sf. 3732, orig. Walther 1964, as “*Amentotaxus parvifolia*” (scale bar 5 mm).

#### **Torreya bilinica SAPORTA et MARION**

20. Needle with preserved base, Sf. 3304, orig. Mai 1963, as “*Podocarpus eocenica*” (scale bar 10 mm).
21. Medial part of a needle with narrow stomatal bands, Sf. 4451 (scale bar 10 mm).
22. Needle with preserved rounded apex, Sf. 8252 (scale bar 5 mm).
23. Needle with preserved base and stomatal bands, Sf. 4109a (scale bar 10 mm).
24. Complete needle with acute apex, Sf. 5908b (scale bar 5 mm).

### PLATE 3

#### **Magnolia seiffhennersdorfensis WALTHER et KVAČEK sp. nov.**

1. Almost complete leaf, Sf. 4441, holotype (scale bar 10 mm).
2. Another leaf compression, Sf. 6319 (scale bar 10 mm).

#### **Magnolia cf. denudataeformis DOROFEEV**

3. Carbonized seed 3-dimensionally preserved, Sf. KM III 1261c, orig. Mai 1963, pl. 7, fig. 4 (scale bar 5 mm).
4. Reverse side of the same specimen (scale bar 5 mm).

#### **Laurophyllum meuselii WALTHER et KVAČEK sp. nov.**

5. Leaf compression, holotype, Sf. 2451 (scale bar 10 mm).
6. Leaf compression with preserved base, Sf. 2566 (scale bar 10 mm).

#### **Laurophyllum acutimontanum MAI**

7. Leaf compression with preserved apex, Sf. 4436 (scale bar 10 mm).

#### **Laurophyllum pseudoprinceps WEYLAND et KILPPER**

8. Leaf compression with preserved base, Sf. 3493 (scale bar 10 mm).

### PLATE 4

#### **Laurophyllum acutimontanum MAI**

1. Almost complete leaf compression, Sf. 2453 (scale bar 10 mm).
2. Leaf compression with preserved petiolate base, Sf. 142 (scale bar 10 mm).
3. Fragmentary leaf with typical venation, Sf. 6198 (scale bar 10 mm).
4. Another incomplete leaf compression, Sf. KM III 1262c (scale bar 10 mm).

5. Another fragmentary leaf with typical venation, Sf. 6209 (scale bar 10 mm).

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

6. Small leaf, Sf. KM III 1269c, orig. Mai 1963, pl. 8, fig. 11, as "*Laurophyllum acutimontanum*" (scale bar 5 mm).
7. Standard leaf compression, Sf. KM III 1261c, orig. Mai 1963, pl. 8, fig. 4, as "*Cinnamomophyllum (Cinnamomum) scheuchzeri*" (scale bar 10 mm).
8. Extremely broad leaf, Sf. 20, orig. Kvaček and Walther 1974, pl. 1, fig. 4 (scale bar 10 mm).

***Daphnogene cinnamomifolia* (BRONGNIART) UNGER  
forma *lanceolata* (UNGER) KVAČEK et WALTHER**

9. Smaller leaf compression, Sf. 5990 (scale bar 10 mm).
10. Bigger leaf compression, Sf. 5996 (scale bar 10 mm).

## PLATE 5

***Dusembaya seifhennersdorfensis* (ENGELHARDT) MAI**

1. Seeds, lectotype (below) and paratype (above), Sf. 8289, orig. Engelhardt 1870, pl. 8, fig. 4, as "*Carpolithes seifhennersdorfensis*" (scale bar 3 mm).
2. Detail of ellipsoidal isolated seed compression 3-dimensionally preserved, Sf. 3204a (scale bar 2 mm).
3. Detail of broadly discoid isolated seed compression 3-dimensionally preserved, Sf. 3204b (scale bar 2 mm).

**Nymphaeales fam. et gen. indet.**

4. Complete leaf, Sf. 4374 (scale bar 5 mm).
5. Detail of venation, the same specimen (scale bar 3 mm).

***Cercidiphyllum crenatum* (UNGER) R. BROWN**

6. Winged seed, Sf. 8234, orig. Mai 1963, pl. 8, fig. 2 (scale bar 2 mm).
7. Incomplete leaf with well preserved margin, Sf. 3439a (scale bar 10 mm).
8. Almost complete leaf, Sf. 4080a (scale bar 10 mm).

## PLATE 6

***Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK**

1. Broader leaf form, Sf. 6419 (scale bar 10 mm).
2. Standard leaf form, KM III 1221c (scale bar 10 mm).
3. Stalked abortive infructescence, Sf. 6429 (scale bar 5 mm).
4. Stipule, KM III 209c, orig. Mai 1963, pl. 1, fig. 5, as "*Hellia salicornioides*" (scale bar 10 mm).
5. Probable abortive female inflorescence, Sf. 6627, orig. Mai 1963, pl. 12, fig. 5, as "*Sparganium neptunii*", Kvaček and Manchester 2004, fig. 2i (scale bar 5 mm).
6. Mature infructescence, Sf. 8381, orig. Walther 1964, pl. 7, figs 7–8, as "*Liquidambar europaea*" (scale bar 5 mm).

***Ulmus fischeri* HEER**

7. Standard almost complete leaf, Sf. 7236 (scale bar 10 mm).
8. Small leaf form with simple teeth, Sf. 8338, orig. Walther 1964, pl. 15, fig. 1 as "*Zelkova Ungeri*" (scale bar 10 mm).

***Zelkova zelkovifolia* (UNGER) BŮŽEK et KOTLABA**

9. Obliquely asymmetrical leaf, Sf. 7210 (scale bar 10 mm).

10. Almost complete leaf, Sf. 7225 (scale bar 10 mm).
11. Leaf base, Sf. 7216 (scale bar 10 mm).
12. Complete leaf, Sf. 7237 (scale bar 10 mm).
13. Aberrant fragmentary leaf, Sf. 7209 (scale bar 10 mm).

## PLATE 7

***Celtis pirskenbergensis* (KNOBLOCH) KVAČEK et WALTHER stat. n.**

1. Leaf with venation, Sf. 2340 (scale bar 10 mm).
2. Detail of fig. 1 (scale bar 5 mm).
3. Leaf base with venation, Sf. 2354 (scale bar 10 mm).
4. Detail of fig. 3 (scale bar 5 mm).
5. Almost complete leaf, Sf. 2377 (scale bar 10 mm).
6. Leaf impression (negative), Sf. 2353 (scale bar 10 mm).
7. Detail of the same specimen (scale bar 5 mm).
8. Large leaf, Sf. KM III 1255c, orig. Mai 1963, pl. 6, fig. 8, as "*Celtis cf. begonioides*" (scale bar 10 mm).

## PLATE 8

***Celtis (?) bohémica* ENGELHARDT**

1. Stalked leaf base, Sf. 2234.1 (scale bar 10 mm).

***Eotrigonobalanus furcinervis* (ROSSMÄSSLER) WALTHER et KVAČEK**

2. Incomplete leaf base with venation, Sf. 1248 (scale bar 10 mm).

***Quercus lonchitis* UNGER**

3. Fragmentary narrow leaf, Sf. 1425 (scale bar 10 mm).
4. Detail of the same specimen (scale bar 5 mm).
5. Another leaf fragment, Sf. 2259 (scale bar 10 mm).
6. Detail of the same specimen (scale bar 10 mm).
7. Almost complete leaf compression, Sf. 8253 (scale bar 10 mm).
8. Detail of the same specimen (scale bar 5 mm).

***Ostrya atlantidis* UNGER**

9. More complete leaf, Sf. 4849 (scale bar 10 mm).

## PLATE 9

***Betula dryadum* BRONGNIART**

1. Fruit bract, Sf. 3317, orig. Mai 1963, pl. 5, fig. 9 (scale bar 2 mm).

***Betula alboides* ENGELHARDT emend.**

2. Poorly preserved leaf, holotype, Sf. 8264, orig. Engelhardt 1870, pl. 3, fig. 23 (scale bar 5 mm).
3. Larger leaf form, Sf. 1705 (scale bar 5 mm).
4. Smaller leaf form, Sf. 1911 (scale bar 5 mm).
5. Small leaf with less deeply dissected margin, Sf. 3730, orig. Walther 1964, pl. 7, fig. 1, as "*Betula subpubescens*" (scale bar 5 mm).
6. Small leaf with deeply dissected margin, Sf. 4361 (scale bar 10 mm).
7. Detail of margin, the same specimen (scale bar 5 mm).

***Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK**

8. Almost complete leaf, Sf. 6160 (scale bar 10 mm).
9. Leaf base with venation, Sf. 6197 (scale bar 10 mm).
10. Detail of the same specimen (scale bar 5 mm).

***Alnus kefersteinii* (GOEPPERT) UNGER**

11. Stalked infructescence, Sf. 3741, orig. Walther 1964, pl. 17, fig. 6 (scale bar 5 mm).
12. Group of three infructescences on a common stalk, Sf. 4702 (scale bar 5 mm).

**PLATE 10**

***Carpinus roscheri* WALTHER et KVAČEK sp. n.**

1. Broad leaf form, Sf. 8272, orig. Engelhardt 1870, pl. 4, fig. 2, as *Carpinus grandis* (scale bar 10 mm).
2. Standard leaf, holotype, Sf. 8408 (45), orig. Mai 1963, pl. 4, fig. 5, as "*Carpinus cf. grandis*", Walther 1964, pl. 8, fig. 4, as *Corylus macquarii* (scale bar 10 mm).
3. Leaf fragment with deeply incised teeth, Sf. 8115 (scale bar 10 mm).
4. Detail of the same specimen (scale bar 5 mm).
5. Large leaf, Sf. 8488, (scale bar 10 mm).

***Carpinus grandis* UNGER**

6. Standard leaf form, Sf. 3314, orig. Mai 1963, pl. 4, fig. 7, as "*Carpinus cf. grandis*" (scale bar 5 mm).
7. Small leaf form, Sf. 1672 (scale bar 5 mm).

***Carpinus mediomontana* MAI**

8. Large fruit bract, Sf. 8249a (scale bar 5 mm).
9. More dissected bract, Sf. 4820 (scale bar 5 mm).

***Carpinus cordataeformis* MAI**

10. Fruit bract, Sf. 3331, holotype, orig. Mai 1963, pl. 4, fig. 1, text-fig. 6b (scale bar 5 mm).
11. Larger fruit bract, Sf. 3188, det. D. H. Mai (scale bar 5 mm).

**PLATE 11**

***Carya fragiliformis* (STERNBERG) KVAČEK et WALTHER comb. n.**

1. Leaflet fragment with well visible venation, Sf. 40, orig. Walther 1964, pl. 9, fig. 4, as "*Carya serraefolia*" (scale bar 10 mm).
2. Complete leaflet, Sf. 49, orig. Walther 1964, pl. 10, fig. 1, as "*Carya serraefolia*" (scale bar 10 mm).
3. Falcate lateral leaflet, Sf. 14b (scale bar 10 mm).

***Carya cf. quadrangula* (KIRCHHEIMER) LEROY**

4. Fruit compression, Sf. 8243, orig. Mai 1963, pl. 3, fig. 5, as "*Carya cf. costata*" (scale bar 5 mm).

***Cyclocarya* sp.**

5. Leaflet compression, Sf. 3292a, orig. Mai 1963, pl. 3, fig. 1, as "*Cyclocarya cyclocarpa*" (scale bar 10 mm).
6. Detail of the same specimen (scale bar 10 mm).
7. Terminal leaflet, Sf. 14, orig. Walther 1964, pl. 11, fig. 6, as "*Cyclocarya cyclocarpa*" (scale bar 10 mm).

***Engelhardia macroptera* (BRONGNIART) UNGER**

8. Fruit impression, Sf. 6047 (scale bar 10 mm).
9. Counter compression of the same specimen, Sf. 6048 (scale bar 10 mm).

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

10. Lateral leaflet, Sf. 6049 (scale bar 10 mm).

**PLATE 12**

***Salix varians* GOEPPERT**

1. Leaf, Sf. 17a, orig. Walther 1964, pl. 9, fig. 3 (scale bar 10 mm).
2. Detail of margin, the same specimen (scale bar 3 mm).

***Populus zaddachii* HEER**

3. Incomplete leaf, Sf. 6460 (scale bar 10 mm).

***Sloanea artocarpites* (ETTINGSHAUSEN) KVAČEK et HABLY**

4. Incomplete leaf, Sf. 6053 (scale bar 10 mm).
5. Detail of the same specimen (scale bar 1 mm).

***Tilia gigantea* ETTINGSHAUSEN**

6. Incomplete leaf, Sf. 4357 (scale bar 10 mm).

**PLATE 13**

***Dombeyopsis lobata* UNGER**

1. Leaf base, Sf. 4342b (scale bar 10 mm).

***Dombeyopsis* sp.**

2. Lower part of leaf impression, Sf. 6000:1 (scale bar 10 mm).

***Craigia bronnii* (UNGER) KVAČEK, BŮŽEK et MANCHESTER**

3. Capsule valve, Sf. 5935 (scale bar 5 mm).
4. Capsule valve, KM III 1278c (scale bar 5 mm).
5. Folded capsule valve, Sf. 5915:1 (scale bar 5 mm).
6. Large capsule valve, Sf. 5941 (scale bar 5 mm).

***Hydrangea microcalyx* SIEBER**

7. Detached sepal, KM III 1275c, orig. Mai 1963, pl. 10, fig. 8 (scale bar 5 mm).
8. Another sepal, Sf. 8280, orig. Engelhardt 1870, pl. 5, fig. 17, as "*Caesalpinia micromera*" (scale bar 5 mm).

**PLATE 14**

***Rosa saxonica* (ENGELHARDT) KVAČEK et WALTHER comb. nov.**

1. Compressed fruit, Sf. 8283, holotype, orig. Engelhardt 1870, pl. 5, fig. 11, as "*Diospyros saxonica*" (scale bar 10 mm).
2. Detail showing impressions of fruitlets, the same specimen (scale bar 5 mm).

***Rosa lignitum* HEER**

3. Leaflet impression (negative), Sf. 6536:2 (scale bar 10 mm).
4. Large leaflet, Sf. 7238 (scale bar 10 mm).
5. Two leaflets attached, Sf. 3368 (scale bar 10 mm).
6. Small leaf, Sf. 140 (scale bar 10 mm).
7. Large leaf, Sf. 2800 (scale bar 10 mm).

**PLATE 15**

***cf. Crataegus* sp.**

1. Fragmentary leaf, Sf. 3287 (scale bar 5 mm).

***Prunus langsдорffii* KIRCHHEIMER**

2. Endocarp, Sf. 8245, orig. Mai 1963, pl. 10, fig. 4c (scale bar 3 mm).
3. Endocarp impression, Sf. 8245, orig. Mai 1963, pl. 10, figs 4a, b (scale bar 3 mm).
4. Another endocarp impression, Sf. 8236 (scale bar 3 mm).

***Dicotylphyllum ungeri* (ENGELHARDT) KVAČEK et WALTHER comb. n.**

5. Fragmentary leaf, Sf. 8286b, holotype, orig. Engelhardt 1870, pl. 6, fig. 18 (scale bar 10 mm).
6. Leaf apex Sf. 8286a, lectotype, orig. Engelhardt 1870, pl. 6, fig. 18 (scale bar 10 mm).
7. Detail of the same specimen (scale bar 5 mm).

***Acer engelhardtii* WALTHER**

8. Incomplete leaf, Sf. 74, orig. Walther 1972, pl. 37, fig. 5 (scale bar 10 mm).

***Acer angustilobum* HEER sensu HANTKE**

9. Fragmentary small leaf, Sf. 1680 (scale bar 10 mm).
10. Almost complete leaf, Sf. 4404 (scale bar 10 mm).

***Acer palaeosaccharinum* STUR s. l.**

11. Leaf fragment, Sf. 4145:2 (scale bar 10 mm).

***Acer* spp.**

12. Partial samara, Sf. 8402:1 (scale bar 10 mm).
13. Similar partial samara, Sf. 8396 (scale bar 10 mm).
14. Partial samara with a very short attachment scar, Sf. 8313, "*Acer dasycarpoides*" sensu Mai 1995, text-fig. 59, (scale bar 10 mm).
15. Complete fruit, Sf. 8251, orig. Mai 1963, pl. 10, fig. 14, as "*Acer angustilobum*" (scale bar 10 mm).

**PLATE 16**

***Acer pseudomonspessulanum* UNGER**

1. Incomplete leaf, KM III 298 (scale bar 10 mm).

***Acer* cf. *tricuspidatum* BRONN**

2. Incomplete leaf, Sf. 37b, orig. Walther 1964, pl. 23, fig. 8 (scale bar 10 mm).
3. Almost complete leaf, Sf. 8291, orig. Engelhardt 1870, pl. 8, fig. 2, as "*Acer trilobatum*" (scale bar 10 mm).

***Acer ruemianum* HEER sensu HANTKE**

4. Standard leaf form, Sf. 4339 (scale bar 10 mm).
5. Quinquelobate leaf form, Sf. 4514 (scale bar 10 mm).

**PLATE 17**

***Nyssa disseminata* (LUDWIG) KIRCHHEIMER**

1. Fruit compression, Sf. 3307, orig. Mai 1963, pl. 12, fig. 2 (scale bar 3 mm).

***Nyssa altenburgensis* WALTHER et KVAČEK**

2. Shallow dentate leaf compression, Sf. 4445 (scale bar 10 mm).
3. Large coarsely dentate leaf, Sf. 8233:1, orig. Kvaček and Walther 1981, pl. 3, fig. 2, as "cf. *Nyssa altenburgensis*" (scale bar 10 mm).
4. Detail of the same specimen (scale bar 10 mm).

***Ailanthus prescheri* WALTHER**

5. Leaflet fragment, Sf. 6520 (scale bar 10 mm).
6. Detail of the same specimen (scale bar 3 mm).
7. Complete leaflet, Sf. 6519 (scale bar 10 mm).

***Oleinites hallbaueri* (MAI) SACHSE**

8. Leaf base, holotype, Sf. 3294, orig. Mai 1963, pl. 2, fig. 4, text-fig. 3a (scale bar 10 mm).
9. Detail of the same specimen (scale bar 5 mm).

***Oleinites maii* (BŮŽEK, HOLÝ et KVAČEK) SACHSE**

10. Leaf base, Sf. 3352 (scale bar 10 mm).

**PLATE 18**

***Schefflera dorofeevii* ŁAŃCUCKA-ŚRODONIOWA**

1. Carbonized endocarp, Sf. 3189 (scale bar 2 mm).

***Ilex tenuiputamenta* MAI**

2. Isolated carbonized endocarp, Sf. 8242, holotype, orig. Mai 1970, pl. 62, fig. 5 (scale bar 2 mm).

***Palaeohosiea sulleticensis* KVAČEK et BŮŽEK**

3. Endocarp impression, Sf. 7458 (scale bar 5 mm).
4. Endocarp impression, Sf. 8235, orig. Mai 1963, pl. 10, fig. 2, as "*Prunus bilinica*" (scale bar 5 mm).

***Ampelopsis* cf. *rotundata* CHANDLER**

5. Seed impression from ventral side, Sf. 3318a, orig. Mai 1963, pl. 11, fig. 5b, as "*Vitis teutonica*" (scale bar 2 mm).
6. Counterpart of the same specimen showing seed impression from dorsal side, Sf. 3318b, orig. Mai 1963, pl. 11, fig. 5a, as "*Vitis teutonica*" (scale bar 2 mm).

***Ampelopsis hibschi* BŮŽEK, KVAČEK et WALTHER**

7. Leaf fragment, Sf. 2693, orig. Bůžek et al. 1981, pl. 5, fig. 2 (scale bar 10 mm).

***Leguminosites* sp. 1**

8. Leaflet, Sf. 6312 (scale bar 5 mm).
9. Slender leaflet, Sf. 6256 (scale bar 5 mm).
10. Emarginate (?) leaflet, Sf. 6258 (scale bar 5 mm).

***Leguminosites* sp. 2**

11. Leaflet base, Sf. 6299 (scale bar 10 mm).

***Leguminosites* sp. 3**

12. Leaflet, Sf. 6278 (scale bar 10 mm).

***Leguminosites* sp. 4**

13. Leaflet, Sf. 6251:1 (scale bar 10 mm).
14. Leaflet, Sf. 6252 (scale bar 10 mm).

***Leguminosites* sp. 5**

15. Large leaflet, Sf. 7558 (scale bar 10 mm).

***Dicotylphyllum deichmuelleri* KVAČEK et WALTHER**

16. Complete leaf with carbonized lamina, specimen missing (scale bar 10 mm).
17. Leaf fragment, Sf. 2240 (scale bar 10 mm).

***Dicotylphyllum* sp. 1**

18. Almost complete leaf, Sf. 7475 (scale bar 10 mm).

**PLATE 19**

***Diospyros brachysepala* A. BRAUN**

1. Calyx from above, Sf. 8297, orig. Engelhard 1870, pl. 5, fig. 9 (scale bar 5 mm).
2. Calyx from below, Sf. 8276, orig. Engelhard 1870, pl. 5, fig. 8, counter-impression of the same specimen (scale bar 5 mm).
3. Another calyx from below, Sf. 3221 (scale bar 5 mm).

***Diospyros* sp.**

4. Leaf fragment, Sf. 6317 (scale bar 10 mm).
5. Detail of the same specimen (scale bar 5 mm).

***Apocynophyllum neriifolium* HEER**

6. Leaf, Sf. 8277, orig. Engelhardt 1870, pl. 5, fig. 2, as "*Ficus multinervis*" (scale bar 10 mm).
7. Detail of the same specimen (scale bar 10 mm).



***Saportaspermum dieteri* KVAČEK et WALTHER sp. n.**

8. Winged seed, Sf. 8237b, holotype (scale bar 5 mm).
9. Counterpart of the same specimen, Sf. 8237a, (scale bar mm).
10. Impression of another winged seed, Sf. 8238 (scale bar 5 mm).
11. Compression of another winged seed, Sf. 8241 (scale bar 5 mm).
12. Detail of seed body from the same specimen (scale bar 5 mm).

***Saportaspermum cf. occidentale* MEYER et MANCHESTER**

13. Winged seed, Sf. 7370 (scale bar 5 mm).

**PLATE 20**

***Toxicodendron herthae* (UNGER) KVAČEK et WALTHER**

1. Leaflet base, Sf. 7476 (scale bar 10 mm).

***Potamogeton seifhennersdorfensis* ENGELHARDT**

2. Leafy stem, Sf. 6497 (scale bar 10 mm).
3. Venation of leaf apex Sf. 6481 (scale bar 3 mm).
4. Fruit, Sf. 3302, orig. Mai 1963, pl. 2, fig. 1 (scale bar 1 mm).
5. Counterpart of the same specimen (scale bar 1 mm).

***Potamogeton* sp.**

6. Leaf, Sf. 3151 (scale bar 5 mm).

***Smilax weberi* WESSEL**

7. Almost complete leaf, Sf. 3736 (scale bar 10 mm).
8. Leaf base, Sf. 4447 (scale bar 10 mm).

***Spirematospermum wetzleri* (HEER) CHANDLER**

9. Impression of fruit capsule, Sf. 8379, orig. Walther 1965, text-fig. 1 (scale bar 10 mm).
10. Artificial mold of seeds from the same specimen (scale bar 3 mm).

**PLATE 21**

***Sabal cf. lamanonis* (BRONGNIART) HEER**

1. Fragmentary leaf, Sf. 4446 (scale bar 10 mm).

***Leersia seifhennersdorfensis* WALTHER**

2. Fertile plant, Sf. 12a, holotype, orig. Walther 1974, pl. 11 (scale bar 10 mm).
3. Detail of the same specimen (scale bar 5 mm).

**Monocotyledonae gen. et sp.**

4. Fragment of grass-like leaf, Sf. 6384 (scale bar 10 mm).

**Rhizomes and roots**

5. Probable monocot rootlets, Sf. 3566 (scale bar 10 mm).
6. Medial part of a rhizome with almost parallel roots, KM s.n. (scale bar 10 mm).

**PLATE 22**

***Taxodium dubium* (STERNBERG) HEER**

1. Stomata, orig. Walther 1964, pl. 4, fig. 2, prep. missing (scale bar 50 µm).

**cf. *Quasisequoia couttsiae* (HEER) KUNZMANN**

2. Stomatal band, prep. 45/93 from Sf. 195 (scale bar 50 µm).

***Tetraclinis salicornioides* (UNGER) KVAČEK**

3. Stomata, prep. 32/7 (scale bar 50 µm).

***Cephalotaxus parvifolia* (WALTHER) KVAČEK et WALTHER**

4. Stoma, prep. 49/93 from Sf. 4453, (scale bar 50 µm).
5. Abaxial leaf side, prep. 49/93 from Sf. 4453 (scale bar 100 µm).

***Torreya bilinica* SAPORTA et MARION**

6. Boundary between stomatal band and adjacent outer non-stomatal area, prep. 47/93 from Sf. 4451 (scale bar 50 µm).
7. Abaxial leaf side, prep. 47/93 from Sf. 4451 (scale bar 100 µm).

***Magnolia seifhennersdorfensis* WALTHER et KVAČEK sp. nov.**

8. Adaxial cuticle, prep. 72/94 from Sf. 4441, holotype (scale bar 50 µm).
9. Abaxial cuticle, prep. 70/94 from Sf. 4441, holotype (scale bar 50 µm).
10. Abaxial cuticle, prep. 70/94 from Sf. 4441, holotype (scale bar 50 µm).

***Laurophyllum acutimontanum* MAI**

11. Abaxial cuticle, prep. 15/05 from Sf. 2505 (scale bar 50 µm).

***Laurophyllum meuselii* WALTHER et KVAČEK sp. nov.**

12. Adaxial cuticle, prep. 3/05 from Sf. 2451, holotype (scale bar 50 µm).
13. Abaxial cuticle, prep. 3/05 from Sf. 2451, holotype (scale bar 50 µm).

***Laurophyllum pseudoprinceps* WEYLAND et KILPPER**

14. Adaxial cuticle, prep. 31/05 from Sf. 3493 (scale bar 50 µm).
15. Abaxial cuticle, prep. 32/05 from Sf. 3493 (scale bar 50 µm).

**PLATE 23**

***Platanus neptuni* (ETTINGSHAUSEN) BŮŽEK, HOLÝ et KVAČEK**

1. Adaxial cuticle, prep. 39/93 from Sf. 442b (scale bar 50 µm).
2. Abaxial cuticle with peltate trichome prep. 39/93 from Sf. 442b (scale bar 50 µm).

***Quercus lonchitis* UNGER**

3. Abaxial cuticle with stellate trichome, prep. 34/05 from Sf. 8253 (scale bar 50 µm).

***Alnus gaudinii* (HEER) KNOBLOCH et KVAČEK**

4. Abaxial cuticle, prep. 50/94 from Sf. 4465 (scale bar 50 µm).
5. Abaxial cuticle with 4-celled gland base, prep. 50/94 from Sf. 4465 (scale bar 50 µm).

***Carpinus grandis* UNGER**

6. Adaxial cuticle, prep. No. 80/71 from Sf. 2 (scale bar 50 µm).
7. Abaxial cuticle, prep. No. 80/71 from Sf. 2 (scale bar 50 µm).

***Carya fragiliformis* (STERNBERG) KVAČEK et WALTHER comb. nov.**

8. Peltate trichome on abaxial cuticle, prep. 184/77 from Sf. 146 (scale bar 50 µm).
9. Abaxial cuticle with trichome bases, prep. 196/71 from

Sf. 146 (scale bar 50 µm).

10. Fragmentary peltate trichome on abaxial cuticle, prep. 95/77 from Sf. 142 (scale bar 50 µm).

***Cyclocarya* sp.**

11. Trichome base, prep. 15/94 from Sf. 4449 I (scale bar 50 µm).  
12. Abaxial cuticle, prep. 15/94 from 4449 I (scale bar 50 µm).

***Ulmus fischeri* HEER**

13. Abaxial cuticle, prep. 47/68 (scale bar 50 µm).

***Salix varians* GOEPPERT**

14. Adaxial cuticle, prep. 121/71 from Sf. 18b (scale bar 50 µm).  
15. Abaxial cuticle, prep. 129/71 from Sf. 18b (scale bar 50 µm).

**PLATE 24**

***Salix varians* GOEPPERT**

1. Abaxial cuticle, prep. 129/71 from Sf. 18b (scale bar 50 µm).

***Dombeyopsis lobata* UNGER**

2. Abaxial cuticle, prep. 225/71 from Sf. 21 (scale bar 50 µm).  
3. Abaxial cuticle, prep. 225/71 from Sf. 21 (scale bar 50 µm).

***Acer engelhardtii* WALTHER**

4. Adaxial cuticle, prep. 30/68 from Sf. 55a, syntype (scale bar 50 µm).  
5. Abaxial cuticle, prep. 33/68 from Sf. 55a, syntype (scale bar 50 µm).

***Nyssa altenburgensis* WALTHER et KVAČEK**

6. Abaxial cuticle with trichome base, prep. 14/93 from Sf. 4445 (scale bar 50 µm).  
7. Stoma on abaxial cuticle, prep. 18/93 from Sf. 4445 (scale bar 50 µm).

***Oleinites hallbaueri* (MAI) SACHSE**

8. Adaxial cuticle, prep. 121a from Sf. 3294, holotype (scale bar 50 µm).  
9. Abaxial cuticle, prep. 121a from Sf. 3294, holotype, (scale bar 50 µm).

***Oleinites maii* (BŮŽEK, HOLÝ et KVAČEK) SACHSE**

10. Adaxial cuticle, prep. 148c from Sf. 3352 (scale bar 50 µm).  
11. Abaxial cuticle, prep. 148c from Sf. 3352 (scale bar 50 µm).

***Dicotylophyllum deichmuelleri* KVAČEK et WALTHER**

12. Adaxial cuticle, prep. missing (scale bar 20 µm).  
13. Abaxial cuticle, prep. missing (scale bar 20 µm).

***Smilax weberi* WESSEL**

14. Stomata, prep. 69/93 from Sf. 4447 (scale bar 50 µm).  
15. Stomata, prep. 72/93 from Sf. 4447 (scale bar 50 µm).

PLATE 1

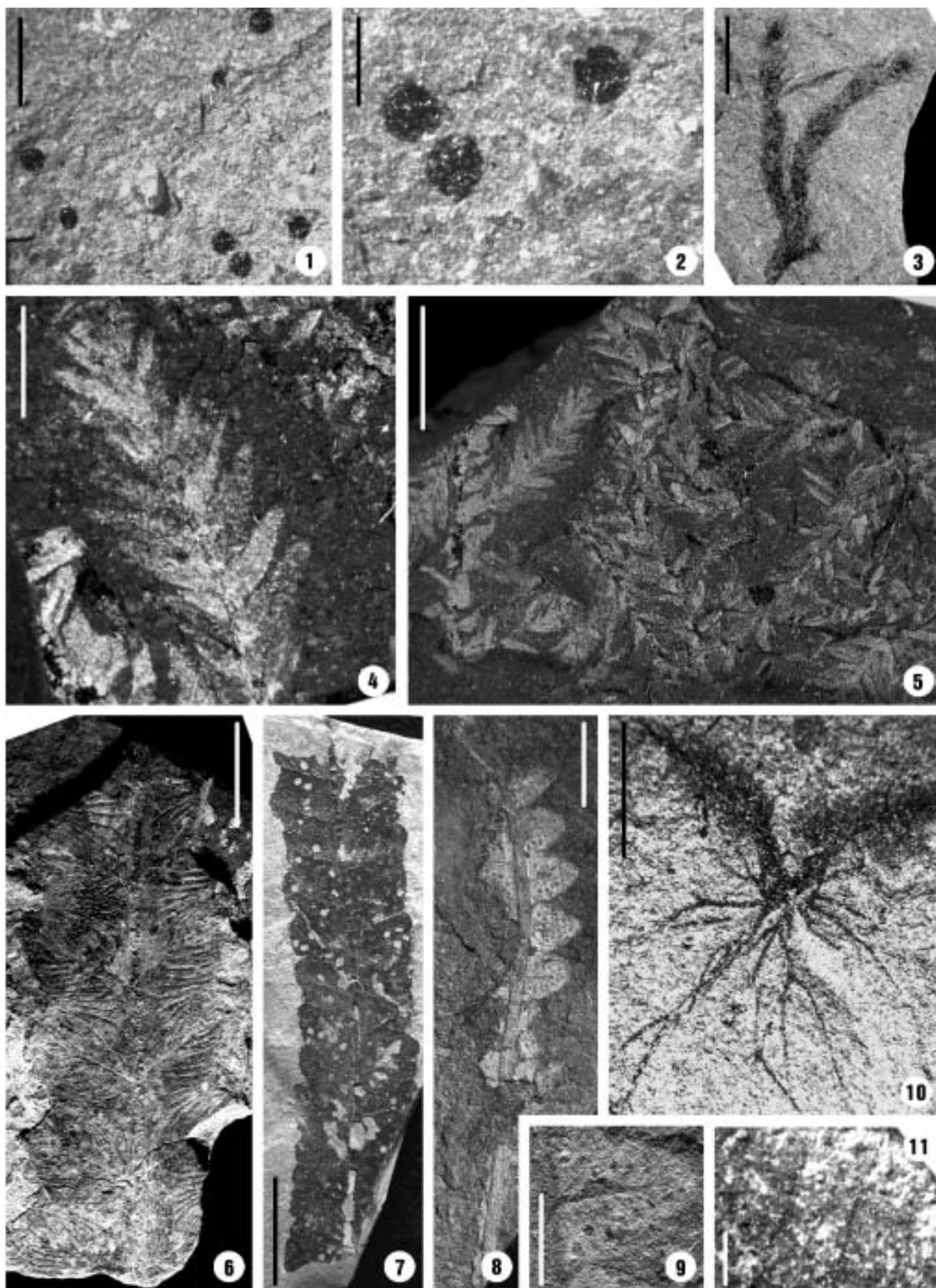


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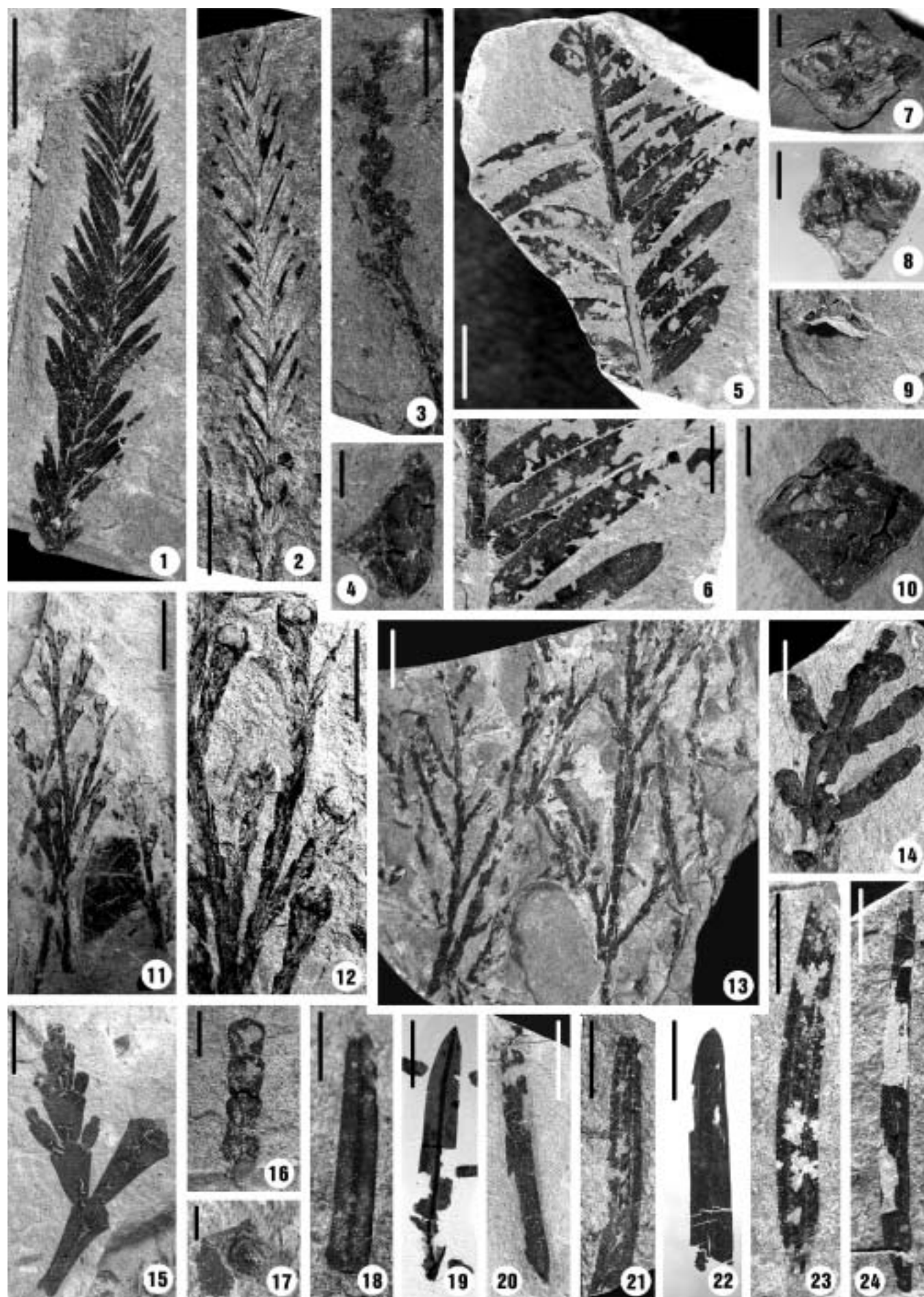




PLATE 3

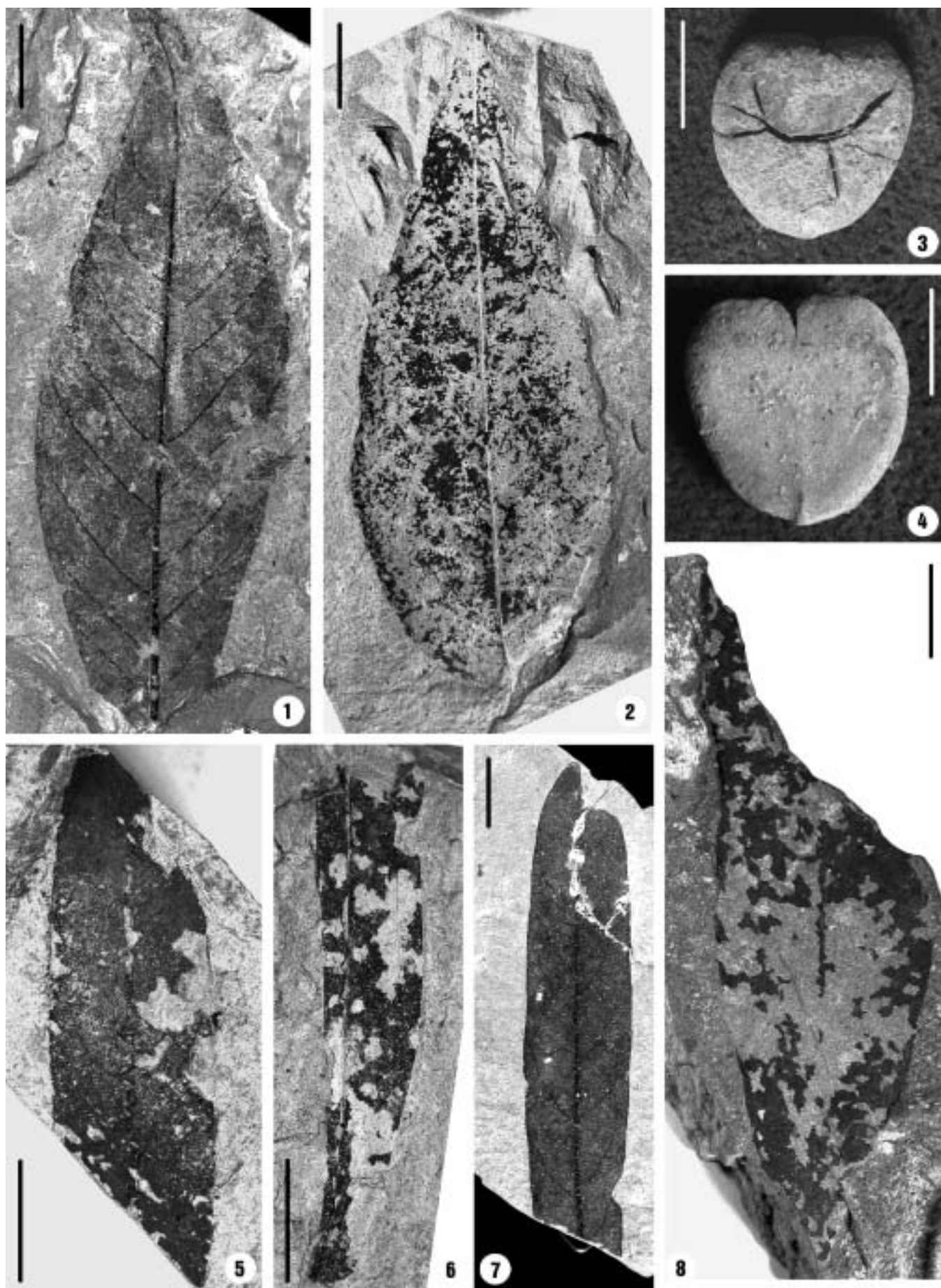


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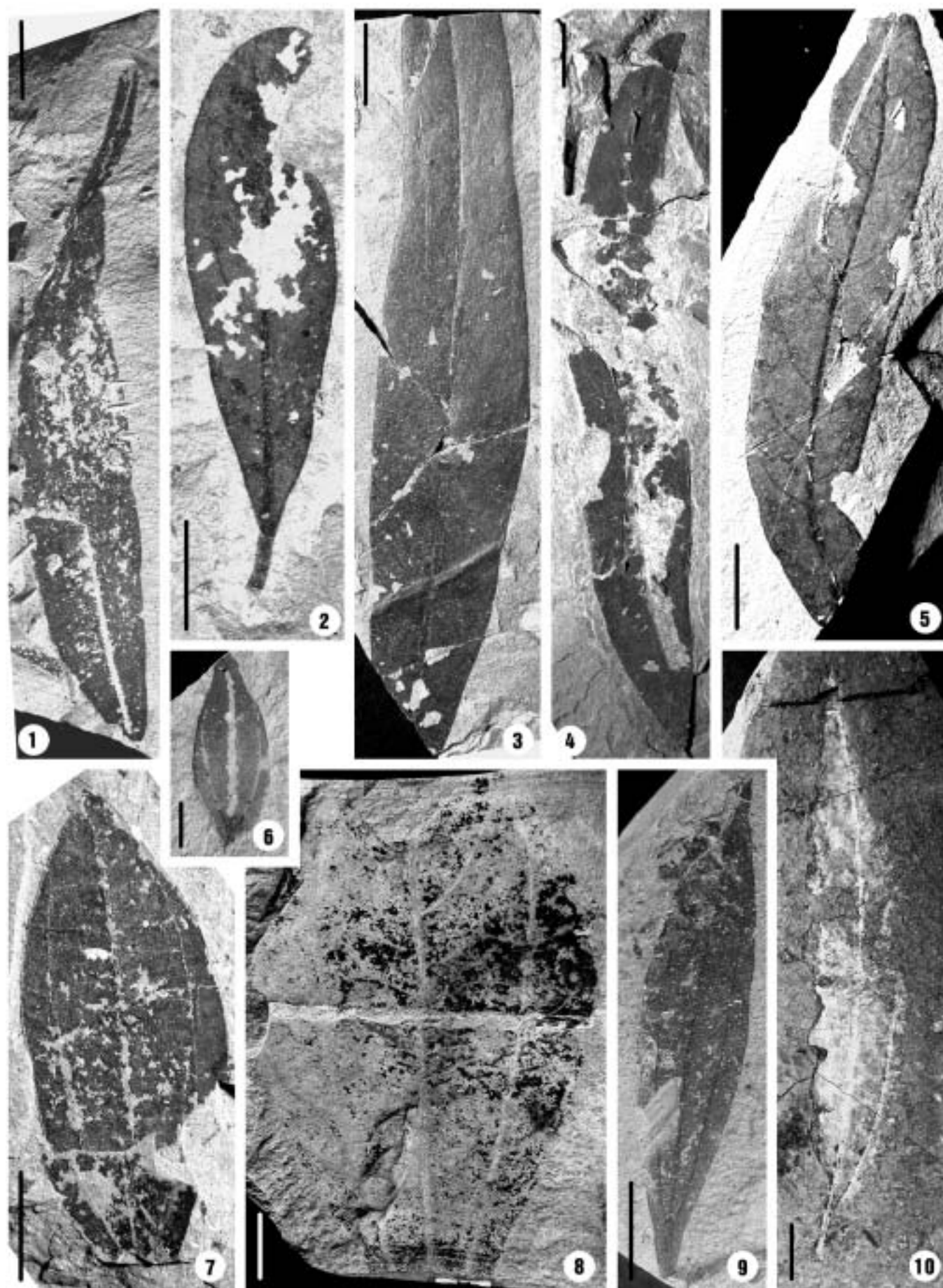


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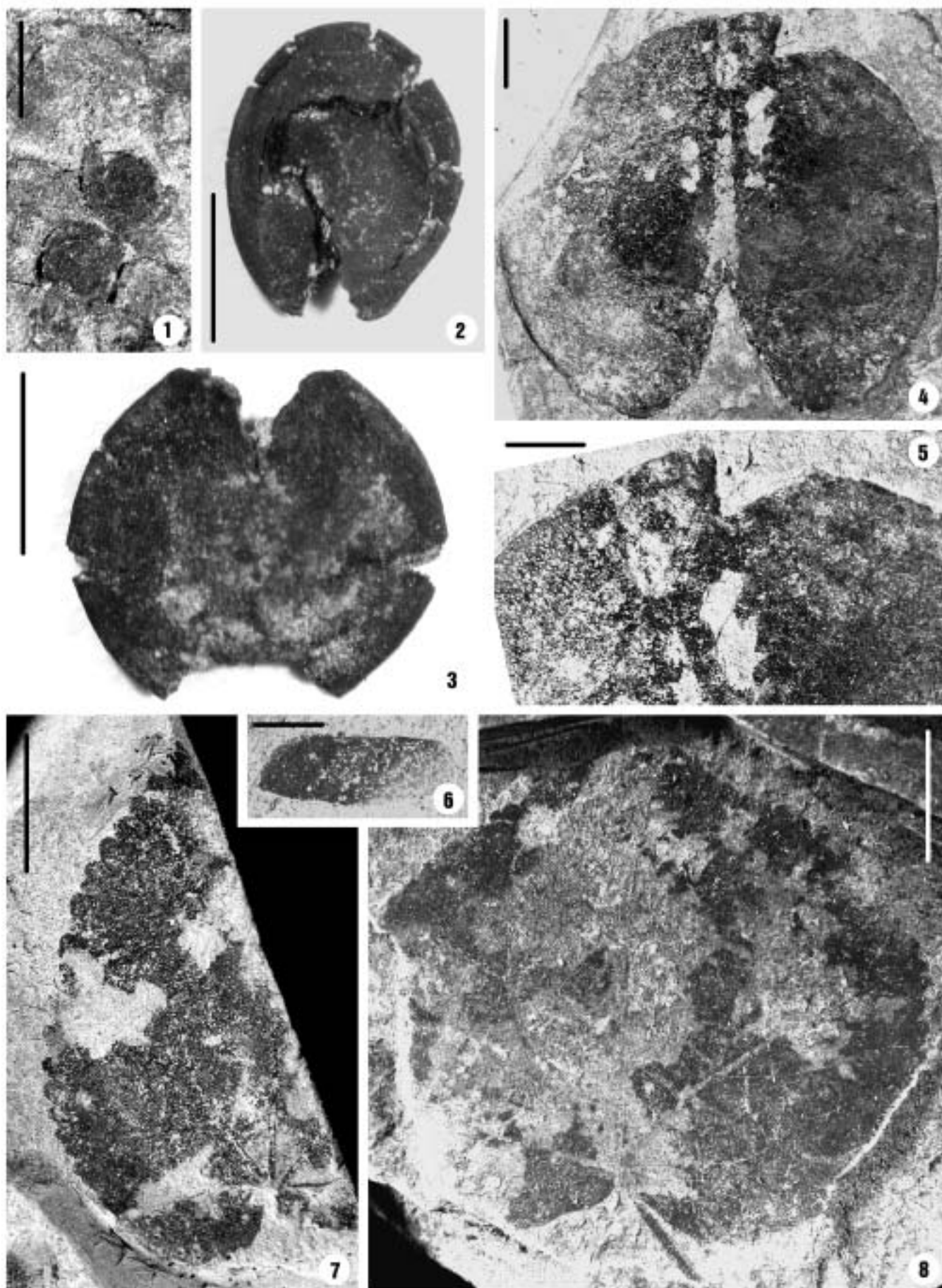




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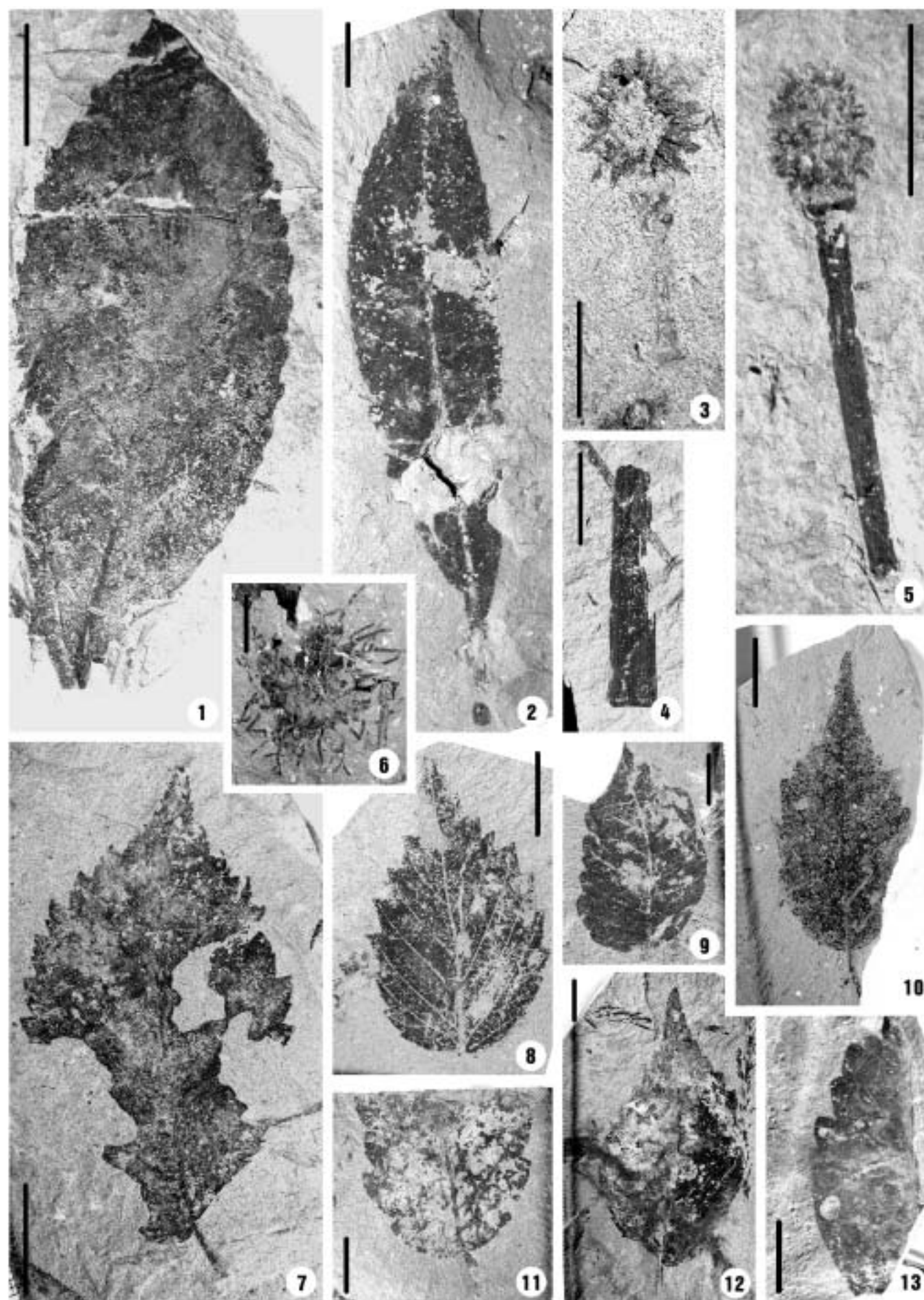




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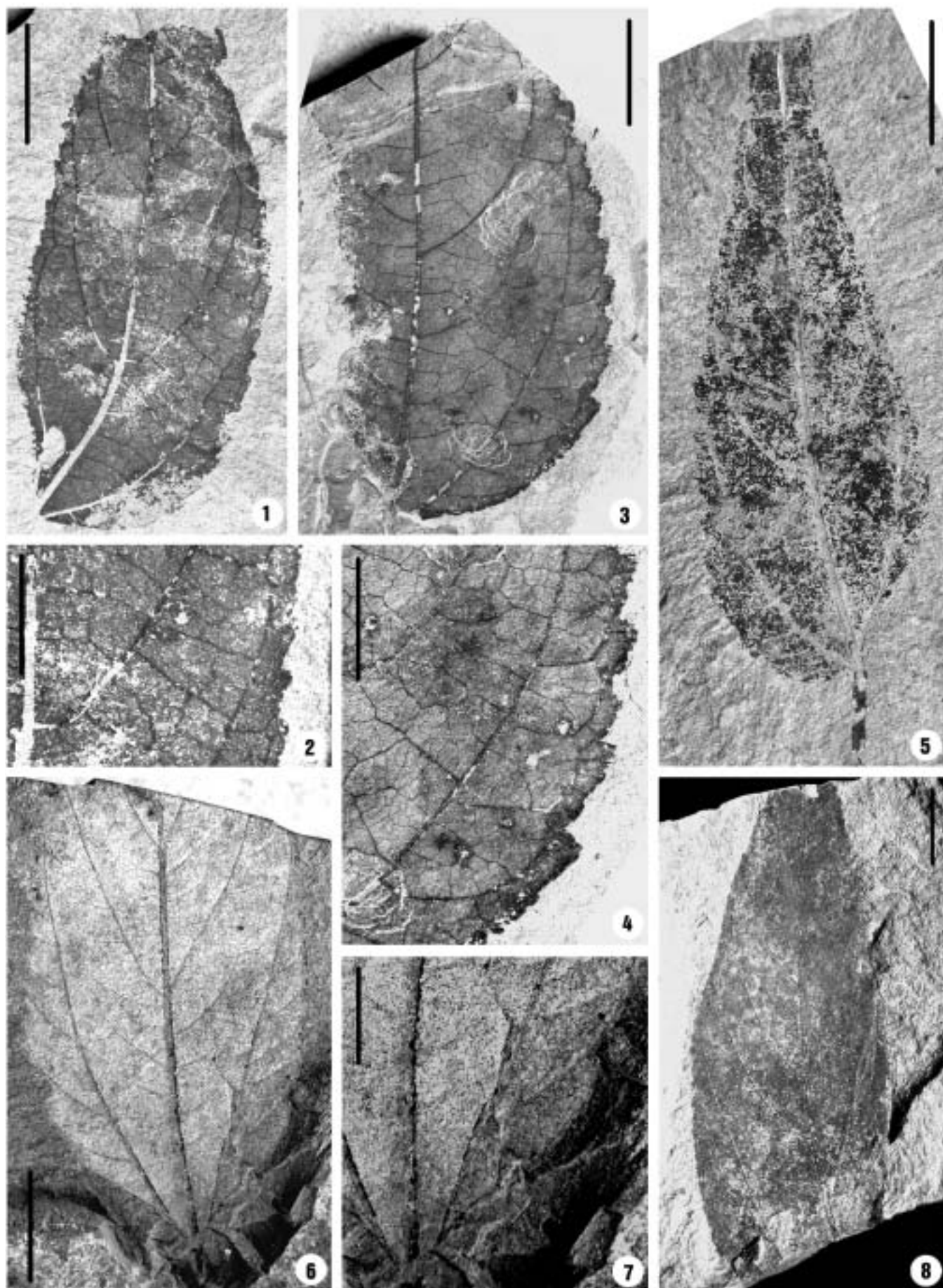


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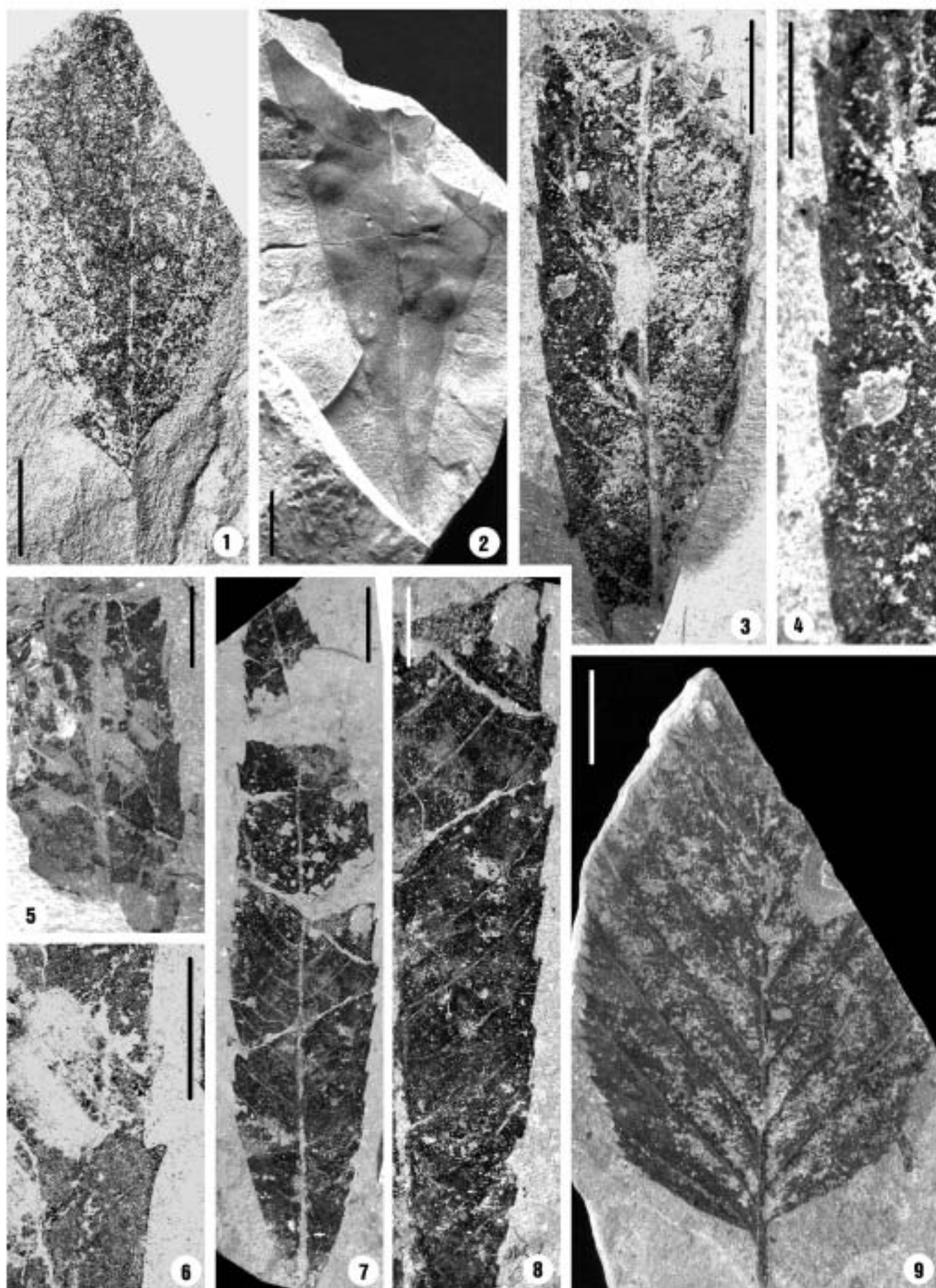


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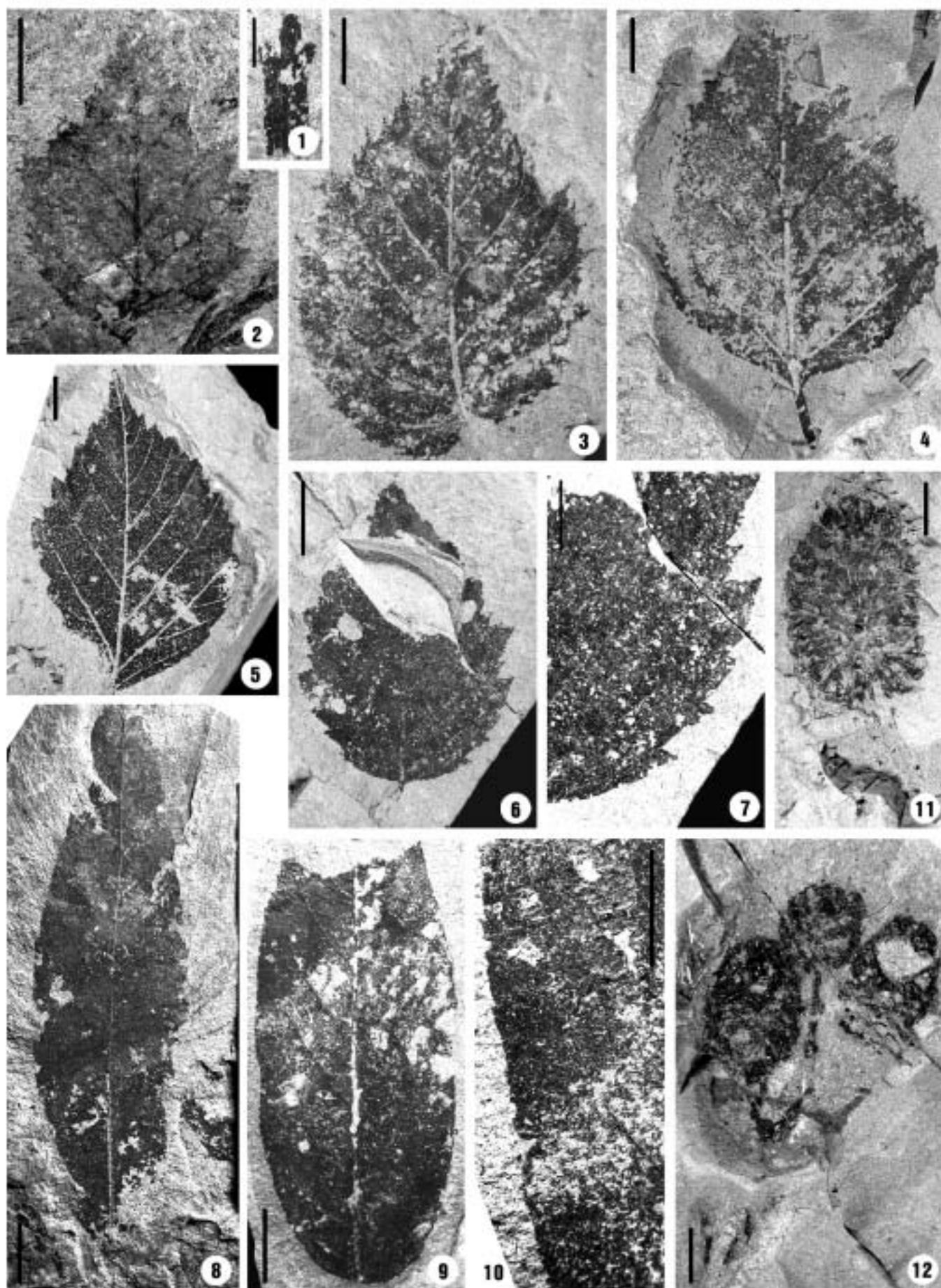




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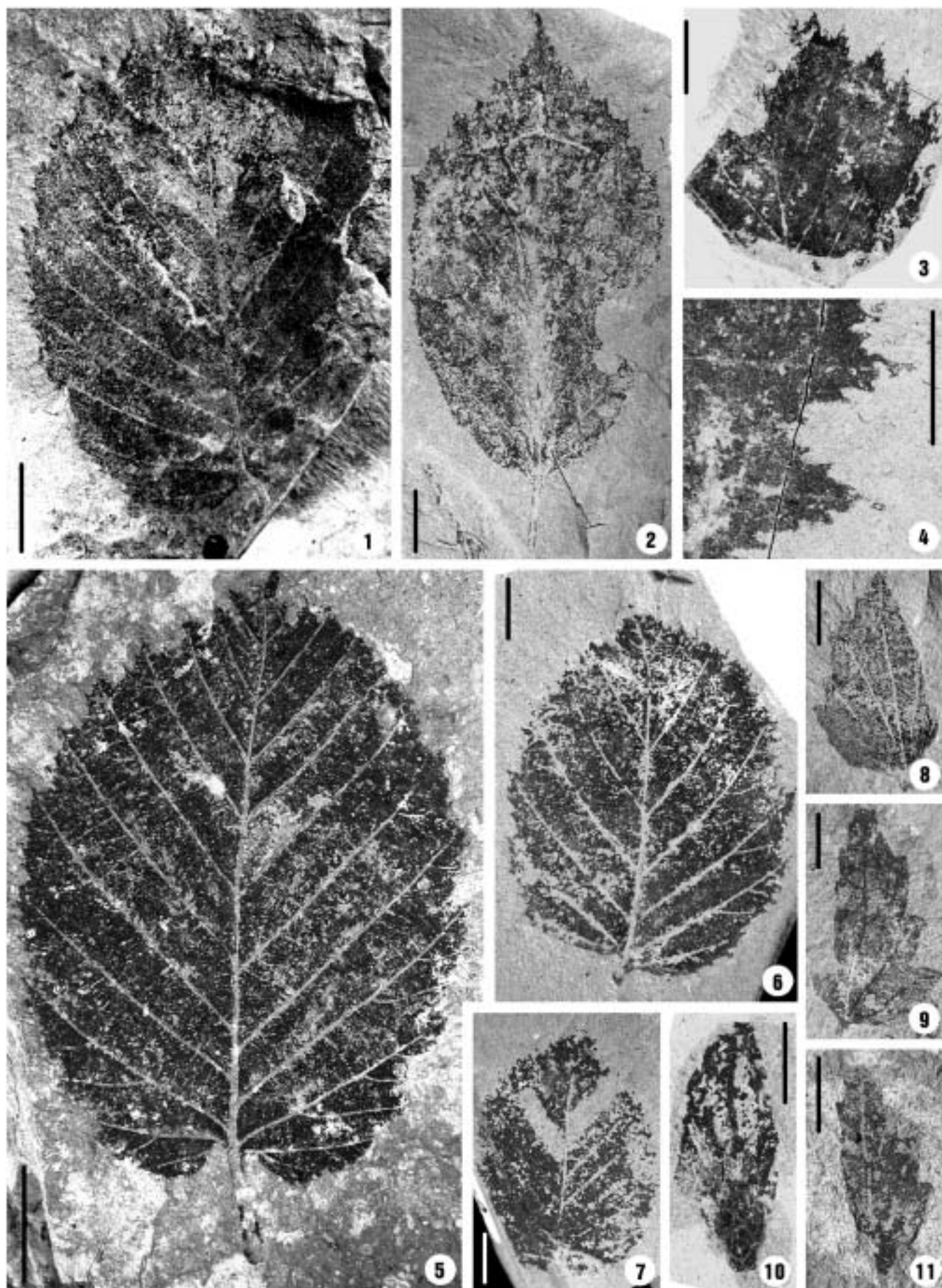


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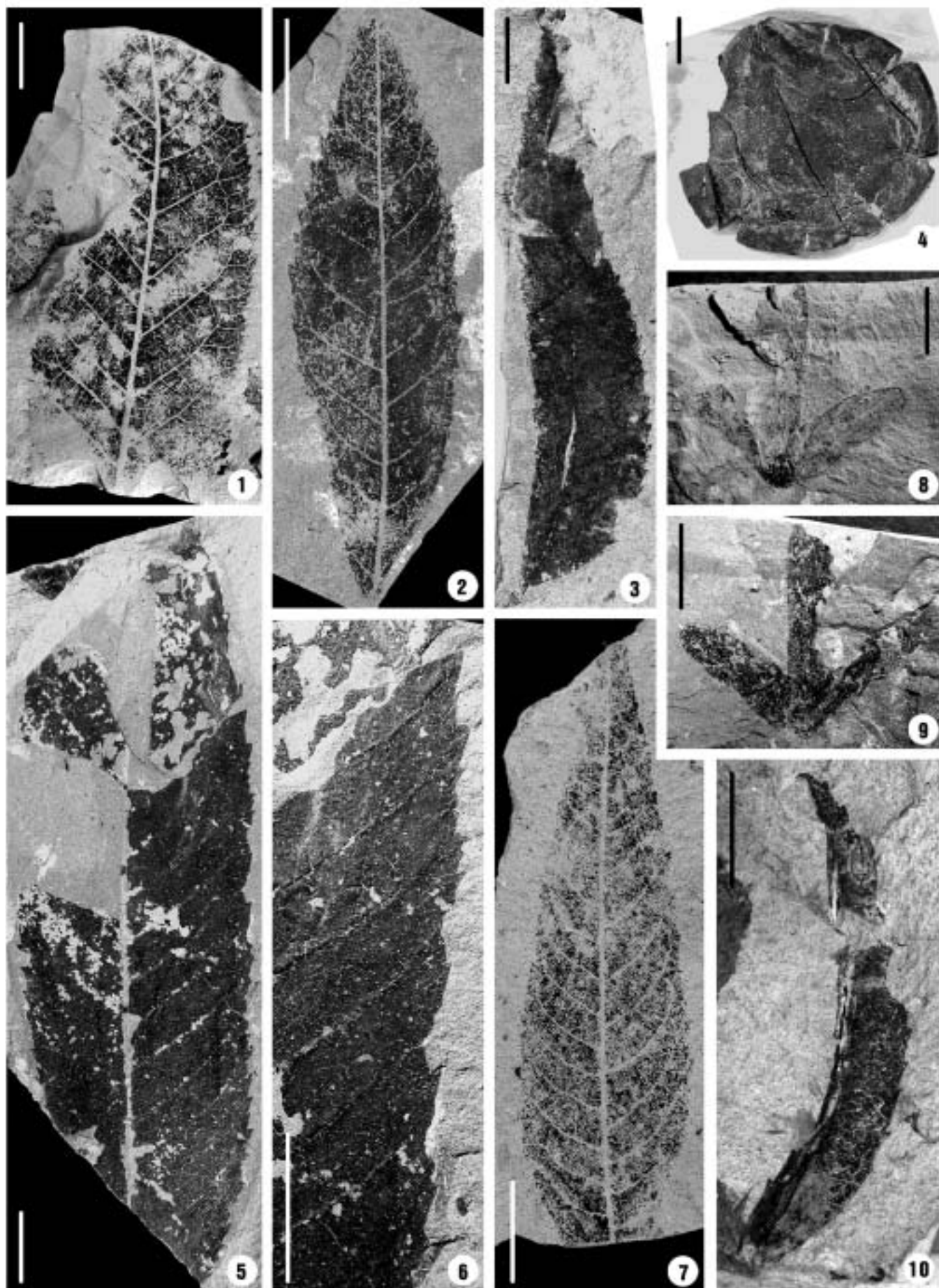


PLATE 12

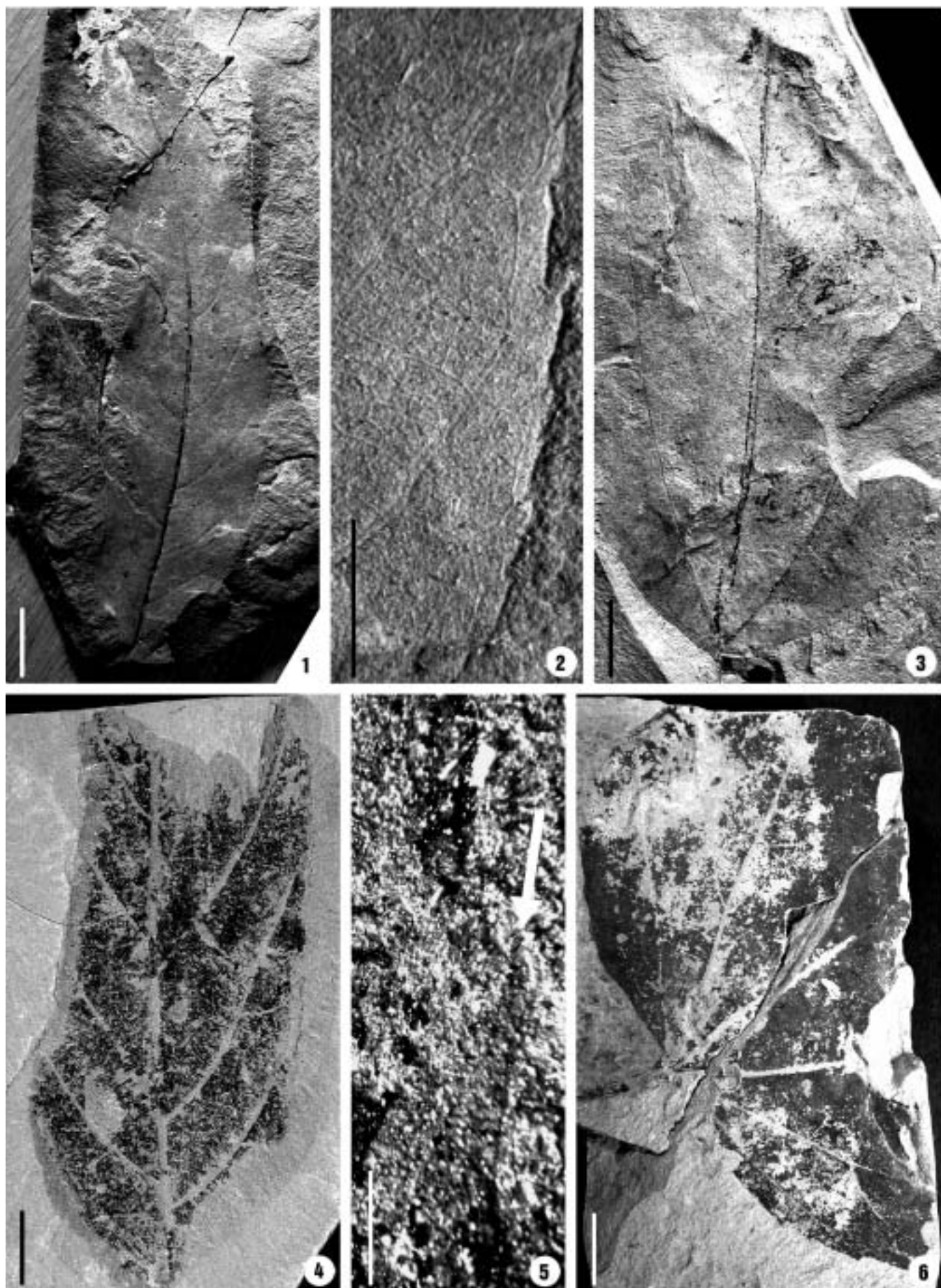




PLATE 13

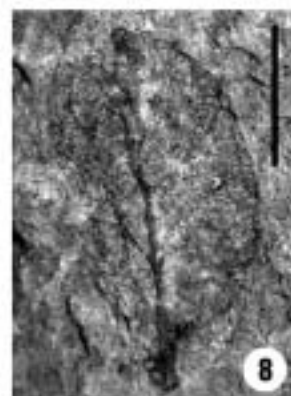
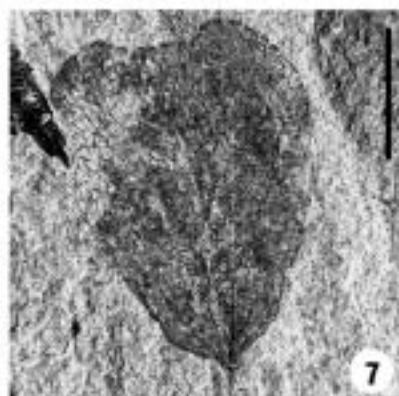


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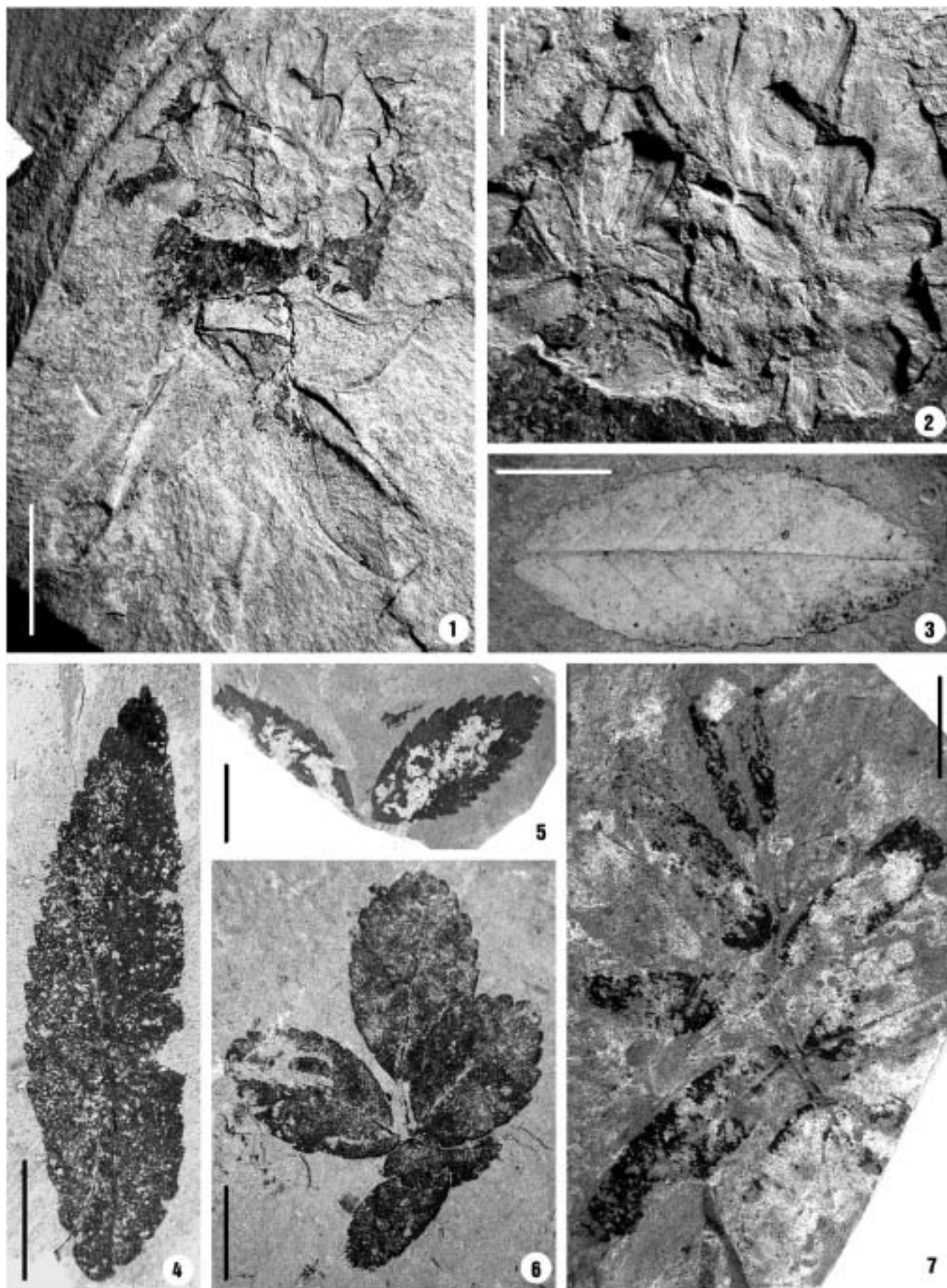




PLATE 15

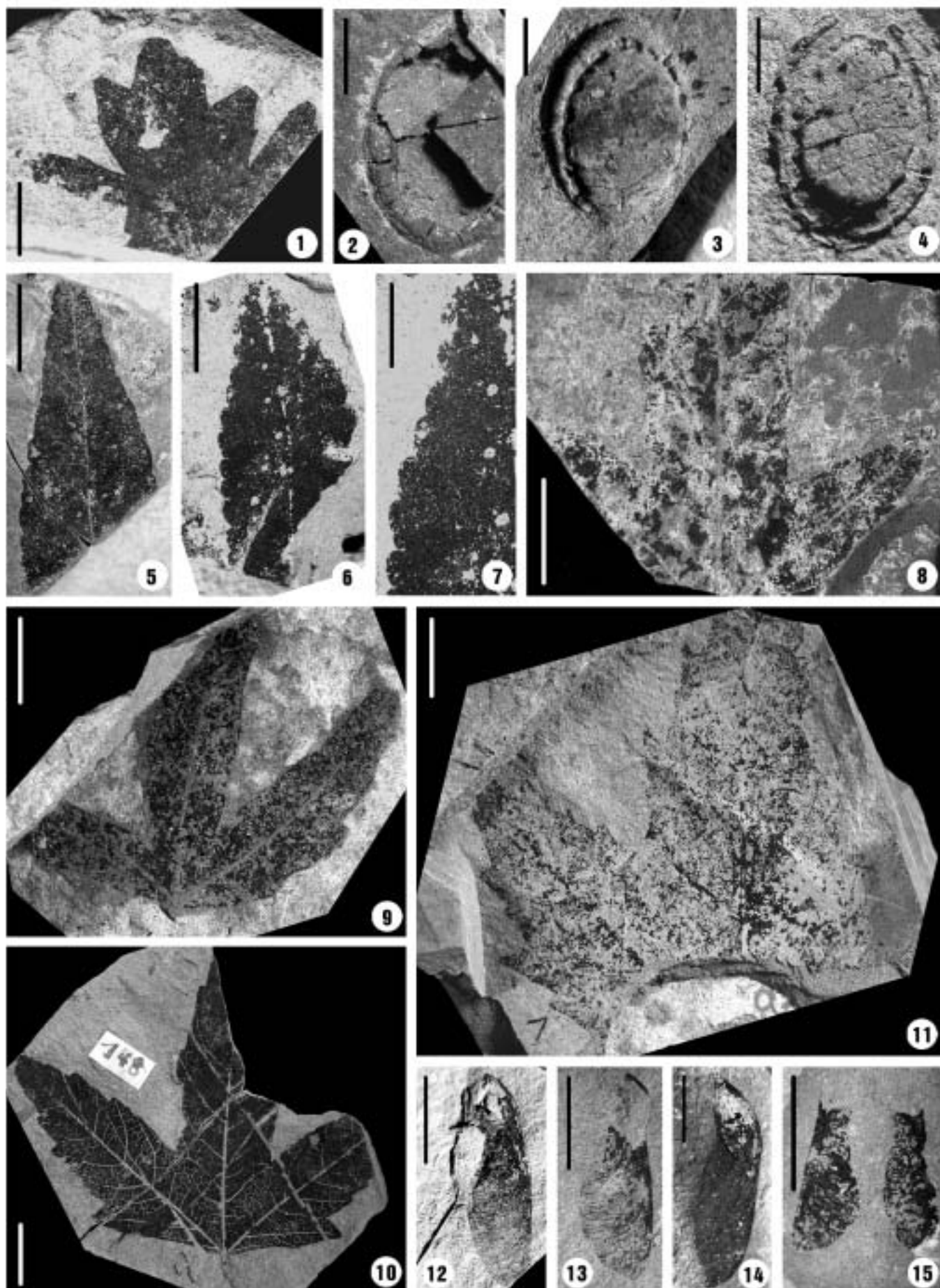
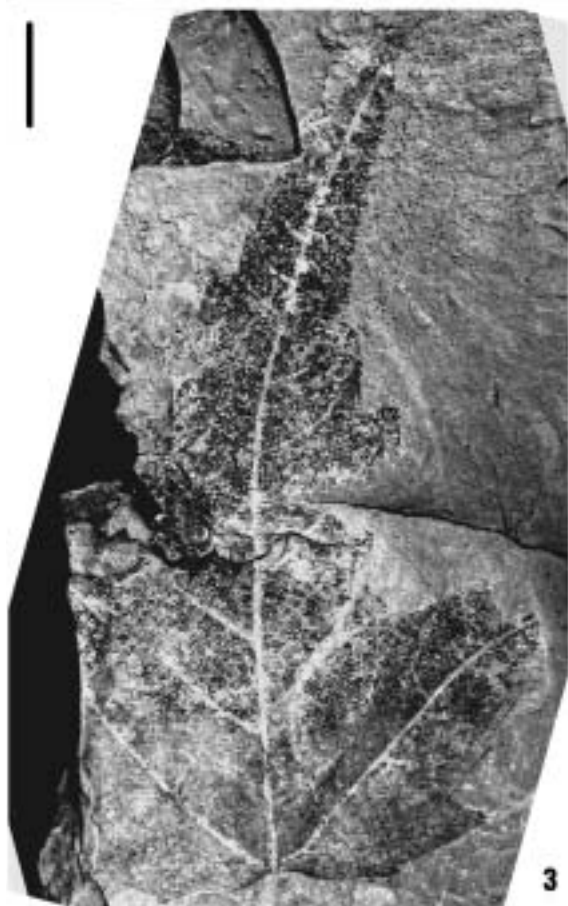
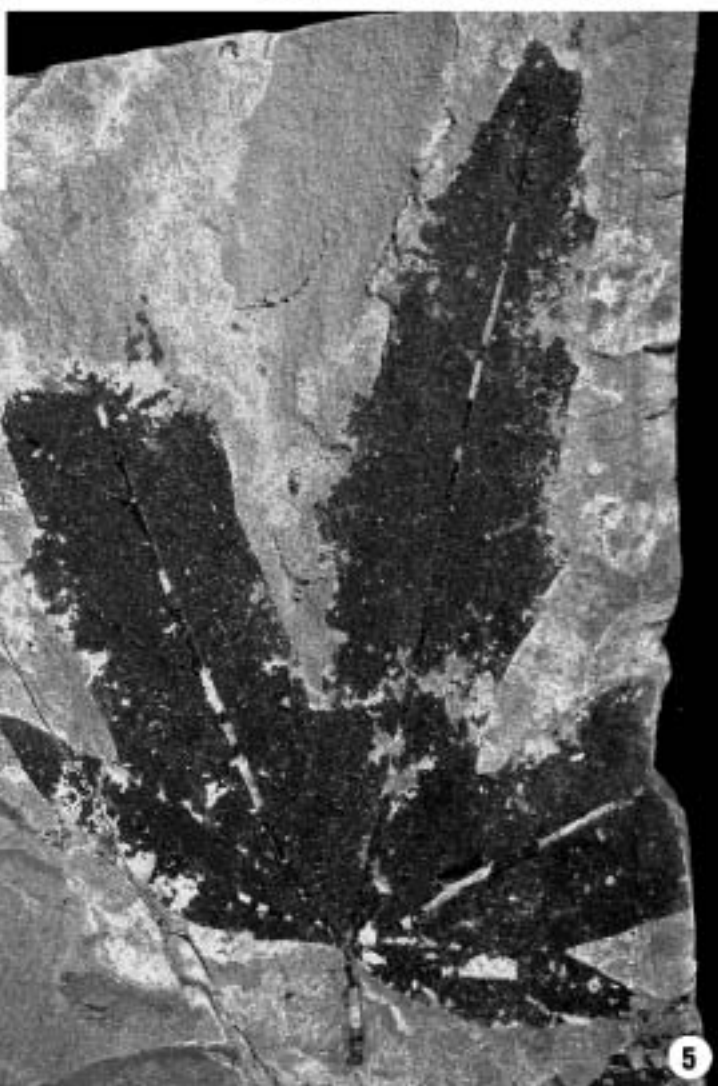
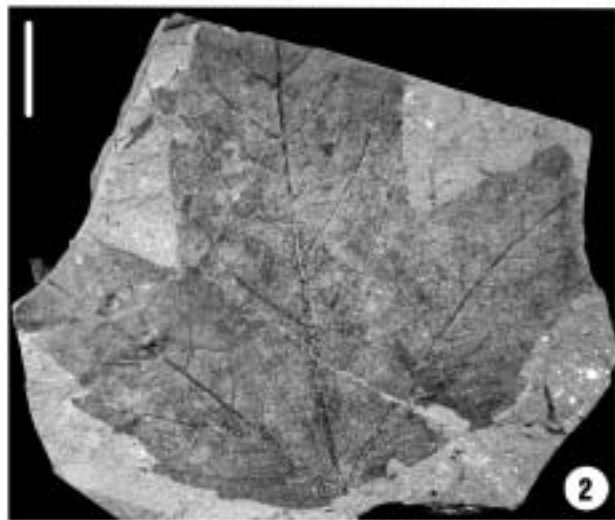
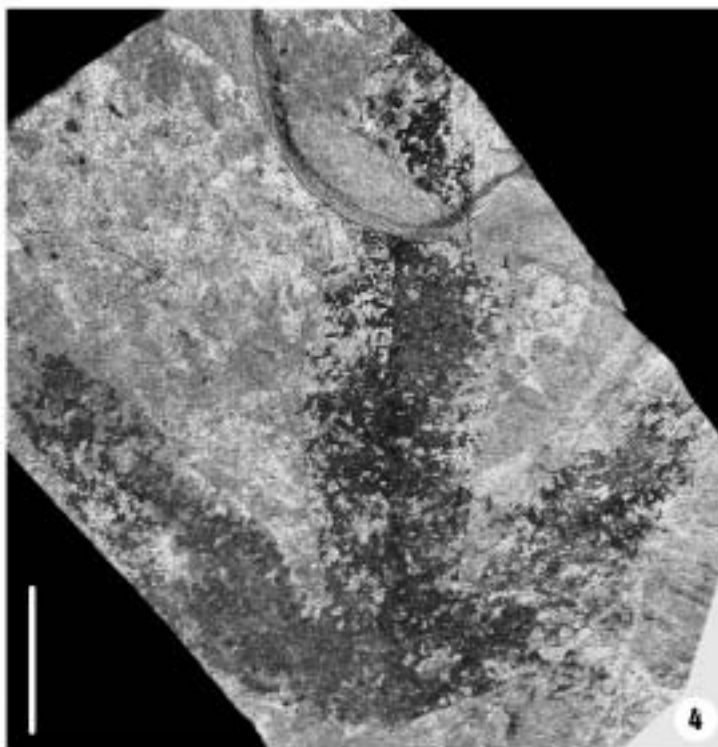
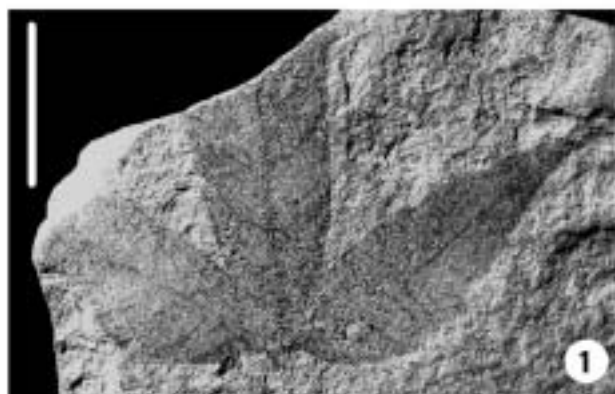


PLATE 16



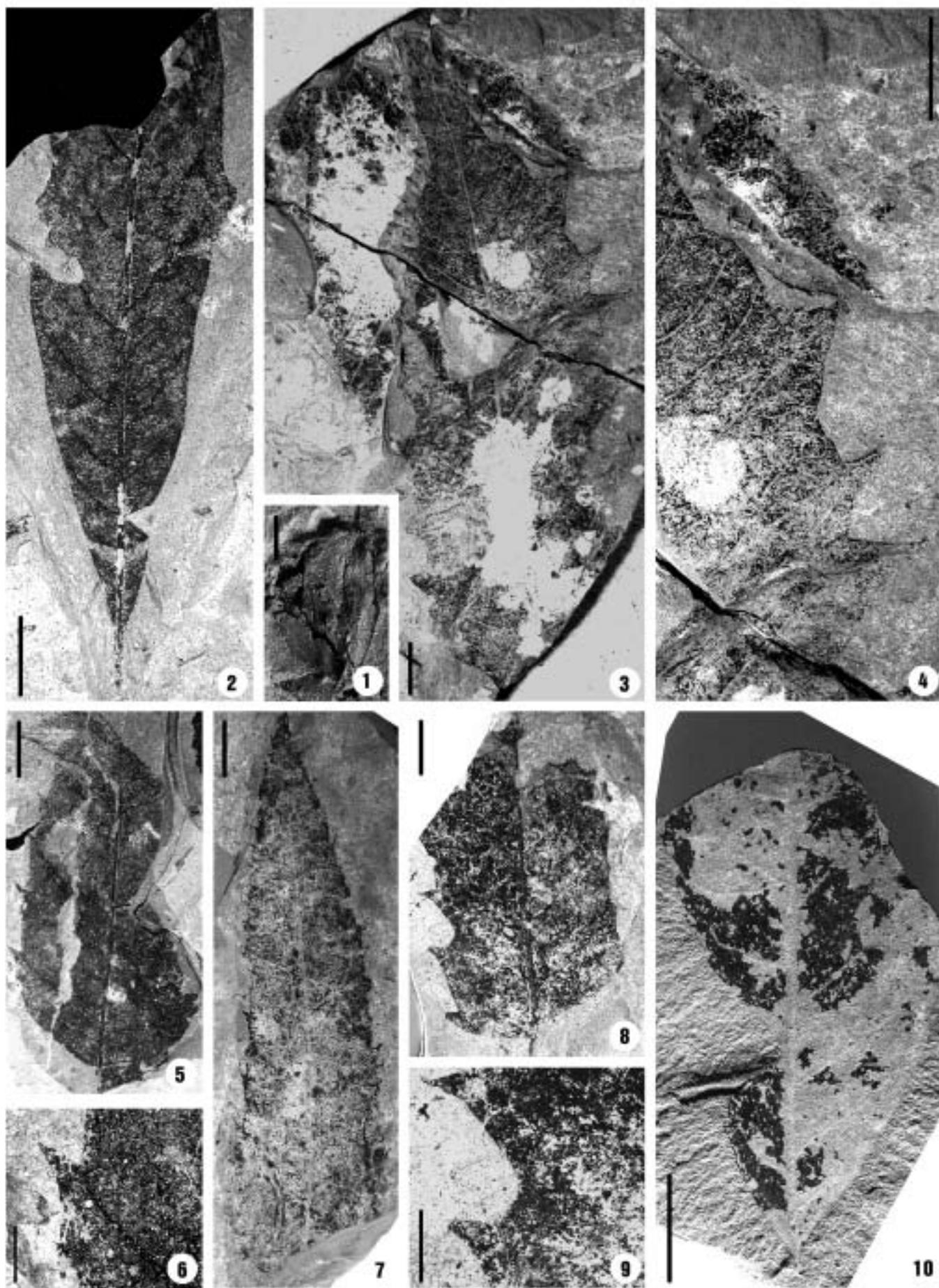




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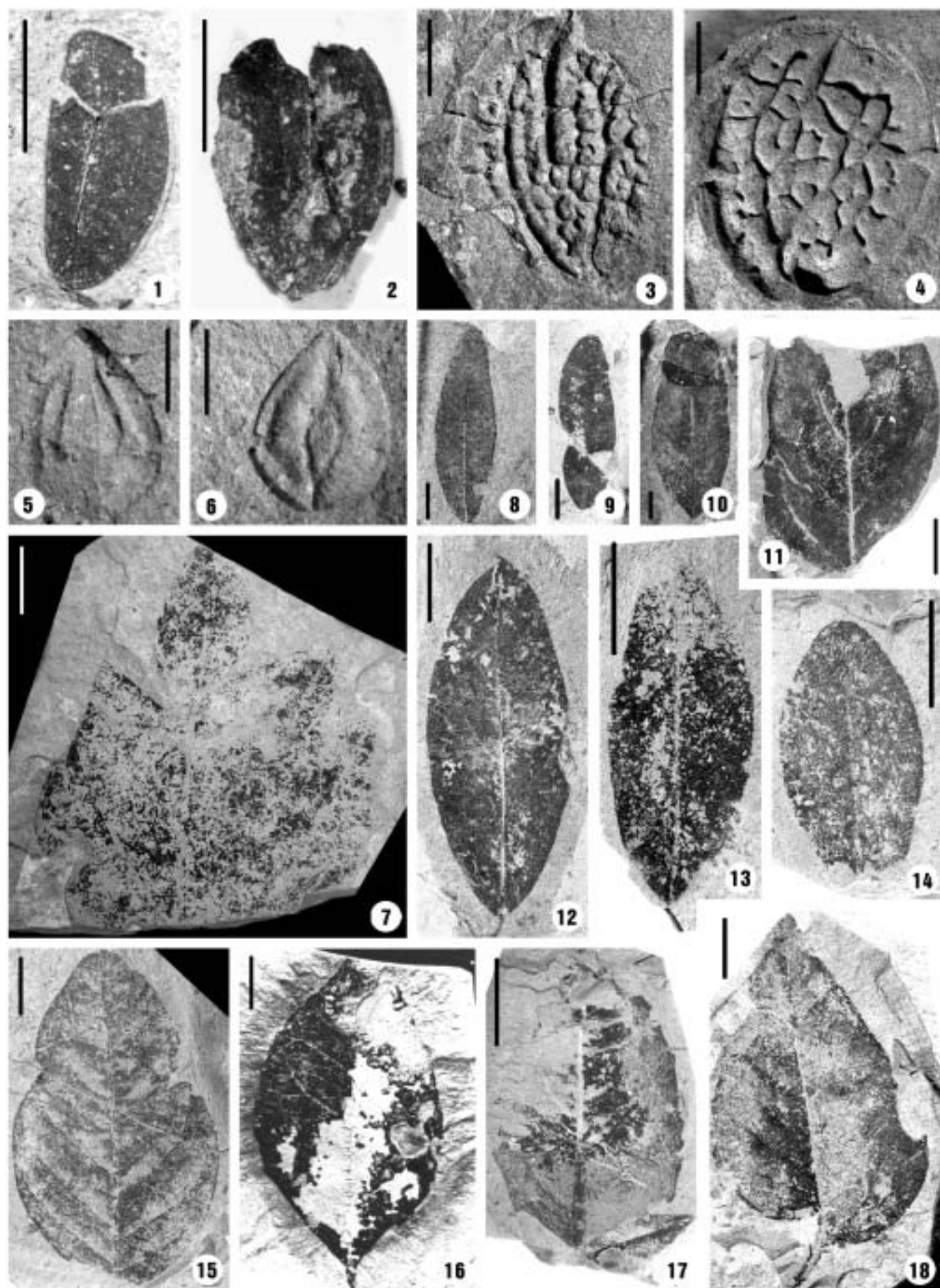


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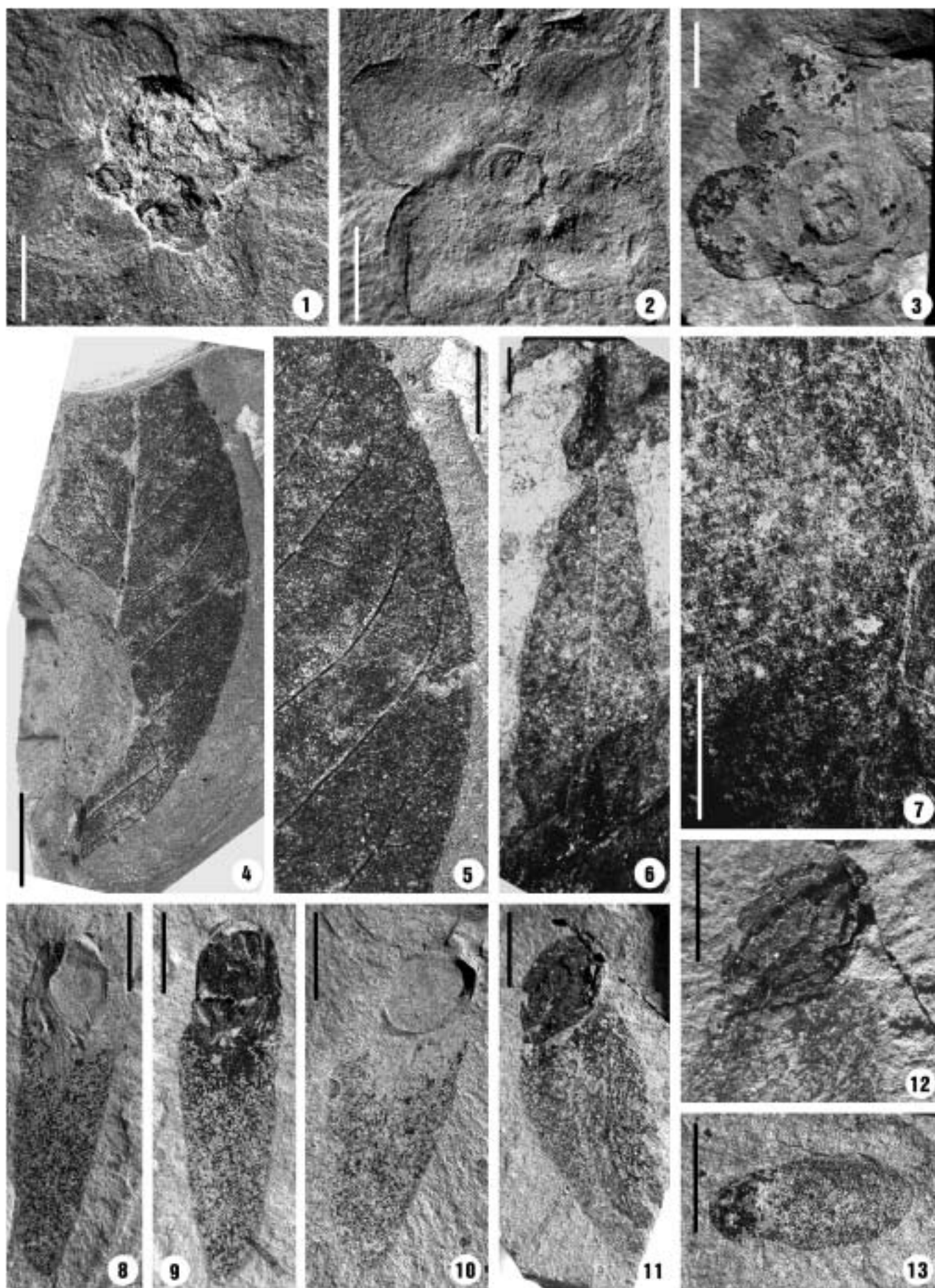


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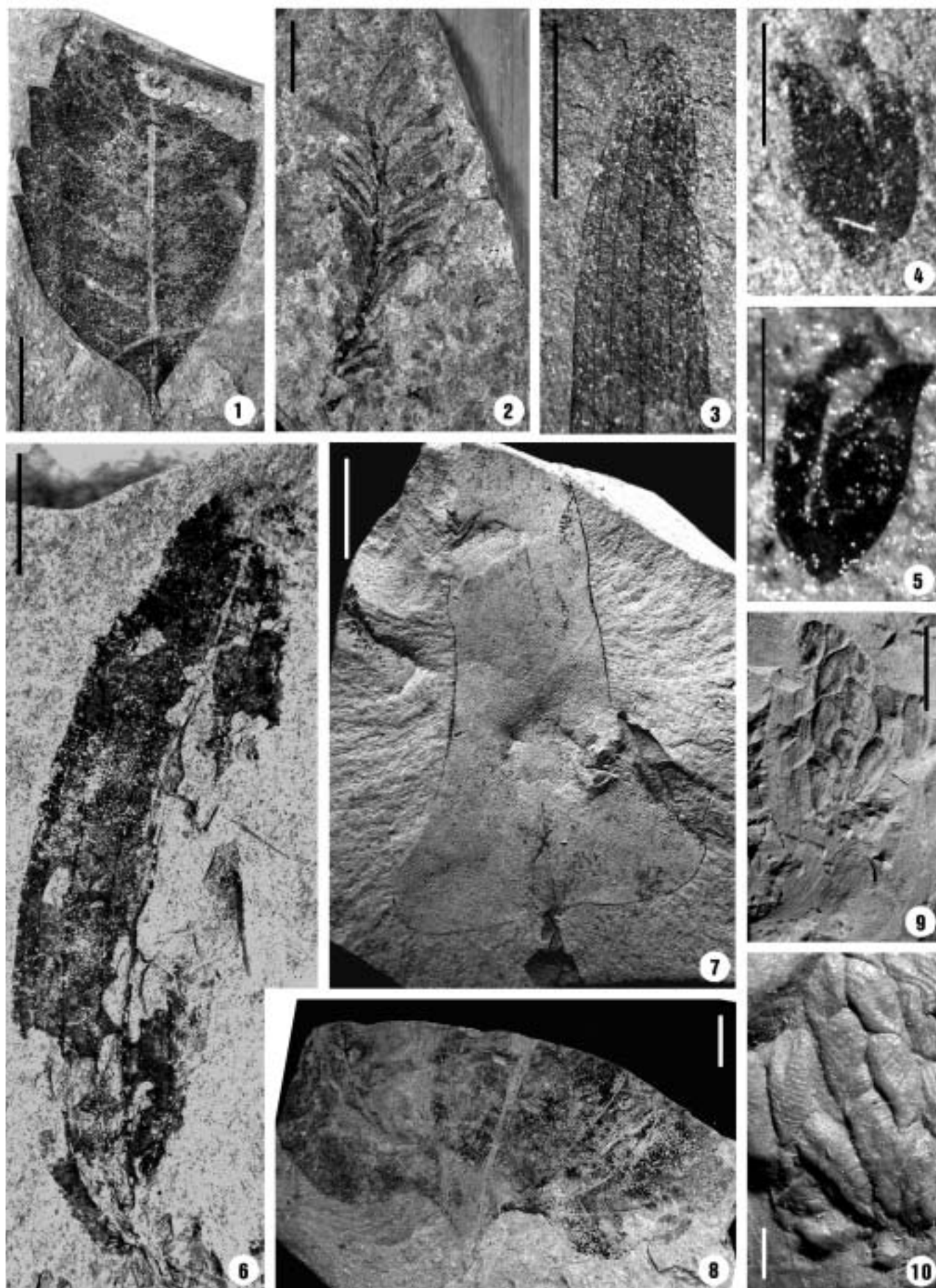




PLATE 21

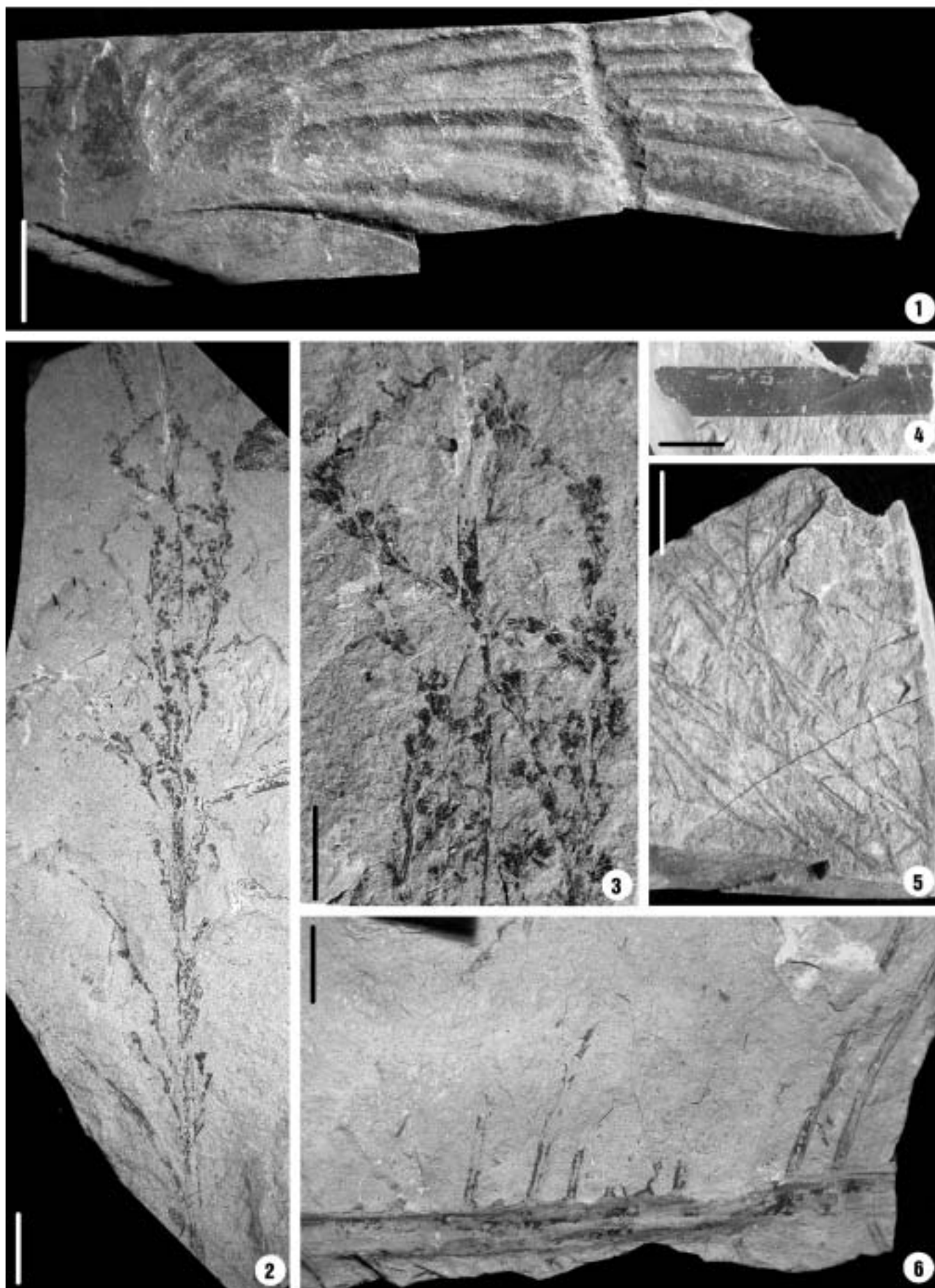


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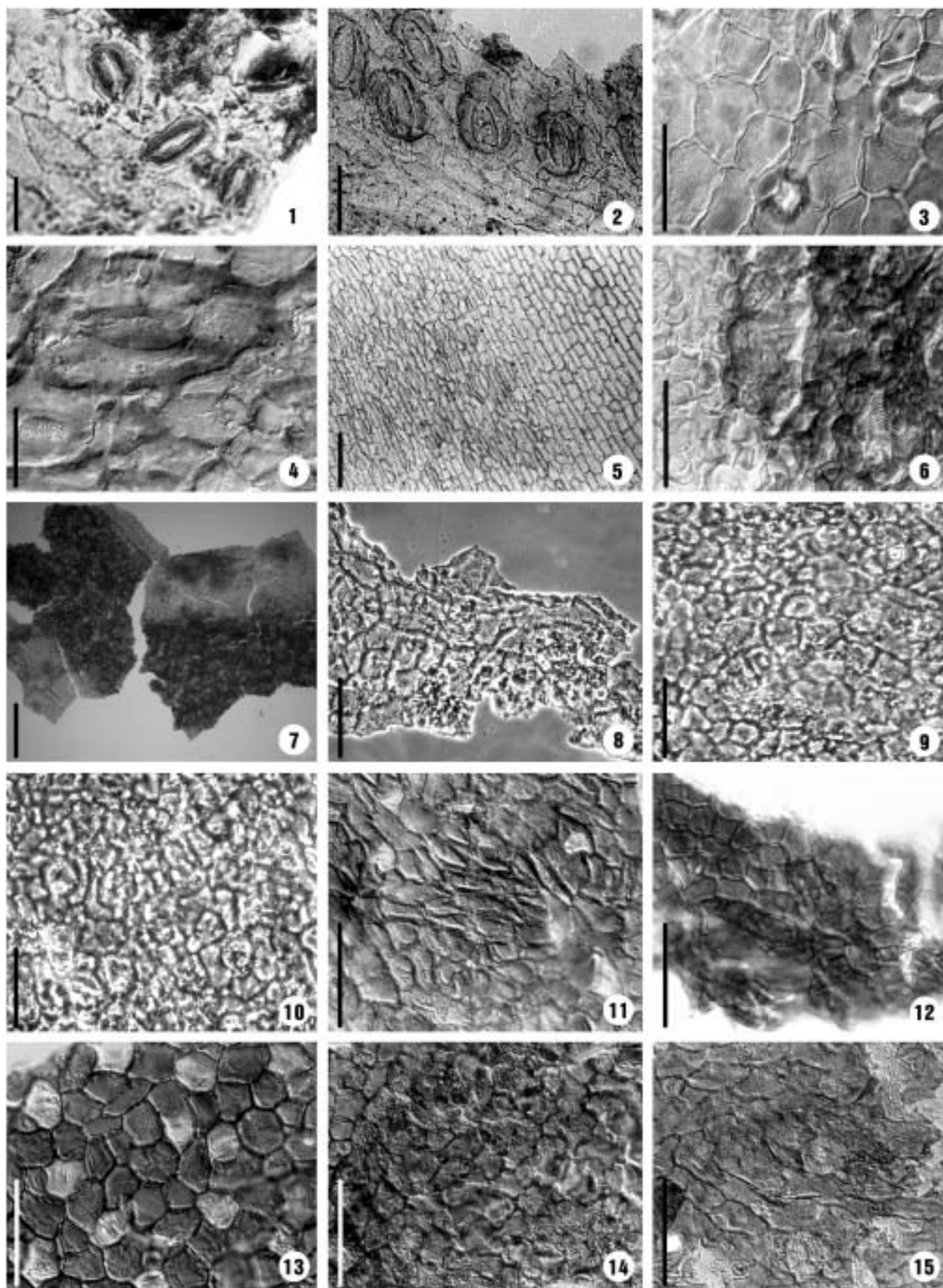


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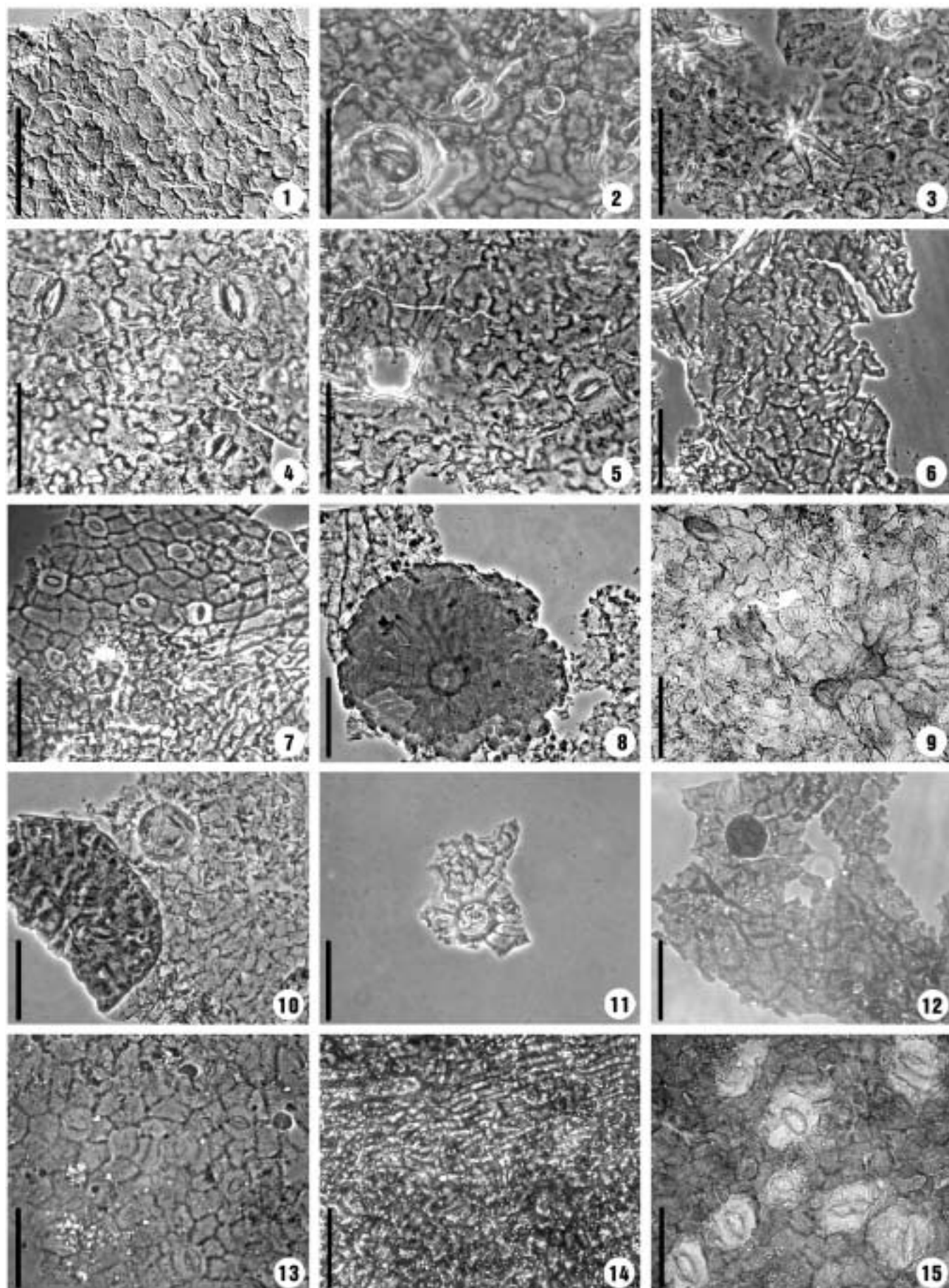




PLATE 24

