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REVISION OF EARLY MIOCENE PLANTS PRESERVED IN BAKED ROCKS IN THE NORTH BOHEMIAN TERTIARY

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Abstract. Several localities of porcelanite (baked clay) have yielded plant assemblages of Early Miocene age in the Most Basin and its periphery. They have been known since Sternberg's times and published mainly by Ettingshausen, Velenovský and Engelhardt in the 19th century. In this revision, detailed descriptions and situation of all plant-bearing sites are given with a review of the megafossil content. Gross morphological characters of impressions enabled identification of 6 pteridophytes, 5 conifers and more than 60 angiosperms, icluding newly suggested *Rosa europaea* (ETTINGSHAUSEN) comb. n., *Rubus vrsovicensis* nom. n., *Fraxinus bilinica* (UNGER) comb. n., and *Hydrochariphyllum miocenicum* (VELENOVSKÝ) comb. n. Baked rocks, which were caused by earth fires of coal and adjacent sediments, belong to the Most Formation. The plant assemblages reflect mostly swampy and riparian vegetation.

■ flora, Lower Miocene, porcelanite, North Bohemia

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Introduction

Due to the distinctive nature of baked rocks, porcelanite sites represent the most characteristic geological phenomenon of the periphery of the Most (former North Bohemian) Basin. They were caused by earth fires after exposition of coal seams in the latest Neogene and during the Quaternary to Recent. The coal ignited spontaneously and coal seams burned into ash, melting into slag. Adjacent clay strata and sloams were baked into porcelanite of various, mostly reddish colours. Their occurrences line the southern margin of the Most Basin and are scattered to the south together with small satellite basins into the České středohoří Mountains. They witness a much wider extent of the coal-bearing Miocene deposits beyond the basin, which were removed by denudation processes during the Quaternary.

Although the origin of the porcelanite rocks dates to the Quaternary, the plant remains preserved in them are clearly connected with the original clay of the coal-forming basin fill, Early Miocene in age. Some of the sites are typical of the well-bedded porcelanite overfilled with plant remains. They are noted for nicely preserved leaf impressions. For collection purposes, the porcelanite has advantages over mere clay being very hard, and reflecting very precisely details of venation. The rocks are often split into slabs on the exposures and one only needs to select suitable pieces in clasts. Unfortunately, it is usually difficult to undertake additional mechanical preparation of the specimens due to the very hard consistence of the rock. Leaf impressions often overlie each other concealing details of the margin. They are also unsuitable for obtaining cuticle characters - they may reflect a rough relief of cell structure removable by colodion film technique, but usually without necessary details of pubescence and stomata.

Two of the porcelanite sites - Želénky/Zabrušany and Vršovice belong undoubtedly to the most popular and well known sites of the North Bohemian Tertiary. Together with the flora of the Břešťany Clay and that of Kučlín they both are respected as world famous "Lagerstätte" of Tertiary plants. Most of the world collections house some pieces, both in private collections and in various institutions. In our republic, the most important collections (including original specimens) are housed in the National Museum (Sternberg 1820-38, Velenovský 1881), Czech Geological Survey (coll. *Bůžek - Z. Kvaček*) and Charles University, Faculty of Science (a part of Engelhardt 1891). Type and figured specimens from the 19th century (Göppert 1836, Ettingshausen 1866-9, Menzel 1901) are scattered over Europe, e.g., at the Wroclaw University, Hungarian Natural History Museum, Budapest, Natural History Museum, Vienna, Geological Survey (Geologische Bundesanstalt), Vienna and Staatliches Museum für Mineralogie und Geologie, Dresden. Material from old as well as newly discovered sites is concentrated in the County Museum, Most (Hurník 1999), Regional Museum, Teplice, Town Museum, Ústí n/L. and in the collection of the Bílina Mines. Surprisingly, the County Museum in Louny, situated only a few km from the Vršovice

site, possesses almost nothing from there. We have tried to look through most of the earlier published material and sort out parts of the available collections. However, a full inventory of all items is beyond the scope of this paper. It must be noted that a large part of the published and figured specimens (e.g., by Engelhardt 1891), originally kept in private collections, is now missing.

The following abbreviations are used in the text, mostly prefixing specimen numbers, for the selected repositories:

BA – Geologische Bundesanstalt, Wien
BP – Hungarian Natural History Museum, Budapest
DB – Bílina Mines
MT – Regional Museum, Teplice
MM – County Museum, Most
MCh – County Museum, Chomutov
NM – National Museum, Palaeontological Department, Praha

History of the research

First it is necessary to review opinions on the origin of baked rocks in North Bohemia. In the 19th century, the explanation for earth (ground) fires was mostly connected with basalt lava flows. F. A. Reuss (1790) was probably the first who saw causes of earth fires in oxidation of iron sulphides in coal matter and combustion of coal deposits into "pseudo-volcanic rocks". Also Zippe (1831) upheld the same opinion. A protagonist of the view connecting earth fire with basalt eruptions was A. E. Reuss (1840). In his extensive work on the geology of environs of Teplice and Bílina he summarised and challenged various approaches to this problem. And he accepted the direct impact of glowing lava on the coal seam as being the most logical cause. He derived this explanation from the regular association of porcelanite rocks with basalt lava flows of the České Středohoří Mts. on the southern periphery of the basin. In locations, where igneous rocks did not occur, he anticipated existence of such bodies beneath the porcelanite. In his opinion, only glowing lava was hot enough to cause full combustion of coal and melting of ash, clay, and even sand or conglomerate adjacent to the coal seam into slag. Other factors, like oxidation of iron bisulfide or oxidation of coal matter itself, acted in his opinion only exceptionally. He also argued with Haidinger (1839), who believed in the indirect influence of lava flows. Haidinger supposed that igneous bodies initiated spontaneous ignition of coal by raising the seam and disintegrating it by intrusions, thus allowing better access of air to the coal matter.

The problem of the age of origin is also related to the process of combustion. The geological law of "identical fossils" is not valid in this case. The origin of a new rock (porcelanite), which petrologically differs from the previous matter (clay), is not a product of diagenesis, contact or regional metomorphism, nor re-deposition. The porcelanite occurrence arose, like another typical rock of North Bohemia - ganister quartzite, due to an exogenic process. In our case, it is combustion of the coal seam due to spontaneous ignition. If this process were connected with basalt lava, than the age of it would fall into the Oligocene or Miocene. Today new palaeomagnetic dating (Tyráček 1994) indicates that the change of clay into porcelanite, and also the period of earth fire, took place in connection with strong denudation in the latest Tertiary and during the Quaternary. In fact, earth fires may occur due to antropogenic influence even today (see combustion of the coal seam at Mlžany in the 18th century reported by F. A. Reuss, 1801, or references by Váně 1961).

The first palaeobotanic data connected with baked rocks in North Bohemia are only in the form of brief notes. F. A. Reuss (1801) was the first to report on plant impressions, axes and leaves, from Hošnice at Most. Sternberg (1822) described and figured "die Endspitze einer kleiner *Pteris*-Art" (which is now the neotype specimen of *Taxodium dubium*) from "pseudo-volcanic products" of Chomutov-Most-Litvínov environs, and later (Sternberg 1823) three other remains (*Phyllites dubius, Phyllites julianiformis* and *Phyllites juglandiformis*) from "Porzellanjaspis aus dem Biliner-Stollen" and *Muscites stolzii* (Sternberg 1833) from Bílina (coll. *Stolz*). Notes on leaf impressions of ferns, broad-leaved trees and reeds occurring in the "pseudo-volcanic rocks" at Želénky were published by Sommer (1833). Göppert (1836) described *Asplenites dentatus* (now *Blechnum dentatum*) from "Porzellanjaspis von Teplice". More information about porcelanite rocks within the Most Basin is included in the above mentioned geological study by A. E. Reuss (1840). He states (Reuss 1840: 118) that the porcelanite is well bedded, obviously due to its origin from shale clay. And the bedding planes are densely covered by plant impressions of mostly dicotyledons, also needles of conifers, remains of reed, rarely of ferns. Exceptionally rare are animal fossils, represented mainly by shells of Unionids. He lists Chudeřice, Straky and Želénky and mentions *Volkmannia sessilis* from the porcelanite at Malé Březno. The latter occurrence is obviously misapplied. Presl (1838) described clearly sphenophyte cones of Carboniferous age on the basis of a drawing supplied by Münster, who received this fossil from a visitor to North Bohemian spa, allegedly from Malé Březno. Carboniferous fossils are commonly preserved in porcelanite, which arose on burning refuse dumps at many places of Central Bohemia. Thus the locality Malé Březno south of Most cannot come into consideration being Miocene in age.

First Ettingshausen (1866-1869) studied monographically the Tertiary flora of North Bohemia including that from several sites of porcelanite. He included in his monograph an extensive fossil material at that time housed in the collections of Prince Ferdinant von Lobkowicz, Bílina, mostly gathered by A. E. Reuss (now in the Hungarian Natural History Museum, Budapest), the Geological Survey in Vienna, mostly gathered by Haidinger (still partly preserved in the same collection), and the "Hof-Mineralien-Kabinet" (now in the Natural History Museum, Vienna). The sites of porcelanite ("Brandschiefer") are referred to as Sobrussan (i.e. Zabrušany), Schelenken (i.e. Želénky), Kutterschitz (i.e. Chudeřice) and Straka (i.e. Straky). Ettingshausen sometimes mentions a more general locality "Brandschiefer von Bilin", which probably means some of the above mentioned sites near Bílina. Most plants have been described from Zabrušany (63 taxa) and Bílina (12). 4 species bear a less precise reference "the Bílina Tertiary Basin", 2 species come from Straky, 3 species from Chudeřice and only one species (*Taxodium dubium*) from Želénky (see Appendix)

In his textbook on geology of Bohemia, Krejčí (1877: 915-927) summarised the list of plants from the Tertiary of Bohemia adding to the flora of baked rocks *Carpinus grandis* from

Zabrušany and *Carpinus heerii* and *Castanea atavia* from Hostomice. The latter newly recovered flora from Hostomice (Ober-Hostomitz) is reported also by Engelhardt (in Geinitz 1878), in which *Glyptostrobus europaeus, Betula prisca, Betula Brongniartii, Carpinus Heeri* and *Castanea atavia ?* have been included. (The original collection done by the mine manager Klier is at present not available.) Plants from Bohemian porcelanite sites were also mentioned in the textbook on palaeobotany by Schenk (1890).

The posthumous paper by Sieber (1881), read at the session of the Sience Academy in Vienna in 1880, adds 6 more taxa to the flora of Zabrušany, among them also *Hydrangea microcalyx* (a doubtful record of this newly described species typified by another specimen from the Late Eocene diatomite of Kučlín) and *Rhus merianii* (i.e. *Rubus merianii*). Although some of the specimens figured in this account are housed in the National Museum, Praha, those from the porcelanite of Zabrušany have not been recovered so far.

One year later Velenovský (1881) published an extensive study of the flora of Vršovice (Vršovic bei Laun), in our review included within a broader site Černodoly. About 60 taxa have been reported by Velenovský from this site, including 14 new species, three being based on fruit remains and 2 uncertain leaf remains (see Appendix). Most of the figured specimens are housed in the National Museum, Praha.

Engelhardt (1891) gave a comprehensive account of the flora from the environs of Duchcov (Dux), in which he described also the flora from Želénky. From this site 50 taxa are given, including 4 as new species. Unfortunately, most of the figured specimens are now missing. The majority were offered to Engelhardt for the study from private collections of mine managers Tobisch, Sieber and Prof. Ulrich from Dux . Only a few specimens from the collections of the Technical University, Prague (coll. *Krejčí*) survived at the Faculty of Science, Charles University (see Appendix). In the introduction of his study, Engelhardt (1891: 133) mentioned also large slabs of porcelanite from Lišnice-Polerady densely covered by leaf impressions, and identified among them four "*Ficus*" species (*F. multinervis, F. lanceolata, F. Hercules* and *F. tiliaefolia*).

In his monograph on Gymnosperms from the North Bohemian Tertiary, Menzel (1901) partly revised, partly contributed to the flora of the porcelanite sites Želénky, Straky, Vršovice and Lišnice-Polerady, having restudied collections of his own, those of Professor Deichmüller and from the Museum in Dresden (now partly in the Staatliches Museum für Mineralogie und Geologie, Dresden), and those from the Charles University, Prague, Regional Museum in Teplice, and Agriculture School in Libverda (now partly in the Town Museum, Ústí n/ L.). He reports on *Podozamites miocenica* (i.e. *Hydrochariphyllum miocenicum*) from Vršovice, *Taxodium distichum miocenicum* (i.e. *Taxodium dubium*) from Želénky, Straky, Vršovice and Lišnice-Polerady, *Sequoia Langsdorfii* (in our revision *Taxodium dubium*) from Želénky, Straky and Vršovice, *Sequoia couttsiae* (i.e. *Quasisequoia couttsiae*) from Želénky, and *Glyptostrobus europaeus* from Hostomice, Želénky, Vršovice, Lišnice-Polerady, and also from the Doupov Mountains. Menzel lists among records of *Pinus rigios* also the Doupov Mountains, where no porcelanite occurrence has been recovered till now.

Katzer (1902) lists the flora of the Bohemian Tertiary and mentions the Vršovice, Zabrušany and Straky sites. The review of the Tertiary plants of North Bohemia published by Brabenec (1909) includes all the so far described sites of porcelanite. Brabenec sometimes confused porcelanite with the German term "Brandschiefer" and occasionally included as porcelanite ("vypálené břidlice, lupky" in Czech) also the occurrences of the bituminous shale from the Oligocene (Suletice-Berand, Kundratice). In his lists of occurrences, he added some new elements to the local floras including those from the baked rocks (e.g. *Craigia bronnii* for the site Želénky).

The World War I interrupted palaeobotanical research of North Bohemia until the 1950s. First reports from the new period of research are given by Procházka (1954, 1955, 1956) concerning the porcelanite sites Čemníky and Dolany in the Pětipsy area and by Hurník (Luft-Hurník 1957a) from a new site Lajsník near Most. The latter author (Luft 1956b) recovered a new fern for North Bohemia - *Lygodium* - in the old collections of the National Museum from Želénky. In his palaeofloristic study of the Most Basin (Hurník 1961), he includes the sites Želénky and Zabrušany in his Most-Bílina paleofloristic region and he also mentions Želénky among horizons of water plants. At that time Bůžek started his long-term activities in the North Bohemian Tertiary and reported first results from Želénky (Bůžek 1961) and from other, partly new, sites such as Kladruby, Všechlapy, Hostomice, Světec, Lyskovice, Chotějovice and Chotověnka (Bůžek 1962). Most of these collections are housed in the repository of the Czech Geological Survey at Lužná. Hurník and Knobloch (1966) mention in their palaeofloristic review the site Vršovice as a part of the "Seam Formation" and Želénky and Zabrušany as belonging to the "Overlying Formation".

Bůžek (1971) monographically studied the Miocene flora of the southwestern part of the Most Basin in the Pětipsy area, including two sites of porcelanite - Čermníky and Dolany, mentioned already by Procházka (1954, 1955, 1956) and Bůžek (1959). Bůžek (1971: 31) lists *Spirematospermum wezleri* and *Salix varians* (coke coal), *Taxodium dubium, Glyptostrobus europaeus, Alnus* sp., *Ulmus pyramidalis* and *Acer tricuspidatum* from the former (the layer No. 155c), and 13 species from the latter (mostly from the inter-seam beds, only three species from the overlying clay). The documentation is housed in the repository of the Czech Geological Survey in Lužná.

Some more specimens from baked rocks were published in several separate taxonomical studies. Z. Kvaček and Holý (1974) in the revision of a Tertiary alder *Alnus julianiformis* figured a single specimen from the site Kaňkov (coll. *Holý* at NM). Procházka and Bůžek (1975) revisited all records of *Acer* of the North Bohemian Tertiary including those from baked rocks. They reduced the number of maples in the respective sites as follows: Of five species described by Velenovský (1881) at Vršovice, two have remained - *Acer tricuspidatum* and *A. integerrimum* f. *nervatum.* Three species from Želénky have been reduced to two, *A. tricuspidatum* being represented by two forms (*tricuspidatum* and *productum*). The same number is reported from Zabrušany. Only *A. dasycarpoides* (determined as *A. rueminianum* by Ettingshausen) is known from Straky. Z. Kvaček (1976) refigured Sternberg's specimen (neotype) of *Taxodium dubium* from baked rock of the North Bohemian Basin, probably Bílina. Hurník (1978) in his revision of the fern genus *Woodwardia* included in his study also Velenovský's specimens from Vršovice (coll. NM). He states that only a single species *W. muensteriana* occurs in the North

Bohemian Tertiary, including the material from Vršovice (see also Hurník's thesis - Luft 1956a), and mentiones Dolany as another occurrence of this fern, known at that time.

Information on various floras in the North Bohemian baked rocks are scattered in various geological guide books (Walther 1978, Elznic and Zelenka 1987), explanations to the geological maps, congress proceedings of the Czech geological society and in the geological monograph of the Most Basin (Malkovský et al. 1985). The specimens described by Sternberg (1820-1838) have been newly treated and refigured, when available, in the collection catalogue (J. Kvaček and Straková 1997).

In the last ten years, new collections in various, partly new sites were made, mostly by Z. Dvořák, Bílina Mines, and M. Radoň, Regional Museum, Teplice, and the authors. This extensive material is now deposited in the respective institutions and included in the present study. Plant material was recovered at some occurrences of porcelanite, previously more or less sterile in plant fossils. These are Kaňkov near Braňany, Dobrčice, Nechvalice and Svinčice. The first report on the flora and its stratigraphical position of the site Dobrčice was published by Hurník (1999) on the basis of a collection housed at the County Museum, Most. First major collections from Svinčice were made by Z. Kvaček and his students in 1999 (at DB).

The review of the flora preserved in baked rocks in North Bohemia

Since Sternberg's times about 150 plant species have been described from various sites of porcelanite, which very often represent mere synonyms of newly revised taxa of a different systematic position. In many instances, the species have been based on poorly preserved specimens, not showing diagnostic characters, and their status is problematic. Therefore, an attempt has been made to clarify the so far published lists from the respective sites, in many instances revisiting actual specimens scattered in the collections of various institutions in our country and abroad. We have tried to select reliably documented elements of this flora from those of ambiguous affinities. We have not endeavoured to determine every collected fossil, which in many cases do not show sufficient traits to rely on (young ontogenetic stages of leaves, fragments, many monocots etc.). For convenience of the readers, the systematic revisions of major monographs are attached as Appendix. Three localities are extraordinarily rich both in species and collections - Vršovice, Zabrušany and Želénky. These sites are similar to each other in the flora composition, and correspond to similar conditions of fluvio-lacustrine and coal-forming habitats within the Žatec and Bílina deltas. Their comparisons and vegetation analysis together with other sites are given below in a separate chapter.

The following taxonomic part is arranged according to the current system employed by Tachtadžjan (see Brummit 1992). To avoid misunderstandings, a more traditional approach is given preference below over novelties in family treatments (e.g., fusions of Taxodiaceae with Cupressaceae, Aceraceae with Sapindaceae, Tiliaceae with Malvaceae etc.).

Only critical taxa are treated in detail. The flora of the baked rocks thus includes 6 ferns, 5 conifers, and more than 60 angiosperms. Four cummulative units - *Leguminosites* spp., *Dicotylophyllum* spp., *Carpolithes* spp. and *Cyperacites* spp. incorporate more natural species, which are not differentiated. Some "organ" species for the foliage and fruits (*Paliurus tiliaefolius* + *P. favonii*) are kept apart only for formal reasons, and designate parts of the same plant.

POLYPODIOPHYTA

Osmundaceae GÉRARDIN et DESW.

Osmunda L.

Osmunda parschlugiana (UNGER) ANDREÁNSZKY

Pl. 1, fig. 5

Pteris parschlugiana UNGER, 1847, p. 122, pl. 36, fig. 6
Osmunda parschlugiana (UNGER) ANDREÁNSZKY, 1959, p. 45, pl. 7, fig. 4, text-fig. 2

Pinnules of *O. parschlugiana* are only rarely found in the baked rocks. This fern was confined mostly to the sandy-clayey facies (Bůžek 1971, Z. Kvaček and Bůžek 1982) and occurred in the coal clay (Sakala 2000, this volume) and fine-grained porcelanite exceptionally.

Schizaeaceae KAULFUSS

Lygodium SW.

Lygodium kaulfussii HEER

Pl. 1, fig. 6

Lygodium kaulfussii HEER, 1861, p. 409, pl. 8, fig. 21, pl. 9, fig. 1
Lygodium gaudinii sensu Luft-Hurník, 1957a, p. 284, text-fig. 1/1a-b

The first record found in the Most Basin at Želénky (Luft-Hurník 1957a) can now be complemented by two more specimens from Světec (coll. *Štross*, 1936, NM) and one from Kaňkov (coll. *Dvořák*, DB). All of them match by rounded tips of digitate fronds the forms assigned by Kräusel and Weyland (1950) to *L. kaulfussii* (contrary to *L. gaudinii* HEER with narrowly pointed tips).

Thelypteridaceae PICH. SERM.

Pronephrium C. PRESL

Pronephrium stiriacum (UNGER) KNOBLOCH et Z. KVAČEK

Pl. 1, figs 1-2, text-fig. 1.1

Polypodites stiriacus UNGER, 1847, p. 121, pl. 36, figs 1-5
Lastraea stiriaca (UNGER) HEER, 1855, p. 31, pls. 7-8
Abacopteris stiriaca (UNGER) CHING, 1963, p. 298
Pronephrium stiriacum (UNGER) KNOBLOCH et Z. KVAČEK, 1976, p. 12, pl. 1, fig. 1

Accumulations of larger and smaller parts of this fern occur in particular layers (e.g., in Dobrčice) indicating that *P. stiriacum* formed dense stands in swamps. Fertile pinnules prove that the records from the North Bohemian Tertiary exactly correspond to those from other parts of Europe (e.g., Barthel 1976).

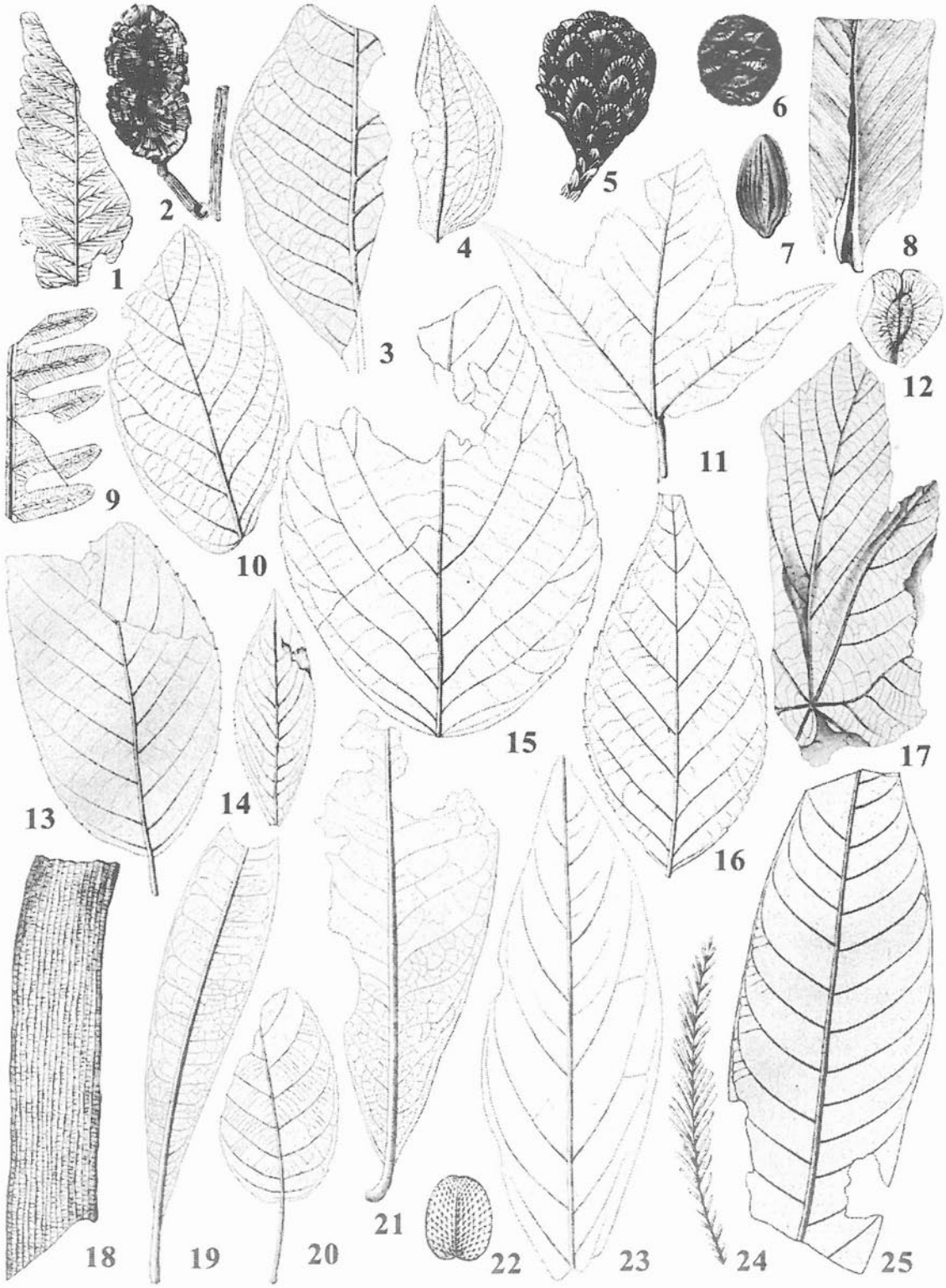

Fig. 1. Vršovice - pelitic porcelanite (from Velenovský 1881, mostly re-identified, nat. size). 1. *Pronephrium stiriacum* (UNG.) KNOBLOCH et Z. KVAČEK, 2. *Alnus kefersteinii* (GÖPP.) UNG., 3. *Nyssa haidingeri* (ETT.) KNOBLOCH et Z. KVAČEK, 4. *Smilax weberi* WESSEL, 5. *Glyptostrobus europaeus* (BRONGN.) UNG., 6. *Quasisequoia couttsiae* (HEER) KUNZMANN, 7. *Nyssa sp.*, 8. cf. *Zingiberoideophyllum liblarense* KRÄUSEL et WEYLAND, 9. *Woodwardia muensteriana* (C. PRESL) KRÄUSEL, 10. *Rubus vrsovicensis* nom. n., 11. *Acer tricuspidatum* BRONN, 12. *Craigia bronnii* (UNG.) Z. KVAČEK, BŮŽEK et MANCHESTER, 13. *Alnus gaudinii* (HEER) KNOBLOCH et Z. KVAČEK, 14. *Salix varians* GÖPP., 15. *Alnus* cf. *rostaniana* SAPORTA, 16. *Alnus julianiformis* (STERNB.) Z. KVAČEK et HOLÝ, 17. *Dombeyopsis lobata* UNG., 18. "*Typha*" *latissima* A. BR., 19. *Myrica* cf. *integerrima* KRÄUSEL et WEYLAND, 20. *Alnus gaudinii* (HEER) KNOBLOCH et Z. KVAČEK, 21. *Dicotylophyllum* sp., 22. *Salvinia reussii* ETT., 23. *Laurophyllum* cf. *saxonicum* LITKE, 24. *Taxodium dubium* (STERNB.) HEER, 25. *Quercus rhenana* (KRÄUSEL et WEYLAND) KNOBLOCH et Z. KVAČEK.

Blechnaceae (C. PRESL) COPEL.

Blechnum L.

Blechnum dentatum (GÖPPERT) HEER

Pl. 1, figs 4, 7-8, text-fig. 3.4

Aspidites dentatus GÖPPERT, 1836, p. 355, pl. 21, fig. 7-8
Taeniopteris dentata (GÖPPERT) C. PRESL in STERNBERG, 1838, p. 141
Blechnum goeppertii ETTINGSHAUSEN, 1866, p. 14, pl. 3, figs 1-4, nom. superfl.
Marratiopsis dentata (GÖPPERT) SCHIMPER, 1869, p. 607
Blechnum dentatum (GÖPPERT) HEER, 1872, p. 11, pl. 1, figs 1-1b
Blechnum braunii sensu Ettingshausen, 1866, p. 15, pl. 3, figs 5-8

According to Barthel (1976), who refigured the type specimen of *Aspidites dentatus* GÖPP. from Teplice, the names *B. braunii* ETT. and *B. goeppertii* ETT. fall into the synonymy of this species. However, he indicates A. Braun (1852) as the author of the combination. Although Braun referred *Taeniopteris dentata* (GÖPPERT) C. PRESL in STERNBERG to the genus *Blechnum*, he did not create the respective combination. Hence his treatment is invalid (in the sense of ICBN, Art. 33.1 - Greuter et al. 1994). Heer (1872) was the first who did it, and he must be considered, contrary to the view of Barthel (1976), the author of this recombination.

It is sometimes difficult to differentiate between fragmentary pinnae of *Blechnum dentatum* (pinnae long, parallel-sided, the base asymmetrical, narrow cuneate on one side, margin markedly dentate) and *Osmunda parschlugiana* (pinnules shortly elongate, the base also asymmetrical, but usually truncate to cordate, margin smooth to finely crenulate). This is the case of the specimen from Želénky, identified by Engelhardt (1891) as *Pteris pennaeformis* HEER. An assignment to *Blechnum dentatum* seems more likely because of the narrow cuneate leaf base, but the specimen is not available to confirm this assumption. *B. dentatum* is rare at Želénky (e.g., at NM), the true *Osmunda parschlugiana* has not been recovered there in pelitic porcelanite.

We were unable to spot any topotypical specimens in the porcelanite occurrences near Teplice. The Göppert's referrence to Teplice may mean also Chudeřice, but still the exact position of the type locality remains uncertain. The occurrence of this fern is more abundant around Bílina, namely in the latter locality. A more complete frond fragment has been found in the *Štross* collection from the former mine Rudiay II at Světec (pl. 1, fig. 8), where detached pinnae, in some cases fertile, are common. This fern is rare elsewhere (e.g., at Zabrušany, Želénky, in the seam roof in the Bílina Mine).

Woodwardia SMITH

Woodwardia muensteriana (C. PRESL in STERNBERG) KRÄUSEL

Pl. 1, fig. 3, text-fig. 1.9

Pecopteris muensteriana C. PRESL in STERNBERG, 1838, p. 154, pl. 36, f. 2
Woodwardites muensterianus (C. PRESL) F. BRAUN, 1841, p. 33
Woodwardites roessnerianus UNGER, 1847, p. 123, pl. 37, fig. 4
Woodwardia roessneriana (UNGER) HEER, 1855, p. 29, pl. 5, figs 1-4, pl. 6, fig. 1; Velenovský, 1881, p. 11, pl. 1, figs 1-8
Woodwardia muensteriana (C. PRESL) KRÄUSEL, 1921, p. 336, pl. 12, f. 1-5; Hurník, 1978, p. 26, pl. 1, text-figs 2 b, 3-5

The monographical treatement of the material from the Most Basin was published by Hurník (1978), who also revisited the porcelanite material from Vršovice (Velenovský 1881). In his opinion, which is also followed here, *Woodwardia muensteriana* (based on the missing specimen from the Bavarian Miocene, Bullenreuth) and *W. roessneriana* (based on the specimen from the Croatian Sarmatian, Radoboj) are conspecific. This fern is common in the interseam beds from the Žatec area to Louny, but very rare in the strata above the main seam roof (e.g., Sakala 2000, this volume). Sometimes the areolae typical of the *Woodwardia* foliage are weakly developed or even missing (see Hurník 1978, pl. 1, fig. 1).

Salviniaceae T. LESTIB.

Salvinia SÉGUIER

Salvinia reussii ETTINGSHAUSEN

Pl. 2, figs 1-2, text-fig. 1.22

Salvinia reussii ETTINGSHAUSEN, 1866, p. 18, pl. 2, figs 21-22; Sieber, 1881, p. 73, pl. 1, fig 5; Engelhardt, 1891, p. 144, pl. 1, figs 22-25
Salvinia cordata ETTINGSHAUSEN, 1866, p. 18, pl. 2, figs 19-20
Salvinia mildeana sensu Engelhardt, 1891, p. 144, pl. 1, figs 26-27
Salvinia formosa sensu Velenovský 1881, p. 12, pl. 1, figs 14-17

Accumulations of whole plants and detached elliptical reticulate fronds of *Salvinia* are most typical of aquatic plant horizons in the Bílina area, including occurrences of baked rocks, but are also commonly found elsewhere. In the study by Bůžek et al. (1971), *S. reussii* typified by the specimens from North Bohemia was treated as different from the species described in the later Miocene (*S. mildeana* GÖPP. - Sośnica, *S. formosa* HEER - Schrotzburg), and this approach is followed here.

PINOPHYTA

Taxodiaceae WARM.

Taxodium RICH.

Taxodium dubium (STERNBERG) HEER

Text-figs 1.24, 3.5, 5.1

Phyllites dubius STERNBERG, 1823, p. 37; 1825, Tent. 39, pl. 36, fig. 3
Filicites sp. STERNBERG, 1821, p. 29; index icon., pl. 24, fig. 2
Taxodium dubium (STERNBERG) HEER, 1853, p. 136; Z. Kvaček, 1976, p. 290, text-fig. 5-6b,c; J. Kvaček and Straková, 1997, p. 69, pl. 23, fig. 3
Taxodium distichum miocenicum auct. (non HEER); Engelhardt, 1891, p. 151, pl. 2, figs 23-34, pl. 3, figs 9-10; Menzel, 1901, p. 85
Sequoia langsdorfii auct. (non (BRONGNIART) HEER); Ettingshausen, 1866, p. 29, pl. 13, fig. 10 (non fig. 9), Velenovský, 1881, p. 16, pro parte, pl. 1, figs 28-29; Menzel, 1901, p. 89, pro parte

Deciduous shoots of bald cypress occur commonly in the baked rocks of North Bohemia. *T. dubium* is actually typified by the material from porcelanites at Bílina (Z. Kvaček 1976). Leaf cuticular study of the coalified foliage from the same area (Z. Kvaček, personal observation) proved that even broader needles recalling *Sequoia sempervirens* (LAMB.) ENDL., which regular accompany the typical shoots, do not belong to *Sequoia*. The seed cones, their fragments and seeds of *Taxodium* are exceptionally preserved, which puzzled Ettingshausen

(1866), Velenovský (1881) and Menzel (1901), who connected this more robust twigs with the *Sequoia*-like seed cones (now *Quasisequoia*).

Quasisequoia SRINIVASAN et FRIIS

Quasisequoia couttsiae (HEER) KUNZMANN

Pl. 2, figs 3-4, text-fig. 1.6

Sequoia couttsiae HEER, 1862, pp. 1051-1055, pls. 59-61
Athrotaxis couttsiae (HEER) GARDNER, 1884, p. 90, pl. 6, figs 1-9, pl. 10, figs 6-9
Quasisequoia couttsiae (HEER) KUNZMANN, 1999, p. 57, pl. 10, figs 5-6, pls. 11-13, text-fig.13-14
Taxodium dubium sensu Ettingshausen, 1866, p. 34, pro parte, pl. 10, figs 8-9, 20-22
Sequoia langsdorfii sensu Velenovský, 1881, p.16, pro parte, pl. 1, figs 30-35

This coal-forming conifer, which is spread in the coal facies and the Břešťany Clay of the Most Basin, is safely recognizable only in more complete specimens with seed cones attached to the foliage. *Sequoia*-like seeds, which occur often in association, belong obviously to the same plant. Kunzmann (1999) was able to remove such seeds from similar, better preserved seed cones and proved the affinity of this so far enigmatic member of the Taxodiaceae to an extinct *Sequoia*-like genus *Quasisequoia*. Sterile foliage is not safely distinguishable from *Glyptostrobus* on the basis of its morphology alone.

Glyptostrobus ENDL.

Glyptostrobus europaeus (BRONGNIART) UNGER

Pl. 6, fig. 7, text-fig. 1.5

Taxodium europaeum BRONGNIART, 1833, p. 168-175, pl. 30
? *Muscites stolzii* STERNBERG, 1833, p. 38, pl. 17, figs 2-3
Glyptostrobus europaeus (BRONGNIART) UNGER, 1850 b, p. 434; Velenovský, 1881, p. 15, pl. 1, figs 21-26; Menzel 1901, p. 87, pl. 5, figs 1-3
Glyptostrobus bilinicus ETTINGSHAUSEN, 1866, p. 39, pl. 11, figs 1-2; Engelhardt 1891, p. 152

Glyptostrobus europaeus is the most common conifer in the Most Basin. Its seed cones and seeds are very distinct, contrary to the sterile foliage, and allow safe identifiaction. Only these organs prove its presence on respective sites. *Glyptostrobus europaeus* occurs in most of the sites of baked rocks.

Pinaceae LINDL.

Pinus L.

Pinus rigios (UNGER) ETTINGSHAUSEN

Pl. 2, fig. 7

Pinites rigios UNGER, 1850a, p. 362
Pinus rigios (UNGER) ETTINGSHAUSEN, 1866, p. 41, pl. 13, figs 11-12

The occurrence of this ternate pine foliage in baked rocks of the Most Basin is rarer (e.g. Nechvalice). Menzel (1901) reports this species also from a porcelanite site of the Doupov Mts., but the exact position of the locality is vague.

Pinus engelhardtii MENZEL

Pl. 2, fig. 6

Pinus engelhardtii MENZEL, 1901, 57, pl. 3, fig. 28

A single seed cone mold of this pine is housed in the County Museum, Most. It is preserved in baked rock, but its exact locality is unknown. Accumulations of *P. engelhardtii* line the NW border of the basin at the foot of the Krušné hory Mts., where they occur in pelocarbonate nodules and mica clay and sand facies.

MAGNOLIOPHYTA

Lauraceae JUSS.

Laurophyllum GÖPP.

Laurophyllum cf. *saxonicum* LITKE

Pl. 2, fig. 8, text-figs 1.23, 3.16

? *Laurophyllum saxonicum* LITKE, 1968, p.176, pl. 36, figs 8-11, text-figs 9-17
Ficus lanceolata sensu Velenovský, 1881, p. 27, pl. 4, figs 15-16 (non 17)
Terminalia radobojensis sensu Velenovský, 1881, p. 46, pl. 10, figs 1-4 (non pl. 9, fig. 25)
Rhamnus dechenii sensu Engelhardt, 1891, p. 189, pl. 17, fig. 1

The coalified specimens safely determined by cuticle structure (Z. Kvaček 1971, as *Laurophyllum nemejcii* Z. KVAČEK; Hurník and Z. Kvaček 1999) suggest that this fossil member of the laurel family, closely recalling *Persea*, was spread in the coal facies both in the interseam and overlying beds. We suspect its common occurrence, according to the irregular camptodromous venation of large obovate leaves, at Vršovice and Želénky, rarely elsewhere.

Daphnogene UNGER

Daphnogene polymorpha (A. BRAUN) ETTINGSHAUSEN

Text-figs 4.11, 5.4

Ceanothus polymorphus A. BRAUN, 1845, p. 171
Daphnogene polymorpha (A. BRAUN) ETTINGSHAUSEN, 1851, p. 16, pl. 2, figs 23-25
Cinnamomum scheuchzeri sensu Velenovský, 1881, p. 33, pl. 4, figs 21-25

This cinnamomoid foliage occurs only occasionally in baked rocks, namely in more sandy layers, together with other riparian and mesophytic elements, e.g., at Vršovice and Zabrušany.

Berberidaceae JUSS.

Berberis L.

Berberis berberidifolia (HEER) PALAMAREV et PETKOVA

Pl. 2, fig. 5, text-fig. 5.13

Ilex berberidifolia HEER, 1859, p. 72, pl. 122, figs 12-18 (? non Ettingshausen, 1869, p. 38, pl. 46, fig. 16)

Celastrus arethusae ETTINSGHAUSEN, 1869, p. 34, pl. 48, fig. 16
Berberis berberidifolia (HEER) PALAMAREV et PETKOVA, 1987, p.47, pl. 14, fig. 7

A single leaf impression from Zabrušany matches this barberry in the venation and spiny remote marginal teeth, although it deviates somewhat from the standard by its ovate form. Typical specimens occurred in sandy facies and pelocarbonate in the former Julius Fučík Mine, Želénky (Z. Kvaček 1960) and the Bílina Mine (Bůžek et al. 1992).

Cercidiphyllaceae ENGL.

Cercidiphyllum SIEB. et ZUCC.

Cercidiphyllum crenatum (UNGER) R. BROWN
Text-figs 3.1, 4.10

Dombeyopsis crenata UNGER, 1850a, p. 448
Grewia crenata (UNGER) HEER, 1859, p. 42, pl. 109, fig. 12, pl. 110, figs 1-5, 7-11;Velenovský, 1881, p. 36, pl. 9, figs 10-14; Engelhardt, 1891, p. 130, pl. 14, fig. 1
Grewia ovalis HEER, 1859, p. 44, pl. 110, fig. 2; Velenovský, 1881, p. 37, pl. 9, fig. 15
Cercidiphyllum crenatum (UNGER) R. BROWN, 1935, p. 575, pl. 68, figs 1, 6, 8-10

Thanks to the typical leaf form, which can be distinguished from similar *Paliurus tiliaefolius* by crenulate margin and irregularly reticulate tertiary venation, *Cercidiphyllum* is easy to recognize even in fragmentary specimens. It occurs in most of the sites of fine-grained porcelanite and seems to have been growing in moist habitats, as it does today. No fruit and flower remains have been recovered in porcelanites, contrary to occurrences in clays (Z. Kvaček and Konzalová 1996, Sakala 2000, this volume).

Hamamelidaceae R. BR.

Parrotia C. A. MEY.

Parrotia pristina (ETTINGSHAUSEN) STUR
Pl. 3, fig. 2, text-figs 4.16, 5.2

Styrax pristinum ETTINGSHAUSEN, 1851, p. 19, pl. 3, fig. 9
Parrotia pristina (ETTINGSHAUSEN) STUR, 1867, p. 192-193, pl. 5, figs 2-3; Ettingshausen 1869, p. 4, pl. 39, fig. 23, pl. 40, fig. 24-25; Engelhardt, 1891, p. 178, pl. 14, fig. 18
Parrotia pseudo-populus ETTINGSHAUSEN, 1869, p. 5, pl. 39, fig. 20
Viburnum dubium VELENOVSKÝ, 1881, p. 35, pro parte, pl. 7, fig. 10 (non pl. 6, fig. 19, pl. 7, fig. 11, pl. 10, fig. 18ă)

There are some doubts, as to the generic assignment of the leaf fossils called *Parrotia pristina* (Bůžek 1971). In spite of rather unique combination of gross morphological characters: opposite basal secondaries descending a little below the base of the leaf blade, simple undulate margin, lobes often mucronate, a very similar leaf form is developed in three genera - *Parrotia, Shaniodendron* and *Fothergilla.* The latter genus endemic to North America deviates above all by its roundish ovate symmetrical leaf form and much longer petiole in relation to the leaf lamina (Meyer and Manchester 1997). On the other hand, *Shaniodendron,* a Chinese endemic, is practically indistinguishable from *Parrotia.* In our opinion, these two genera are so closely related that the subgeneric rank would be more appropriate for the Chinese representative. Solution of this problem requires a detailed comparable study of both extant representatives. *Parrotia* is a typical member of riparian forests in the Miocene of the Most Basin. It occurs in sandy baked rocks, e.g., at Zabrušany/Želénky and Vršovice.

Liquidambar L.

Liquidambar europaea A. BRAUN
Pl. 3, fig. 1, text-fig. 5.9

Liquidambar europaea A. BRAUN in BUCKLAND, p. 513; Ettingshausen, 1866, p. 84, pl. 29, fig. 1; Engelhardt 1891, p. 133, pl. 10, fig. 22
Acer rüminianum sensu Ettingshausen, 1869, p. 23, pro parte, pl. 48, fig. 8 (non fig. 9)

Mostly trilobate leaves have been encountered in the Most Basin. *Liquidambar* foliage can be easily mistaken for maples (Ettingshausen 1866), but can be safely distinguished by finely crenulate margin. This tree obviously accompanied *Parrotia* in similar habitats, as the leaves of these two elements occur often together.

Fagaceae DUMORT.

Quercus L.

Quercus rhenana (KRÄUSEL et WEYLAND) KNOBLOCH et Z. KVAČEK
Pl. 3, fig. 3, text-fig.1.25

Illicium rhenanum KRÄUSEL et WEYLAND, 1950, p. 50, pl. 9, figs 5-7, pl. 10, figs 1-2, pl. 11, fig. 8, text-fig. 14
Quercus lusatica JÄHNICHEN, 1966, p. 478, pls. 1-4, 8, pl. 9, figs 21-22, text-figs 1, 3-4.
Quercus rhenana (KRÄUSEL et WEYLAND) KNOBLOCH et Z. KVAČEK, 1976, p. 41, pl. 17, fig. 6, 8, 14, pl. 21, figs 5-6, pl. 24, fig. 10
Laurus primigenia sensu Velenovský, 1881, p. 30, pl. 5, figs 1-5

The leaves of this swamp oak may attain a considerable size and accumulate in particular clay layers in the Most Basin (the association *Quercus rhenana* sensu Z. Kvaček and Bůžek 1982). They are recognized from other entire-margined simple leaves by regular arc-like secondaries diverging at wider angles. Despite lacking cuticles we can be sure that Velenovský (1881) misinterpreted this foliage for the Lauraceae (see Appendix).

Quercus sp.
Pl. 3, fig. 6

Sparganium (?) sensu Velenovský 1881, p. 22, pl. 8, fig. 25

Cupules of this sort were found in association with abundant leaves of *Quercus rhenana* at Skyřice (Hurník and Z. Kvaček 1999). Also in the case of Vršovice, the cupule, although a little smaller, which was not recognized by Velenovský (1881), belongs undoubtedly to the same swamp oak.

Betulaceae GRAY

Alnus MILL.

Alnus julianiformis (STERNBERG) Z. KVAČEK et HOLÝ

Pl. 3, figs 5, 7-8, text-figs 1.16, 3.9, 5.12

Phyllites julianiformis STERNBERG, 1823, p. 37, 39, pl. 36, fig. 2 ("*julianaeformis*")
Fagus feroniae UNGER, 1845, p. 106, pl. 28, figs 3-4; Ettingshausen, 1866, p. 126, pl. 1, fig. 18, pl. 2, figs 7-8, pl. 15, figs 12-20, 22, pl. 16, fig. 1; Velenovský, 1881, p. 23, pl. 3, figs 7-8; Engelhardt, 1891, p. 158, pro parte, pl. 7, figs 32-34, pl. 8, figs 4-8, 10
Fraxinus macroptera ETTINGSHAUSEN, 1869, p. 25, pro parte, pl. 36, fig. 9
Alnus julianiformis (STERNBERG) Z. KVAČEK et HOLÝ, 1974, p. 367, pls. 1-3, pl. 4, fig. 1, text-fig. 1

This alder is a typical element of riparian and swamp forests in the Most Basin. Although variable in size of the leaves, it can be recognized by small number of secondaries (mostly 5-7), an oval outline and usually fine teeth on the margin. The associated infructescences belong to *Alnus gracilis* UNG. The leaves occur in masses near Bílina (e.g., Světec), but they are less frequent elsewhere.

Alnus gaudinii (HEER) KNOBLOCH et Z. KVAČEK

Pl. 4, figs 1-2, text-figs 1.13, 1.20, 5.6

Rhamnus gaudinii HEER, 1856, p. 79, pl. 124, figs 4-15, pl. 125, figs 1, 7, 13
Fagus ettingshausenii VELENOVSKÝ, 1881, p. 24, pl. 3, figs 10-12, pl. 4, figs 1-2
Rhamnus fricii VELENOVSKÝ, 1881, p. 42, pl. 8, figs 7-16, pl. 10, fig. 18d
Alnus gaudinii (HEER) KNOBLOCH et Z. KVAČEK, 1976, 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, 13, 15, 17, pl. 16, figs 1-5, pl. 19, fig. 15m pl. 20, fig. 10, text-figs 11-12
cf. *Rhamnus* sensu Bůžek, 1971, p 72, pl. 32, figs 1-11

Narrow oval, long petiolate leaf forms with numerous arch-like secondaries, which enter fine marginal teeth by numerous side veinlets, prevail in most populations in Europe, although some broader, even subcordate leaves can be encountered. Most frequent occurrence of this alder, which is also here associated with big infructescences of *A. kefersteinii* (GÖPP.) UNG. (see text-fig. 7.2), is Vršovice (Velenovský 1881). *Alnus gaudinii* is scattered in other parts of the basin, usually outside swampy habitats.

Alnus cf. *rostaniana* SAPORTA

Pl. 4, figs 3, 6-7, text-fig. 1.15

? *Alnus rostaniana* SAPORTA, 1891, p. 50, pl. 14, figs 1-2
Alnus cf. *rostaniana* SAPORTA; Hurník and Z. Kvaček, 1999, p.64, pl. 2, figs 2-4

Broader and larger alder leaves used to be assigned to *A. kefersteinii*, an organ species now employed only for infructescences. Some of them belong to the above form, provisionally compared with the Oligocene *A. rostaniana* (type locality Manosque, France). They are not identical with this species, newly re-defined by Walther (Mai and Walther 1991). Our populations deviate in less numerous secondaries from all the so far known occurrences of *A. rostaniana*. They are typical of the sites of the interseam beds, e.g. at Skyřice (Hurník and Z. Kvaček 1999), or in porcelanite at Dobrčice. The associated infructescences (*Alnus* sp. 1 - pl. 4, fig. 4) are of medium size. Although *Alnus* cf. *rostaniana* is similar to larger leaves of *A. julianiformis*, it differs in higher number of secondaries and cuticle structure (Hurník and Z. Kvaček 1999). Already Bůžek (1971 - as *Alnus* sp.) was aware of this peculiar alder, occurring also in the Pětipsy area.

Alnus menzelii RANIECKA-BOBROWSKA

Text-fig. 3.14

Alnus menzelii RANIECKA-BOBROWSKA, 1954, p. 11, figs 11-13, text-fig. 4
Alnus kefersteinii sensu Engelhardt, 1891, p. 156, pl. 4, figs 25-26.
Carpinus grandis sensu Engelhardt, 1891, p. 156, pl. 5, figs 8-9, pl. 6, figs 2-4
Fagus feroniae sensu Engelhardt, 1891, p. 158, pl. 5, fig. 10.

Another broad-leaved alder, but usually with coarsely double serrate margin and cordate leaf base is typically associated with long cyllindric infructescences, which obviously belong to the same plant (see *Alnus* sp. 2 - pl. 4, fig. 5). It occurred in masses in the coal clay of the former mine Julius Fučík, Želénky (Z. Kvaček 1960) and also in the porcelanite of Želénky. Its cuticle structure is more similar to a birch (own observation) and also by its infructescences it deviates from the standard alders. It is found as a swampy element not only in the Most Basin, but also in some other lignite basins, namely in Poland (Raniecka-Bobrowska 1954, at Konin; Kownas 1955, as *Betula macrophylla* HEER, Dobrzyn).

Betula L.

Betula sp.

Pl. 3, fig. 4

? *Phyllites juglandiformis* STERNBERG, 1823, p. 37, 39, pl. 35, fig. 1
? *Fraxinus juglandiformis* (STERNBERG) GIEBEL, 1852, p. 149; Bůžek, 1971, p. 44 pro parte (non pl. 11, figs 4-7, pl. 23, fig. 1)
? *Fraxinus lonchoptera* ETTINGSHAUSEN, 1868, p. 213, pro parte, pl. 36, fig. 9-9b (non fig. 10)

Most of the foliage determined by Ettingshausen (1866) as *Betula prisca* and *Betula grandifolia* belong undoubtedly to *Alnus julianiformis*. Leaves of a true *Betula* occurs rarely in the Most Basin (e.g., Bůžek 1971, as *Betula* sp.). They are occasionally found also in porcelanite. The missing holotype of *Phyllites juglandiformis* STERNBERG from the porcelanite of Bílina matches in several features this sort of leaves, but the number of the secondaries is lower (7 pairs) than in this typical birch (see text-fig. 2). We share the opinion of Knobloch and Z. Kvaček (1976) that it has nothing in common with the leaflets of *Fraxinus bilinica*, despite the fact that Unger (1850a), Giebel (1952) and Bůžek (1971) treated it as conspecific.

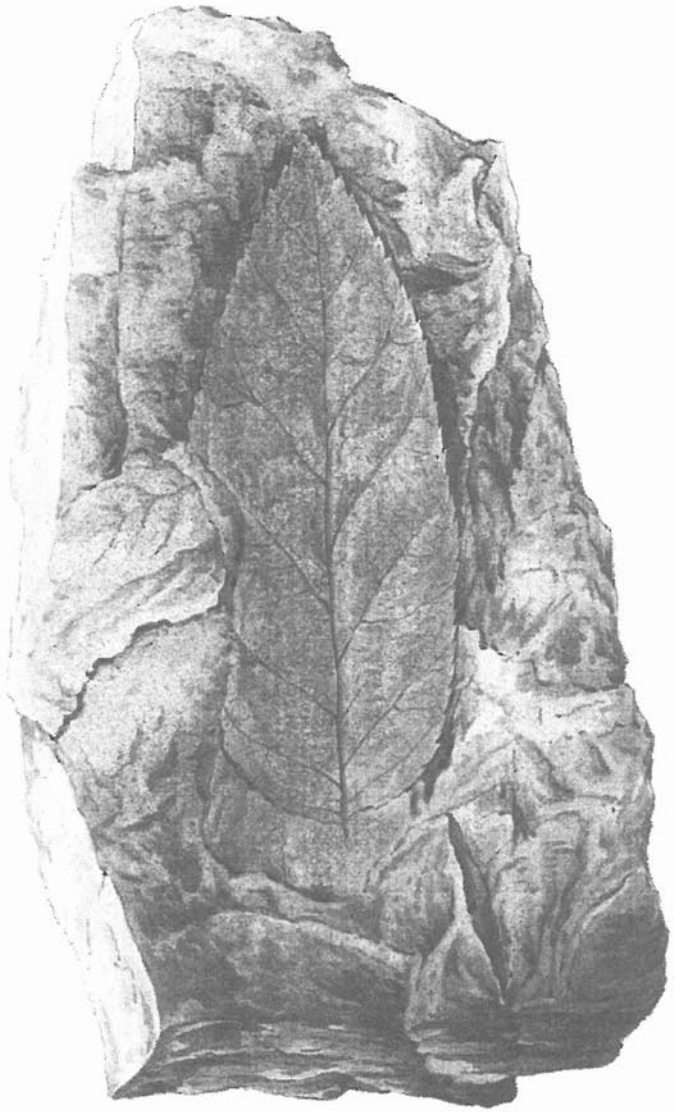

Fig. 2. ***Phyllites juglandiformis*** **STERNBERG, Bílina - the re-figured original painting reproduced in Sternberg (1825, pl. 35, fig. 1), x 1.5.**

Carpinus L.

Carpinus grandis UNGER

Text-fig. 5.15

Carpinus grandis UNGER, 1850a, p. 408, pro parte; 1852, p. 39, pl. 20, fig. 4
Carpinus heerii ETTINGSHAUSEN, 1866, p. 48, pro parte, pl. 15, fig. 11

Hornbeam foliage is difficult to differentiate from *Ostrya* and some other Betulaceae. A finely double serrate margin and dense and straight secondaries are helpful criteria to trace this mostly riparian to mesophytic element. The foliage is in any case not determinable to species and hence *C. grandis* represents a typical morphotaxon. It is rare in porcelanite assemblages. The leaves interpreted as hornbeam by some earlier authors (e.g., Velenovský 1881) have been in most cases transferred to *Ulmus* (see Bůžek 1971).

Myricaceae BLUME

Myrica L.

Myrica lignitum (UNGER) SAPORTA

Pl. 5, fig. 3

Quercus lignitum UNGER, 1847, p. 113, pl. 31, figs 5-7
Myrica lignitum (UNGER) SAPORTA, 1865, p. 102

The foliage belonging to *Myrica* is most easily determinable with the aid of cuticle structure (peltate trichomes with biseriate stalks). *Myrica lignitum* is the most common species in the European Tertiary, typically variable in the leaf margin (both entire and dentate forms). In the Most Basin, the occurrence of this species is limited to the mica and Břešťany clay facies. Hence it is extremely rare in porcelanite (e.g., Nechvalice).

Myrica cf. *integerrima* KRÄUSEL et WEYLAND

Pl. 5, figs 1-2, text-fig. 1.19

Dryandroides lounensis VELENOVSKÝ, 1881, p. 33, pl. 9, figs 17-22
? *Myrica. integerrima* KRÄUSEL et WEYLAND, 1954, p. 128, pl. 17, figs 4, pl. 27, figs 4-7; Z. Kvaček, 1960, p. 25, pl. 4, fig. 1-3

Anatomically defined leaf taxa are difficult to apply to this impression material. The above designation is applied because *M. integerrima* occurred commonly in the coal facies of the Most Basin, e.g. at Želénky and Bílina (Z. Kvaček 1960, own observation). This species matches well by entire leaves and dense venation some of the impressions in porcelanite. It should be noted that the population at Vršovice has narrower leaves than the standard of the species. Better preserved compression material from the Upper Interseam Beds is needed to elucidate this problem. We hesitate to assign to this species also *Ficus arcinervis* sensu Velenovský (1881, pl. 4, figs 18-20) because of the lack of reticulate higher-order venation. The affinity to *Decodon* is more likely (see Appendix).

Comptonia L'HÉRIT. ex AITON

Comptonia difformis (STERNBERG) BERRY

Pl. 5, fig. 7

Asplenium diforme STERNBERG, 1822, p. 29, 33, pl. 24, fig. 1, nom. illegit.
Aspleniopteris difformis STERNBERG, 1825, p. 21, pl. 24, fig. 1
Comptonia acutiloba BRONGNIART, 1828, pp. 143, 209
Comptonia difformis (STERNBERG) BERRY, 1906, p. 495 ("*diforme*")

This very distinct foliage typically occurs in the Břešťany clay and "overlying clay" facies, rarely elsewhere within the Most Basin. It was rarely found in the porcelanite belonging to the Overlying Beds (Dolany, Nechvalice). The epithet "*difformis*" must be applied for the correct name for priority reasons (see J. Kvaček and Straková 1997).

Juglandaceae A. RICH. ex KUNTH.

Carya NUTT.

Carya cf. *serrifolia* (GÖPPERT) KRÄUSEL

Text-fig. 3.8

? *Quercus serrifolia* GÖPPERT, 1855, p. 17, pl. 5, fig. 14 ("*serraefolia*")
? *Carya serrifolia* (GÖPPERT) KRÄUSEL, 1921, p. 389, pl. 5, fig. 2
Pterocarya denticulata auct. (non WEBER); Ettingshausen, 1869, p. 47, pl. 53, figs 11-15; Engelhardt, 1891, p. 193, pl. 17, fig. 15, 17

We follow Bůžek (1971) to assign this kind of the Juglandaceae leaflets to *Carya*, although the exact indentity with the typical specimens of *C. serrifolia* is not guaranteed. These leaflets may belong to the fruits of different kinds, e.g., *C. bohemica* BRABENEC, *C. costata* (C. PRESL ex UNGER) UNGER or some other species. They are rarely found in porcelanite sites as a typical riparian-mesophytic element.

Engelhardia LESCH. ex BLUME

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

Pl. 5, fig. 4

Banksia orsbergensis WESSEL et WEBER, 1855, p. 146, pl. 25, fig. 9a
Engelhardia orsbergensis (WESSEL et WEBER) JÄHNICHEN, MAI et WALTHER, 1977, p. 326, pls. 38-49, text-figs 1-4

Leaflets of this sort are typically sessile, finely and remotedly toothed, with dense secondary venation and asymmetrical base. A single fragmentary specimen found in the baked rocks at Nechvalice belongs undoubtedly to this species. It is one of the characteristic elements of the Břešťany Clay flora (see Z. Kvaček and Bůžek 1982).

Salicaceae MIRB.

Salix L.

Salix varians GÖPPERT

Pl. 5, fig. 5, text-fig. 1.14

Salix varians GÖPPERT, 1855, p. 26, pl. 20, figs 1-2; Velenovský, 1881, p. 30, pl. 5, figs 16-17, pl. 6, fig. 8

Willow leaves are commonly associated with the coal clay and sandy-clayey deposits of the Most Basin. *S. varians*, which has longly ovate leaves, preferred obviously swampy habitats. Mass occurrences of its leaves have been found mostly in the coal facies (e.g., Čermníky, Bůžek 1971, Bílina Mine, own observation). In the porcelanite sites, it is an accessory, but regular element.

Salix haidingeri ETTINGSHAUSEN emend. BŮŽEK

Text-figs 4.5-6

Salix haidingeri ETTINGSHAUSEN, 1866, p. 88, pl. 29, figs 9-16
Salix macrophylla sensu Velenovský, 1881, p. 29, pro parte, pl. 5, figs 11, 13-15

This willow differs from the above mentioned *S. varians* by narrow elongate, parallel-sided leaves. Such fossils were assigned to *S. angusta* A. BRAUN by earlier authors dealing with the flora of the Most Basin. Bůžek (1971) discussed in detail the new status and systematic position of *S. haidingeri*. It occurs in masses in the alluvial deposits, exceptionally also in the coal clay facies (Sakala 2000, this volume). Larger leaves were misinterpreted by Velenovský (1881) for *S. macrophylla* HEER, which is slightly broader, with a distinct oblique tertiary venation.

Salix macrophylla HEER

Pl. 5, figs 8, 10

Salix macrophylla HEER, 1856, p. 9, pl. 67; Velenovský, 1881, p. 29, pro parte, pl. 5, figs 9-10, 12

We share the opinion of Bůžek (1971) that these large willow leaves with very oblique course of tertiary veins may represent in fact larger forms of *S. varians,* most probably shade leaves. Like in other cases of shade leaves, they deviate from

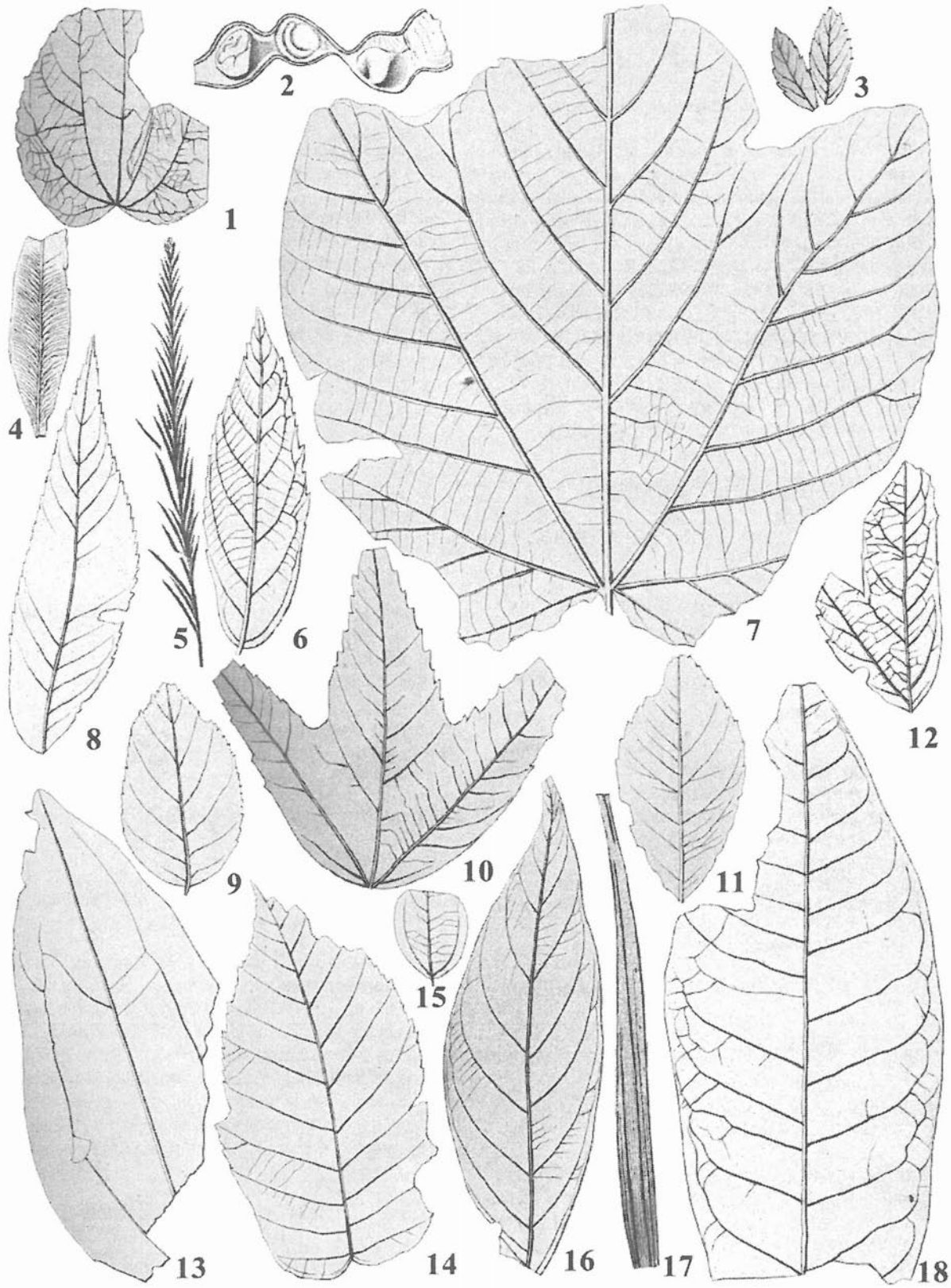

Fig. 3. Želénky - pelitic porcelanite (from Engelhardt 1891, and Ettingshausen 1866-9, mostly re-identified). 1. *Cercidiphyllum crenatum* (UNG.) R. BROWN, 2. *Leguminosites tobischii* ENGELHARDT, 3. *Rosa europaea* (ETTINGSHAUSEN) comb. n., 4. *Blechnum dentatum* (GÖPP.) HEER, 5. *Taxodium dubium* (STERB.) HEER, 6. *Rubus merianii* (HEER) KOLAKOVSKII, 7. *Dombeyopsis lobata* UNG., 8. *Carya* cf. *serrifolia* (GÖPP.) KRÄUSEL, 9. *Alnus julianiformis* (STERNB.) Z. KVAČEK et HOLÝ, 10. *Acer tricuspidatum* BRONN, 11. "*Viburnum*" *atlanticum* ETT., 12. *Rubus merianii* (HEER) KOLAKOVSKII, 13. *Smilax weberi* WESSEL, 14. *Alnus menzelii* RANIECKA-BOBROWSKA, 15. *Paliurus tiliaefolius* (UNG.) BŮŽEK, 16. *Laurophyllum* cf. *saxonicum* LITKE, 17. *Cyperacites* sp., 18. *Nyssa haidingeri* (ETT.) Z. KVAČEK et BŮŽEK.

the type of the species and occur only rarely, e.g., at Vršovice, in association with sun leaves of the ordinary *S. varians*.

Tiliaceae JUSS.

Craigia W. W. SMITH et W. E. EVANS

Craigia bronnii (UNGER) Z. KVAČEK, BŮŽEK et MANCHESTER

Pl. 5, fig. 11, text-fig. 1.12

Ulmus bronnii UNGER, 1845, p. 79, pro parte, pl. 25, figs 2-4 (non fig. 1); Ettinsgshausen, 1866, p. 62, pro parte, pl. 18, figs 1-5
Pteleaecarpum bronnii (UNGER) WEYLAND, 1948, p. 130, pl. 21, fig. 5, text-figs. 5-9
Craigia bronnii (UNGER) Z. KVAČEK, BŮŽEK et MANCHESTER, 1991, p. 522
Ulmus longifolia auct.(non UNGER); Ettinsghausen, 1866, p. 62, pro parte, pl. 18, fig. 8; Velenovský, 1881, p. 25, pro parte, pl. 3, figs 24-25

These very characteristic fruit remains were misinterpreted for elm samaras, and recently recognized as isolated detached valves of capsules (Bůžek et al. 1989 as *Pteleaecarpum bronnii* (UNG.) WEYL.). They match the fruits of an extant relictual genus *Craigia*, endemic to southern China (Z. Kvaček et al. 1991). This fossil plant occurs as an important accessory element in swamp and riparian assemblages of the Most Basin, and also in many porcelanite sites.

Dombeyopsis UNG.

Dombeyopsis lobata UNGER

Pl. 5, fig. 12, textfigs 1.17, 3.7

Dombeyopsis lobata UNGER, 1850a, p. 447
Dombeyopsis sidaefolia UNGER, 1850a, p. 448
Ficus dombeyopsis UNGER, 1860, p. 13, pro parte, pl. 5, figs 1-5 (non 6-7), pl. 6, fig. 1
Cecropia heerii ETTINGSHAUSEN, 1866, p. 82, pl. 27, pl. 28, fig. 7
Cecropia europaea ETTINGSHAUSEN, 1866, p. 82, pl. 28, fig. 1-2
Ficus tiliaefolia auct. (non (A. BRAUN) HEER); Unger, 1860, p. 14, pl. 6, fig. 2; Ettinsghausen, 1866, p. 80, pl. 25, figs 4-5, 7, 10; Velenovský, 1881, p. 28, pl. 6, figs 1-4; Engelhardt, 1891, p. 162, pl. 7, fig. 9

These large trilobate to unlobed, mostly symmetrical, entire-margined, rarely slightly toothed leaves with a long petiole and typical palmate venation are commonly associated with the above fruit remains. In some places, the foliage is accumulated in thin layers (e.g. at Želénky), suggesting that it was a deciduous woody element. The cuticle structure brought evidence of the affinity to the Malvales (Knobloch and Z. Kvaček 1976).

Unger (1850a, 1860) kept apart trilobate and non-lobate leaf forms, which he designated as *Dombeyopsis lobata* (= *Ficus dombeyopsis* UNGER, 1860, nom. superfl., pl. 6, fig. 1, TYPE BP 59.666 - Březánky), and *Dombeyopsis sidaefolia* (= *Ficus tiliaefolia* sensu Unger 1860, pl. 6, fig. 2, TYPE BP 64.300 - Březánky) respectively. They represent a mere natural variation of the foliage and belong to the same plant as fruits of *Craigia bronnii*.

Ulmaceae MIRB.

Ulmus L.

Ulmus pyramidalis GÖPPERT

Pl. 5, fig. 6, text-figs 4.4, 5.10

Ulmus pyramidalis GÖPPERT, 1855, p. 28, pl. 13, figs 10-12.
Ulmus crassinervia ETTINGSHAUSEN, 1866, p. 63, pl. 18, figs 28-29.
Ulmus longifolia UNGER, 1845 (non RAFINESQUE), pl. 26, figs 5-6; 1847, p. 101, pro parte; Ettingshausen, 1866, p. 62, pl. 18, figs 7, 9-10; Velenovský, 1881, p. 25, pro parte, pl. 4, figs 3-13; Engelhardt, 1891, p. 160, pl. 9, figs 14, 16-20.
Carpinus grandis sensu Velenovský, 1881, p. 23, pl. 2, fig. 25, pl. 3, figs 1-5

Elm leaves of the longly ovate form, nearly symmetrical at the base, and partly with simple toothed margin have been often mistaken for hornbeam foliage (Heer 1859, Velenovský 1881), from which it can be differentiated by more distinct venation and the form of teeth. Contrary to opinions of other authors, we consider shorter and strongly asymmetrical forms occurring in the same layers (partly referred to *Zelkova*) as natural variation of the same species. Only one kind of elm samaras (*Ulmus* sp. - pl. 5, fig. 9) has been found in the association in the Most Basin, e.g., at Želénky and elsewhere (Bůžek 1971) and we do not hesitate to connect it with this foliage. Elms are typically connected with the alluvial sandy-clayey facies.

Zelkova SPACH

Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA

Text-fig. 4.12

Ulmus zelkovifolia UNGER, 1843, pl. 24, figs 9-13 (non fig. 7); 1845, pl. 26, fig. 7 (non 8); 1847, p. 94, pro parte ("*zelkovaefolia*")
Planera ungeri ETTINGSHAUSEN, 1851, p. 14, pl. 2, figs 5-14, 16 (non 15, 17-18); 1866, p. 65, pro parte, pl. 18, figs 17, 20; Velenovský, 1881, p. 26, pro parte, pl. 3, fig. 23 ("16")
Zelkova ungeri (ETTINGSHAUSEN) KOVÁTS, 1856, p. 27, pl. 5, figs 1-12, pl. 6, figs 1-6.
Zelkova zelkovifolia (UNGER) BŮŽEK et KOTLABA in KOTLABA, 1963, p. 59, pl. 3, figs 7-8 ("*zelkovaefolia*")

Typical leaves of this species are coarsely simple toothed. Less convincing are records of finely toothed forms, unless they are attached to the twigs (deciduous, often fruiting ultimate shoots). Most finely toothed specimens interpreted as *Zelkova* (and *Planera*) by some authors (Ettingshausen 1866, Velenovský 1881) are in fact short forms of *Ulmus pyramidalis*. True *Zelkova* occurs extremely rarely in porcelanite sites (e.g., Vršovice), being more or less mesophytic.

Rosaceae JUSS.

Rosa L.

Rosa europaea (ETTINGSHAUSEN) comb. n.

Pl. 6, figs 1, 9, text-figs 3.3, 4.8, 5.11, 5.14

Myrsine europaea ETTINGSHAUSEN, Denkschr. K. K. Akad. Wiss. math. -naturwiss. Cl. 28. 1868, p. 225, pl. 37, fig. 22 (basionym)
Quercus pseudo-alnus ETTINGSHAUSEN, 1866, p. 60, pro parte, pl. 17, fig. 6

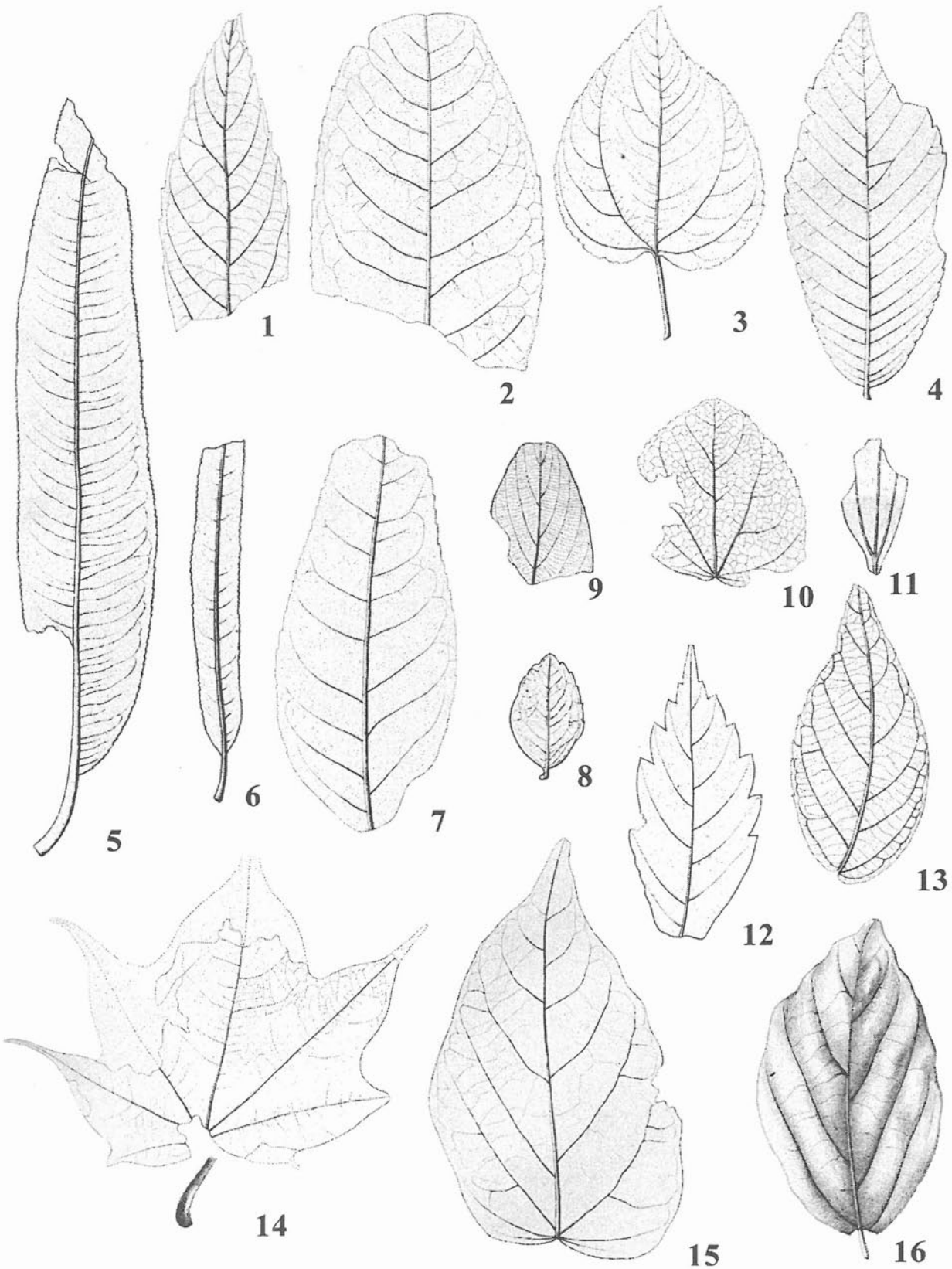

Fig. 4 Vršovice - silt porcelanite (from Velenovský 1881, mostly re-identified, nat. size). 1. *Rubus merianii* (HEER) KOLAKOVSKII, 2. *Fraxinus bilinica* (UNG.) comb. n., 3. *Paliurus tiliaefolius* (UNG.) BŮŽEK, 4. *Ulmus pyramidalis* GÖPP., 5-6. *Salix haidingeri* ETT., 7. *Fraxinus bilinica* (UNG.) comb. n., 8. *Rosa europaea* (ETTINGSHAUSEN) comb. n., 9. *Berchemia multinervis* (A. BR.) HEER, 10. *Cercidiphyllum crenatum* (UNG.) R. BROWN, 11. *Daphnogene polymorpha* (A. BR.) ETT., 12. *Zelkova zelkovifolia* (UNG.) BŮŽEK et KOTLABA, 13. *Rubus vrsovicensis* nom. n., 14. *Acer integerrimum* (VIVIANI) MASSALONGO, 15. "*Ficus*" *truncata* HEER, 16. *Parrotia pristina* (ETT.) STUR.

? *Rosa lignitum* HEER, 1869, p. 99, pl. 30, fig. 33
Ilex berberidifolia sensu Ettingshausen, 1869, p. 38, pro parte, pl. 46, fig. 17
Rhus prisca sensu Ettingshausen, 1869, p. 50, pl. 51, fig. 11
Zanthoxylon serratum sensu Velenovský, 1881, p. 45, pl. 5, fig. 18
? *Planera ungeri* sensu Engelhardt, 1891, p. 162, pl. 3, figs 22-23

Holotype: BA 6043 (pl. 6, fig. 9)

Leaflets of roses are not difficult to recognize by dense venation and characteristic simple fine serration. Sometimes they are still partly attached to the leaf rhachis. Previous records from the Most Basin have been usually referred to as *Rosa bohemica* ENGELHARDT (Bůžek 1971) or *Rosa lignitum* HEER (Bůžek et al. 1992), but the basionym *Myrsine europaea* has priority over the mentioned names. The type specimen (BA 6043) is fragmentary, with hardly visible venation, but its affinity to roses is certain because of the typical form and dentation of the lamina. Of course, the foliage of roses is not characteristic enough to allow discrimination at the species level. Thus *Rosa europaea* suggested above must be taken as a morphotaxon, unless more complete material including fruits is available.

Rubus L.

Rubus merianii (HEER) KOLAKOVSKIJ

Pl. 6, figs 2, 5, text-figs 3.6, 3.12, 4.1

Rhus merianii HEER, 1859, p. 82, pl. 126, figs 5-11; Sieber, 1881, p. 24, pl. 5, figs 39-40; Velenovský, 1881, p. 44, pro parte, pl. 7, figs 16-20; Engelhardt, 1891, p. 193, pl. 14, figs 10, 18, 20, 22-23, pl. 15, figs 1, 3, 8-9, 11, 17
Rubus merianii (HEER) KOLAKOVSKIJ, 1964, p. 131
Rhus quercifolia sensu Engelhardt, 1891, p. 193, pl. 18, fig. 23
Ilex longifolia sensu Engelhardt, 1891, p. 187, pl. 10, fig. 17

Blackberries are common plants in swamps of the North Bohemian Tertiary, as documented by fruitlets, and mainly the foliage. *R. merianii* has narrow leaflets, which may bear an additinal asymmetrical lobe. In calm sedimentary conditions, complete compound leaves may remain preserved, e.g. in the Bílina Mine (Sakala 2000, this volume) or Želénky (coll. Charles University). Želénky is the site with the richest occurrence of this plant. Fruitlets (pl. 6, fig. 7) are commonly associated there and may aid to resolve its affinities. Similar compressions are known from the coal facies of the basin (Bůžek and Holý 1964, as *Rubus* sp. div.). Some prickle twigs (pl. 6, fig. 6) may also belong to this blackberry. In view of complicated taxonomy of extant *Rubus*, we do not attempt to discuss systematic affinities without looking at the compression material.

Rubus vrsovicensis nom. n.

Pl. 6, figs 3-4, 8, 10, text-figs 1.7, 4.13

Rhus elegans VELENOVSKÝ, 1881 Abh. K. Böhm. Gesell Wiss. math. nat. Cl. VI. 11. p. 45, pl. 10, figs 5-11 (non AIT.), nom. illegit. (basionym)
Rhus merianii sensu Velenovský, 1881, p. 44, pro parte, pl. 8, fig. 27, pl. 10, fig. 12

Lectotype: NM G 1891 (pl. 6, fig. 8)

At Vršovice, rarely elsewhere (Dobrčice, Želénky) a broad-leaved blackberry occurs. Its leaflets are sometimes revolute at margin and seem to be entire. A pronounced asymmetry and the prominent venation are suggestive of compound leaves of *Rubus*. Compression specimens of the same species were recovered in the coal clay in the Bílina Mine (Sakala 2000, this volume). Similar, but coarsely toothed leaflets of *Rubus* were misinterpreted for leaves of *Corylus* by Bůžek (1971, as cf. *Corylus insignis* HEER) in the Pětipsy area.

The epitheton "*elegans*" cannot be used in a new combination with *Rubus*, because *Rhus elegans* VELENOVSKÝ is an illegitime later homonym, and the combination is pre-occupied by *Rubus elegans* P. J. MUELL.

Lythraceae J. ST. -HILL.

Decodon J. F. GMEL.

Decodon gibbosus (E. M. REID) E. M. REID in NIKITIN

Pl. 7, fig. 1

Diclidocarya gibbosa E. M. REID, 1920, p. 82, pl. 4, figs 23, 25, text-fig. 1 left
Decodon gibbosus (E. M. REID) E. M. REID in NIKITIN, 1929, p. 37, pl. 5, figs 8-9; Z. Kvaček and Sakala, 1999, p.202, pls. 1-2, pl. 3, figs 1-5, pl. 4, figs 1-6, text-fig. 1-3
Ficus multinervis auct. (non HEER); Ettinsghausen, 1866, p. 68, pl. 20, figs 5-6; Bůžek, 1971, p. 94, pl. 48, figs 5-8
? *Ficus arcinervis* sensu Velenovský, 1881, p. 28, pl. 4, figs 18-20
Salix angusta sensu Engelhardt, 1891, p. 164, pl. 10, fig. 16
Dryandroides laevigata sensu Engelhardt, 1891, p. 168, pl. 8, figs 11-14, pl. 9, figs 2-4, 14
Chrysophyllum palaeocainito sensu Engelhardt, 1891, p. 173, pl. 9, fig. 16
Sapindus bilinicus sensu Engelhardt, 1891, p. 183, pro parte, pl. 12, figs 1, 3, 6-9
Dodonea salicites sensu Engelhardt, 1891, p. 185, pl. 9, fig. 7

A recent study of the compression material from the Bílina Mine (Z. Kvaček and Sakala 1999) has shown that the leaves of the "*Ficus multinervis*" type, which are fairly common in alluvial and swampy facies of the Most Basin, belong in fact to the genus *Decodon*, today monotypic, endemic to North America. Although we were unable to trace molds of *Decodon* seeds in porcelanite, leaves with typical dense secondaries and an intramarginal vein occur sporadically in layers with monocots, e.g., at Želénky and Světec. Due to delicate nature of the foliage, the venation is sometimes hardly visible and the identification doubtful.

Leguminosae JUSS.

Leguminosites BOWERBANK

Leguminosites tobischii ENGELHARDT

Text-fig. 3.2

Leguminosites tobischii ENGELHARDT, 1891, p. 198, pl. 18, figs 19-20
Acacia beneschii BRABENEC, 1904, p. 16, pl. 1, fig. 5

The pods described under the above names were found only once in the porcelanite at Želénky and occur only very rarely elsewhere (Bůžek 1971). They belong to the moniliform type (strongly constricted between seeds). Such fruits are more frequent among Papilionoideae, namely in *Sophora* L., e.g., *S. japonica* L. (Herendeen 1992 b).

Leguminosites spp. (foliola)

Pl. 7, figs 2-4

Several leaflets, either emarginate or acuminate have been rarely noticed among the studied material. They undoubtedly belong to some of the large group of Leguminosae because of the form and venation. Their closer determination is out of the question on the basis of available characters.

Podocarpium A. BR.

Podocarpium podocarpum (A. BRAUN) HERENDEEN

Pl. 7, fig. 5

Gleditschia podocarpa A. BRAUN (in BUCKLAND 1836, p. 513, nom. nud.); 1845, p. 173
Podocarpium knorrii A. BRAUN in STIZENBERGER, 1851, p. 90
Podogonium knorrii (A. BRAUN) HEER, 1859, p. 114, pl. 134, figs 22-26a, pl. 135 (except fig. 19), pl. 136, figs 1-9 (non Velenovský 1881)
Podogonium lyellianum HEER, 1859, p. 117, pl. 136, figs 22-52
Podogonium oehningense (KOENIG) KIRCHHEIMER, 1957, p. 261, nom. inval.
Gleditsia knorrii (HEER) GREGOR in GREGOR et HANTKE, 1980, comb. illegit., p. 166
Gleditsia lyelliana (HEER) HANTKE in GREGOR et HANTKE, 1980, p. 167
Podocarpium podocarpum (A. BR.) HERENDEEN, 1992c, p. 731-736

According to the recent revision of this plant (Herendeen 1992 a, c), it represents an extinct legume related to the African representatives of Caesalpinioideae, trib. Detarieae or Amherstieae. *Podocarpium* occurs in the Most Basin mostly in sandy-clayey facies (Bůžek 1971) as a typical mesophytic element. Its meagre remains, namely leaflets, have been recorded in the baked rocks at Želénky and Mirošovice. Inspection of the specimens from Vršovice (Velenovský 1881) revealed that the fruits are in fact fragmentary maple samaras and the leaflets represent indeterminable fragments (see Appendix).

Aceraceae JUSS.

Acer L.

Acer tricuspidatum BRONN emend. WALTHER

Text-figs 1.11, 3.10

Acer tricuspidatum BRONN, 1838, p. 865, pl. 25, figs 10 a, b; Walther, 1968, p. 636, pls 1-2; Procházka et Bůžek, 1975, p. 24, pls 22-24, text-figs 2, 3, 4d, 5-13
Acer trilobatum A. BRAUN, 1845, p. 172; Velenovský 1881, p.37, pl. 7, figs 1-2, pl. 8, fig. 26, pl. 9, figs 2, 4; Engelhardt, 1891, p. 182, pl. 11, figs, 10-11, 13, 18-19, 21-23, 26-27, pl. 12, figs 15-17, pl. 13, fig. 24
Acer magnum VELENOVSKÝ, 1881, p. 38, pl. 7, figs 7-9; Engelhardt, p.182, pl. 12, figs 12-13

This is a most common maple, usually connected with swamp facies. The full synonymy is included in the monograph by Procházka and Bůžek (1975). Their treatment of this variable species is followed also here. The porcelanite sites are not very rich in maple leaves except perhaps for Želénky, where they cover some particular layers. Rare maple fruits accompany the foliage (e.g., Velenovský 1881, pl. 7, fig. 3), yet the correlation to the species based on leaves is uncertain.

Acer dasycarpoides HEER emend. PROCHÁZKA et BŮŽEK

Text-fig. 5.8

Acer dasycarpoides HEER, 1859, p. 198, pl. 114, figs 3, 9, pl. 115, fig. 6, pl. 155, figs 6-8; Ettingshausen 1869, p. 19, pl. 44, figs 16-17; Procházka and Bůžek, 1975, p. 36, pl. 21, figs 6-10, text-figs 4a-c, 14-15
Acer angustilobum HEER, 1859, p. 57, pl. 117, fig. 25a, pl. 118, figs 4-7; Sieber, 1881, p. 84, pl. 2, fig. 13; Engelhardt, 1891, p. 180, pl. 14, fig. 2-3
Acer rueminianum HEER, 1859, p. 59, pl. 118, figs 11-13; Ettingshausen, 1869, p. 23, pro parte, pl. 46, fig. 9 (non 8); Engelhardt, 1891, p. 181, pl. 14, fig. 16

Maple leaves of the European Tertiary with narrow dentate lobes are sometimes split in more species. Walther (1972) attempted to support this interpretation by differences in cuticle structure (*A. haselbachense* WALTHER, *A. engelhardtii* WALTHER and *A. angustilobum* HEER with the papillate underside vs. *A. rueminianum* HEER without papillae). In our case the lack of anatomical details prevents us to adhere to his system. Therefore a more or less artificial species *A. dasycarpoides* is applied for the scanty material from the porcelanite occurrences. Maples of this group occur mostly in alluvial facies and silty-sandy baked rocks (e.g., Zabrušany).

Acer integerrimum (VIVIANI) MASSALONGO

Text-fig. 4.14

Acerites integerrima VIVIANI, 1833, p. 131, pl. 11, fig. 6
Acer integerrimum (VIVIANI) MASSALONGO, 1858, p. 94; Procházka and Bůžek, 1975, p. 15, text-fig. 1 a-b
Acer nervatum VELENOVSKÝ, 1881, p. 39, pl. 7, figs 5-6

This type of maple leaf is characterized by entire acuminate to cuspidate lobes. It occurs in general infrequently in the Most Basin, usually in the alluvial facies, in baked rocks only rarely (Vršovice).

Rutaceae JUSS.

Toddalia JUSS.

Toddalia maii GREGOR

Pl. 7, figs 6-7

Toddalia maii GREGOR, 1975, p. 125, text-fig. 5; 1979, p. 323, 338-339, text-figs 22, 36-37
cf. *Cytisus latisiliquata* sensu Bůžek et Holý, 1964, p. 120, pl. 6, fig. 5, text-figs 2/9a-c

Accumulations of typical reniform seeds belonging to *Toddalia,* a tropical-subtropical liana, have been recently found by Z. Dvořák in the baked rocks at Želénky and Dobrčice. The compression material of this plant, allowing a more precise identification, comes from mica-sandy facies of the Krušné hory piedmonts, less frequently in the Bílina delta (Z. Kvaček and Bůžek 1982)

Rhamnaceae JUSS.

Paliurus MILL.

Paliurus tiliaefolius (UNGER) BŮŽEK

Pl. 7, fig. 10, text-figs 3.15, 4.3, 5.7

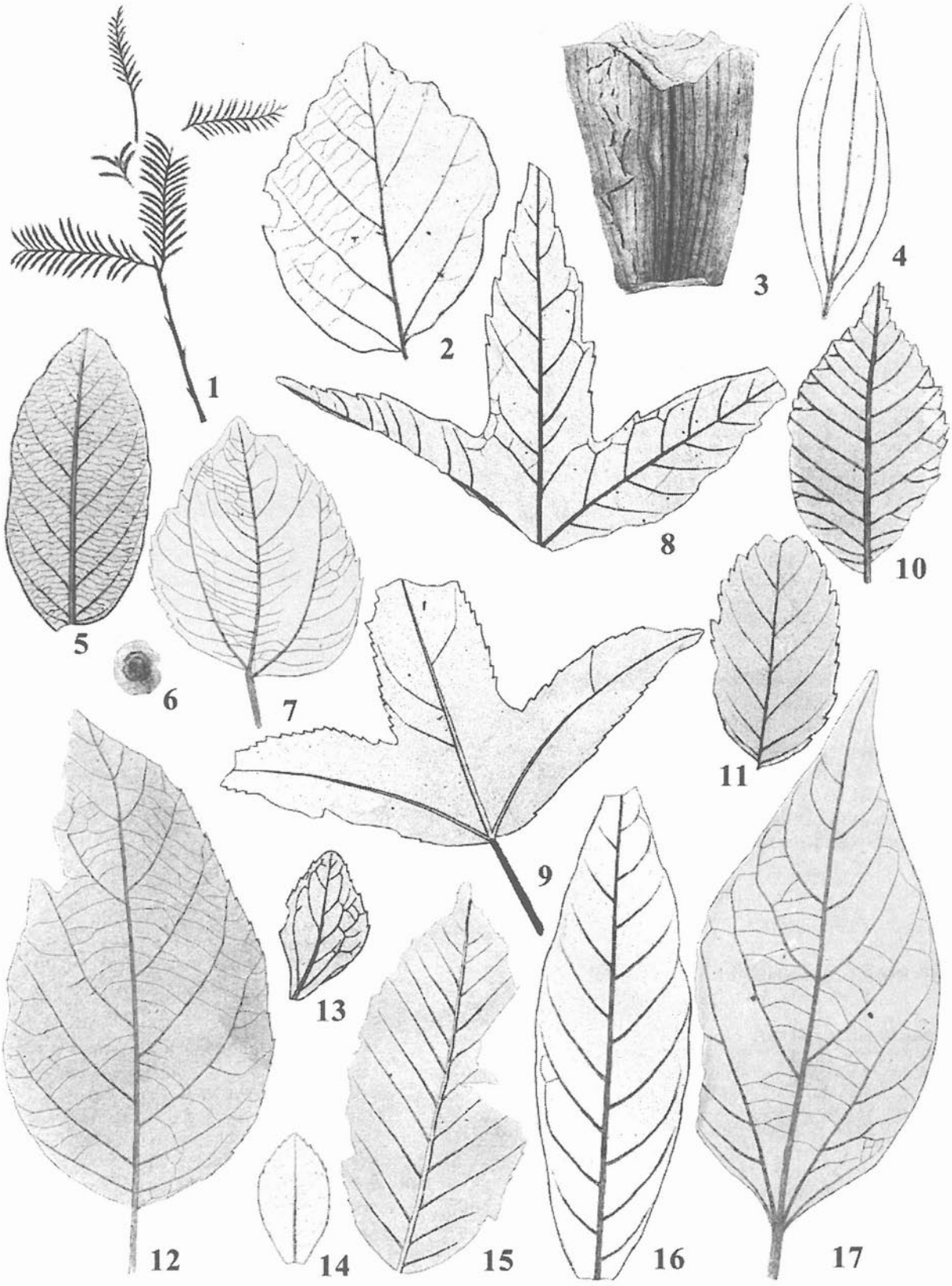

Fig. 5. Zabrušany - silt porcelanite (from Ettingshausen 1866-9, mostly re-identified, nat. size). 1. *Taxodium dubium* (STERNB.) HEER, 2. *Parrotia pristina* (ETT.) STUR, 3. *Cyperacites* sp., 4. *Daphnogene polymorpha* (A. BR.) ETT., 5. *Berchemia multinervis* (A. BR.) HEER, 6. *Paliurus favonii* UNGER, 7. *Paliurus tiliaefolius* (UNG.) BŮŽEK, 8. *Acer dasycarpoides* HEER, 9. *Liquidambar europaea* A. BR., 10. *Ulmus pyramidalis* GÖPP., 11. *Rosa europaea* (ETTINGSHAUSEN) comb. n., 12. *Alnus julianiformis* (STERNB.) Z. KVAČEK et HOLÝ, 13. *Berberis berberidifolia* (HEER) PALAMAREV et PETKOVA, 14. *Rosa europaea* (ETTINGSHAUSEN) comb. n, 15. *Carpinus grandis* UNG., 16. *Alnus gaudinii* (HEER) KNOBLOCH et Z. KVAČEK, 17. "*Ficus*" *truncata* HEER.

Ceanothus tiliaefolius UNGER, 1847, p. 143, pl. 49, figs 1-6
Zizyphus tiliaefolius (UNGER) HEER, 1859, p. 75, pl. 123, figs 1-7; Ettingshausen, 1869, p. 39, pl. 50, figs 8, 14-15, 17-18; Velenovský 1881, p. 41, pl. 8, figs 22-23; Engelhardt, 1891, p.189, pl. 13, figs 6-16
Cinnamomum subrotundum sensu Engelhardt, 1891, p. 168, pl. 8, fig. 7
Paliurus tiliaefolius (UNGER) BŮŽEK, 1971, p. 74, pro parte (fruct. excl.), pl. 33, figs 1-3, 5, 8, 14 right, pl. 34, figs 1-17

Characteristic broadly ovate to cordate triveined leaves of *P. tiliaefolius* recall (and can be mistaken for) *Cercidiphyllum* and cinnamomoid forms (Engelhardt 1891). They are common in the alluvial sandy facies, less frequent in the coal clay (Sakala 2000, this volume). Thorny twigs occurring in the association (Engelhardt 1891, pl. 13, figs 11, 13-14) may belong to the same plant. The fruits, which afforded the main argument for the change of systematic position, have not been found so far in the natural connection, and according to the current palaeobotanical practice, they must be treated as a separate entity. The richest occurrence of *P. tiliaefolius* in baked rocks is Želénky.

Paliurus favonii UNGER

Pl. 7, fig. 9, text-fig. 5.6

Paliurus favonii UNGER, 1847, p. 147, pl. 50, figs 7-8; Ettingshausen, 1869, p. 39, pl. 50, figs 6-7
Paliurus fricii BRABENEC, 1904, p. 18, pl. 1, fig. 11a
Paliurus tiliaefolius (UNGER) BŮŽEK, 1971, p. 74, pro parte (fol. excl.), pl. 33, figs 4, 6-7, 9-21

Trilocular fruits of *Paliurus* with a circular wing in the equatorial position occur regularly in association with the leaves. As found by Manchester (personal communication in 1999) they were mistaken for similar but quadrilocular nuts of *Cyclocarya* by Bůžek et al. (1992, Z. Kvaček 1998). Hence the latter genus must be excluded from the floral list of the Most Basin. The fruits of *Paliurus* prevail in the alluvial facies of the Žatec and Bílina delta, they are rare in baked rocks (e.g., at Želénky).

Berchemia NECK. ex DC.

Berchemia multinervis (A. BRAUN) HEER

Pl. 7, fig. 8, text-figs 4.9, 5.5

Rhamnus multinervis A. BRAUN in BUCKLAND, 1836, p. 513
Berchemia multinervis (A. BRAUN) HEER, 1859, p. 77, pl. 128, figs 9-18; Velenovský 1881, p. 42, pl. 4, figs 26-27; ? Engelhardt, 1891, p. 188, pl. 12, figs 2, 19-28; Bůžek 1971, p. 73, pl. 32, figs 12-15, pl. 33, figs 22-23
Quercus pseudo-laurus ETTINGSHAUSEN, 1866, p. 60, pro parte, pl. 17, fig. 13

These elliptic rhamnoid leaves with delicate and dense tertiary veins are generally assigned to the genus *Berchemia*, and compared with *B. scandens* (HILL) K. KOCH, a liana growing in swamps of SE USA. They occur also but rarely in the coal clay facies (Sakala 2000, this volume), more frequently in alluvial deposists of the Žatec and Bílina deltas. The records in baked rocks are exceptional (e.g., Zabrušany, Vršovice).

Vitaceae JUSS.

? Vitis L.vel ***Ampelopsis*** MICHX.

cf. ***Vitis*** vel ***Ampelopsis*** sp.

Pl. 7, fig. 12

Heliotropites reussii ENGELHARDT, 1891, p. 171, pl. 7, fig. 9
Diachenites ovalis ENGELHARDT, 1891, p. 171, pl. 7, fig. 20

Molds of seeds recalling the Vitaceae have been rarely found in several sites of porcelanite. Their attribution to a particular genus or species is doubtful due to poor preservation. Seed compressions of *Vitis teutonica* A. BRAUN have been safely documented from the Most and Chomutov parts of the basin (Bůžek and Holý 1964).

? ***Ampelopsis*** MICHX.

cf. ***Ampelopsis*** sp.

Pl. 7, fig. 11

A single poorly preserved leaf impression from Světec matches a previously reported leaf form from the Pětipsy area (Bůžek 1971, as cf. *Ampelopsis* sp.). The affinity to the Vitaceae is probable in view of the dentation and large size of the specimens.

Cornaceae (DUMORT.) DUMORT.

Nyssa GRONOV ex L.

Nyssa haidingeri (ETTINGHAUSEN) Z. KVAČEK et BŮŽEK

Pl. 8, fig. 1, text-figs 1.3, 3.18

Laurus haidingeri ETTINGHAUSEN, 1866, p. 174, pl. 30, figs 5, 8-9
Bombax oblongifolium ETTINGHAUSEN, 1869, p. 12, pl. 42, figs 8-9; Engelhardt, 1891, p. 178, pl. 13, figs 14-16
Nyssa haidingeri (ETTINGHAUSEN) Z. KVAČEK et BŮŽEK, 1972, p. 373, pl.1, pl. 2, figs 1-2, pl. 3, figs 1-3, pl. 4, figs 1-5, text-figs 1-2
Persea speciosa sensu Ettinghausen, 1868, p. 197, pl. 32, figs 15-16; Velenovský, 1881, p. 32, pro parte, pl. 6, fig. 6
Cinchona sp. sensu Velenovský 1881, p. 98, pl. 6, figs 17-18
Apeibopsis descloesi (?) sensu Engelhardt, 1891, p. 179, pl. 10, fig. 19
Juglans acuminata sensu Engelhardt, 1891, p. 192, pro parte, pl. 15, fig. 7

Large, mostly entire-margined leaves, recognized by Z. Kvaček and Bůžek (1972) on the basis of leaf anatomy as the foliage of *Nyssa*, are spread in coal clay facies over the whole Most Basin (Z. Kvaček and Bůžek 1982). It is more difficult to recognize this species in impression material, such as occurs in baked rocks, which is often fragmentary due to the large size of the foliage. Associated *Nyssa* endocarps are helpful. Another distinguishing character from a similar *Laurophyllum saxonicum* is fairly dense secondary venation diverging in the lower part of the blade at wider angles. Even then the determination of many specimens is uncertain.

Nyssa sp.

Text-fig. 1.7

Nyssa vertumnii sensu Velenovský, 1881, p. 37, pl. 6, figs 20-24

Echitonium sophiae sensu Engelhardt, 1891, 170, pl. 7, fig. 19
Nyssa disseminata sensu Bůžek and Holý, p. 123, pl. 6, figs 6-9
Nyssa sp. sensu Bůžek, 1971, p. 86, pl. 48, fig. 10; Z. Kvaček and Bůžek, 1972, p. 378, pl. 2, figs 3-9, pl. 3, figs 4-8

Flattened *Nyssa* endocarps have been commonly found in coal and coal clay strata of the Most Basin, unfortunately in poor state of preservation. Z. Kvaček and Bůžek (1972) were unable to decide to which species they actually belong. They are certainly different from the record of the Middle Miocene Salzhausen site, which yielded another kind of foliage (mostly toothed leaves with the striate-papillate underside). The molds of endocarps from baked rocks (Vršovice, Želénky) are still less suitable to decide this question.

Oleaceae HOFFMANNS et LINK

Fraxinus L.

Fraxinus bilinica (UNGER) comb. n.

Pl. 8, figs 7-(?)8, text-figs 4.2, 4.7

Juglans bilinica UNGER, 1849, Naturwiss. Abh. 3(6), p. 126, pro parte (non pl. 14, fig. 20) (basionym); Unger, 1850a, p. 469, pro parte (syn. excl.); Engelhardt, 1891, p. 192, pro parte, pl. 18, fig. 4
Carya bilinica (UNGER) ETTINGSHAUSEN, 1852, p. 12 (non pl. 2, fig. 17); Unger, 1860, p. 39, pro parte, pl. 17, figs 1-8 (non 9-10); Ettingshausen, 1869, p. 46, pro parte, pl. 51, figs 6, 13-15, (non fructus figs 9-10), pl. 52, figs 4, 7-11 (non fig. 3); Velenovský, 1881, p. 44, pro parte, pl. 8, figs 1, 3 (non pl. 9, fig. 16)
Carya ungeri ETTINGSHAUSEN ex UNGER, 1860, p. 40, pl. 18, figs 1-4
? *Fraxinus ungeri* (GAUDIN) KNOBLOCH et Z. KVAČEK, 1976, p. 63, de typo solo (non LESQUEREUX)
Fraxinus lonchoptera ETTINGSHAUSEN, 1868, p. 25, pro parte, pl. 36, fig. 22 (non fructus figs 11-12)
Quercus laharpii sensu Ettingshausen, 1866, p. 60, pl. 17, fig. 1
Juglans juglandiformis auct. (non (STERNBERG) GIEBEL); Bůžek, 1971, p. 44, pl. 11, figs 4-7, pl. 23, fig. 1

Lectotype: BP 55.2252 (Unger, 1860, pl. 17, fig. 7)
Paralectotype: BA 6215 (Unger, 1860, pl. 17, fig. 2)

Leaflets of ash have been previously misinterpreted for the Juglandaceae, in spite of the fact that ash samaras occur often in association. The above list of synonyms is certainly incomplete as the venation of the foliage is often not well visible, particularly in baked rocks, due to tough texture of the lamina. Thus the determination of such specimens is uncertain. Small peltate trichomes and their characteristic bases preserved in compression material in the Bílina Mine corroborate the affinity to *Fraxinus* (Sakala 2000, this volume). Ash foliage is a regular component of leaf assemblages from coal clay as well as alluvial facies.

We consider the treatment of *Juglans bilinica* UNGER by Iljinskaja (1964) and Knobloch and Z. Kvaček (1976) not fully correct. Although this species was first published in connection with the flora of Swoszowice, Unger (1849) based the diagnosis of his *Juglans bilinica* (repeated also in Unger 1850a and 1860) beyond any doubt on the material from Bílina, as it follows also from the epithet and the descrepancy between the diagnosis ("J. foliolis...ovato-oblongis v. ovato-lanceolatis") and the figured elliptical leaflet from Swoszowice (Unger 1849, pl. 14, fig. 20). Unger admitted only that this specimen from Swoszowice corresponds with *J. bilinica*. The species concept suggested by us above, i.e. with the type from Bílina, was in current use of most earlier authors till Iljinskaja's (1964) misleading re-interpretation. Hence we re-typify the name *Juglans bilinica* by the specimens from Bílina (contrary to the opinion of Iljinskaja 1964), and we exclude this species from the synonyms of *Pterocarya paradisiaca* (UNGER) ILJINSKAJA. *Phyllites juglandiformis* STERNBERG, included as a synonym of *J. bilinica* by Unger (1850a), and others, differs from it, as far as can be asumed from the original painting of the missing holotype (text-fig. 2), by craspedodromous venation and fewer secondaries (see Knobloch and Z. Kvaček 1976). *Fraxinus ungeri* (GAUDIN) KNOBLOCH et Z. KVAČEK is based on the specimens from the Late Neogene of Toscana and its identity with *Fraxinus bilinica* in our sense is not guaranteed, and not even probable. Moreover, the combination is illegitimate, being a later homonym of *Fraxinus ungeri* LESQUEREUX (S. G. Žilin, personal communication). A broader cuticular and carpological study of ash populations in the European Tertiary is needed to clarify their relationship.

Fraxinus macroptera ETTINGSHAUSEN

Pl. 8, fig. 2

Fraxinus primigenia UNGER, 1850a, p. 431, pro parte; 1860, p. 22, pro parte, pl. 8, fig. 2 (non figs 1, 3-8).
Fraxinus macroptera ETTINGSHAUSEN, 1868, p. 213, pro parte, pl. 36, fig. 10 (non 9)
Fraxinus lonchoptera ETTINGSHAUSEN, 1868, p. 213, pro parte, pl. 36, figs 11-12 (non 22)

Ash samaras occurring in association with the above foliage belongs undoubtedly to the same plant. The records from the porcelanite sites are extremely rare (e.g., Želénky).

Dicotyledonae inc. fam. and gen.

"Ficus" truncata HEER

Pl. 8, fig. 10, text-figs 4.15, 5.17

Ficus truncata HEER, 1859, p. 183, pl. 152, fig. 15; Velenovský 1881, p. 29, pl. 6, fig. 5; Bůžek, 1971, p. 92, pl. 466, figs 1-9, pl. 47, figs 1-8, pl. 48, figs 1-4, text-figs 15 a-f.
Ficus titanum ETTINGSHAUSEN, 1866, p. 77, pl. 22, fig. 12; Engelhardt, 1891, p. 163, pl. 10, fig. 17.

A very characteristic, but still enigmatic leaf form is spread in the Most Basin in sandy facies of the Žatec and Bílina deltas. The strictly symmetric blade base varies from cuneate to cordate, as was first demonstrated on the rich material from the former mine Julius Fučík at Želénky (Z. Kvaček 1960). Another characteristic feature is an inconspicuous pulvinus just below the lamina base on the petiole (Bůžek 1971, pl. 46, fig. 8, pl. 48, fig. 3). Compression specimens are needed to obtain information on the epidermal structure, which would aid in resolving the systematic affinities. Deeply cordate forms of "*Ficus*" *truncata* are sometimes similar to non-lobate leaves of *Dombeyopsis lobata*, which differs in a more regular pattern of a "spider-net" type of venation. Only very few records of this element come from baked rocks (Vršovice, Želénky/Zabrušany, Dobrčice).

"Juglans" acuminata A. BRAUN ex UNGER

Pl. 8, fig. 3, pl. 9, figs 8-9

Juglans acuminata A. BRAUN ex UNGER, 1850a, p. 468; Ettingshausen 1869, p. 45, pl. 51, fig. 12; Velenovský, 1881, p. 44, pro parte, pl. 8, figs 2, 6; Bůžek, 1971, p. 42, pl. 9, figs 9-15, pl. 10, figs 1-6, pl. 11, figs 1-3, text-figs 3a-f
Juglans parschlugiana sensu Ettingshausen 1869, p. 46, pl. 51, figs 7-10

Such entire-margined leaflets assigned previously to the Juglandaceae differ from the only possible match, *Juglans regia* L., and have been recently compared with another tree with markedly asymmetric base and regular dense secondary venation of leaflets - *Cedrela* P. BR. of the family Meliaceae (e.g., Andreánszky 1955, Z. Kvaček and Hably 1991, as *Cedrela macrophylla* ANDREÁNSZKY, Palamarev and Petkova 1987, as *Cedrela attica* (UNGER) PALAMAREV et PETKOVA). Yet evidence from epidermal structure is still lacking and characteristic seeds of *Cedrela* (see Meyer and Manchester 1997) have not been found associated with this foliage in the European Tertiary. The fragmentary specimens of *Nyssa* or Lauraceae have often been mis-identified as *Juglans acuminata* (see Appendix), which in its typical leaflet form was rarely encountered in baked rocks.

"Viburnum" atlanticum ETTINGSHAUSEN

Text-fig. 3.11

"*Viburnum*" *atlanticum* ETTINGSHAUSEN, 1868, p. 209, pl. 36, fig. 2; Engelhardt, 1891, p. 172, pl. 8, figs 15-16; Bůžek, 1971, p. 96, pro parte, pl. 49, figs 1-10, 12

The leaves in question are bluntly irregularly dentate, often with a gland on the tooth. Poorly preserved cuticle structure (Z. Kvaček, own observation) suggests a probable affinity to the Theaceae. This plant is again a more or less mesophytic element, connected with the riparian forests of alluvial plains and levees. Its occurrence in baked rocks is very limited.

Dicotylophyllum SAPORTA

Dicotylophyllum spp.

Pl. 9, figs 1-7, text-fig. 1.21

A considerable part of the so far recovered, and partly described plants from the baked rocks belong to uncertain entities, mostly indeterminable because of poor preservation or merely because they do not show diagnostic characters. They are quoted in the appendix and some of them are reproduced here for illustration to show diversity of the assemblages. Only a few are of more interest. One of them is a single fragmentary specimen, described as *Paulinia furcinervis* VELENOVSKÝ (1881) from Vršovice (pl. 9, fig. 1). The enlarged picture shows crenulate margin and cordate base. We cannot rule out an affinity to *Rosa europaea.* Another single leaf impression from Světec (pl. 9, fig. 2) is noteworthy because of broadly spatulate blade, and five primaries running from the petiole. Such leaves used to be interpreted as Viscaceae or Loranthaceae. In cases of leaves with entire margin (pl. 9, figs 3-9, text-fig. 1.21) we are mostly at a loss to decide their affinities.

Carpolithes STERNBERG

Carpolithes spp.

Pl. 8, figs 4-6, 9

Prunus denticulata VELENOVSKÝ, 1881, p. 47, pl. 7, fig. 19,
Carex sp. sensu Velenovský, 1881, p.18, pl. 1, figs 36-38.
Planera ungeri sensu Velenovský, 1881, p.26, pro parte, pl. 3, fig. 18.
Fructus div. sensu Velenovský, 1881, p. 49, pl. 7, fig. 21, pl. 9, figs 7, 26-27.

Molds of seeds and endocarps are not attractive objects for collecting in baked rocks and have often been neglected. Only Velenovský (1881) noticed and illustrated a considerable number. Some characteristic fruit and seed remains are treated in the above described material. The rest represent mainly indeterminable fossils, which may be deciphered only by experienced carpologists. One sort - fructus sensu Velenovský (1881, pl. 9, fig. 7) seems to be a trilocular endocarp of spherical form recalling *Symplocos salzhausensis* (LUDWIG) KIRCHH. This species is known e.g., from Brandis in Saxony (Mai and Walther 1991), i.e. from the levels equivalent to the Most Formation. Similar objects have been found among the material from Světec. Unfortunately, the late Č. Bůžek was unable to finish his carpological studies in the Most Basin and we lack comparable compression material. In the first account (Bůžek and Holý 1964) no similar type of endocarps has been mentioned. There will certainly be considerably more carpological material in the collections which we overlooked or set aside for further studies for specialists in carpology. A catkin-like inflorescence found at Dobrčice (pl. 8, fig. 9) is indeterminable, because of lack of pollen *in situ.*

Hydrocharitaceae JUSS.

Hydrochariphyllum Z.KVAČEK

Hydrochariphyllum miocenicum (VELENOVSKÝ) comb. n.

Pl. 10, figs 1-4

Podozamites miocenicus VELENOVSKÝ, 1881, Abh. K. böhm. Ges. Wiss. VI, 11, p. 13, pl. 1, figs 18-20 ("*miocenica*") (basionym)

Lectotype: NM G 1845 (pl. 10, fig. 1)

A detailed study of the type specimens from Vršovice revealed fine parallel veins throughout the lamina. There are no cross veins and very indistinct differentiation of parallel primaries in their thickness. The leaf lamina was probably thin, not leaving a deep impression in the baked rock. Thus the original interpretation by Velenovský (1881) as the foliage of a Gymnosperm is highly improbable. On the other hand, such rounded - elliptical shapes are common among some aquatic monocots. The remains of *Hydrochariphyllum buzekii* Z. KVAČEK, recently described from the Bílina Mine (Z. Kvaček 1995a), show various preservation modes of the venation. Many specimens of this plant have indistinctly preserved cross-veins, and longitudinal veins are expressed as fine striation - like in *Podozamites miocenicus*. Although the genus *Hydrochariphyllum* was created originally for suborbicular leaf forms, broadly elliptical can be accepted as an extreme variant. Among the extant Hydrocharitaceae, such variation is common (e.g., in *Limnobium* RICH., *Ottelia* PERSOON). We do not attempt to match these rare fossils with a particular

extant genus, but believe that our interpretation fits better with the associated flora.

Hydrochariphyllum buzekii Z. KVAČEK

Pl. 10, fig. 5

Hydrochariphyllum buzekii Z. KVAČEK, 1995, p. 23, pls 1-2, text-fig. 1

Only three slabs (an impression and its counterimpression, and another fragment) from Želénky with a few leaves of this plant have been recovered during many years of collecting at this site (coll. *Z. Dvořák* 1990). Contrary to *Limnobiophyllum*, these leaves show a typical parallel venation with cross veins. They are petiolate, vary little in shape from broadly ovate to roundish, and attain only 13-15 x 15-17 mm in size, but differ from the type collection from the Bílina Mine (Z. Kvaček 1995, pl. 1, figs 1, 3, 5-7) by deeply cordate leaf bases. In this respect they match small juvenile leaves of *Limnobium spongia* (BOSC) STEUDEL, except for an aerenchymous area often developed on the undersurface of the latter (Zomlefer 1994). This aquatic plant is widely spread in standing waters of the southeastern and eastern USA (Cook and Urmi-König 1983).

Smilacaceae VENT.

Smilax L.

Smilax weberi WESSEL in WESSEL et WEBER

Pl. 10, fig. 6, text-figs 1.4, 3.13

Smilax grandifolia (UNGER) HEER, 1855, p. 82, pl. 30, fig. 8 (non BUCKLAND); Velenovský, 1881, p. 19, pl. 2, figs 18-20
Smilax weberi WESSEL in WESSEL et WEBER, 1855, p. 127, pl. 21, fig. 1
Smilax convalium sensu Velenovský, 1881, p. 20, pl. 2, figs 21-23
Cinnamomum buchii sensu Engelhardt, 1891, p. 167, pl. 8, fig. 5

Bůžek (1971) discussed in detail the occurrences of *Smilax* in the Most Basin. He suggests that large and rounded forms and smaller and slender (*S. convallium* HEER) belong to the same plant and express only variation in leaf morphology. Such a variation is commonly developed in extant representatives of this genus.

Zingiberaceae LINDL.

Spirematospermum CHANDLER

Spirematospermum wetzleri (HEER) CHANDLER

Gardenia wezleri HEER, 1859, p. 192, pl. 141, figs 81-103.
Spirematospermum wetzleri (HEER) CHANDLER, 1925, p. 17, pl. 1, figs 8 a-c.

Seeds with typical spiral striation on the surface have been reported from coke coal of Čermníky (Bůžek 1971) and newly recovered also from Černodoly (coll. *S. Hurník*). Objects similar to the seeds of *Spirematospermum* were identified as *Carpolithes striatus* ENGELHARDT (1891, pl. 15, fig. 27) from Želénky. The pictures are too imperfect, and the actual specimens are missing to allow a serious revision.

? *Zingiberoideophyllum* KRÄUSEL et WEYLAND

cf. *Zingiberoideophyllum liblarense* KRÄUSEL et WEYLAND

Pl. 12, fig. 3, text-fig. 1.8

? *Zingiberoideophyllum liblarense* KRÄUSEL et WEYLAND, 1954, p. 120, pl. 23, figs 1-4
Musa bilinica sensu Velenovský, 1881, p. 21, pl. 2, figs 16-17.

Large multiveined leaves, where the parallel venation runs from a medial costa are typical of the monocots allied to Zingiberales. They may achieve a considerable size and thus the fragments look as ordinary strap-like foliage. Such fragments were recognized as belonging to the Zingiberaceae on the basis of leaf anatomy by Kräusel and Weyland (1954). The same structure was found in similar, but much more complete fossils in the coal facies within the Most Basin, mostly in association with the fruits and seeds of *Spirematospermum wetzleri* (own observation). Therefore, we do not hesitate to consider similar leaf impressions as belonging to the same plant. Leaf impressions of this sort, but without any anatomical evidence were referred to as *Zingiberites* HEER, or *Zingiberopsis* HICKEY (see Hickey and Peterson 1978), mostly from the Upper Cretaceous and Palaeogene of North America and Arctic regions. *Musa bilinica* ETTINGSHAUSEN from the Upper Eocene of Kučlín differs from *Zingiberoideophyllum* by much finer venation (type specimens at BP), but certainly belongs to the same group of fossil monocots.

Palmae JUSS.

Calamus L. sensu lato

Calamus noszkyi JABLONSZKY

Pl. 11, figs 1-2, 6

Calamus noszkyi JABLONSZKY, 1914, p. 236-244, pl. 9, figs 1-3

The foliage of calamoid palms with fine spines on the edge of the leaf segments has not been so far described in the North Bohemian Basin, although typical groups of thorny spines and fruits do occur in the coaly facies (Holý and Bůžek 1964). Sheeth fragments with such spines are also well known in the European Tertiary and are usually identified as *Calamus daemonorops* (UNG.) CHANDLER.

Huard (1967) suggested that it is impossible to differentiate between the genera of calamoid palms, namely *Calamus* and *Daemonorops*, on the basis of such fragments, and established a formal genus *Spinophyllum* HUARD for such remains (see also Czeczott and Juchniewicz 1975, Mai and Walther 1978). We agree with Mai and Walther (1978) to accept a broader concept of the genus *Calamus* (incl. *Daemonorops*).

The foliage at hand probably belongs to the same calamoid palm as the sheath remains. As it represents a different organ, it should be given a separate morphospecies. A very similar foliage of this kind occurs in the Lower Miocene of Hungary (Hably 1983) and Slovakia (Sitár and Z. Kvaček 1997).

Sabal ADANS.

Sabal lamanonis (BRONGNIART) HEER

Pl. 11, figs. 3, 5, 7

Palmacites lamanonis BRONGNIART, 1822, p. 210, pl. 3, fig. 1
Sabal lamanonis (BRONGNIART) HEER, 1855, p. 86

Remains of sabaloid palms are difficult to identify to the species level, and several entities - morphospecies - are currently used in the literature (for the review see Knobloch et al. 1996). The above designation is employed here for forms with a less developed costa, like in the extant *Sabal minor* (JACQ.) PERS. Some other, partly coalified leaf remains of sabaloid palms (*Sabal major* - type) have been found in the roof of the coal seam in the Bílina Mine (coll. *Dvořák*), and the former mine Ležáky near Most (Hurník 1973). Ettingshausen (1866-9) reports them from the Břešťany Clay.

Araceae JUSS.

Limnobiophyllum KRASSILOV emend. Z. KVAČEK

Limnobiophyllum expansum (HEER) Z. KVAČEK

Pl. 10, fig. 7

Hiraea expansa HEER, 1859, p. 65, pl. 121, fig. 16; Engelhardt, 1891, p. 183, pl. 16, figs 2-3
Hydromystria expansa (HEER) HANTKE, 1954, p. 81, pl. 14, figs 9-12
Limnobiophyllum expansum (HEER) Z. KVAČEK, 1995b, p. 51, text-figs 2-6

This aquatic plant, which forms rows of orbicular leaves, interconnected with stolons, is extremely rare in Europe (Z. Kvaček in press), while its ancestor occurs in masses in the Early Tertiary of North America and East Asia (Stockey et al. 1997). This extinct genus links the Araceae and Lemnaceae families. In the baked rocks it was found only once at Želénky (Engelhardt 1891).

Typhaceae JUSS.

? ***Typha*** L. vel ***Sparganium*** L.

"Typha" latissima A. BRAUN

Pl. 12, fig. 2, text-fig. 1.18

Typha latissima A. BRAUN in HEER, 1855, p. 98, pls. 43-44; Velenovský, 1881, p. 22, pl. 2, figs 1-3; Engelhardt, 1891, p. 150, pl. 2, figs 21-22

Similar strap-like monocot leaves with the venation of *Sparganium* and *Typha* are widely dispersed in the horizons with aquatic plants. As the anatomically preserved remains of this kind suggest - *Typhaeloipum* UNGER (1850a, 1852) - their relationship to *Sparganium* is more probable. Thus the name *Typha latissima* is actually misleading. Meyer and Manchester (1997) assigned leaf impressions of this kind to a new entity *Typhoides buzekii* gen. et sp. n. Unfortunately, the name *Typhoides* is pre-occupied (*Typhoides* MOENCH = *Phalaris* L., Graminae). In our opinion the type specimens of *Typhaeloipum lacustre* UNG. need to be revisited and then this name would suit for the above entity. In the meantime we employ the traditional designation, stressing that "*Typha*" *latissima* is a morphotaxon, which may represent partly the foliage of *Sparganium*.

Monocotyledonae inc. fam. et gen.

Cyperacites SCHIMPER sensu novo

Cyperacites spp.

Pl. 12, fig. 4, 5, text-figs 3.17, 5.3

Some layers in the Most Basin, particularly in the Žatec and Bílina deltas are overfilled with remains of aquatic plants and strap-like monocot leaves of dubious affinity ("horizons with aquatic plants" sensu Hurník 1961, association *Decodon* - Poaceae vel Cyperaceae sensu Z. Kvaček and Bůžek 1982). Such layers appear also in the sites of baked rocks, namely at Vršovice, Želénky and others. Previous authors attempted to recognize among such monocot remains genera and species, which in our opinion is not realistic. Therefore we refrain from a detailed analysis of this sort of leaf fossils, which requires a special comparative study of venation patterns. Instead of calling them awkwardly Monocotyledonae gen. et sp., we employ the genus *Cyperacites* SCHIMPER (1870-1872) in a wider sense to include such fossils, mostly assigned to a number of species of *Poacites* BRONGNIART and *Cyperites* LINDLEY et HUTTON (These two latter genera are typified by Carboniferous lycopod leaves and are inappropriate for angiospermous remains; *Monocotylophyllum* REID et CHANDLER is an invalid name without any species attached.). With some efforts, even strap-like foliage may bring some information on the diversity of the monocot flora, if detailed venation patterns (Zastawniak 1972) and/or epidermal structures are employed

Palaeobotanical sites in baked rocks of the North-Bohemian Tertiary

To avoid misunderstandings and inconsistencies of the stratigraphical position of respective porcelanite sites, we review various stratigraphical schemes of the Most Basin (Table 1) and explain the system we employ. The most commonly used litostratigraphic divisions, both formal and informal, are the modified versions of that by Procházka (1954), which was based on his geological research of the Žatec delta. Our division conforms to the informal stratigraphy suggested by Elznic et al. (1986) and the formal subdivision by Klomínský (1994). The detailed units for the designation of the split main coal seam correspond to those suggested by Hurník and Marek (1962).

Most localities of the fossil flora in baked rocks belong to two groups, and two stratigraphical levels within the Most Formation. According to the lithostratigraphy of the basin (Elznic et al. 1986, Klomínský 1994) the older suite of sites is situated within the deposits of the Main Coal Seam (i.e., Middle Most Fm.): Vršovice, Dobrčice, Svinčice, Lajsník, Lišnice-Polerady and Dolany (pro parte). The younger sites are confined to the Upper Sandy-Clayey Beds: Zabrušany, Želénky, Straky, Chudeřice, Hostomice, Bílina, Dolany (pro parte), Čermníky, Kaňkov, and the Overlying Beds: Dolany (pro parte), Nechvalice. The secondary accumulation of baked rocks at Mirošovice is of an uncertain stratigraphical position.

The periphery of the basin, where some of the sites are situated, shows discontinuous basin fill and these parts are

Table 1. Stratigraphical distribution of plant-bearing baked rocks in the basin fill
(1 - Vršovice/Černodoly, Dobrčice, Svinčice, etc., 2 - Želénky/Zabrušany, Chudeřice, etc., 3 - Nechvalice, etc.)

Procházka 1954	Hurník and Marek 1962		Elznic 1970	Elznic 1973	Domácí 1977		Elznic et al. 1986		Klomínský et al. 1994	age	
Series of overlying clays and sands	PRODUCTIVE SERIES	Overlying Fm.	Osek Phase Lom Phase	Lom Fm.	MOST FORMATION	Lom Mb.	BASIN SEDIMENTARY COMPLEX	Overlying Beds	(Upper)	Early	3
			Mariánské Radčice Phase	Overlying Fm.		Libkovice Mb.					
			Libkovice Phase					Upper Sandy-Clayey Beds			2
SEAM SERIES: Upper Coal Fm.		SEAM FM: Upper Seam Beds	Břešťany Phase					Main Coal Seam (in delta facies several seam benches divided by layers of clay and sand)	Most Fm.		
Upper Interseam Fm.		Upper Interseam Beds		Brown-coal Seams Fm.							1
Middle Coal Fm.		Middle Seam Beds							(Middle)		
Lower Interseam Fm.		Lower Interseam Beds	Liptice-Bílina Phase			Holešovice Mb.				Miocene	
Lower Coal Fm.		Lower Seam Beds									
Series of underlying clays and sands		Lower Sandy-Clayey Beds with Basal Coal Seam	Duchcov Phase					Lower Sandy-Clayey Beds	(Lower)		
		Underlying Fm.		Underlying Fm.		Duchcov Mb.		Underlying Beds			
Volcanic Series	Volcano-detritic Series			Volcanogenic Fm.	Střezov Fm.		Subbasinal Volcanic Complex		Střezov Fm.	Oligocene	
	Basal Series			Basal Fm.	Staré sedlo Fm.		Basal Beds		Staré Sedlo Fm.	Eocene	

difficult to assign to a particular lithostratigraphical unit. So for example the Dobrčice locality was classified by Kopecký et al. (1990) as a part of the Upper Sandy-Clayey (or Overlying) Beds (two seams were developed in this outcrop, of which only the upper one and adjacent clay were burned). However, frequent occurrence of ferns suggests that, in fact, it belongs in the Main Coal Seam. Three facies in the sediments above the main seam can be recognised, and also in the porcelanite occurrences. They are partly connected with different plant assemblages: back swamp clay, often transitional with the Main Coal Seam (e.g., Želénky, Bílina), alluvial sand and clay of the Bílina delta (i.e., Upper Sandy-Clayey Beds), considered by Elznic (1973) and others an equivalent of the Main Coal Seam (e.g., Želénky, upper part, Křemýž), and the lacustrine clay, i.e., the Overlying Beds pro parte (e.g., Nechvalice, Dolany, upper part).

Most of the localities are at present exhausted by exploitation (stone quarries or balast pits) and re-cultivated, or inaccessible. Only the sites at Černodoly near Louny (i.e. Vršovice) are exposed and promising for collecting. In the 1980s a new site - Dobrčice south of Most - was opened by quarries, which remained still uncovered. Both localities should be designated as "natural monuments". In other sites, plant fossils occur very rarely. So for instance a new stone pit at Svinčice was long considered sterile, but in 1999 by chance the first author (Z.K.) was fortunate in recovering a florula.

The survey given below treats individual sites together with their history, exact geological setting, aspects of fossil plant assemblages, and references to the palaeobotanical studies (incl. collections). The geographic position is shown in textfigs 6-9. For the orientation of the readers in older literature, translations of Czech and German geographic names are given in table 2. Table 3 gives an overview of the selected localitites according to their position in the basin fill.

Vršovice near Louny (i.e. Černodoly near Nečichy)

When Prof. A. Frič suggested that a young Czech botanist Velenovský should study the Tertiary flora of Bohemia, the latter decided to start this project with the Vršovice locality near Louny. Contrary to other sites already described by Ettingshausen (1866-9), this was untouched and at that time unknown. Although Krejčí (1877: 904) describes in detail baked rocks at Vršovice, he does not mention the occurrence of fossil plants: "Very interesting are such [baked] seams in environs of Louny at the southernmost limit of the Tertiary basin, where they lay immediately on the *Bacculites* clay marl, and having been later much eroded, they cover only tops of some hills, while the slopes are built by the *Bacculites* beds. In such a way burned seams appear on the Křížový or Červený hills west of Louny, and particularly on several hills, appearing reddish in colour from a long distance, on the left bank of the Oharka river near Vršovice". Krejčí (1878) did not mention the locality of Vršovice even in his list of the Bohemian Tertiary flora. His description suggests that the hills were not covered by woody vegetation at those times, and hence collecting was easy. The quotation of Krejčí (1877) also suggests that he is the author of the locality name, which he visited obviously from the south, i.e. from Vršovice. According to Velenovský (1881) the site lies NE of the village of Dobromiřic (i.e. Dobroměřice) on the Červený hill and on several hills eastwards next to the settlement of Černodoly and the village Nečichy. He refers to the site he worked on as Vršovice after the Schwarzen-

Fig. 6. Geographic position of the sites of fossiliferous and barren baked rocks in the North Bohemian Tertiary (palaeontological localities: 1 - Vršovice near Louny, 2 - Želénky (incl. Zabrušany, Všechlapy, Hostomice), 3 - Straky (Kladruby), 4 - Český Újezd, 5 - Nechvalice - Nové Dvory, 6 - Křemýž, 7 - abandoned open-cast mine Jirásek (Světec, Chotověnka, Chudeřice, Chotějovice, Lýskovice, mines Rudiay II, Lotta Marie, Eleonora, Jindřich), 8 - Bílina, 9 - Kaňkov, 10 - Lajsník near Most, 11 - Lišnice - Polerady, 12 - Dobrčice, 13 - Svinčice, 14 - Mirošovice, 15 - Čermníky, 16 - Dolany; quoted barren localities: 1 Postoloprty - Březno near Louny, 2 - Skyřice, 3 - Korozluky).

Table 2 Czech and German names of the localities

Czech name	Czech alternatives (mines)	German name
Bílina	důl Carolina, Rudiay I	Bilin
Braňany	see Kaňkov	Prohn
Břešťany		Preschen
Březánky		Priesen, Briesen
Čermníky		Tschermich
Český Újezd		Böhmisch Neudörf (Klein Augezd)
Dobrčice	Špičák NE of Korozluky	Dobschitz
Dolany		Dolan, Delau
Doly Bílina (Bílina Mines)	Důl (lom) Bílina, Velkolom Maxim Gorkij, lom Maxim Gorkij I, lom Svoboda	Kohlenwerke Bilin, Grosstagebau M. Gorkij, Tagebau M. Gorkij, Svoboda II
Doupovské hory		Doppaugebirge, Duppaugebirge
Duchcov		Dux
Hostomice	Horní Hostomice	Hostomitz
Hošnice		Hoschnitz
Chabařovice		Karbitz
Chotějovice		Kuttowitz, Kottowitz
Chudeřice	Kutršice u Teplic	Kutterschitz
Kaňkov	Kaňkov u Braňan	Ganghof
Kladruby		Kradrob
Korozluky	Kolozruky	Kollosruk
Kostomlaty		Kostenblatt
Křemýž	Křemýš	Krzemusch
Kučlín		Kutschlin
Jenišův Újezd	Dlouhý Újezd	Langaugezd, Lang Ugezd
Lajsník	Lajsník u Mostu	Krebsberg
Lišnice - Polerady		Lischnitz - Polerad, Pohlerad, Polleradi
Ledvice	důl Jirásek	Ladowitz, Tagebau Jirásek
Louny		Laun
Lužice		Luschitz
Lyskovice		Liskowitz
Malé Březno		Kleinpriesen, Klein Priesen
Mirošovice		Mireschowitz
Most		Brüx
Nečichy	Černodoly	Netschich
Nechvalice	Nové Dvory	Nechwalitz, Neuhof
Postoloprty		Postelberg
Skyřice	důl Prokop, Prokopi, Mariana	Skiritz, Skyritz, Zeche Prokopi, Schacht Marianna
Straky		Straka
Světec	Rudiay II	Schwatz, Rudiaier Kohlenwerke
Svinčice		Schwindschitz
Teplice		Teplitz
Ústí n/L.		Aussig
Vršovice	Vršovice u Loun, Černodoly	Werschowitz, Vršovic bei Laun
Všechlapy		Wschechlab
Vtelno	Lom Benedikt	Vteln, Tagebau Benedikt
Zabrušany		Sobrussan, Sobrussau
Želénky		Schellenken
Žichov		Schichow

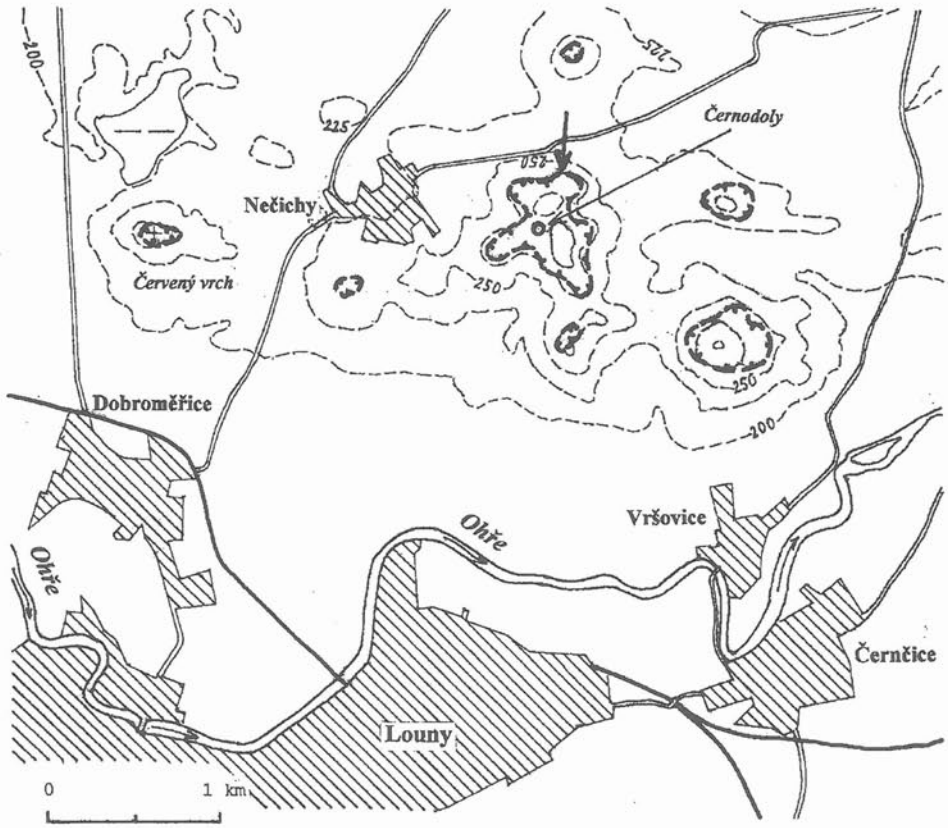

Fig. 7. Detailed situation of the sites near Vršovice (arrow - accessible northern quarry face).

berg's castle (now outside the suburbs of the town Louny) more than 1 km S from the hills (see also Váně 1999: 239). At the present time, an easier access to one of the hills leads from the village of Nečichy to the former settlement of Černodoly (see also Reuss 1790), which was later abandoned and in the 1960s destroyed (text-fig. 7).

The position of porcelanite with the flora was described by Hurník (1978). The slope of a hill on the south-east (above a shooting gallery) exposes the base of the Tertiary strata, formed by dark brown sand about 3 m thick with organic admixture and frequent limonite inter-beds, which weather out. It recalls "the basal sandstone in the area of the Žatec beds, cropping out in the Hořenec gorge". There is a layer approximately 5 m thick of sand, sandy clay and clay of various colours over it. Some levels were overfilled with plant remains. The burned coal seam above is often baked into slag. Overlying strata are also baked and bedding is disturbed. Several slag and ash layers at various heights suggest several coal seamlets over each other. Hurník collected a rich fossil flora on the highest hill south of Nečichy (probably the same as mentioned by Velenovský), where a stone pit was active a few years ago and the northern quarry face has remained. Luft-Hurník (1957b) assigned the geological section to the upper inter-seam beds on the basis of mass occurrence of *Woodwardia*. Bůžek (in Malkovský et al. 1985) considers assignment to both the lower or upper inter-seam beds as possible on the basis of the occurrence of entire leaves of bay-berry (*Dryandroides lounensis*). (He finds no palaeofloristic difference between these two stratigraphical levels.) As the entire leaves of bay-berry are common in coal facies, he does not rule out a position partly within the middle seam beds. Bůžek also noted an interchanging petrological character of fossiliferous strata at Vršovice and assigned particular index elements to various facies: *Dombeyopsis lobata* to coal facies, *Ulmus pyramidalis* to sandy-clayey facies.

Velenovský (1881) described from Vršovice 71 taxa, of which he lists only 60 in his summary table, omitting Butomaceae, Poaceae and Cyperaceae, as well as *Paulinia furcinervis, fructus* (three taxa) and *folium*. After our revision, the number of well defined taxa has lowered (about 40 species). However, most of the grass-like remains are included in a single cumulative unit. In his summary table including also frequency, Velenovský (1881) considers as most frequent *Woodwardia roessneriana* (i.e. *W. muensteriana*), *Salvinia formosa* (i.e. *S. reussii*), *Sequoia langsdorfii* (i.e. *Taxodium dubium*), *Phormium affine* (i.e. *Cyperacites* sp.), *Typha latissima*, and *Dryandroides lounensis* (i.e. *Myrica* cf. *integerrima*) and also *Nyssa vertumni* (endocarps assigned now to *Nyssa* sp.), leaves of maple (i.e. *Acer tricuspidatum*), *Rhamnus fricii* (i.e. *Alnus gaudinii*), *Terminalia radobojensis* (i.e. *Laurophyllum* cf. *saxonicum*) and *Ulmus pyramidalis*. Common are *Alnus kefersteinii* (i.e. *Alnus* cf. *rostaniana*), *Carpinus grandis* (i.e. *Ulmus pyramidalis*), *Fagus feroniae* (i.e. *Alnus julianiformis*), *Salix macrophylla* (partly *Salix haidingeri*), *Laurus primigenia* (i.e. *Quercus rhenana*), *Acer nervatum* (i.e. *A. integerrimum*), *Rhus merianii* (i.e. *Rubus merianii*), *Rhus elegans* (i.e. *Rubus vrsovicensis*) and *Ficus tiliaefolia* (i.e. *Dombeyopsis lobata*).

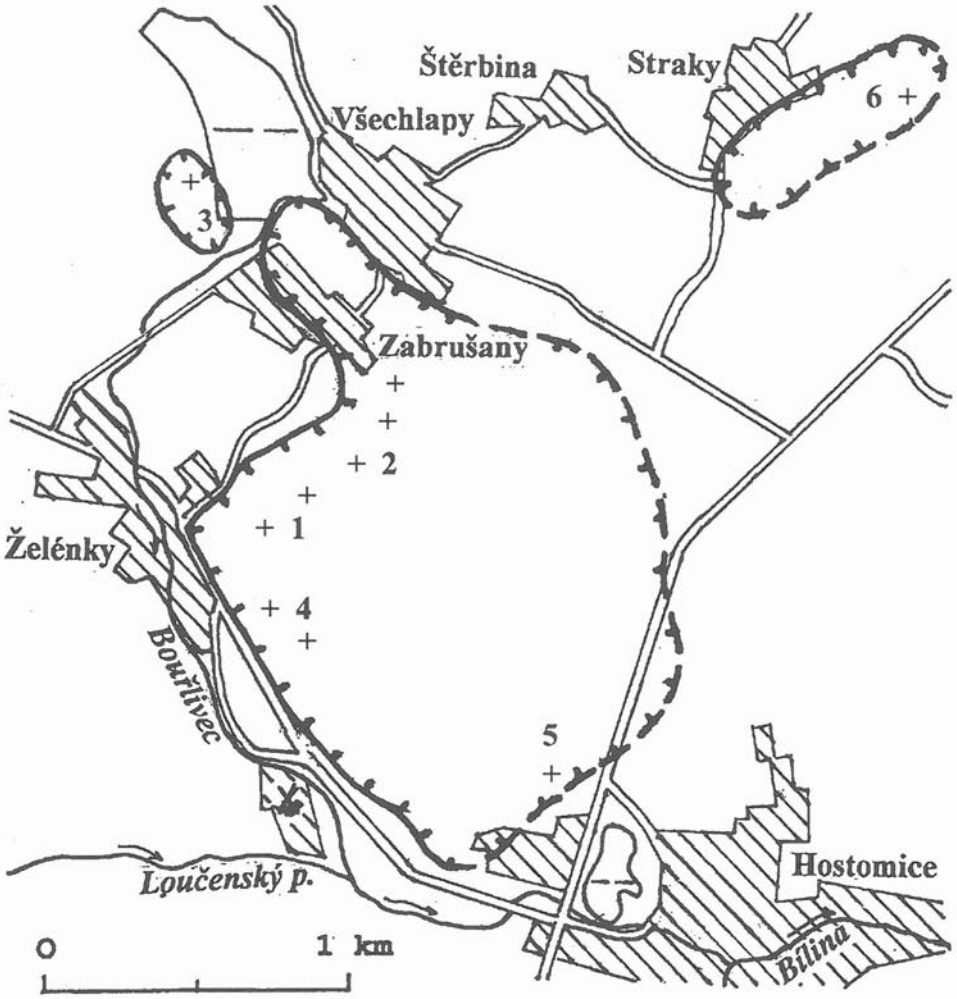

Fig. 8. Boundaries of the deposit near Želénky and palaeobotanical sites (1 - Želénky, 2 - Zabrušany, 3 - Všechlapy, 4 - Želénky/ Hostomice, 5 - Hostomice, 6 - Straky).

The collections made by Velenovský personally are nearly complete and housed in the National Museum, Praha. Kotlaba (1959, 1960) published an inventory of this collection but many additional specimens were recovered after this revision, because Kotlaba overlooked a part of the figured specimens situated in some cases together on one slab (see Appendix). Outside the National Museum, there are larger or smaller collections designated as from Vršovice, Nečichy or Černodoly in the County Museum, Most, the Regional Museum, Teplice, and the headquarters of the Bílina Mines, Bílina (made by Z. Dvořák). New field activities brought two additional taxa: *Osmunda parschlugiana,* and *Spirematospermum wetzleri.*

At present the most accessible collecting site is on the northeastern hill with an abandoned quarry on the top. The upper part of the hill was lowered by exploitation into a flat surface bordered with small remnants of baked rocks. Only some places are rich in plant remains, mostly roots and grass-like monocots. A typical assemblage of the Vršovice flora can be found only in the NE corner of the quarry, where a quarry face, about 5 m high, with talus remained. Most slabs of bedded porcelanite are full of impressions. Among them, Betulaceae and other broad-leaved elements (*Salix, Myrica, Acer, Rubus, Dombeyopsis, Nyssa, Fraxinus, Ulmus*) prevail. Other plant taxa listed as common by Velenovský, e.g. *Woodwardia, Salvinia, Glyptostrobus,* "*Terminalia*", are rare, particularly the ferns, which may have been confined to a particular level, not accessible today. In the wooded slopes around the outcrop, only pieces of slag, sometimes in large boulders, and underneath the strata of the Cretaceous marl occur. The base of the Tertiary is covered by talus.

Želénky (incl. Zabrušany)

Collections designated as Želénky were made in the immediate environs of this village, on outcrops of baked rocks on the Červený hill E of the village, which continued further eastwards into the periphery of the neighbouring village of Zabrušany (text-fig. 8). In the geological (and also palaeotological) point of view both sites can be united. For the same reason, also Všechlapy (Bůžek 1962) and probably Hostomice (Engelhardt in Geinitz 1878) belong to the same large body of baked rocks, namely its southern part. The geological prospection revealed continuation of porcelanite layers over the coal seam buried under 10 m thick loess between Hostomice and Tuchlov (Zelenka and Martinovská 1995). The extent of the baked rocks

is shown in text-fig. 8. In post-war times, a florula was collected in an outcrop about 300 m away from the road crossing Hostomice-Želénky by Bůžek (1961, 1962). Procházka (1951) reported baked rocks containing rare plant remains on the left side of the road from Želénky to Hostomice. The continuity of the baked rocks between Želénky and Zabrušany was clearly seen during advancing surface exploitation of the deposits. This single body of porcelanite is also indicated in the old geognostic map by A. E. Reuss (1840) (see also F. A. Reuss 1790).

Exact locations of the material described by Ettingshausen (1866-9) and Sieber (1881) as from Zabrušany, and Engelhardt (1891) as from Želénky (coll. *Tobisch*), is not indicated in the pertinent text. It is noteworthy that Ettingshausen indicates only one taxon as occurring from Želénky (*Taxodium dubium* var. e), while Engelhardt notes only Želénky. Ettingshausen did not make his own collection there, because he obtained the studied material from Zabrušany mostly from the collections of the Geological Survey, Vienna, and a few specimens from the Lobkowicz collections. He did not obviously differentiate between the sites Zabrušany and Želénky, as he states (Ettingshausen 1869: 75) "unter der Bezeichnung "Brandschiefer von Sobrussan" vereinige ich die nahe beisammen liegenden und die gleiche Flora einschliessenden Localitäten Sobrussan, Schelenken, Kutterschitz und Straka." It seems certain that in this case the specimens come from the same porcelanite spread on the slopes between those two villages (see Bůžek 1962). Also Engelhardt (1891) was surely acquainted with this area, because he introduced his discussion with Reuss (1840) on the origin of baked rocks with a statement that rocks of the ground fires of coal ("Kohlenbrandtgesteine") near Želénky form an elongate ridge between Želénky and Zabrušany. He notes that the material includes various levels of the baked rocks overlying the burned coal seam, which is transformed into slag. The mentioned ridge was probably not wooded in the 19th century, as it can be assumed by small pits as remnants of old exploitation in the woods on the right side of the road between Želénky and Zabrušany. The specimens designated by Engelhardt (1891) as "Schellenken - Sphärosiderit" (coll. *Sieber*) are not included in our revision and may come from the local coal mine from the clay ironstone above the coal.

After the World War II, Želénky attracted the attention of several palaeobotanists, mainly Procházka, Hurník and Bůžek. In the 1950s and 1960s, the richest site was easily accessible on the eastern side of the soccer playground north of the village (Hurník 1964). In other places, only rare plant remains were reported by Procházka (1951). A stone pit at Všechlapy, which was opened in 1959 was also visited by Bůžek in the 60s. Later a large stone quarry operated at Želénky for the Bílina Mines. This was a most fruitful period of collecting (Holý, Bůžek, the authors, several excursions), which ended several years ago. Today the whole porcelanite body is removed and the quarries re-cultivated. Only very small remnants of the baked rocks are accessible on the road crossing on the northern periphery of Želénky.

Ettingshausen (1866-9) described 74 species from Zabrušany, Engelhardt (1891) 69 taxa from Želénky. In our revision the number of species from Želénky has been reduced. According to the list including the sites Zabrušany and Hostomice, the flora contains about 55 taxa (see also Appendix for the taxonomic revisions).

According to Engelhardt (1891) the assemblages at Želénky were dominated by *Taxodium dubium*, *Betula prisca* (i.e. *Alnus julianiformis*), *Alnus kefersteinii* (i.e. *Alnus menzelii*), *Acer trilobatum* (i.e. *Acer tricuspidatum*), *Zizyphus tiliaefolius* (i.e. *Paliurus tiliaefolius*), *Juglans bilinica* (i.e. *Fraxinus bilinica*), *Pterocary denticulata* (i.e. *Carya* cf. *serrifolia*). In the post-war collections, various layers were overfilled with leaf impressions of *Salvinia reussii*, *Blechnum dentatum*, *Taxodium dubium*, *Glyptostrobus europaeus*, *Myrica* cf. *integerrima*, *Alnus menzelii*, *Alnus julianiformis*, *Acer tricuspidatum*, *Rubus merianii*, *Dombeyopsis lobata*, *Paliurus tiliaefolius*, *Decodon gibbosus*, and various monocots. In the sandy facies, *Ulmus pyramidalis*, *Zelkova zelkovifolia*, *Acer dasycarpoides*, "*Ficus*" *truncata*, *Parrotia pristina*, and *Carpinus grandis* occurred. The flora of Všechlapy was tentatively identified by Bůžek (1962): the assemblage from the quarry face includes *Alnus feroniae* (i.e. *Alnus julianiformis*), *Salix lavateri* (i.e. *Salix haidingeri*), *Parrotia pristina*, *Zizyphus tiliaefolius* (i.e. *Paliurus tiliaefolius*), and *Ficus truncata* and conforms to that from sandy layers of Želénky. The assemblage from the bottom layers at the NE margin differs in occurrence of *Salvinia mildeana* (i.e. *S. reussii*), *Taxodium dubium*, *Alnus feroniae* (i.e. *A. julianiformis*), *Rhus merianii* (i.e. *Rubus merianii*) and *Acer trilobatum* (i.e. *A. tricuspidatum*), and corresponds to a standard flora of Želénky.

Despite non-selective field collections, which would allow direct reconstruction of plant association, the list of taxa and lithological character of fossiliferous slabs suggest that similar associations have been present at Želénky as those described in detail in the open-cast mine Bílina (the former Maxim Gorkij). In fine-grained porcelanite, the prevailing vegetation must have been bound to a swampy coal-forming environment, which has been assigned by Bůžek et al. (1993) to *Glyptostrobus-Quasisequoia* swamp forest with aquatic horizons of the *Salvinia* and monocots/*Decodon* associations, including rare specimens of *Limnobiophyllum*. In back swamp vegetation, *Salix*, *Quercus rhenana* and *Taxodium-Nyssa* forests with *Alnus menzelii*, *Dombeyopsis* and *Rubus* dominated. Sandy facies reflects also at Želénky the levee riparian deciduous forest of the *Ulmus pyramidalis-Parrotia* association on damp soils. It is richer than the previous units, including *Salix haidingeri*, *Acer dasycarpoides*, *Carpinus grandis*, *Zelkova*, *Parrotia* and the enigmatic "*Ficus*" *truncata*.

Animal fossils are extremely rare at Želénky. The first report was published by Engelhardt (1891), who announced a mollusc of the genus *Anodonta*. Bůžek (1962) mentioned an impression of another mollusc (together with *Alnus*) in the Bílina museum. Hurník recovered in the 60s a big shell of cf. *Margaritana* (pl. 12, fig. 1). Bůžek (1962) reports from Všechlapy a fragment of tortoise shell.

The figured specimens published by Ettingshausen (1966-9) also from Kučlín, Břežánky, Žichov and Kostomlaty are partly preserved in the Hungarian Natural History Museum, Budapest (Lobkowicz collection), Geological Survey, Vienna, and Natural History Museum, Vienna (together with undetermined material), some illustrated specimens sold by Ettinghausen to Great Britain are housed in British Natural History Museum, London. A part of the specimens figured by Engelhardt (1891) has been preserved at the Faculty of Science, Charles University, Prague (coll. *Krejčí* of "Polytechnicum"). Maple impressions revisited by Procházka (Procházka and Bůžek 1975) and

a *Lygodium* frond (Luft-Hurník 1957) have been recovered also at the National Museum, Prague, where an extensive but not determined material is deposited since the activities of the late F. Holý and earlier collectors. An extensive collection from Želénky made by the late Č. Bůžek is placed in the repository of the Czech Geological Survey at Lužná. Undetermined pieces from Želénky are scattered in many other museum collections, e.g. Staatliches Museum für Mineralogie und Geologie zu Dresden, Joanneum, Graz, County Museum in Most (coll. *F. Thuma, S. Hurník*), in the Regional Museum, Teplice, in the Bílina Mines, in the Town Museum, Ústí n/L.etc. Most interesting documents are included in the present revision, which enrich the flora of Želénky by *Woodwardia, Alnus gaudinii, Acer integerrimum, Fraxinus macroptera, Podocarpium podocarpum, Rosa europaea, Paliurus favonii, Hydrochariphyllum buzekii, Craigia bronnii, Nyssa* sp., *Toddalia maii* and some others.

Straky

The palaeobotanical material from this locality was collected by Reuss (Ettingshausen 1866: 15), and the figured specimens are a part of the Lobkowicz collection (now at the Hungarian Natural History Museum, Budapest). In his text, Ettingshausen refers to this locality only in the descriptions of *Blechnum braunii* (i.e. *Blechnum dentatum*), which is its type locality, and *Acer rueminianum*. Bůžek (1962) suggested that these old gatherings studied by Ettingshausen were made from the other side of the same baked rock deposits at Kladruby. He assigned to the same name his own collections from an old stone pit "east of the settlement Straky". We consider the new name (i.e., Kladruby) superfluous, and from the geographical point of view not founded. Hence the name Kladruby is excluded from the list of palaeobotanical sites of baked rocks.

Bůžek's collections reported by him in Bůžek (1961) are housed in the repository of Czech Geological Survey in Lužná. A few specimens including *Ulmus pyramidalis* and *Quercus rhenana* have been found in the collections of the Regional Museum, Teplice.

Český Újezd at Chabařovice

Plant fossils have been reported from this place only by Bůžek (1962). The locality was discovered by F. Macák in an abandoned stone pit on the left bank of the Podhořany brook. In spite of the very scanty occurrence of plant fossils in the claystone of the lacustrine facies ("Overlying Clay") in the Ústí-Teplice part of the basin, Bůžek was able to find *Glyptostrobus europaeus*, *Alnus feroniae* (i.e. *A. julianiformis*), *Comptonia difformis*, *Cinnamomum polymorphum* (i.e. *Daphnogene polymorpha*), and Poaceae gen. et sp. div. The material, which should also be in the repository of Czech Geological Survey in Lužná, has not been revisited by us.

Nechvalice - Nové Dvory

Zelenka and Martinovská (1995) incorporated this porcelanite occurrence into a large deposit called Nechvalice near Bystřany - Malhostice. According to these authors it is the largest body of caustically metamorphosed Miocene sediments in central Europe. It is to be noted, however, that the body is discontinuous, being divided during denudation into several isolated occurrences (like in the environs of Most or Duchcov). The disintegration may be also due to uneven relief of the neovolcanites beneath the coal-bearing basin fill. The largest deposit within this body occurs at Nechvalice - Nové Dvory, forming two isolated islands of the porcelanite. Therefore Macůrek and Zelenka (1985) recognised the Nové Dvory and Nechvalice parts of the deposit. Plant remains have been discovered by Radoň (1999) in the Nové Dvory part.

The exploitation was carried out for several decades. The stone pit is situated about 0.5 km E of the village Nové Dvory. The last owner of the quarry Palivový kombinát, Ústí/L. used the stone for railway stabilisation in the strip mine Chabařovice (now closed).

The uniform coal seam about 15 m thick underwent burning due to denudation of overlying sediments and exposures of coal by erosion of the river Bílina and its tributaries. In the case of this locality, it was eroded by the Bystřice brook. Due to variable thickness of the seam and irregular burning, the caustic influence reaches various heights of the clay. And the transition between the baked and fresh clay is relatively sudden. The maximum thickness verified by geological prospection was 25 m.

During the exploitation no plant remains were recovered there. Only lately Radoň (1999) recovered a florula (housed in the Regional Museum, Teplice), which is included in this revision. The following elements have been safely determined: *Taxodium dubium*, *Glyptostrobus europaeus*, *Quasisequoia couttsiae*, *Pinus rigios*, *Quercus rhenana*, *Myrica lignitum*, *Comptonia difformis*, *Engelhardia orsbergensis*, *Alnus julianiformis*, *Leguminosites* spp., *Acer tricuspidatum*, *Paliurus tiliaefolius*, and *Cyperacites* sp. As stated by Radoň (1999), this assemblage is typical of the Břešťany clay. Z. Kvaček and Bůžek (1982) assigned such a mixture of swamp and upland elements to their *Engelhardia-Taxodium* association.

Křemýž

This site has also been reported by Bůžek (1962) in connection with old collections housed in the 60s in the Duchcov museum, and own field work. He did not mention identification of the old museum collection. His material, recovered in a small pit about 400 m NE of the road curve leading into the village, includes only *Alnus* cf. *feroniae* (i.e. *A.* cf. *julianiformis*).

The abandoned open-cast mine Jirásek

This mine operated in a large area NNE of Bílina and embraced also several smaller occurrences of porcelanite, where Bůžek (1961, 1962) collected. Some of the locale sites are also referred to in the old collections of the National Museum, Praha, Charles University, and literature as Světec, Chotověnka, Chudeřice (Kutterschitz), Chotějovice and Lískovice (text-fig. 9).

Plant fossils from Světec near Bílina housed in the above two institutions are not specifically localised on the labels. A specimen of molluscs was also recovered there by Bůžek and transferred into the Geological Institute of the Academy of Sciences, Praha. Some other specimens were gathered during constructions and exploitation in the mine Rudiay II. Particularly a collections made by *Štros* 1936 (NM) is rich. In several hundreds of specimens, *Alnus julianiformis* dominates, followed by *Blechnum dentatum, Quasisequoia couttsiae*, and *Myrica* cf. *integerrima.* All other elements were recorded less often: *Lygodium kaulfusii, Pronephrium stiriacum, Glyptostrobus europaeus, Taxodium dubium, Decodon gibbosus,*

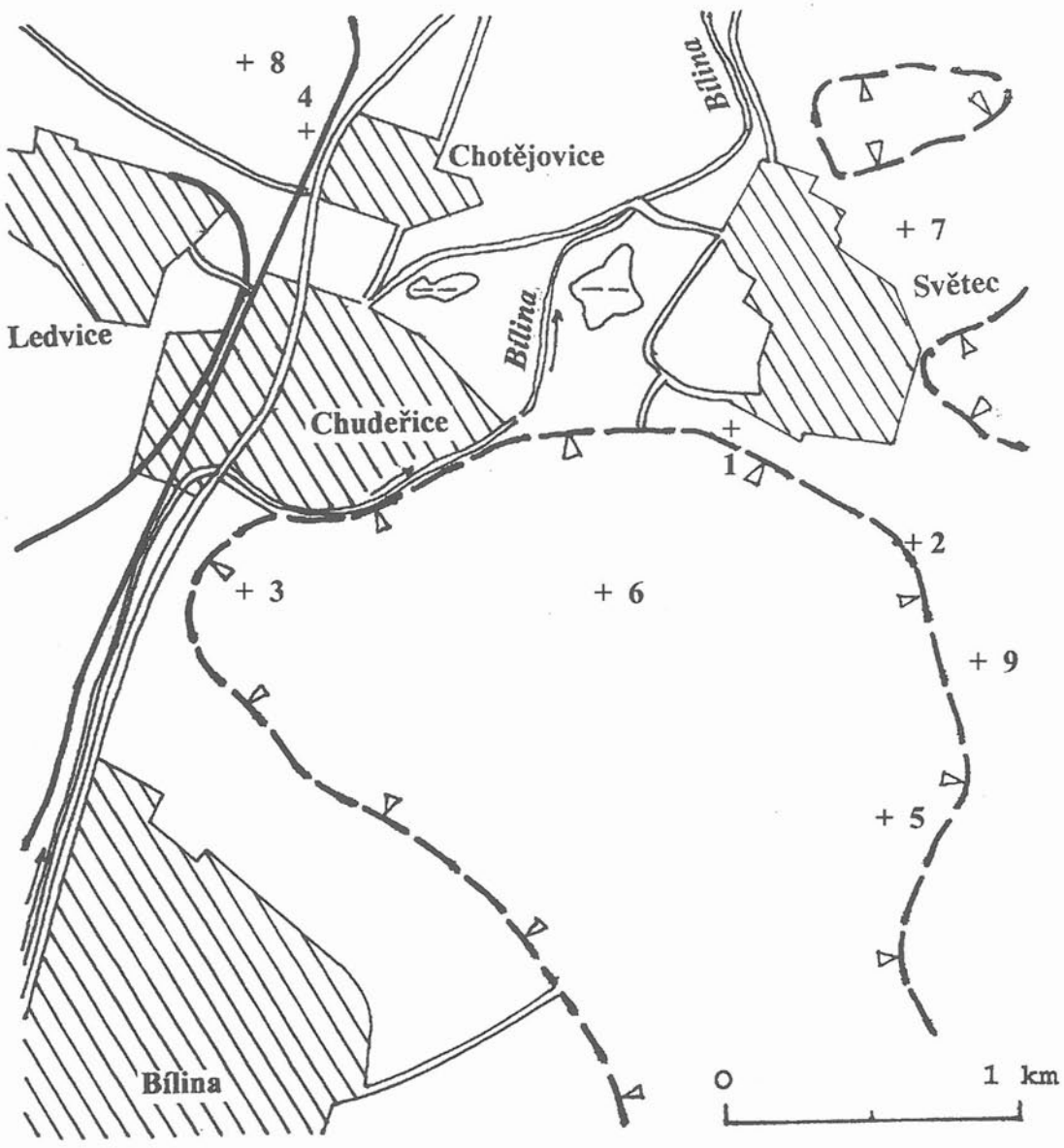

Fig. 9. Detailed situation of the sites within the abandoned open-cast mine Jirásek, today mostly covered under the Radovesice dump pile (1 - Světec, 2 - Chotověnka, 3 - Chudeřice, 4 - Chotějovice, 5 - Lyskovice, 6 - mine Rudiay II, 7 - mine Lotta Marie, 8 - mine Eleonora, 9 - mine Jindřich).

Rubus merianii, Nyssa haidingeri, Salix varians, Dombeyopsis lobata, Ulmus pyramidalis, "Juglans" acuminata, Sabal major, Calamus noszkyii, Smilax weberi and several doubtful dicot leaves (e.g., cf. *Ampelopsis* sp., *Leguminosites* sp., ? Viscaceae) and endocarps (*Carpolithes* spp.). The surface of a few slabs was covered by *Salvinia reussii.* Bůžek collected in re-deposited material in the southern part of the Lotta Marie open-cast mine. The Chudeřice site was mentioned by Reuss (1840) in connection with the occurrence of a fossil seed similar to *Foliculites kaltennordheimensis* (i.e. *Stratiotes kaltennordheimensis*). Other plant fossil from there were described by Ettingshausen (1866-1869) and survived in Budapest as a part of the Lobkowicz collection. In older Czech literature (e.g. Brabenec 1909), the name Chudeřice is often misspelled as "Kutršice" from the German version of this village. Scanty fossil plants were recorded by Bůžek from the former strip mines Eleonora at Chotějovice and Jindřich from Chotověnka.

Noteworthy is a steep mine face at the Jirásek mine, which was accessible on the NW margin of the village of Lýskovice. Bůžek identified in his collection from this site: *Blechnum braunii* (i.e. *B. dentatum*), *Salvinia mildeana* (i.e. *S. reussii*), *Taxodium dubium*, *Glyptostrobus europaeus*, *Salix macrophylla*, *Alnus feroniae* (i.e. *A. julianiformis*), *Persea speciosa* (i.e. *Nyssa haidingeri*), *Pterocarya* sp. (i.e. *Carya* cf. *serrifolia*), *Ficus multinervis* (i.e. *Decodon gibbosus*), *Ulmus* sp., *Zizyphus tiliaefolius* (i.e. *Paliurus tiliaefolius*), *Dombeyopsis dechenii* (i.e. *Dombeyopsis lobata*), *Smilax* sp., and Poaceae gen. et sp. Bůžek kept all his collection including the above mentioned in the repository at Lužná, but we were unable to revisit all this material. Today most of these occurrences are

covered by the Radovesice dump and other properties of the Bílina open-cast mine and have been destroyed by re-cultivation. Original location is shown in text-fig. 9.

Bílina

There are several fossils referred to as coming from Bílina by Ettingshausen (1866-9). Their exact position cannot always be assumed from the text. Although old geological maps (Wolf 1880, Anonymus 1898) do not show any occurrence of baked rock in the environs of Bílina, there are several reported in new publications. Zelenka and Martinovská (1995) described an occurrence NE of Bílina as Bílina-Chudeřice (today covered by the Radovesice dump). According to unverified information, a tiny "island" of porcelanite occurs also on the western limit of the hill Chlum. Hibsch (1924), as the above mentioned authors, and Kopecký et al.(1990), and even Reuss (1840) draw on the geological maps a few porcelanite occurrences on the western part of Bílina. It is possible that even Ettingshausen refers to such occurrences. First reports of mining in the Bílina town date to the 18th and beginning of the 19th century, when the mine of Lobkowicz Carolina (later re-named to Rudiay I) was opened by an inclined gallery situated near the present-day railway station (Luxa et al. 1997). It cut through probably one porcelanite body in this part of Bílina, from which Sternberg received some material, and described a few plants: *Phyllites dubius* (i.e. *Taxodium dubium*), *Phyllites julianiformis* (i.e. *Alnus julianiformis*), *Phyllites juglandiformis* (i.e. cf. *Betula* sp.), and *Muscites stolzii* (i.e. *Glyptostrobus europaeus* vel *Quasisequoia couttsiae*). These collections are only partly housed in the National Museum, Prague.

Ettingshausen (1866-1869) refers as from the locality Bílina: *Panicum macellum* (not figured, probably at BA), *Poacites acuminatus* (in the figure caption Zabrušany), *P. rigidus* (in the figure caption Zabrušany), *Cyperus Chavannesi* (not figured, probably at BA), *Juncus retractus* (in the figure caption Zabrušany), *Litorella Baldassaril* (not figured, probably at BA), *Casuarina sotzkiana* (not figured, probably at BA), *Betula prisca* (not figured, probably at BA), *Alnus kefersteinii* (not figured, probably at BA), *Fagus castaneaefolia* (not figured, probably at BA - Velenovský 1881 transferred this species to his *Fagus Ettingshausenii*), and *Fagus feroniae* (not figured, probably at BA). The references to Bílina by Ettingshausen are probably only simplifications as he did not indicate any particular occurrence of baked rock directly from Bílina in his survey of the local floras (Ettingshausen 1869: 69).

Kaňkov

A relatively large deposit of baked rocks was developed on the outcrop of the coal seam E of Braňany near the settlement of Kaňkov. Only a few plant fossils have been collected from there and this locality is not known in older literature. First collections were made by Holý in the 1970s and partly included in the study of *Alnus julianiformis* (Z. Kvaček and Holý 1974). Later also Z. Dvořák collected there and recovered *Lygodium kaulfussii*, *Alnus julianiformis*, *Acer tricuspidatum* and Poaceae vel Cyperaceae. This material is housed in the Bílina Mines collections.

Lajsník near Most

The Lajsník hill, partly covered by woods, lies on the outskirts of the new town of Most (former Rudolice) at the road leading to Praha. A remnant of the burned coal seam rests on weathered volcanite rocks exposed at the foot of the hill. This occurrence was probably connected before erosion with another one on the Skřivánčí hill, exploited in the 80s. This is a continuation of porcelanites from the southern limits of Most and from Vtelno, which did not yield any fossils. Only Hurník was able to recover some identifiable plants from the eastern margin of the former Benedikt open-cast mine in Vtelno. This collection, which is housed in the County Museum, Most, includes roots determined as *Phragmites oeningensis* A. BR. sensu Ettingshausen (1866), *Taxodium dubium*, *Betula* sp., *Alnus julianiformis*, *Cercidiphyllum crenatum*, *Zelkova zelkovifolia* and *Rubus merianii*.

The flora from the site Lajsník (Luft 1955) was tentatively determined as *Glyptostrobus europaeus*, *Ulmus longifolia* (i.e. *U. pyramidalis*), *Zelkova ungeri* (i.e. cf. *Z. zelkovifolia*), *Acer trilobatum* (i.e. *A. tricuspidatum*), *Liquidambar europaea*, and *Dryandroides lounensis* (i.e. *Rubus merianii*). This collection is also housed in the County Museum, Most.

Baked rock on the Lajsník hill was considered as belonging to the strata overlying the coal seam. However, there is no exposed geological section on the wooded hill to corroborate this idea. The porcelanite preserved there is only few meters thick and can hardly belong to the strata overlying the main seam. Also a fragment of *Woodwardia* was recovered in the collection suggesting that the fossiliferous rocks represent in fact sterile layers within the coal.

The chance to obtain richer plant collections at this site is now very low.

Lišnice-Polerady

This site is introduced into the literature by Engelhardt (1891: 133), who was unable to get more material from the environs of Most, "in welcher Nichtdeutsche viel versprachen, aber trotzt wiederholter Besuche und oftmaliger Bitte ihr Wort nicht hielten". From baked rocks of Lišnice Polerady (Lischnitz-Pohlerad) he lists *Ficus multinervis* (i.e. *Decodon gibbosus*), *Ficus lanceolata* (? *Quercus rhenana*), *Ficus hercules* (? *Laurophyllum saxonicum* vel *Quercus rhenana*) and *Ficus tiliaefolia* (i.e. *Dombeyopsis lobata*). We have not been able to find this collection.

Hurník (Luft 1956b) designated under the same name outcrops of clay, sandy clay and weathered coal clay with the fossil flora on slopes north of the road from Lišnice to Polerady. Porcelanite bodies occurred in the past on a ridge N of Lišnice (today the southern part of the Velebudice dump pile). In the remnants of this deposit, no identifiable plant remains, except for roots and wood, have ever been found. Small occurrences of porcelanite were scattered on the fields N of the village, as they can be traced today in small fragments of the rock with indeterminable plant remains. Bůžek (in Tyráček et al. 1988) did not mention any flora from there. Today the only accessible site is caustically influenced sandstone in pits after exploitation of oxihumolite between the two villages. It contains masses of leaf impressions belonging to *Quercus rhenana*.

Dobrčice

Two large deposits of porcelanite are situated E of Korozluky in the Most region (text-fig. 6). Both were exploited in stone pits for balast under mine railways. One is situated on a ridge

Table 3

Distribution of plant species in the main localities of baked rocks

Upper Interseam Beds: Vr - Vršovice+Černodoly, Če - Čermníky, Do - Dolany, La - Lajsník, LP - Lišnice-Polerady, Db - Dobrčice; Upper Sandy-Clayey Beds: Za - Zabrušany, Že - Želénky, Sv - Světec, St - Straky, Ch - Chotějovice, Bi - Bílina; Overlying Beds: Ne - Nechvalice, Do - Dolany.

taxon	Vr	Če	Do	La	LP	Db	Za	Že	Sv	St	Ch	Bi	Ne	Do
Osmunda parschlugiana	+					+		?	+					
Lygodium kaulfussii								+	+					
Pronephrium stiriacum	+		+			+			+		+			
Blechnum dentatum							+	+	+	+	+			
Woodwardia muensteriana	+		+			+								
Salvinia reussii	+					+		+	+		+			
Taxodium dubium	+	+	+		+	+	+	+	+	+		+	+	
Quasisequoia couttsiae	+		+			+		+	+	+			+	
Glyptostrobus europaeus	+	+	+	+	+	+		+	+			+	+	
Pinus rigios					?								+	
Pinus engelhardtii							unknown locality							
Laurophyllum cf. *saxonicum*	+					+	?	+						
Daphnogene polymorpha	+						+							
Berberis berberidifolia							+							
Cercidiphyllum crenatum	+		+					+						
Parrotia pristina	+			+			+	+						
Liquidambar europaea				+			+	+						
Quercus rhenana	+				+			+	+	+			+	
Quercus sp. (cupule)	+													
Alnus julianiformis	+			+		+	+	+	+		+	+	+	
Alnus gaudinii	+			+			+							
Alnus kefersteinii	+													
Alnus cf. *rostaniana*	+	+		+		+								
Alnus sp. 1 (infructescence)						+								
Alnus menzelii				+				+						
Alnus sp. 2 (infructescence)							+	+						
Betula sp.				+				+	+					
Carpinus grandis							+			?	?			
Myrica lignitum													+	
Myrica cf. *integerrima*	+						?	+	+					
Comptonia difformis													+	+
Carya cf. *serrifolia*								+						
Engelhardia orsbergensis													+	
Salix varians	+	+				+			+					
Salix haidingeri	+						+	+						
Salix macrophylla	+					+								
Craigia bronnii	+							+						
Dombeyopsis lobata	+		+		+	+		+	+					
Ulmus pyramidalis	+	+	+	+		?	+	+		+				
Ulmus sp. (fruit)								+						
Zelkova zelkovifolia	+						+	+						
Rosa europaea	+						+	+						
Rubus merianii	+						+	+	+					
Rubus vrsovicensis	+					+		+	+					
Decodon gibbosus	?				?	+		+	+					
Leguminosites tobischii								+						

taxon	Vr	Če	Do	La	LP	Db	Za	Že	Sv	St	Ch	Bi	Ne	Do
Podocarpium podocarpum								+						
Leguminosites spp.	?							+	+			+		
Acer tricuspidatum	+	+	+	+		+	+	+					+	
Acer dasycarpoides							+	+						
Acer integerrimum	+													
Acer sp. (fruit)	+						+	+						
Toddalia maii						+		+						
Paliurus tiliaefolius	+					+	+	+					+	
Paliurus favonii							+	+						
Berchemia multinervis	+						+							
cf. *Vitis* vel *Ampelopsis* sp.								+						
cf. *Ampelopsis* sp.									+					
Nyssa haidingeri	+		+				+	+	+					
Nyssa sp. (endocarp)	+							+						
Fraxinus bilinica	+		+			+	?	+						
Fraxinus macroptera								+						
"Ficus" truncata	+					+	+	+						
"Juglans" acuminata	+		+						+					
"Viburnum" atlanticum								+						
Dicotylophyllum spp.	+					+	+	+	+				+	
Carpolithes spp.	+							+	+					
Hydrochariphyllum miocenicum	+													
Hydrochariphyllum buzekii								+						
Smilax weberi	+							+	+					
Spirematospermum wetzleri	+	+												
cf. *Zingiberoideophyllum liblarense*	+													
Calamus noszkyi									+					
Sabal lamanonis									+					
Limnobiophyllum expansum								+						
"Typha" latissima	+							+						
Cyperacites spp.	+					+	+	+	+				+	

between Korozluky and Skršín near the road leading to Praha. This site was nearly barren except for fossil roots and twigs. The other deposit on the opposite ridge along the Korozluky brook was accessible by a road leading from Dobrčice to Korozluky castle. The baked rocks fill a satellite basin oval in outline, 600 x 1200 m in size. Geological prospection (Martinovská and Zelenka 1989) verified two coal seams, mostly weathered into oxihumolite. Larger parts of the upper seam were burned, and this baked the adjacent clay into porcelanite.

In spite of its location in the cadastral district of Korozluky, the current name of the latter site is known as Dobrčice (given during the geological prospection and deposit evaluation) and we maintain this name. Bůžek (in Kopecký et al. 1990) applied a different designation "Špičák NE of Korozluky". During the exploitation a rich flora has appeared there, but it has not been collected systematically. Bůžek (in Kopecký et al. 1990) lists fronds of the fern *Pronephrium stiriacum*, and leaflets of cf. *Fraxinus ungeri*. He noted that the vegetation corresponds to riparian forests with fern undergrowth.

At present the quarry is re-cultivated, but plant impressions can be found in two places, in the upper old quarry and the lower slightly depressed quarry. The baked rock of sandy clay underlying the upper seam is accessible between both places on the northern margin. Larger or smaller slabs of porcelanite with plant fossils lie on re-cultivated flattened pit faces in the lower quarry (coll. *Z. Kvaček, Sakala*) . The other site is a steep colourful pit face on the NE margin the older quarry (coll. *Radoň*).

The composition of the flora has not been published before except for a preliminary paper by Hurník (1999) and is included in the present study. Collections from this site are housed in the Regional Museum, Teplice (coll. *Radoň*), in the County Museum, Most (coll. *Hurník*) and the Bílina Mines (coll. *Dvořák, Z. Kvaček, Sakala*). In some layers (e.g. in the uppermost part of the colourful face, coll. *Radoň*) the fern fronds, partly almost complete, of *Pronephrium stiriacum* cover bedding planes. Some additional fern species have been recovered - *Woodwardia muensteriana*, *Osmunda parschlugiana* and

Salvinia reussii. Commonly occurring are cone scales and foliage of *Taxodium dubium*, seed cones and foliage of *Glyptostrobus europaeus* and *Quasisequoia couttsiae*, leaves of *Alnus julianiformis*, *Alnus* cf. *rostaniana*, *Salix macrophylla* and *Cyperacites*. In the collections of the Bílina Mines, specimens of *Toddalia maii*, *Decodon gibbosus* (foliage), *Laurophyllum* cf. *saxonicum* and *Paliurus tiliaefolius*, of the animal fossils a molusc and an impression of the caterpillar are also available. The collection of the County Museum, Most (Hurník 1999) includes mostly well preserved fern fronds, and similar elements mentioned above, with additional *Salix varians*, *Acer tricuspidatum* and *Dombeyopsis lobata*.

In the past, stratigraphical position of this flora was equivocal. During geological prospection (Janeček 1986, Martinovská and Zelenka 1989), two coal seams were verified. It was logical to place the flora within the roof of the main seam (here split into two seamlets). In this concept the flora would correlate with those in the region of Bílina and Duchcov (see also Kopecký et al. 1990). However, the flora of Dobrčice corresponds in its composition with those from the inter-seam beds. Noteworthy is a mass occurrence of ferns including *Woodwardia*. The dominant fern *Pronephrium stiriacum* and other elements suggest an affinity and correlation with the flora of the satellite basin at Skyřice (Hurník and Z. Kvaček 1999), which falls unequivocally into the inter-seam beds. Hence three coal seamlets possibly occurred at Dobrčice, of which the uppermost one was removed by erosion. The detailed geological evalution indicates a 1 m thick coal clay about 1-3 m above the upper seam weathered into the oxihumolite. The fossil flora comes probably from this layer, a situation which repeats in the Skyřice satellite basin. Elznic and Zelenka (1987) mentioned two to three coal seamlets from Dobrčice. Therefore we can be sure that the Dobrčice flora is an assemblage coming from the upper inter-seam beds.

At this time, we also mention a florula from the baked rocks on the SW margin of the Skyřice basin. It also contained dominant ferns *Pronephrium* and *Woodwardia*. The porcelanite was accessible in the 1950s before it was buried by the Velebudice dump.

Svinčice

This new palaeobotanical site lies about 2.5 km S from the site Dobrčice. Although the deposit of baked rocks has been exploited there for several decades, fossil plants were recovered in 1999 by Z. Kvaček, J. Sakala and J. Prokop. The stone pit is situated on a hill called "Na rudě" at the margin of the upland flat, built of neovolcanite (mostly basaltoid) lava flows, which extends over a large area between the villages of Lužice, Svinčice, Patokryje and Obrnice and as far as to the Zlatník hill. Only in the environs of Svinčice, small remnants of baked rocks remained preserved in shallow depressions between the volcanic bodies (Zelenka and Martinovská 1995). The largest deposit is exploited in the above stone pit, owned today by Equi Bořeň limited.

Porcelanite strata are disturbed, mostly as slag and porcelanite of various reddish colours. Only thin well bedded layers are rich in plant impressions. The first expedition on 4th August, 1999, revealed a suite of elements characteristic of swampy habitats: *Pronephrium stiriacum*, *Woodwardia muensteriana*, *Osmunda parschlugiana*, *Glyptostrobus europaeus*, *Laurophyllum* sp., *Laurophyllum* cf. *saxonicum*, *Alnus julianiformis*, *Alnus gaudinii*, *Alnus* cf. *rostaniana*, *Nyssa haidingeri*, *Cragia bronnii*, *Dombeyopsis lobata*, *Ulmus pyramidalis*, Monocotyledonae (coll. Bílina Mines). Hurník recovered in other levels an occurrence of *Sabal lamanonis*, rare in porcelanite sites, and a large-leaved *Fraxinus bilinica*.

Mirošovice

In 1998 M. Pletichová collected between Mirošovice, Žichov and Lužice on the fields of the same upland flat as mentioned above a small collection of fossil plants. We inspected this locality on the right bank of the Lužice brook and found only heaps of fragments of porcelanite, obviously redeposited, probably transported during the building of a small dam of the stream in the 1970s. The nearest deposit of porcelanite lies S of Mirošovice on the northern slope of a ridge between Lužice and Mirošovice.

In spite of the position of this secondary site within the Lužice valley, we designated it as Mirošovice. We want to avoid confusion with the classic sites Lužice and Žichov, that yielded fossils in silicite ("Halbopal") nodules from the Oligocene volcanic strata (see e.g., Ettinshausen 1869).

The Pletichová's collection (at DB) includes *Taxodium dubium*, *Myrica* sp., *Alnus julianiformis*, *Rubus merianii*, *Podocarpium podocarpum*, *Craigia bronnii*, *Paliurus tiliaefolius*, *Smilax weberi* and Monocotyledonae gen. et sp.

Chomutov environments

Although the Žatec delta facies south of Chomutov includes one of the largest porcelanite deposits, only two sites yielded plant remains. They have been described in the literature as Dolany and Čermníky (see Bůžek 1971). Both sites are today flooded by the Nechranice dam on the Ohře river. First Procházka (1954), and later Bůžek (1971) collected at a small occurrence of baked rocks on the SW margin of the "amphitheatre", assigned by Bůžek to his site No. Ce 155c at Čermníky. At Dolany (see Váně 1961) the baked rocks belonging to the upper inter-seam as well as overlying strata were exposed by the gully in steep slopes above the river curving west of the village (Bůžek 1971: 25). Fossil plants were collected both by Procházka and Bůžek, and are housed in the repository of the Czech Geological Survey at Lužná.

The flora of Dolany, according to the list by Bůžek (1971), includes in the upper inter-seam strata: *Woodwardia muensteriana*, *Abacopteris* (i.e. *Pronephrium stiriacum*), *Taxodium dubium*, *Glyptostrobus europaeus*, *Juglans acuminata*, *Juglans juglandiformis* (i.e. *Fraxinus bilinica*), *Ulmus pyramidalis*, *Dombeyopsis lobata*, *Acer tricuspidatum*, "*Persea*" *speciosa* (i.e. *Nyssa haidingeri*), in the overlying strata: *Comptonia acutiloba* (i.e. *C. difformis*), *Alnus* sp., and *Ulmus pyramidalis*. The character of the respective florulae does not differ from those known in other parts of the basin.

Finally, we refer to the occurrences called "porcelanites in the Doupov Mts." or "baked claystone at Doupov" (Brabenec 1909). Brabenec merely translated the original German version of these occurrences given by Menzel (1901) as "Erdbrandgesteine des Duppaer Gebirge" (as one of the occurrences of *Pinus rigios*), and "Brandgestein von Duppau" (in case of *Glyptostrobus europaeus*). The exact position of these baked rocks in the Doupov Mts. is unknown to us and Menzel gives no other details of the geography, or any reference to the collection.

Vegetation analysis

Reconstruction of vegetation cover in respective sites requires systematic collecting from particular fossiliferous layers and facies. This rarely occurs in older collections and even recent outcrops of baked rocks. Therefore, one must rely on the lithological type of slabs bearing plant fossils, or on reported assemblages by earlier authors. For instance Z. Kvaček and Bůžek (1982) in their vegetational analysis of the Most Basin reassessed assemblages reported by Velenovský (1881) from Vršovice. These assemblages do not automatically reflect natural vegetation units because of taphonomic bias. The more autochthonous the fossiliferous deposit (fine-grained porcelanite, coal, coal clay) yields the assemblage, the nearer the assemblage reflects the respective original plant cover. In general, sandy/silty baked rocks reflect riparian forests on fertile alluvial plains and levees; pelitic porcelanite, which prevails in most sites, incorporates either swampy and aquatic vegetation or, in case of equivalents of the Overlying Beds (Nechvalice, Dolany) also forests, that surrounded the lake on acidic soils. We may attempt to apply the units defined by Z. Kvaček and Bůžek (1982) subjectively, and those derived by statistical multivariate analysis (Boulter et al. 1993) to the data of the present study.

The pure coal-forming association with dominating *Glyptostrobus* and *Quasisequoia* is not characteristically developed in any of the studied sites. However, another swampy association dominated by *Quercus rhenana* (identified as *Laurus primigenia*) was noticed by Velenovský (1881: 30) at one location at Vršovice. Engelhardt (1891:133) mentioned (in a footnote) another site of this association at Lišnice-Polerady. Pure stands of swampy ferns *Pronephrium* and *Woodwardia* revealed by multivariate analysis (Boulter et al. 1993 - "fern marsh") can be assumed by accumulations of these plants in particular layers in Vršovice and Dobrčice (uppermost layers in the "colour" wall - according to Radoň, pers. comm., and also in the lower pit - coll. Bílina Mines). Velenovský (1881: 6) reports also various assemblages dominated by *Myrica* ("*Dryandroides*"), *Alnus* ("*Fagus*") and *Salix*, or *Paliurus* ("*Zizyphus*"), *Typha* and *Dombeyopsis* ("*Ficus*" *tiliaefolia*), or *Cercidiphyllum* ("*Grewia*"), *Pronephrium* ("*Goniopteris*"), *Rubus* ("*Rhus*") etc. together with *Glyptostrobus*, *Taxodium* ("*Sequoia*" pro parte) and *Woodwardia* (text-fig. 1). Similar composition (except *Woodwardia*) is known from pelitic layers from Želénky (text-fig. 3). We can relate this mixture to various kinds of swamp forests (*Nyssa-Taxodium* association sensu Z. Kvaček and Bůžek 1982), in which the share of broad-leaved trees varied depending on the degree of flooding. This is also the site where palms grew - like *Sabal* stands (Svinčice) or cane breaks of *Calamus* (Světec). In some layers of Želénky, and particularly at Chudeřice and Světec, we can assume a less flooded forest of alder (*Alnus julianiformis*, *Alnus menzelii*) with swampy ferns (*Blechnum*) and *Decodon* in undergrowth. It is a new association corresponding to alder stands (*Alnetea*). It can be found also in Dobrčice, where another combination of species - *Alnus* cf. *rostaniana* and *A. julianiformis* occurred. Velenovský (1881) also mentioned an aquatic plant horizon dominated by Graminae, Cyperaceae and *Salvinia*. Similar horizons are developed also at Želénky, but to a lesser extent. Our experience of plant assemblages in the Bílina Mine indicates that grass-like accumulations together with *Decodon*, *Potamogeton*, i.e. rooted heliophytes (Cyperaceae/Poaceae - *Decodon* association of Z. Kvaček and Bůžek) are usually separated from free-floating carpet-like masses of *Salvinia*, *Azolla* and *Limnobiophyllum* (*Salvinia-Azolla* association). Passing on to more silty/sandy facies (Vršovice, Želénky, Zabrušany, rarely in Dobrčice), assemblages change conspicuously in composition. Velenovský (1881: 6) lists *Acer*, *Alnus* ("*Fagus*"), *Ulmus* (incl. "*Carpinus*"), *Fraxinus* ("*Carya*"), *Zelkova* ("*Planera*") and *Salix haidingeri* (*S. macrophylla* pro parte). We may add *Parrotia* and "*Ficus*" *truncata* depending on the lithology of the slab (text-fig. 4). A greater number of additional trees and shrubs occur in the association (*Parrotia-Ulmus* sensu Z. Kvaček and Bůžek), which represents the riparian, only briefly flooded forest on alluvial plains and levees. *Osmunda*, *Liquidambar*, *Carya*, *Rosa*, *Podocarpium*, "*Ficus*" *truncata* and "*Viburnum*" *atlanticum* are regularly associated (text-fig. 5). This kind of vegetation is usually situated in beds higher above the seam, which are only rarely influenced by ground fire. One site of baked rocks at Nechvalice (coll. *Radoň*) has yielded an assemblage corresponding precisely to those met in the Břešťany Clay (*Pinus-Engelhardia* association sensu Z. Kvaček and Bůžek). It is characterised by a mixture of swamp trees (*Glyptostrobus*, *Quasisequoia*, *Quercus rhenana*, *Paliurus*, *Acer tricuspidatum*) with newly appearing elements of acidic soils - *Pinus*, *Myrica lignitum*, *Comptonia*, *Engelhardia*. It is an assemblage characteristic of lower levels of the Overlying Beds both in the Most - Teplice and Chomutov areas. Still higher in the section of the Most Basin, assemblages rich in Lauraceae and other termophilous elements, and containing *Quercus kubinyii* have been recovered, mostly from the cores in the basin centre near Lom and Mariánské Radčice (Bůžek et al. 1993). These levels of the basin fill have not undergone baking.

Conclusions

World famous palaeobotanical sites of baked rocks in North Bohemia have been known for over two centuries, although most are now vanishing from the earth's surface. Progressive mining followed by re-cultivation causes large-scale changes of landscape around and within the basin. It has not spared these special locations which are considered to be natural monuments by most European palaeobotanists and palaeontologists. It is thanks to the long-term collecting activities of earlier and present generations of scientists and amateur collectors, that thousands of plant fossils are housed at several universities, museums and other scientific, industrial and cultural institutions. In spite of our attempt to review all these scientific treasures and to record the present situation on most of these sites by our own field studies, a full re-evaluation of all the material has not been achieved.

Porcelanites, as remnants of ground fire of the Miocene coal, initiated on denudation outcrops during the Pleistocene, are a specific type of baked rocks typical of the North Bohemian Tertiary. Due to high temperature, combustion products of coal seams include not only ash and slag, but also baked clay containing at several places plant fossils, rarely molluscs and insects. Some of the sites - Želénky and Zabrušany in particular - are only parts of larger deposits, which were mostly removed during recent decades for industrial purposes, such

as road metal for railway in open-cast mines. In the case of Želénky, there are hardly any remains of what formerly represented the richest locality of fossils of this type. Another site Vršovice, near Louny, has had nearly the same fate. Today, after long years of intensive exploitation, only one quarry face, a few meters high and tenths of meters long, remained accessible to obtain the typical plant assemblage of Vršovice. And year after year forestry re-cultivation continues, preventing further palaeontological field work. Newly exposed deposits at Dobrčice and Svinčice in the Most area are in fact the only sites offering a good opportunity to collect. It is sad to observe that the former fame associated with earlier occurrences of fossiliferous porcelanite is now at an end. We urge our generation to try to preserve these remaining localities in the form of protected areas within a nature conservation policy. Our study does not fully cover the revision and evaluation of the fossil flora, and many scientific problems concerning animal fossils, palaeoecology or sedimentology/petrology remain to be solved in the future.

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Appendix

The following review gives our opinion on the identifications of the specimens described and illustrated in the earlier works starting with Sternberg (1820-1838) and ending with Engelhardt (1891). Also inventory numbers, if available, and abbreviations of the collections are given. A considerable part of the specimens are not identifiable because of fragmentary nature or poor preservation. In cases that only an illustration is available, our judgement must be taken as very tentative. No judgement can be given on the records not accompanied by the illustration unless the specimen with the label written by the author has been found.

Sternberg (1820-1838)

Sternberg described only very few taxa from the Tertiary strata, although in his old collection a large material remained undetermined. He did not obviously trust possibilities that the fossil foliage of angiosperms could be safely assigned to natural taxonomic entities (Sternberg 1825: "In Scillam et Charibdim incidit, siquis Phyllolites ad species referre conatur"). The type specimens are only partly available in the National Museum, Praha (J. Kvaček and Straková 1997).

Filicites sp.	1821, p. 29, pl. 24, f. 2	? Bílina	NM G2114	*Taxodium dubium* (neotype)
Phyllites dubius	1823, p. 37, pl. 36, f. 3	Bílina	missing	*Taxodium dubium*
Phyllites juglandiformis	1823, p. 39, pl. 35, f. 1	Bílina, "Neue Stolle"	missing	? *Betula* sp.
Phyllites julianiformis	1823, p. 39, pl. 36, f. 2	Bílina, "Neue Stolle"	missing	*Alnus julianiformis*
Muscites stolzii	1833, p. 38, pl. 17, f. 3	Bílina	NM E 24	*Glyptostrobus europaeus* vel *Quasisequoia couttsiae*

Göppert 1836

The monograph of fossil ferns by Göppert (1836) includes only a single taxon, based on the material from the Tertiary baked rocks of North Bohemia. The town Teplice is indicated as its locality (Barthel 1976). However, we expect that the true *locus typicus* is either Chudeřice or Straky, where this plant occurs most frequently.

Aspidites dentatus	p. 355, pl. 21, f. 7-8	Teplice	Univ. Wroclaw	*Blechnum dentatum*

Ettingshausen 1866-69

We were able to recover most of the specimens figured and determined by Ettingshausen (1866-9) in the Hungarian Natural History Museum, Budapest (Lobkowicz collection), the Natural History Museum, Vienna ("Mineralien-Kabinet"), the Geological Survey (Geologische Bundesanstalt), Vienna, and British Natural History Museum, London. The material from Želénky/Zabrušany was determined by Ettingshausen also in the Joanneum Museum, Graz, and the University in Graz.

Enteromorpha stagnalis	1866, p. 5, pl. 1, f. 15	Zabrušany	missing	indetermined roots
Blechnum goeppertii	1866, p. 14, pl. 3, f. 1-4 TYPES	Chudeřice	BP 55.2440, missing	*Blechnum dentatum*
Blechnum braunii	1866, p. 15, pl. 3, f. 5-8	Straky	BP 56.1100, 56.1158, 56.1177	*Blechnum dentatum*
Phegopteris stiriaca	1866, p. 16, pl. 2, f. 16-18	Chudeřice	missing, BP 55.2 434, 56.1201	*Pronephrium stiriacum*
Salvinia cordata	1866, p. 18, pl. 2, f. 19-20, TYPE	Chudeřice	BP 56.1200	*Salvinia reussii*
Phragmites oeningensis	1866, p. 21, pl. 4, f. 9	Zabrušany	BA 6122	indetermined monocot leaf or stem
Panicum macilentum	1866, p. 22	Bílina	missing	?
Panicum miocenicum	1866, p. 22, pl. 5, f. 1-2	Zabrušany	missing	indetermined monocot leaf
Uniola bohemica	1866, p. 22, pl. 5, f. 8-9, TYPE	Zabrušany	BA 6036	indetermined monocot leaf
Arthrostilidium bilinicum	1866, p. 23, pl. 5, f. 12-13, TYPES	Zabrušany	6467 Univ. Graz missing	indetermined monocot leaf
Poacites caespitosus	1866, p. 23, pl. 6, f. 1	Zabrušany	missing	indetermined monocot leaf
Poacites aequalis	1866, p. 24, pl. 6, f. 8, TYPE	Zabrušany	missing	indetermined monocot leaf
Poacites arundinarius	1866, p. 24, pl. 5, f. 3-5, 16, TYPES	Zabrušany	BA 6124, BA 6125, 6468 Univ. Graz	indetermined monocot leaf
Poacites acuminatus	1866, p. 24, pl. 4, f. 11-12, TYPES	Zabrušany	missing	indetermined monocot leaf
Poacites longifolius	1866, p. 24, pl. 4, f. 13-14, TYPES	Zabrušany	missing	indetermined monocot leaf
Poacites rigidus	1866, p. 25, pl. 5, f. 6-7	Zabrušany	BA 6123	indetermined monocot leaf
Poacites cenchroides	1866, p. 25, pl. 5, f. 10-11, TYPE	Zabrušany	missing	indetermined monocot leaf
Poacites chusqueoides	1866, p. 25, pl. 5, f. 14-15, TYPE	Zabrušany	missing	indetermined monocot leaf
Cyperus chavanensis	1866, p. 26	Zabrušany	missing	?
Carex tertiaria	1866, p. 26, pl. 6, f. 7	Zabrušany	BA 6127	indetermined monocot leaf
Juncus retractus	1866, p. 27, pl. 6, f. 2	Zabrušany	missing	indetermined monocot leaf
Litorella baldassarii	1866, p. 30	? Bílina	missing	?
Taxodium dubium dtto	1866, p. 10, f. 8-9, pl. 12, f. 16 pl. 12. f. 12	Zabrušany Želénky	missing missing	*Taxodium dubium* *Taxodium dubium*
Glyptostrobus europaeus	1866, p. 37	? Bílina	missing	?
Glyptostrobus bilinicus	1866, p. 39	? Bílina	missing	?
Casuarina sotzkiana	1866, p. 43	? Bílina	missing	?
Myrica bilinica	1866, p. 43, pl. 14, f. 3, TYPE	Zabrušany	BA 6143	indetermined dicot leaf
Betula prisca	1866, p. 45	? Bílina	missing	?
Alnus kefersteinii	1866, p. 47	? Bílina	missing	?
Carpinus heerii	1866, 48, pl. 15, f. 11, TYPE	Zabrušany	missing	*Carpinus grandis*
Fagus feroniae dtto	1866, p. 50 1866, p. 50	Chudeřice Zabrušany	BP 56.1157 55.2420	*Alnus julianiformis* *Alnus julianiformis*
Fagus castaneifolia	1866, p. 52	? Bílina	BP 56.1166	?
Castanea atavia	1866, p. 52, pl. 16, f. 3	Zabrušany	BA 6044	*Fraxinus bilinica* ? (vel *Alnus gaudinii*)
Quercus neriifolia	1866, p. 54	Zabrušany	BP 56.1194	*Nyssa haidingeri*
Quercus scarabellii	1866, p. 55	Zabrušany	missing	?
Quercus furcinervis	1866, p. 58	Zabrušany	missing	?
Quercus mueretii	1866, p. 58	Zabrušany	missing	?
Quercus pseudo-alnus dtto	1866, p. 59, pl. 17, f. 4-5 pl. 17, fig. 6	Zabrušany	BP 56.1221, 56.1162, BA 6170	*Alnus julianiformis* *Rosa europaea*
Quercus laharpii	1866, p. 60, pl. 17, f. 1	Zabrušany	BA 6037	*Fraxinus bilinica*
Quercus pseudo-laurus dtto	1866, p. 60, pl. 17, f. 13 pl. 17, f. 14-15 TYPES	Zabrušany	BA 6045 missing, BA 6171	*Berchemia multinervis* ? Lauraceae
Ulmus crassinervia	1866, p. 63, pl. 18, f. 28-29	Zabrušany	missing	*Ulmus pyramidalis*

Planera ungeri dtto	1866, p. 65, pl. 18, f. 14-16, 18-19 pl. 18, f. 17, 20	Zabrušany	missing missing	*Ulmus pyramidalis* *Zelkova zelkovifolia*
Ficus titanum	1866, p. 77, pl. 22, f. 12, TYPE	Zabrušany	BP 55.2433	"*Ficus*" *truncata*
Salix haidingeri	1866, p. 88, pl. 29, f. 11, TYPE	Zabrušany	missing	*Salix haidingeri*
Laurus phoeboides	1868, p. 192, pl. 31, f. 4	Zabrušany	missing	? *Nyssa haidingeri*
Laurus princeps	1868, p. 193	Zabrušany	missing	?
Laurus nectandroides	1868, p. 194, pl. 31, f. 6-7	Zabrušany	missing, BP 56.1199	indetermined dicot leaf, *Alnus gaudinii*
Cinnamomum scheuchzeri	1868, p. 198, pl. 32, f. 5	Zabrušany	BP 59.883	*Daphnogene polymorpha*
Santalum acheronticum	1868, p. 200, pl. 34, f. 4	Zabrušany	BA 6426	indetermined dicot leaf
Daphne protogaea	1868, p. 201, pl. 34, f. 2, TYPE	Zabrušany	BP 55.2333	indetermined dicot leaf
Pimelea oeningensis	1868, p. 201	Zabrušany	missing	?
Pimelea maritima	1868, p. 201	Zabrušany	missing	?
Anadenia lignitum	1868, p. 202, pl. 35, f. 2, TYPE	Zabrušany	missing	indetermined dicot leaf
Dryandroides lignitum	1868, p. 206	Zabrušany	missing	?
Notelea vetusta	1868, p. 211, pl. 36, f. 3-3b, TYPE	Zabrušany	missing	indetermined dicot leaf
Cordia bilinica	1868, p. 221, pl. 37, f. 21-21b, TYPE	Zabrušany	6568 Univ. Graz	? *Myrica* cf. *integerrima*
Myrsine europaea	1868, p. 225, pl. 37, f. 22, TYPE	Zabrušany	BA 6043	*Rosa europaea*
Myrsine microphylla	1868, p. 226	Zabrušany	missing	?
Bumelia oreadum	1868, p. 231, pl. 38, f. 14	Zabrušany	missing	indetermined dicot leaf
Vaccinium acheronticum	1868, p. 236, pl. 39, f. 15-16	Zabrušany	missing, BA 6436	indetermined dicot leaves
Andromeda protogaea	1868, p. 236	Zabrušany	missing	?
Andromeda basaltica	1868, p. 237, TYPE	Zabrušany	missing	?
Cornus buchii	1869, p. 4, pl. 40, f. 32	Zabrušany	BA 6064	*Alnus julianiformis*
Parrotia pristina	1869, p. 4, pl. 39, f. 23, pl. 40, f. 24-25	Zabrušany	missing, BP 56.1084, 56.1195	*Parrotia pristina*
Parrotia pseudo-populus	1869, p. 5, pl. 39, f. 20, TYPE	Zabrušany	1864.40922 Naturhist.Mus.Wien	*Parrotia pristina*
Acer trilobatum	1869, p. 18	Zabrušany	BP 56.1178	*Acer tricuspidatum*
Acer pseudocampestre	1869, p. 23, pl. 44, f. 11, pl. 45, f. 5	Zabrušany	BA 6438, missing	*Acer dasycarpoides*
Acer rueminianum dtto	1869, p. 23, pl. 46, f. 8 pl. 46, f. 9	Zabrušany	BP 56.1217 missing	*Liquidambar europaea* *Acer dasycarpoides*
Euonymus napaearum	1869, p. 30, pl. 48, f. 5, TYPE	Zabrušany	missing	indetermined dicot leaf
Celastrus arethusae	1869, p. 34, pl. 48, f. 16, TYPE	Zabrušany	BA 6067	*Berberis berberidifolia*
Celastrophyllum acteonis	1869, p. 35, p. 35, pl. 49, f. 1, TYPE	Zabrušany	BA 5842	? *Laurophyllum* cf. *saxonicum*
Ilex berberidifolia	1869, p. 38, pl. 46, f. 16	Zabrušany	missing	indetermined dicot leaf
Paliurus favonii	1869, p. 39, pl. 50, f. 7	Zabrušany	missing	*Paliurus favonii*
Zizyphus tiliaefolius	1869, p. 39, pl. 50, f. 8	Zabrušany	BP 64.303	*Paliurus tiliaefolius*
Omalanthus tremula	1869, p. 44, pl. 50, f. 27, TYPE	Zabrušany	BA 6070	indetermined dicot leaf
Carya costata	1869, p. 47	Zabrušany	missing	?
Eucalyptus oceanica	1869, p. 52, pl. 54, f. 22	Zabrušany	BP 56.1172	? *Decodon gibbosus*
Podogonium knorrii	1869, p. 60	Zabrušany	missing	?

Sieber 1881

A young palaeobotanist Johann Sieber, who died May 30th, 1880 in the age of 23 years, worked as an assistant of Prof. G. C. Laube at the Charles University, Prague. The documentation material of his posthumously published study (Sieber 1881) was later transferred to the National Museum, Prague, but only those specimens, which could be safely recognised. They mostly come from the sites Kučlín, Břešťany, Braňany, and Valeč. Only a single specimen from this collection is from Zabrušany. Many recorded species were not accompanied by illustrations. There is hardly any chance that the remaining material can ever be find in the collections of the Charles University.

Aspidium fischeri	p. 73	Zabrušany	missing	?
Salvinia reussii	p. 73	Zabrušany	missing	?
Ulmus minuta	p. 77	Zabrušany	missing	?
Persea speciosa	p. 79	Zabrušany	missing	?
Hydrangea microcalyx	p. 82, p. p., pl. 4, f. 26a, 31	Zabrušany	missing	indetermined plant remains
Acer crenatifolium	p. 86	Zabrušany	missing	?
Rhus meriani	p. 90, pl. 5, f. 39-40	Zabrušany	NM G 374, missing	*Rubus merianii*

Velenovský 1881

Most of the documentation material is housed in the National Museum, Praha, besides many other not illustrated specimens. Velenovský used a special numbering of species written on the slabs. In this way, his view can be detected even in the cases, when no identification is attached on the label. The type of the rocks (grain size, colour) varies in a large extent and it can be assumed that the material was collected at different places in the Louny environs.

Woodwardia roessneriana	p. 11, pl. 1, f. 1-8, pl. 10, f. 18α	Vršovice	NM G 1904, 1248.4, 1905, 1899, 1906, 1901, 1931.1, 1872	*Woodwardia muensteriana*
Goniopteris stiriaca	p. 12, pl. 1, f. 9, 11	Vršovice	NM G 1908-1909	*Pronephrium stiriacum*
Goniopteris oeningensis	p. 12, pl. 1, f. 10-13	Vršovice	missing, NM G 1910-1911	*Pronephrium stiriacum*
Salvinia formosa	p. 12, pl. 1, f. 14-17	Vršovice	NM G 1912-1913	*Salvinia reussii*
Podozamites miocenicus	p. 13, pl. 1, f. 18-20	Vršovice	NM G 1845-1847	*Hydrochariphyllum miocenicum*
Taxodium dubium	p. 14, pl. 1, fig. 27	Vršovice	NM G 1915	*Taxodium dubium*
Glyptostrobus europaeus dtto	p. 15, pl. 1, f. 21-23, pl. 1, f. 24-26	Vršovice	NM G 1243 1916-1917	*Glyptostrobus europaeus* *Taxodium dubium*
Sequoia langsdorfii dtto	p.16, pl. 1, figs 28-29 pl. 1, f. 30-35	Vršovice	NM G 1920, 3736.1 1921, 2063-2066, 1931, 1922	*Taxodium dubium* *Quasisequoia couttsiae*
Cyperites tricarinatus	p. 17, pl. 2, f. 8, TYPE	Vršovice	NM G 1848	indetermined monocot leaf
Carex tertiaria	p. 18, pl. 2, f. 4-5	Vršovice	NM G 1924, 1925	indetermined monocot leaf
Carex sp.	p. 18, pl. 1, f. 36-38	Vršovice	NM G 1926	indetermined objects
Poacites sp.	p. 18, pl. 2, f. 6-7, 9	Vršovice	missing, missing, NM G 1927	indetermined monocot leaves
Butomites sp.	p. 19, pl. 2, f. 12	Vršovice	missing	indetermined monocot leaf
Smilax grandifolia	p. 19, pl. 2, f. 18-20	Vršovice	NM G 1929, 1902.2, missing	*Smilax weberi*
Smilax convallium	p. 20, pl. 2, f. 21-23, pl. 10, f. 18 ß	Vršovice	NM G 1938.2, 2059, 1930, 1872	*Smilax weberi*
Phormium affine	p. 20, pl. 2, f. 13-15, TYPES	Vršovice	NM G 1851, 1850, 1849	indetermined monocot leaves
Musa bilinica	p. 21, pl. 2, f. 16-17	Vršovice	NM G 1932	? *Zingiberoideophyllum liblarense*
Typha latissima	p. 22, pl. 2, f. 1-3	Vršovice	NM G 1933, 1934	"*Typha*" *latissima*
Sparganium (?)	p. 22, pl. f. 25	Vršovice	NM G 1937	*Quercus* sp., cupule
Alnus kefersteinii dtto dtto dtto dtto	p. 22, pl. 2, f. 24 pl. 3, f. 13-14 pl. 3, f. 15 pl. 3, f. 16 pl. 3, f. 17	Vršovice	NM G 1903.2 1938.1, 1939 2068.2 1940 2040.4	*Rubus vrsovicensis* *Alnus* cf. *rostaniana* *Alnus julianiformis* *Ulmus pyramidalis* *Alnus kefersteinii*
Carpinus grandis dtto	p. 23, pl. 2, f. 25, pl. 3, f. 1-5 pl. 3, f. 6	Vršovice	NM G 1943, 1942.1, 1944, 1945, 1903.3, 1946 1947	*Ulmus pyramidalis* ? *Alnus gaudinii*
Fagus feroniae	p. 23, pl. 3, f. 7-9	Vršovice	NM G 1948-1950	*Alnus julianiformis*
Fagus ettingshauseni	p. 24, pl. 3, f. 10-12, pl. 4, f. 1-2, TYPES	Vršovice	NM G 1857, 1856, 1854, 1853, 1855	*Alnus gaudinii*

Ulmus longifolia dtto	p. 25, pl. 3, f. 24-25 pl. 4, f. 3-13	Vršovice	NM G 1951, 1953 NM G 1966.2, 1954--1956, 2040.3, 1957-1962	*Craigia bronnii* *Ulmus pyramidalis*
Planera ungeri dtto dtto	p. 26, pl. 3, f. 18 pl. 3, f. 19-22, pl. 4, f. 14 pl. 3, f. 23 (16)	Vršovice	NM G 1965 1966.1, 1967.1, 1968, 1965.1, 1966.3 1969	indetermined objects *Ulmus pyramidalis* *Zelkova zelkovifolia*
Ficus lanceolata dtto	p. 27, pl. 4, f. 15-16 pl. 4, f. 17	Vršovice	NM G 1970-1971 1972	*Laurophyllum* cf. *saxonicum* ? *Laurophyllum* cf. *saxonicum*
Ficus arcinervis	p. 28, pl. 4, f. 18-20	Vršovice	missing, NM G 1973-1974	? *Decodon gibbosus*
Ficus tiliaefolia	p. 28, pl. 1-4	Vršovice	NM G 1975,1977-1978, missing	*Dombeyopsis lobata*
Ficus truncata	p. 29, pl. 6, f. 5	Vršovice	NM G 1980	"*Ficus*" *truncata*
Salix macrophylla dtto	p. 29, pl. 5, f. 9-10, 12 pl. 5, f. 11, 13-15	Vršovice	NM G 1981-1982, 2040.2, 1983, 1506.1, 1506.3, 1506.2	*Salix macrophylla* *Salix haidingeri*
Salix varians	p. 30, pl. 5, f. 16-17, pl. 6, f. 8	Vršovice	NM G 1984-1986	*Salix varians*
Laurus primigenia	p. 30, pl. 5, f. 1-5	Vršovice	NM G 1987-1991	*Quercus rhenana*
Laurus phoeboides	p. 32, pl. 5, f. 6-7, pl. 6, f. 9	Vršovice	NM G 1993-1995	? *Laurophyllum* cf. *saxonicum*
Persea speciosa dtto	p. 32, pl. 6, f. 6 pl. 6, f. 7	Vršovice	NM G 1996.1 1997	*Nyssa haidingeri* *Quercus rhenana*
Cinnamomum scheuchzeri	p. 33, pl. 4, f. 21-25	Vršovice	NM G 1998-2002	*Daphnogene polymorpha*
Dryandroides lounensis	p. 33, pl. 9, f. 17-22, TYPES	Vršovice	NM G 1858, 1859, 1861, 1865, 1931.3, 1860	*Myrica* cf. *integerrima*
Myrsine doryphora	p. 34, pl. 6, f. 10-11, pl. 9, f. 23-24	Vršovice	NM G 2003-2005, missing	indetermined dicot leaves
Myrsine pedunculata	p. 34, pl. 6, f. 12-13, TYPES	Vršovice	NM G 1867-1868	indetermined dicot leaves
Viburnum dubium dtto dtto	p. 35, pl. 6, f. 19, pl. 7, f. 11 pl. 7, f. 10 pl. 10, f. 18*γ*, TYPES	Vršovice	NM G 1870.2, 1871 1870 1872	indetermined dicot leaves *Parrotia pristina* *Alnus gaudinii*
Symplocos detrita	p. 35, pl. 8, f. 21, TYPE	Vršovice	NM G 1874	? *Alnus gaudinii*
Rhododenron haueri	p. 36, pl. 9, f. 8-9	Vršovice	NM G G 2006-2007	indetermined dicot leaves
Grewia crenata	p. 36, pl. 9, f. 10-14	Vršovice	NM G 2008-2011	*Cercidiphyllum crenatum*
Grewia ovalis	p. 37, pl. 9, f. 15	Vršovice	NM G 2012	*Cercidiphyllum crenatum*
Nyssa vertumni	p. 37, pl. 6, f. 20-24	Vršovice	NM G 2013-2014, 2015.1-2, 2016	*Nyssa* sp.
Acer trilobatum dtto	p. 37, pl. 7, f. 1-2, pl. 8, f. 26, pl. 9, f. 2, 4 pl. 7, f. 3	Vršovice	NM G 2017, 2018.1, 1942.2, 2021-2022 2019	*Acer tricuspidatum* *Acer* sp., fruit
Acer crenatifolium	p. 38, pl. 7, f. 4, pl. 9, f. 3, 5	Vršovice	NM G 2023-2025	*Acer tricuspidatum*
Acer magnum	p. 38, pl. 7, f. 7-9	Vršovice	NM G 1876.1, 1875, 1877	*Acer tricuspidatum*
Acer bruckmannii	p. 38, pl. 9, f. 1	Vršovice	NM G 2026	*Acer tricuspidatum*
Acer nervatum	p. 39, pl. 7, f. 5-6, TYPES	Vršovice	NM G 1878-1879	*Acer integerrimum*
Paulinia furcinervis	p. 39, pl. 8, f. 20, TYPE	Vršovice	NM G 2045.5	indetermined dicot leaf
Celastrus ettingshausenii	p. 40, pl. 6, f. 14, TYPE	Vršovice	NM G 1880.1	indetermined dicot leaf
Elaedendron dryadum	p. 40, pl. 6, f. 15-16	Vršovice	NM G 2028-2029	*Alnus gaudinii*
Zizyphus tiliaefolius	p. 41, pl. 8, f. 22-23	Vršovice	NM G 2030-2031	*Paliurus tiliaefolius*
Colubrina tertiaria	p. 41, pl. 8, f. 24, TYPE	Vršovice	NM G 1881	indetermined dicot leaf

Berchemia multinervis	p. 42, pl. 4, f. 26-27	Vršovice	NM G 2032-2033	*Berchemia multinervis*
Rhamnus fricii	p. 42, pl. 8, f. 7-16, pl. 10, f. 18δ	Vršovice	NM G 1887, 1248.1-2, 1883, 1890, 1885, 1248.3, 1886, 1884, 1882, 1872	*Alnus gaudinii*
dtto	pl. 9, f. 6		1889	indetermined dicot leaf
Rhamnus augustinii	p. 43, pl. 7, f. 12	Vršovice	NM G 2034	*Alnus gaudinii*
dtto	pl. 7, f. 13-14		missing, 1931.2	indetermined dicot leaf
Juglans acuminata	p. 44, pl. 8, f. 2, 6	Vršovice	NM G 2035, 2038	"*Juglans*" *acuminata*
dtto	pl. 8, f. 4-5		NM G 2036-2037	? *Laurophyllum* cf. *saxonicum*
Carya bilinica	p. 44, pl. 8, f. 1, 3	Vršovice	NM G 2039-2040	*Fraxinus bilinica*
dtto	pl. 9, f. 16		2041	? *Alnus gaudinii*
Rhus merianii	p. 44, f. 7, f. 16-20	Vršovice	NM G 2042.1, missing, 2043.1-2, 2044	*Rubus merianii*
dtto	pl. 8, f. 27, pl. 10, f. 12		2067, 2045	*Rubus vrsovicensis*
Rhus elegans	p. 45, pl. 10, f. 5-11	Vršovice	NM G 1902.1, 1892, 2068, 1894, 1891, 1903.1, 1893	*Rubus vrsovicensis*
Zanthoxylon serratum	p. 45, pl. 5, f. 18	Vršovice	NM G 2047	*Rosa europaea*
Terminalia radobojana	p. 46, pl. 9, f. 25	Vršovice	NM G 2048	? *Myrica* cf. *integerrima*
dtto	pl. 10, f. 1-4		2049-2052	*Laurophyllum* cf. *saxonicum*
Prunus denticulata	p. 47, pl. 8, f. 17-18	Vršovice	NM G 1897, 1896	*Alnus gaudinii*
dtto	pl. 8, f. 19, TYPES		1898	indetermined fruit
Podogonium knorrii	p. 48, pl. 10, f. 13-14	Vršovice	NM G 1876.3, 2054	*Acer* sp., fruits
dtto	pl. 10, f. 15-17		missing, missing, 1876.1	indetermined dicot leaf
Cinchona sp.	p. 98, pl. 6, f. 17-18	Vršovice	NM G 2055, 2018.2	*Nyssa haidingeri*
folium	p. 49, pl. 3, f. 26-27	Vršovice	NM G 2056-2057	? *Alnus gaudinii*
fructus	p. 49, pl. 9, f. 26-27	Vršovice	NM G 3735, 3732	indetermined fruit
fructus	p. 49, pl. 7, f. 21	Vršovice	NM G 3733	indetermined fruit
fructus	p. 49, pl. 9, f. 7	Vršovice	NM G 2058	indetermined fruit

Engelhardt 1891

This work includes only few figured and type specimens of plant fossils from baked rocks, namely from Želénky. They were originally deposited in two collections: one of mine manager Tobisch, Duchcov, at present missing, and at the "Böhmisches Polytechnikum", at that time supervised by prof. J. Krejčí. This collection was later transferred to the Faculty of Science, Charles University, Praha, where it is kept in part till now.

Pteris pennaeformis	p. 143, pl. 1, f. 19	Želénky	missing	*Blechnum dentatum*
Panicum miocenicum	p. 146, pl. 1, f. 29	Želénky	missing	indetermined monocot leaf
Phragmites oeningensis	p. 145, pl. 2, f. 4	Želénky	missing	indetermined monocot leaf
Poacites lepidus	p. 147, pl. 2, f. 18	Želénky	missing	indetermined monocot leaf
Poacites arundinarius	p. 147, pl. 2, f. 19	Želénky	missing	indetermined monocot leaf
Musa bilinica	p. 149, pl. 3, f. 2	Želénky	missing	indetermined monocot leaf
Myrica carpinifolia	p. 154, pl. 3, f. 12	Želénky	missing	? *Rubus merianii*
Betula prisca	p. 155, pl. 3, f. 14	Želénky	missing	*Alnus julianiformis*
dtto	p. 155, pl. 3, f. 16-18	Želénky	Charles Univ.	*Alnus julianiformis*
Planera ungeri	p. 162, pl. 3, f. 22-23	Želénky	missing	*Rosa europaea*
Alnus kefersteinii	p. 156, pl. 4, f. 25-26	Želénky	missing	*Alnus menzelii*
Alnus rotundata	p. 156, pl. 5, f. 2	Želénky	missing	*Alnus menzelii*
Carpinus grandis	p. 156, pl. 5, f. 8-9, pl. 6, f. 2-4	Želénky	missing	*Alnus menzelii*
Fagus feroniae	p. 158, pl. 5, f. 10	Želénky	missing	*Alnus menzelii*
Quercus furcinervis	p. 160, pl. 6, f. 13	Želénky	missing	? *Rubus merianii*

Ficus tiliaefolia	p. 162, pl. 7, f. 9	Želénky	missing	*Dombeyopsis lobata*
Heliotropites reussii	p. 171, pl. 7, f. 18	Želénky	missing	cf. *Vitis* vel *Ampelopsis* sp.
Diachenites ovalis	p. 176, pl. 7, f. 20	Želénky	missing	cf. *Vitis* vel *Ampelopsis* sp.
Celastrus deucalionis	p. 187, pl. 7, f. 31	Želénky	missing	indetermined dicot leaf
Laurus lalages	p. 166, pl. 8, f. 5	Želénky	missing	indetermined dicot leaf
Cinnamomum buchii	p. 167, pl. 8, f. 6	Želénky	missing	*Smilax weberi*
Cinnamomum subrotundum	p. 168, pl. 8, f. 7	Želénky	missing	*Paliurus tiliaefolius*
Viburnum atlanticum	p. 172, pl. 8, f. 16	Želénky	missing	"*Viburnum*" *atlanticum*
Cissus nimrodi	p. 177, pl. 9, f. 10	Želénky	missing	? Vitaceae gen. indet.
Dodonea salicites	p. 185, pl. 9, f. 6	Želénky	missing	indetermined dicot leaf
Parrotia pristina	p. 178, pl. 9, f. 18	Želénky	missing	*Parrotia pristina*
Ilex longifolia	p. 187, pl. 10, f. 17	Želénky	missing	*Rubus merianii*
Apeibopsis descloesi (?)	p. 179, pl. 10, f. 19	Želénky	missing	*Nyssa haidingeri*
Grewia crenata	p. 180, pl. 11, f. 1	Želénky	missing	*Cercidiphyllum crenatum*
Acer grossedentatum	p. 181, pl. 11, f. 12	Želénky	Charles Univ.	*Acer tricuspidatum*
Acer trilobatum dtto	p. 182, pl. 11, f. 10 pl. 11, f. 14, 19, pl. 12, f. 16-17	Želénky	Charles Univ. missing	*Acer tricuspidatum* *Acer tricuspidatum*
Hiraea expansa	p. 183, pl. 13, f. 2-3	Želénky	Charles Univ.	*Limnobiophyllum expansum*
Zizyphus tiliaefolius	p. 189, pl. 13, f. 12	Želénky	missing	*Paliurus tiliaefolius*
Rhamnus dechenii	p. 189, pl. 14, f. 1	Želénky	missing	*Laurophyllum* cf. *saxonicum*
Pterocarya denticulata	p. 193, pl. 14, f. 15, 17	Želénky	missing	*Carya* cf. *serrifolia*
Rhus meriani	p. 193, pl. 14, f. 23	Želénky	missing	*Rubus merianii*
Juglans bilinica	p. 192, pl. 15, f. 4	Želénky	missing	*Fraxinus bilinica*
Juglans acuminata	p. 192, pl. 15, f. 7	Želénky	missing	*Nyssa haidingeri*
Leguminosites tobischii	p. 198, pl. 15, f. 19-20, TYPES	Želénky	missing	*Leguminosites tobischii*
Rhus quercifolia	p. 193, pl. 15, f. 23	Želénky	missing	*Rubus merianii*
Carpolithes striatus	p. 198, pl. 15, f. 27, TYPE	Želénky	missing	indetermined seed

Revize spodnomiocénních rostlin zachovaných ve vypálených horninách severočeského terciéru

Zlatko Kvaček - Stanislav Hurník

Vypálené horniny, zvláště zvrstvené porcelanity, jsou typickým zjevem severočeských třetihor a byly předmětem zájmu paleontologů pro svůj obsah převážně rostlinných zkamenělin. Pro své využití jako podsypového materiálu pod koleje na povrchových dolech byla jejich ložiska v posledních desetiletích ve velkém rozsahu těžena a zbývá jen několik málo lokalit zachovaných pro příští generace. Známé výskyty, např. u Zabrušan, Želének nebo v okolí Loun, byly v podstatě zcela odtěženy.

V práci podáváme revizi většiny spodnomiocénních rostlin zaznamenaných v dřívějších studijích od doby Sternbergovy (Sternberg 1820-1838), kde se objevují první popsané druhy, do dnešní doby. Studované doklady jsou uloženy ve sbírkách Národního muzea v Praze, Přírodovědeckého muzea ve Vídni, Spolkového geologického ústavu ve Vídni, Maďarského přírodovědeckého muzea v Budapesti (Lobkovická sbírka z Bíliny) a řadě dalších našich i zahraničních institucích. Až na některé sbírky soukromých sběratelů popsaných Engelhardtem (1891) se podařilo dohledat mnoho typových kusů z děl Velenovského (1881), Ettingshausena (1866-1869) i dokladový materiál k předběžným zprávám Procházkovým a Bůžkovým (depozitář Českého geologického ústavu v Lužné).

V rámci revize bylo zjištěno 6 druhů kapradin, 7 jehličnanů a více než 60 krytosemenných rostlin (viz tabulka 3), a z nich navrženo přeřazení tří druhů: *Rosa europea* (ETTINGSH.) comb. n., *Fraxinus bilinica* (UNGER) comb.n., *Hydrocharophyllum miocenicum* (VELENOVSKÝ) comb.n. a navrženo jedno novém jméno: *Rubus vrsovicensis* nom. n.

V popisu lokalit je upřesněna jejich geografická i geologická pozice, historie výzkumu a obsah rostlinných zkamenělin. Pokud je známo, zmiňujeme i sbírky, obsahující hlavní kolekce z té které lokality. Navazující vyhodnocení vegetačních poměrů zasazuje společenstva známá z jednotlivých nalezišť do předchozích schémat (Z. Kvaček - Bůžek 1982, Bůžek et al. 1992, Boulter et al. 1993).

V závěru shrnujeme význam flóry porcelanitů, a to hlavně z hlediska mezinárodního věhlasu. V současné době, kdy výskyty rychle zanikají, považujeme za nezbytné vyhlásit některé z nich za chráněná naleziště.

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Explanations of the plates

PLATE 1

Pronephrium stiriacum (UNGER) KNOBLOCH et Z. KVAČEK
1. Frond fragment, Dobrčice, MT PA 1025, x 0.7.
2. Fertile pinna, Dobrčice, MT PA 1022, x 3.

Woodwardia muensteriana (C. PRESL) KRÄUSEL
3. Fertile pinnule, Vršovice, NM G 1906 (Velenovský 1881, pl. 1, fig. 5), x 5.

Blechnum dentatum (GÖPPERT) HEER
4. Fertile pinna, Světec, NM G 7732, x 2.5.
7. Straky, BP 56.1177 (Ettingshausen 1866, pl. 3, fig. 7, as *Blechnum braunii* ETTINGSHAUSEN), x 1.5.
8. Frond fragment, Světec, NM G 7715, x 0.9.

Osmunda parschlugiana (UNGER) ANDREÁNSZKY
5. Dobrčice, DB Do 9, x.1.5.

Lygodium kaulfussii HEER
6. Světec, NM G 7726, x 2.0.

PLATE 2

Salvinia reussii ETTINGSHAUSEN
1. Chudeřice, BP 56.1200 (Ettingshausen 1866, pl. 2, fig. 19, TYPE of *Salvinia cordata* ETTINGSHAUSEN), x 2.0.
2. Dtto, nat. size.

Quasisequoia couttsiae (HEER) KUNZMANN
3. Shoot with seed cones, Vršovice, NM G 1921, x 1.1.
4. Isolated seed, Dobrčice, MT PA 1026, x 10.0.

Berberis berberidifolia (HEER) PALAMAREV et PETKOVA
5. Zabrušany, BA 6067 (Ettingshausen 1869, pl. 48, fig. 6, TYPE of *Celastrus arethrusae* ETTINGSHAUSEN), x 1.5.

Pinus engelhardtii MENZEL
6. Mold of a seed cone, unknown locality, MM G/pa 779, nat. size.

Pinus rigios ETTINGSHAUSEN
7. Needle fascicle, Nechvalice, MT PA 1019, x 1.8.

Laurophyllum cf. *saxonicum* LITKE
8. Vršovice, NM G 2051 (Velenovský 1881, pl. 10, fig. 3, as *Terminalia radobojensis* UNGER), nat. size.

PLATE 3

Liquidambar europaea A. BRAUN
1. Zabrušany, BP 56.1217 (Ettingshausen 1869, pl. 46, fig. 8, as *Acer rüminianum* HEER), x 1.2.

Parrotia pristina (ETTINGSHAUSEN) STUR
2. Zabrušany, BP 56.1195 (Ettingshausen 1869, pl. 40, fig. 25), x 1.5.

Quercus rhenana (KRÄUSEL et WEYLAND) KNOBLOCH et Z. KVAČEK
3. Želénky, DB Že 1, x 0.7.

Betula sp.
4. Želénky, MT PA 1028, x 1.3.

Alnus julianiformis (STERNBERG) Z. KVAČEK et HOLÝ
5. Bílina, NM G 3813, x 1.4.
7. Bílina, NM G 3815, x 1.3.
8. Dobrčice, DB Do 1, x 1.3.

Quercus sp.
6. Cupule, Vršovice, NM G 1937 (Velenovský 1881, pl. 8, fig. 25, as *Sparganium* (?)), x 4.0.

PLATE 4

Alnus gaudinii (HEER) KNOBLOCH et Z. KVAČEK
1. Vršovice, NM G 1853 (Velenovský 1881, pl. 4, fig. 1, TYPE of *Fagus ettingshausenii* VELENOVSKÝ), x 1.5.
2. Vršovice, NM G 1882 (Velenovský 1881, pl. 8, fig. 16, TYPE of *Rhamnus fricii* VELENOVSKÝ), x 1.6.

Alnus cf. *rostaniana* SAPORTA
3. Dobrčice, DB Do 2, x 0.9.
6. Dobrčice, DB Do 3, x 0.9.
7. Shade leaf, Dobrčice, MT PA 1024, x 0.8.

Alnus sp. 1
4. Infructescence, Dobrčice, DB Do 4, x 2.

Alnus sp. 2
5. Infructescence, Zabrušany, coll. MCh, x 2.

PLATE 5

Myrica cf. *integerrima* KRÄUSEL et WEYLAND
1. Vršovice, NM G 1865 (Velenovský 1881, pl. 9, fig. 20, TYPE of *Dryandroides lounensis* VELENOVSKÝ), nat. size.
2. Vršovice, NM G 1858 (Velenovský 1881, pl. 9, fig. 17, TYPE of *Dryandroides lounensis* VELENOVSKÝ), nat. size.

Myrica lignitum (UNGER) SAPORTA
3. Nechvalice, MT PA 1009, x 1.6.

Engelhardia orsbergensis (WEBER) JÄHNICHEN, MAI et WALTHER
4. Nechvalice, MT PA 1017, x 2.0.

Salix varians GÖPPERT
5. Dobrčice, DB Do 6, x 1.5.

Ulmus pyramidalis GÖPPERT
6. Short leaf form, Straky, MT PA 1036/1, x 1.2.

Comptonia difformis (STERNBERG) BERRY
7. Nechvalice, MT PA 1014, x 2.

Salix macrophylla HEER
8. Dobrčice, DB Do 10, nat. size.
10. Vršovice, NM G 1981 (Velenovský 1881, pl. 5, fig. 9), x 7.

Ulmus sp.
9. Fruit, Zabrušany, Mus. Joanneum (coll. Wiesbauer 4329), x 3.

Craigia bronnii (UNGER) Z. KVAČEK, BŮŽEK et MANCHESTER
11. Fruit valve, Mirošovice, DB Mi 1, x 2.

Dombeyopsis lobata UNGER
12. Svinčice, DB Sv 1, x 1.5.

PLATE 6

Rosa europaea (ETTINGSHAUSEN) comb.n.
1. Želénky, DB Že 2, x 2.0.
9. Zabrušany, BA 6043 (Ettingshausen 1868, pl. 37, fig. 22, TYPE of *Myrsine europaea* ETTINGSHAUSEN), x 1.3.

Rubus merianii (HEER) KOLAKOVSKII
2. Vršovice, NM G 2044 (Velenovský 1881, pl. 7, f. 20, as *Rhus merianii* HEER), x 1.5.
5. Želénky, NM G 7734, x 1.2.

Rubus vrsovicensis nom. n.
3. Vršovice, NM G 1902.1 (Velenovský 1881, pl. 10, f. 5, TYPE of *Rhus elegans* VELENOVSKÝ), nat. size.
4. Dtto, x 2.5.
8. Vršovice, NM G 1891 (Velenovský 1881, pl. 10, f. 9, TYPE of *Rhus elegans* VELENOVSKÝ), x 1.6.
10. Vršovice, NM G 2045 (Velenovský 1881, pl. 7, f. 20 as *Rhus merianii* HEER), x 3.0.

Rubus sp.
6. Prickly twig, Černodoly, DB Nč 1, x 2.3.
7. Fruitlets and an associated cone scale of *Glyptostrobus europaeus* (BRONGNIART) UNGER, Zabrušany, Mus. Joanneum (coll. Wiesbauer 4329), x 4.0.

PLATE 7

Decodon gibbosus (E. M. REID) E. M. REID
1. Foliage, Světec, NM G 7717, nat. size.

Leguminosites spp.
2. Leaflet, Nechvalice, MT PA 1018, x 2.5.
3. Leaflet, Světec, NM G 7731, x 1.4.
4. Leaflet, Mirošovice, DB Mi 2, x 2.5.

Podocarpium podocarpum (A. BRAUN) HERENDEEN
5. Leaflet, Želénky, DB Že 3, x 2.5.

Toddalia maii GREGOR
6. Group of seeds, Dobrčice, DB Do 7, x 4.
7. Group of seeds, Želénky, DB Že 4, x 4.

Berchemia multinervis (A. BRAUN) HEER
8. Zabrušany, BA 6045 (Ettingshausen 1866, pl. 17, f. 13, TYPE of *Quercus pseudo-laurus* ETTINGHAUSEN), nat. size.

Paliurus favonii UNGER
9. Fruit, Želénky, NM G 7733, x 2.5.

Paliurus tiliaefolius (UNGER) BŮŽEK
10. Nechvalice, MT PA 1013, x 1.8.

cf. *Ampelopsis* sp.
11. Světec, NM G 7728, nat. size.

cf. *Vitis* vel *Ampelopsis* sp.
12. Seed molds, Dobrčice, MT PA 1027, x 10.0.

PLATE 8

Nyssa haidingeri (ETTINGSHAUSEN) Z. KVAČEK et BŮŽEK
1. Zabrušany, BP 56.1194 (Ettingshausen 1866, p. 54, as *Quercus neriifolia* A. BRAUN), nat. size.

Fraxinus macroptera ETTINGSHAUSEN
2. Fruits, Želénky, BD Že 5, x 2.0.

"*Juglans*" *acuminata* A. BRAUN
3. Světec, NM G 7723, nat. size.

Carpolithes spp.
4. Endocarp mold, Světec, NM G 7724, x 3.5.
5. Dtto, x 10.0.
6. Endocarp from above, Vršovice, NM G 2058 (Velenovský 1881, pl. 9, fig. 7), x 10.

Fraxinus bilinica (UNGER) comb. n.
7. Zabrušany, BA 6037 (Ettingshausen 1866, pl. 17, fig. 1, as *Quercus laharpii* HEER), nat. size.

? *Fraxinus bilinica* (UNGER) comb. n. (vel *Alnus gaudinii* (HEER) KNOBLOCH et Z. KVAČEK)
8. Zabrušany, BA 6044 (Ettingshausen 1866, pl. 16, fig. 3, as *Castanea attavia* UNGER), nat. size.

Catkin-like inflorescence
9. Dobrčice, DB Do 5, x 5.

"*Ficus*" *truncata* HEER
10. Želénky, NM G 7735, x 1.7.

PLATE 9

Dicotylophyllum spp.
1. Vršovice, NM G 2040.5 (Velenovský 1881, pl. 8, fig. 20, TYPE of *Paulinia furcinervis* VELENOVSKÝ), x 2.5.
2. Světec, NM G 7726, x 2.0.
3. Dobrčice, DB Do 8, x 3.
4. Vršovice, NM G 1867 (Velenovský 1881, pl. 6, fig. 12, TYPE of *Myrsine pedunculata* VELENOVSKÝ), x 2.5.
5. Zabrušany, BA 6144 (Ettingshausen 1866, pl. 14, fig. 3, TYPE of *Myrica bilinica* ETTINGSHAUSEN), nat. size.
6. Dtto, x 2.0.
7. Zabrušany, BA 6070 (Ettingshausen 1866, pl. 14, fig. 3, TYPE of *Omalanthus tremula* ETTINGSHAUSEN), x 1.5.

"*Juglans*" *acuminata* A. BRAUN
8. Světec, NM G 7723, x 5.0.
9. Dtto, x 0.8.

PLATE 10

Hydrochariphyllum miocenicum (VELENOVSKÝ) comb. n.
1. Vršovice, NM G 1845 (Velenovský 1881, pl. 1, fig. 18, TYPE of *Podozamites miocenicus* VELENOVSKÝ), x 2.0.
2. Dtto, x 6.0.
3. Vršovice, NM G 1846 (counterpart of the type specimen shown in figs 1-2), x 5.0.
4. Vršovice, NM G 1847 (Velenovský 1881, pl. 1, fig. 19, TYPE of *Podozamites miocenicus* VELENOVSKÝ), x 6.0.

Hydrochariphyllum buzekii Z. KVAČEK.
5. Želénky, NM G 7737, x 6.

Smilax weberi WESSEL in WESSEL et WEBER
6. Světec, NM G 7716, nat. size.

Limnobiophyllum expansum (HEER) Z. KVAČEK
7. Želénky, coll. Charles University (Engelhardt 1891, pl. 13, fig. 2, as *Hiraea expansa* HEER), nat. size.

PLATE 11

Calamus noszkyi JABLONSKY
1. Světec, NM G 5623, nat. size
2. Světec, NM G 7727, x 0.8.
6. Dtto, detail of the margin, x 3.

Sabal lamanonis (BRONGNIART) HEER
3. Svinčice, MM G/pa 773/6, nat. size.
5. Svinčice, MM G/pa 773/1, nat. size.
7. Svinčice, MM G/pa 773/3, nat. size.

Unioid mollusc
4. Shell impression, Světec, NM G 7730.2, x 2.0.

PLATE 12

cf. *Margaritana* sp.
1. Mollusc shell, Želénky, coll. *Hurník* 1954, presently missing, nat. size.

"*Typha*" *latissima* A. BRAUN
2. Venation, Vršovice, NM G 1934 (Velenovský 1881, pl. 2, fig. 2), x 7.5.

cf. *Zingiberoideophyllum liblarense* KRÄUSEL et WEYLAND
3. Venation, Vršovice, NM G 1934 (Velenovský 1881, pl. 2, fig. 16, as *Musa bilinica* ETTINGSHAUSEN), x 7.0.

Cyperacites spp.
4. Vršovice, NM G 1849 (Velenovský 1881, pl. 2, fig. 15, TYPE of *Phormium affine* VELENOVSKÝ), x 1.2.
5. Dtto, venation, x 4.5.


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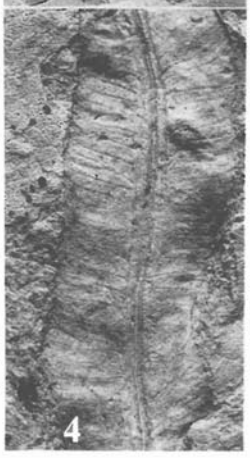
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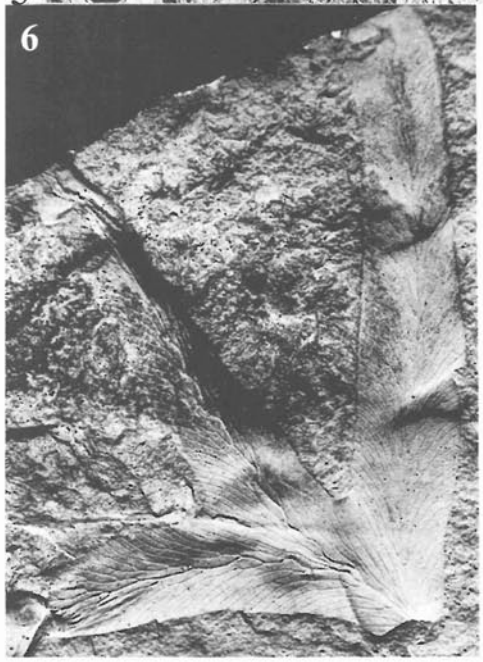
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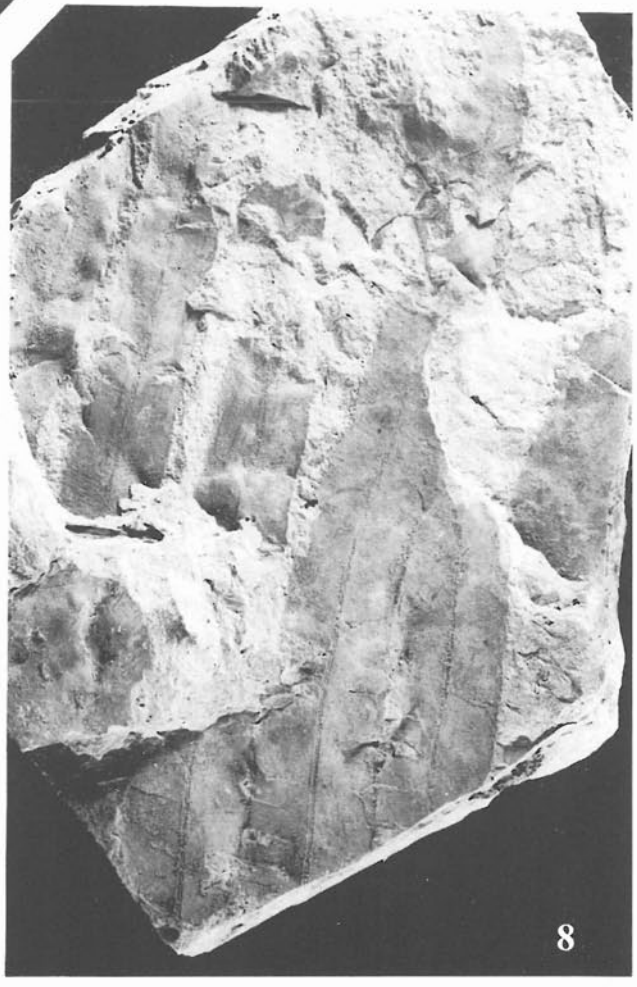
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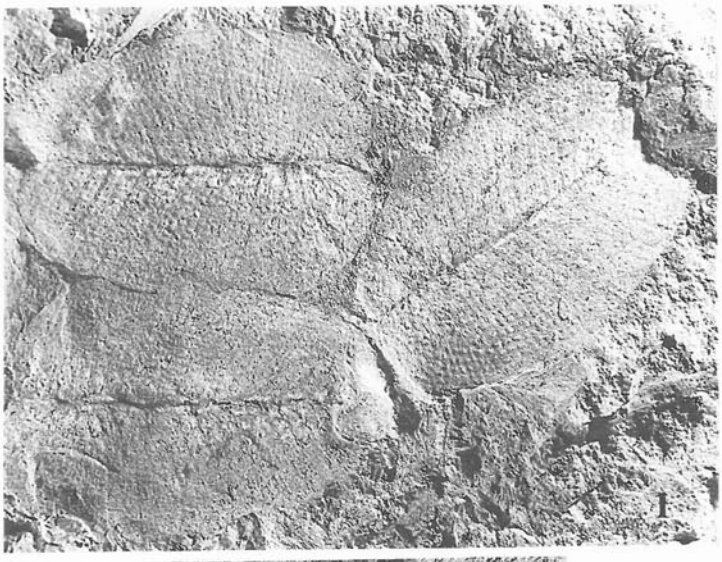
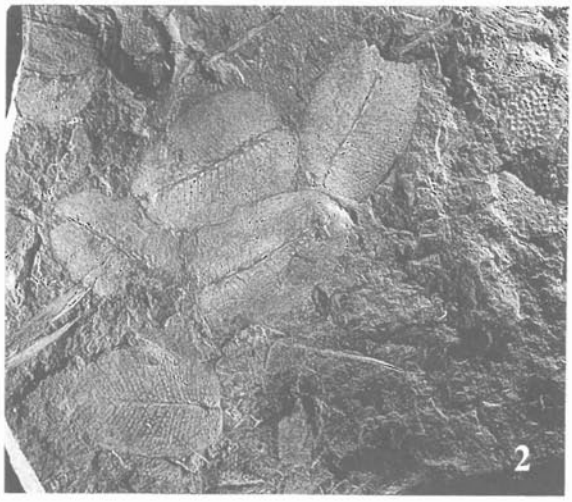
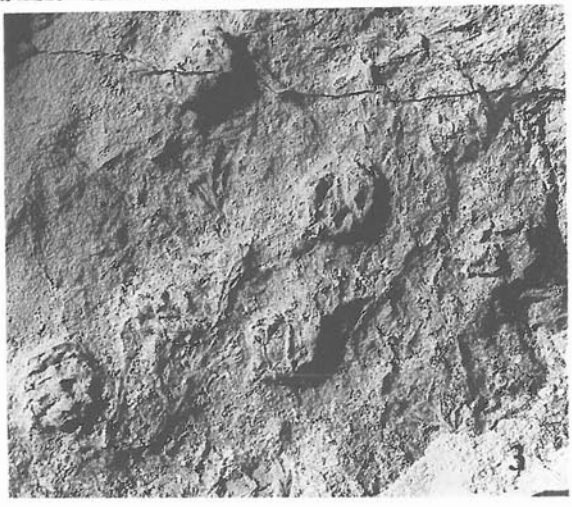
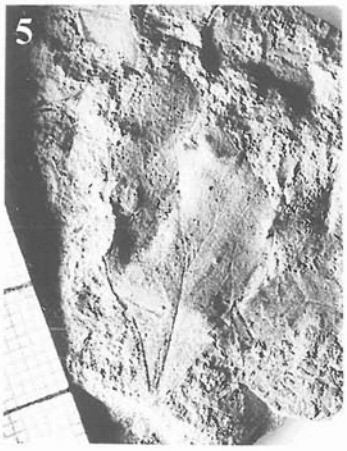
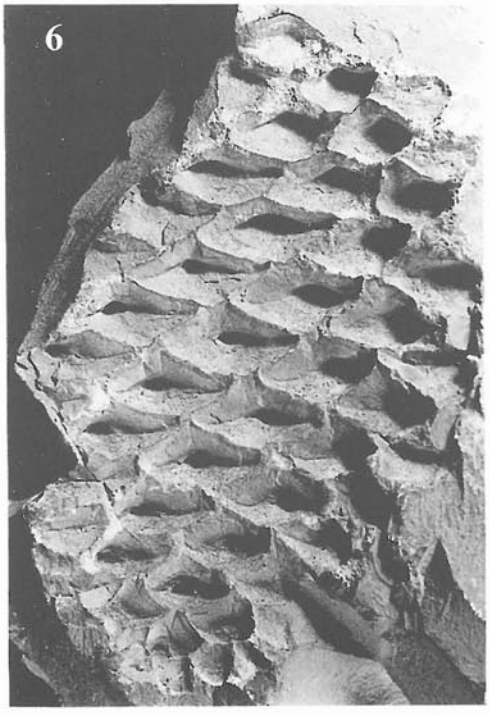
Plate 2

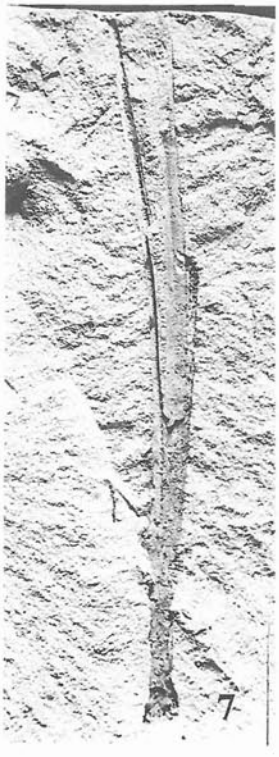


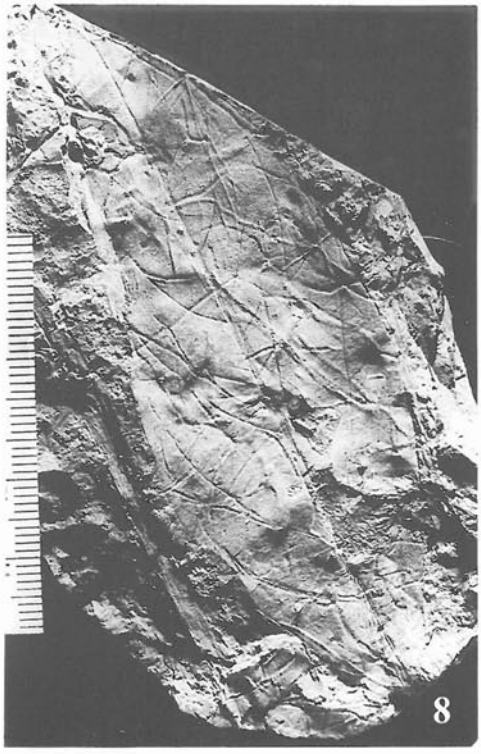










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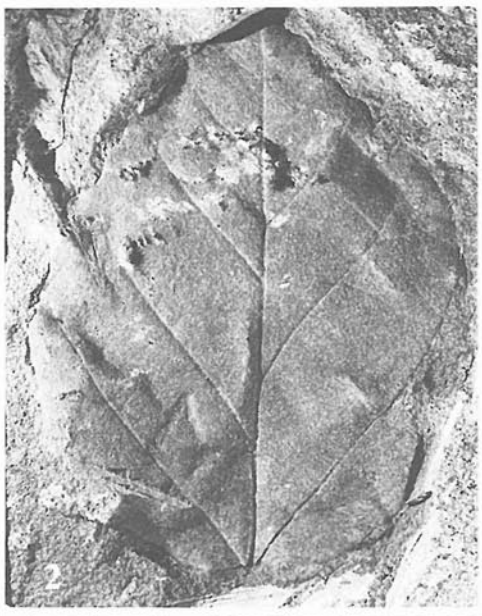
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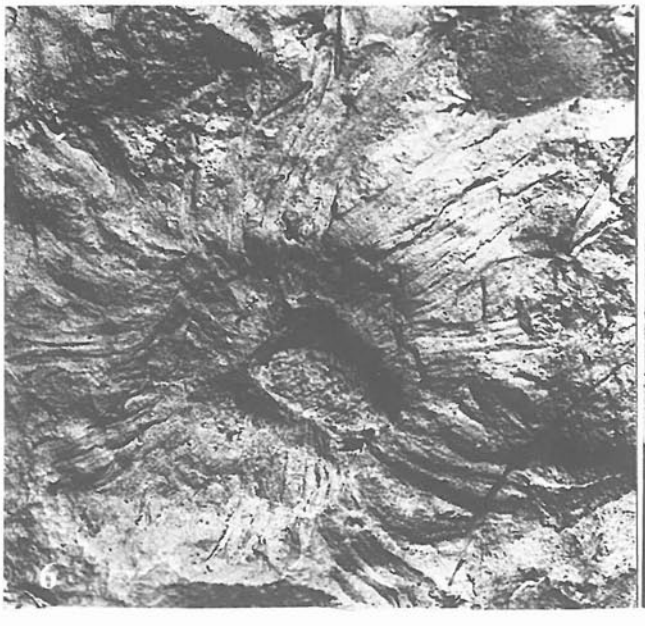
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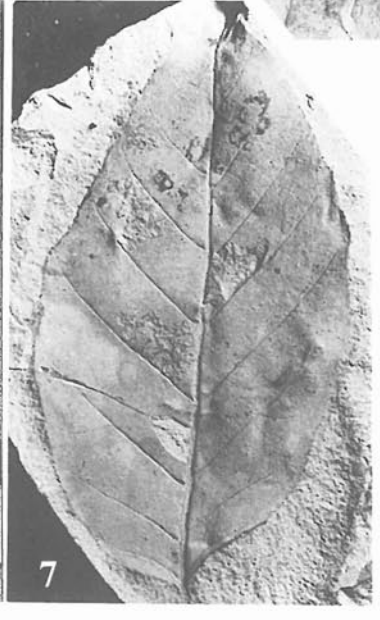
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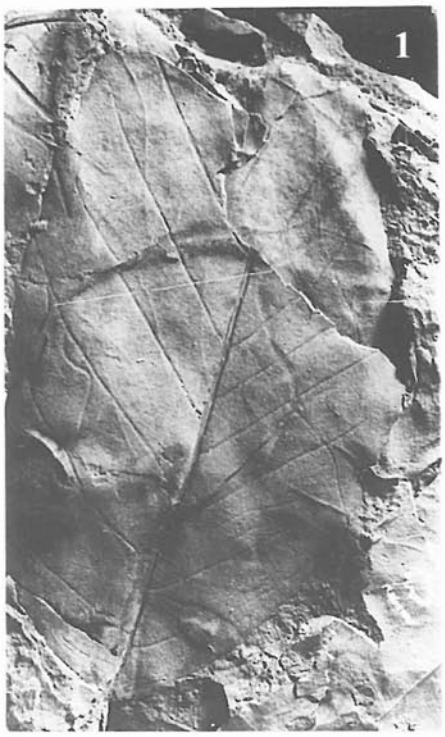
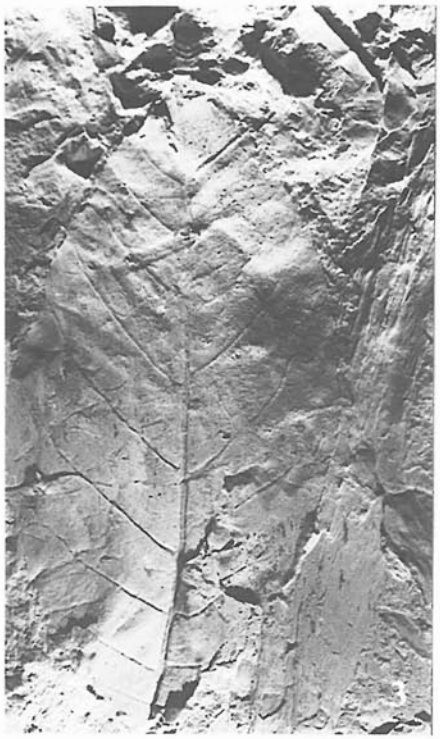
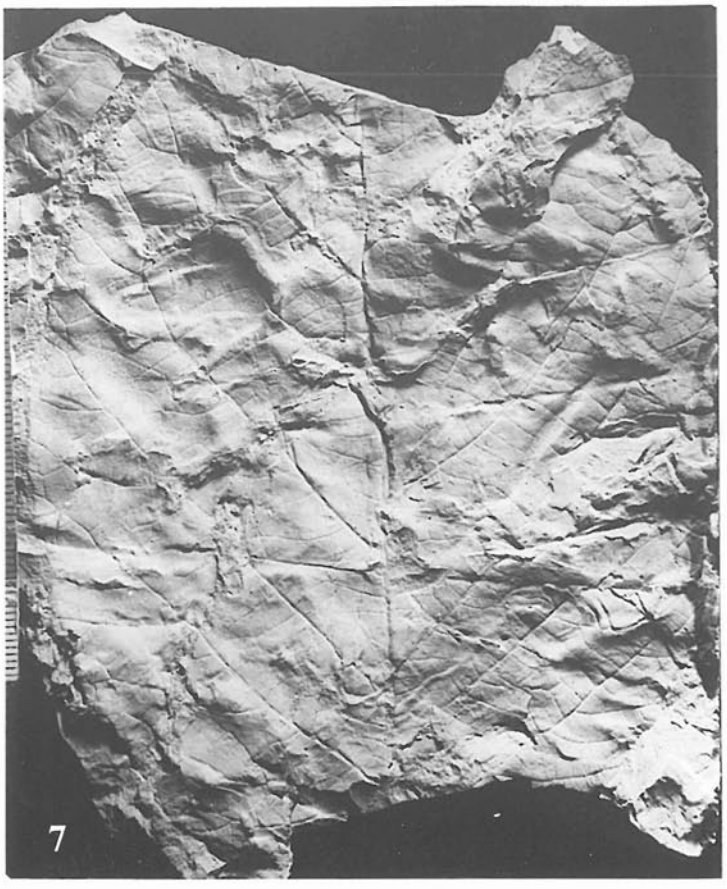
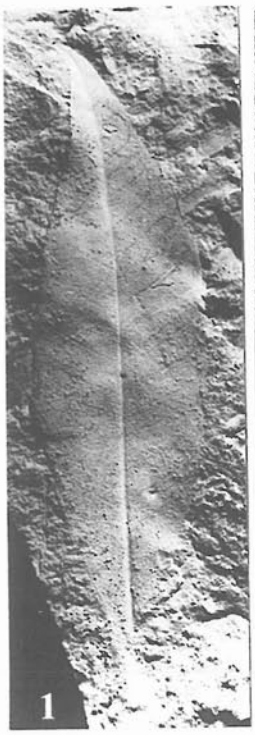
Plate 4





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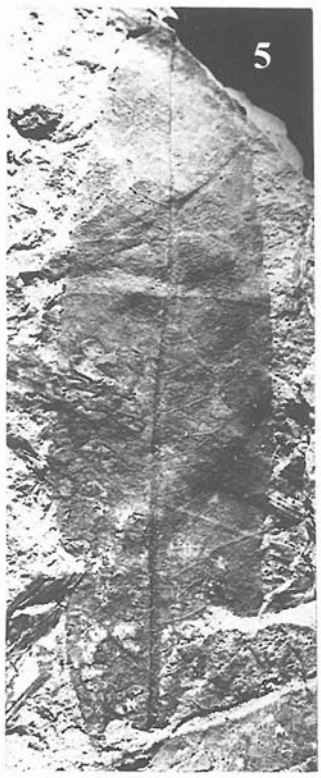
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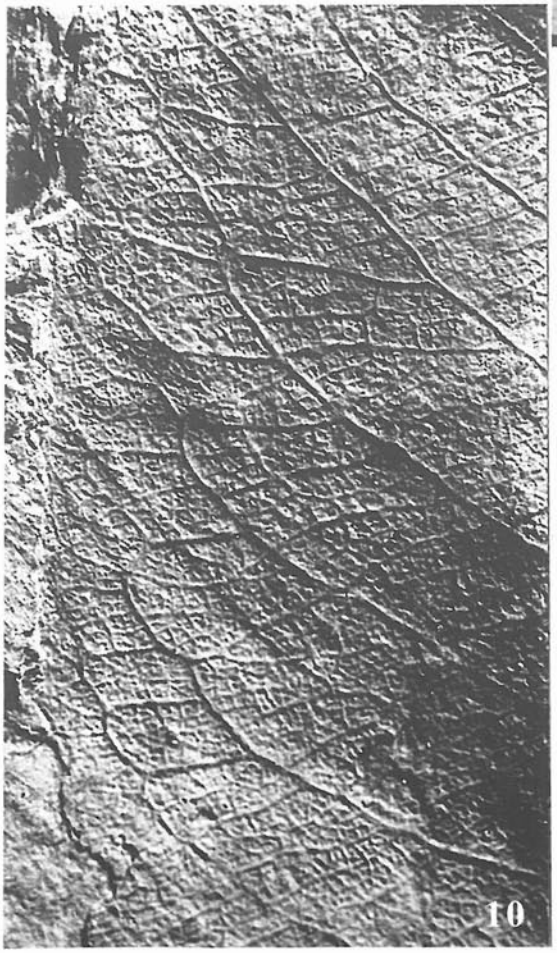
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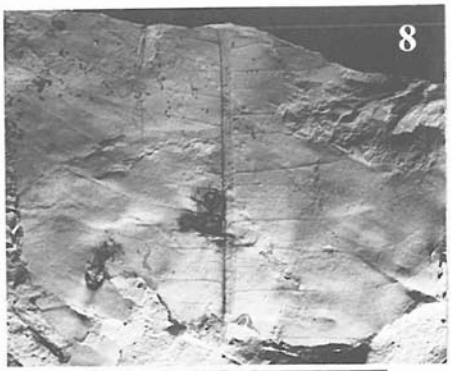
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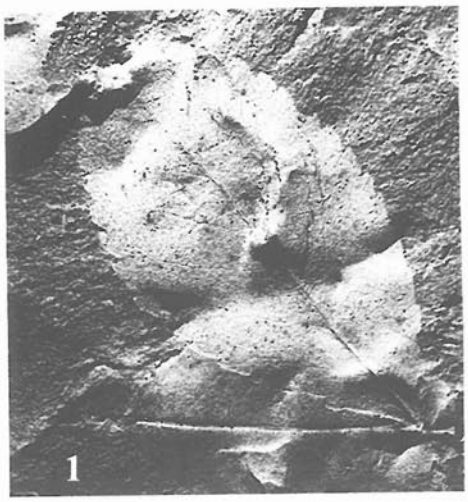
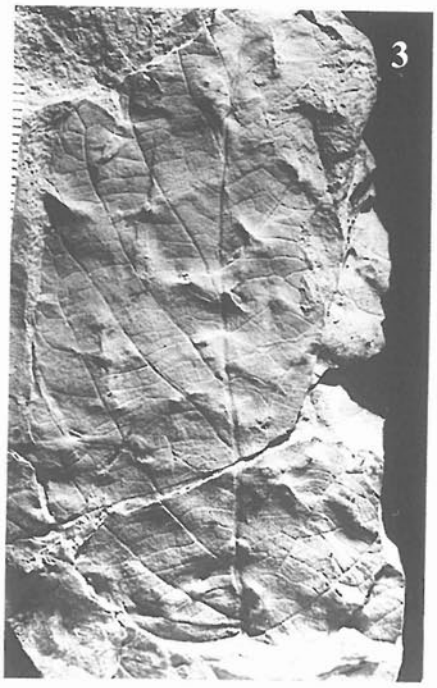
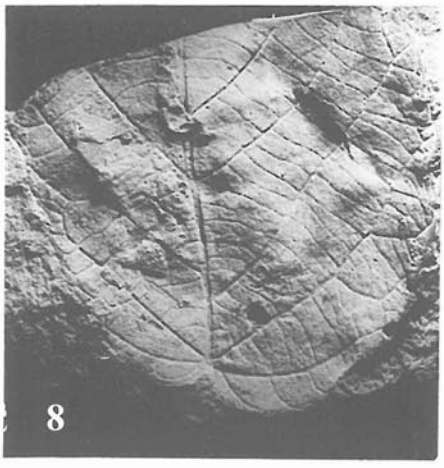
Plate 6





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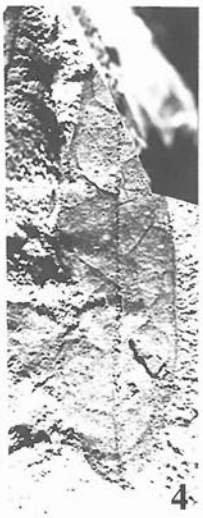
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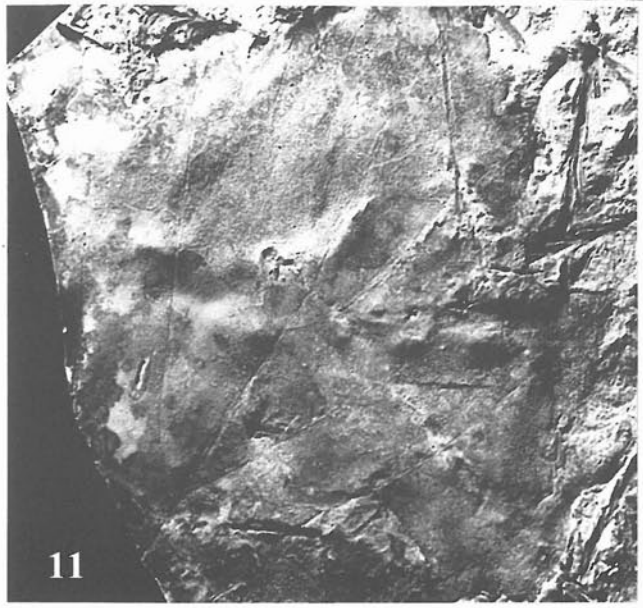
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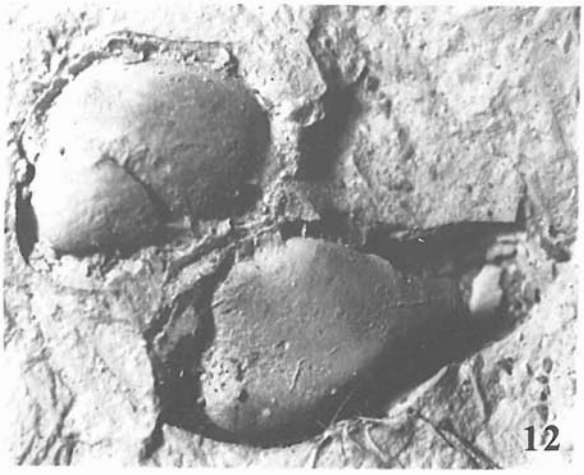
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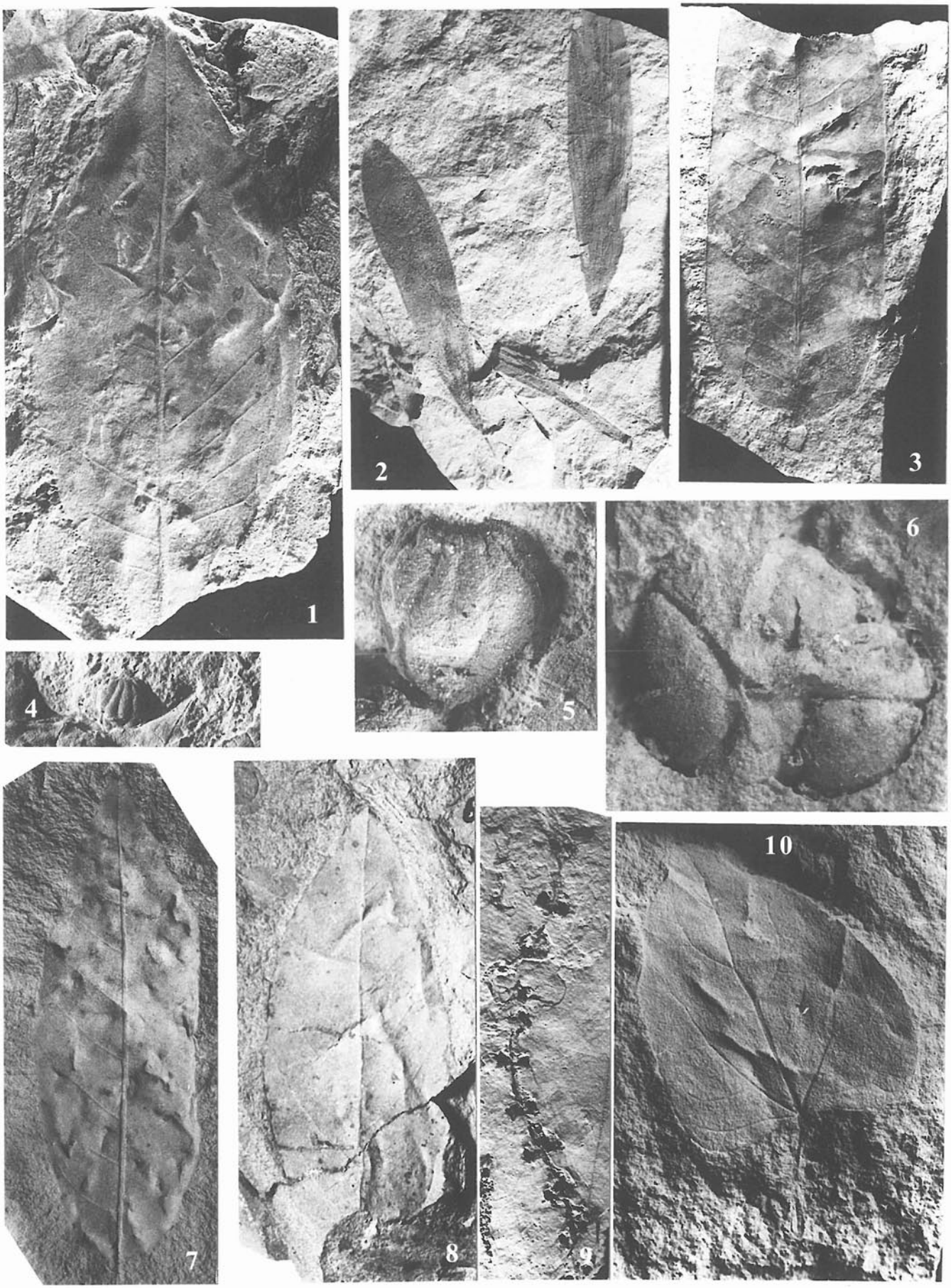

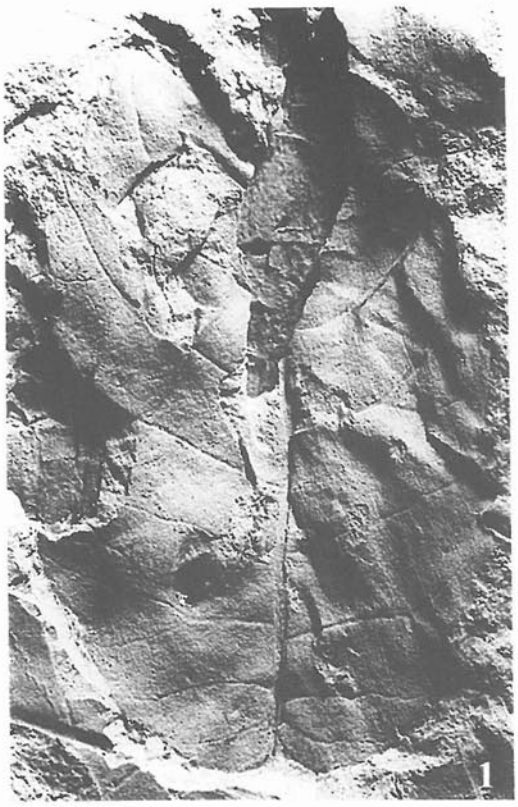
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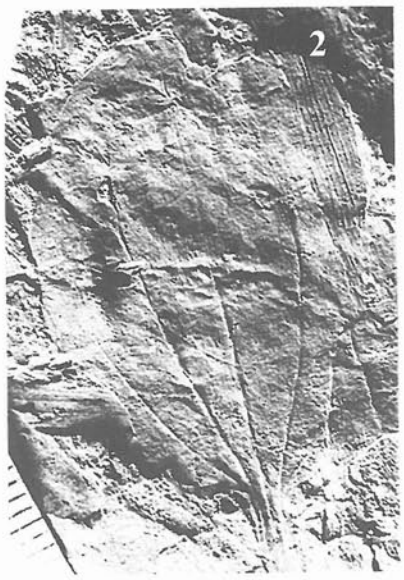
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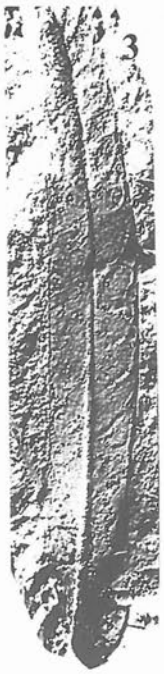
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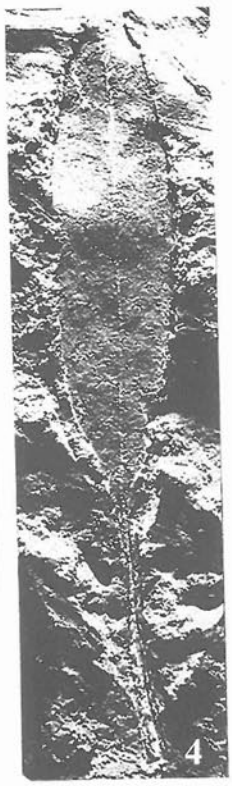
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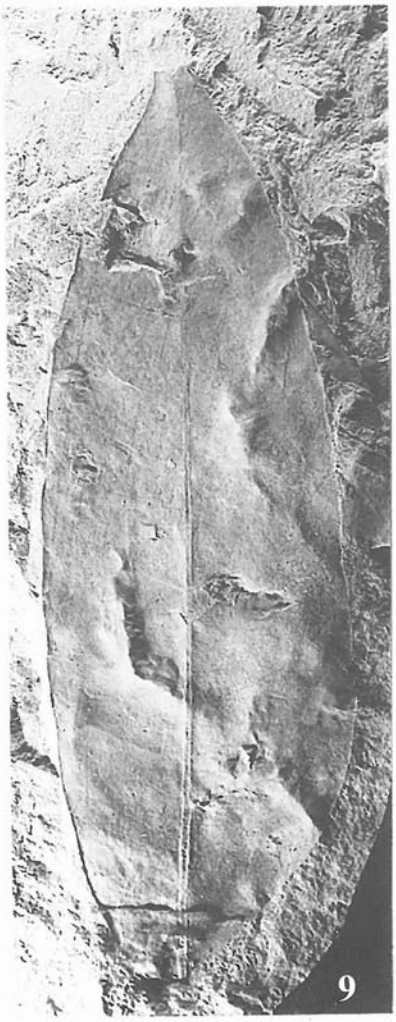
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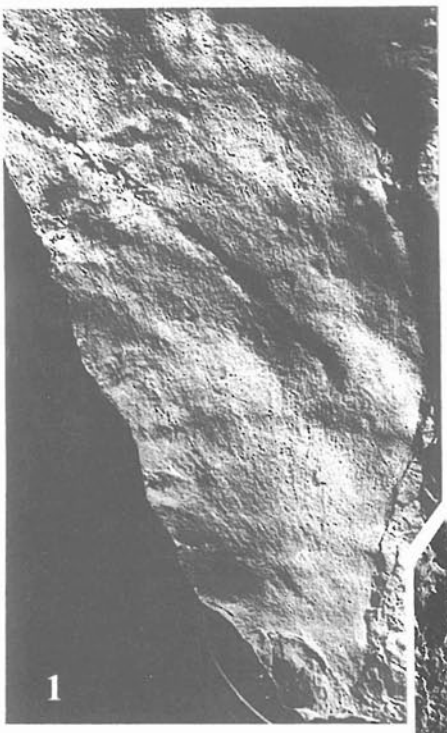
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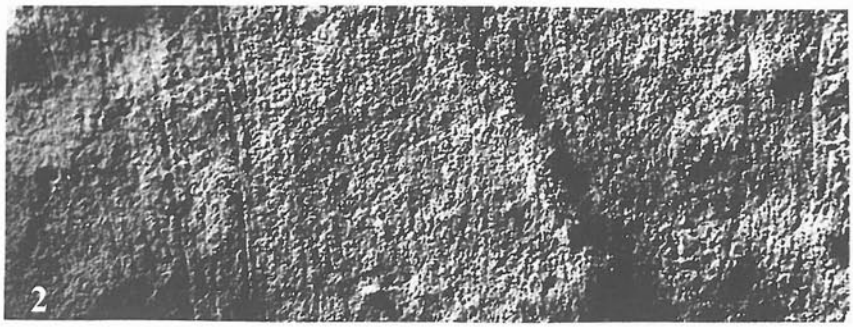
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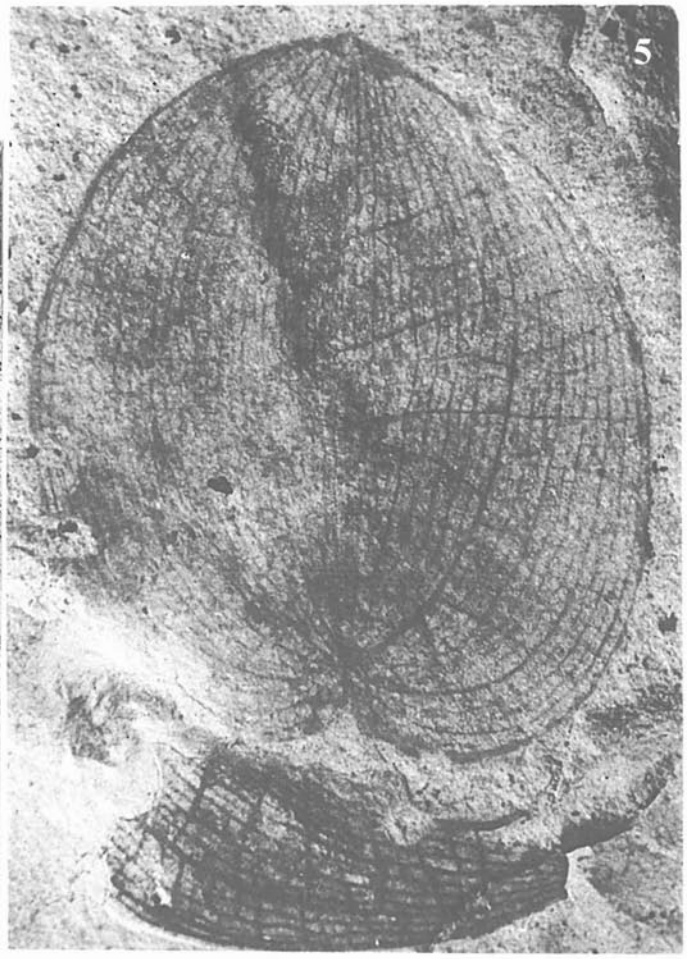
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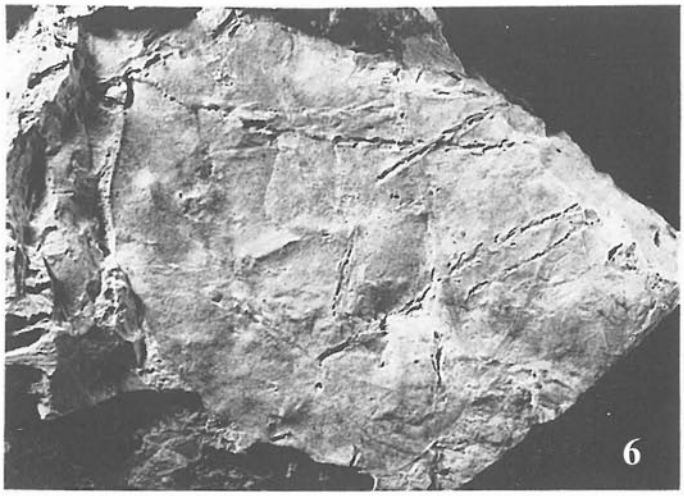
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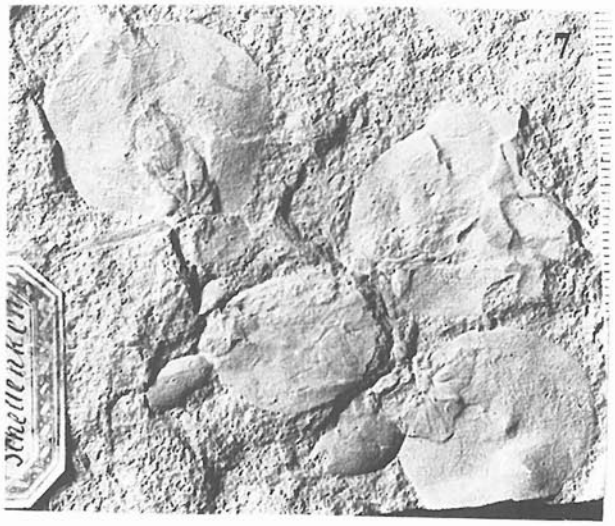
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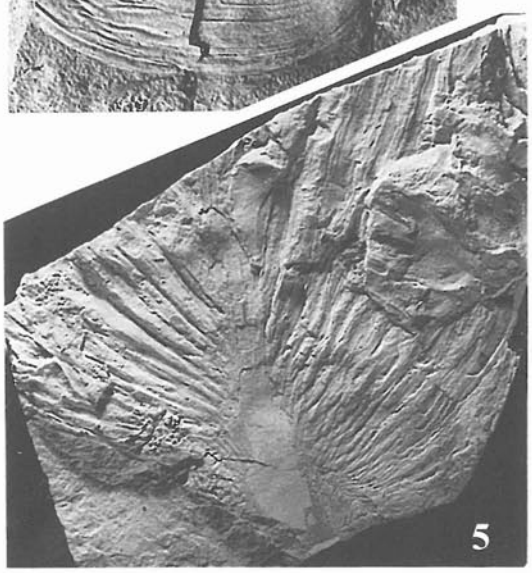
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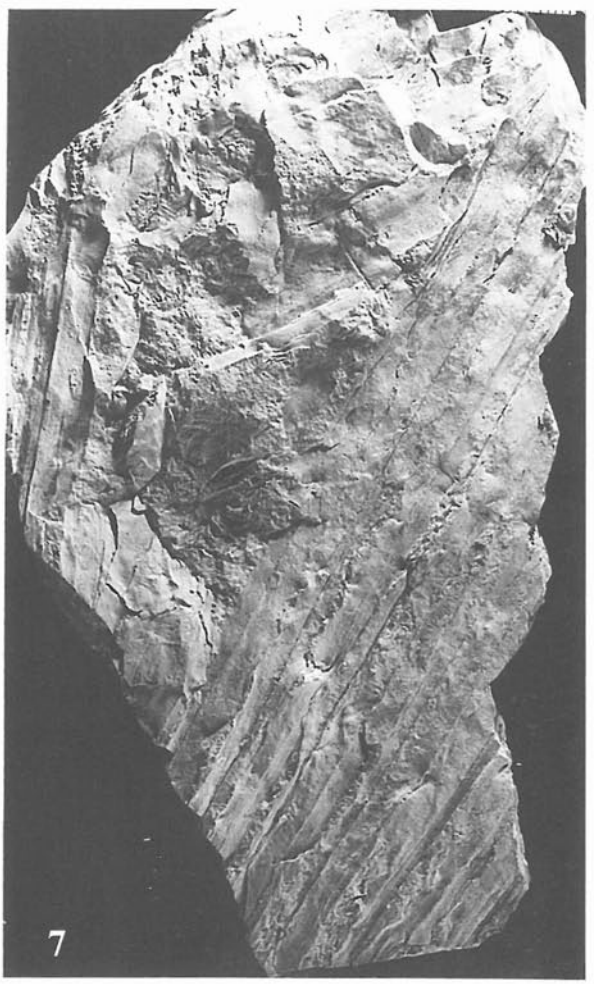
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Plate 12