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# Revision of platanoid foliage from the Cretaceous of the Czech Republic

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**ABSTRACT. Four Cretaceous taxa of fossil platanoid leaves are revised based on leaf macromorphology. They are accommodated in the morphogenus *Ettingshausenia* Stiehler. Three species are from the Cenomanian Peruc Korycany Formation of the Bohemian Cretaceous Basin: *Ettingshausenia cuneifolia* (Bronn) Stiehler, *Ettingshausenia bohemica* (Velenovský) comb. nov. and *Ettingshausenia laevis* (Velenovský) comb. nov., whereas *Ettingshausenia senonensis* (Knobloch) comb. nov. is from the Senonian of the South Bohemian Basins. All four are described, including their typification and synonymy, and their diagnoses are emended to permit comparison with similar European Cretaceous taxa. Anatomical details of *E. cuneifolia* and *E. laevis* are described and discussed based on SEM studies of their cuticle.**

■ ***Ettingshausenia*, Cretaceous, Cenomanian, Santonian, Bohemian Cretaceous Basin, South Bohemian Cretaceous Basins.**

## INTRODUCTION

Problems associated with naming Cretaceous platanoid leaves has been discussed many times in the palaeobotanical literature (e.g. Z. Kvaček 1983, Krassilov 1979, Rüffle 1968, 1995, Maslova et al. 2005). In particular, European platanoid leaves represent an interesting puzzle. In the past, leaves similar to sycamore were described as *Credneria* Zenker 1833 (e.g. Velenovský 1882), which was the best solution at the time due to the absence of reproductive structures. Later, when reproductive structures associated with platanoid leaves were found, the leaves were instead assigned directly to the genus *Platanus* (Velenovský 1889, Knobloch 1995, 1997). However, recent studies on mesofossils from the (Cenomanian) Peruc Korycany Formation (J. Kvaček 2006) and in other Cretaceous strata (Friis et al. 1988, Pedersen et al. 1994, Krassilov and Shilin 1995) revealed that there is no reproductive structure that corresponds in diagnostic characters with the genus *Platanus.* Furthermore, palynological studies (Pacltová 1982) in the Peruc Korycany Formation and elsewhere (e.g., Denk and Tekleva 2006) indicate that the genus *Platanus* is not represented in the Bohemian Late Cretaceous. Maslova et al. (2005) resolved the situation and expressed the idea that sterile platanoid foliage, although superficially similar to the genus *Platanus*, should be assigned to a separate morphogenus. Maslova et al. (2005) recommended using the name *Ettingshausenia* for such foliage rather than the generic name *Credneria.*

It is evident that both *Ettingshausenia* and *Credneria* represent morphogenera that cover more than one natural genus, and it can not be ruled out that they may even represent foliage of another family (e.g., Menispermaceae, see Rüffle 1995). As already point-

ed out by Vakhrameev (1976) and Herman (1992), the genus *Credneria* is characterized by rounded leaf laminae with rounded or truncate bases and two or three pairs of very pronounced suprabasal veins. In contrast, *Ettingshausenia* leaves are typically deltoid or diamond-shaped with pronounced lobes, have cuneate, peltate or pseudopeltate bases, and have poorly developed or absent suprabasal veins.

It seems appropriate that the systematic affinity of these morphogenera remains open. Particularly important are arguments by Denk (2006) who showed that there are no reliable diagnostic characters for assignment of fossil leaves to the Family Platanaceae based solely on macromorphology.

## MATERIAL

The material of *Ettingshausenia cuneifolia, E. bohemica* and *E. laevis* revised in this study comes from the Bohemian Cretaceous Basin, as defined by Čech et al. (1980). The material of *E. senonensis* comes from the South Bohemian Cretaceous Basins defined by Malecha and Špinar (1962). All basins are located in the Bohemian Massif in the Czech Republic, Central Europe. The Bohemian Cretaceous Basin is filled by Upper Cretaceous freshwater, brackish and marine sediments of Cenomanian to Campanian age. The South Bohemian Cretaceous Basins are filled with freshwater sediments of Turolian to Santonian age (Pacltová, pers. communication).

The Peruc-Korycany Formation is situated in the basal most position of the Bohemian Cretaceous Basin. The localities of Vyšehořovice, Břežany and Kounice, which are situated near each other about 30 km east of Praha and comprise several sandstone quarries that were a source of palaeobotanical material nearly for one century, are now completely abandoned. The Vyšehořovice locality is maintained as a Natural monument. Other localities, such as Mělník nad Sázavou located 30 km southeast of Praha, and the Malá Chuchle, Slivenec and Vidoule localities, situated in Praha, are now also inaccessible. The Pecínov Quarry, situated 60 km west of Praha, is a working quarry where the entire Peruc-Korycany Formation is exposed. The sedimentary succession in Pecínov was divided by Uličný & Špičáková (1996) into 5 units. Units 1 and 2 typically include fluvial pebbly sandstones, conglomerates and sandstones with interbedded mudstones. Unit 3 consists of mudstones rich in pyrite concretions. They are products of marginal marine and brackish sedimentation in back swamps and supratidal marshes. Unit 4 is represented by cross-bedded sandstones, mudstones and laminites, products of sedimentation on a tidal flat crossed by meandering tidal creeks. The lower part of Unit 5 is built of sandstones containing a rich marine fauna and occasionally preserved stems of tree ferns and poorly preserved leaf impressions. Intertidal to supratidal mudstones bearing a rich megaflora are locally preserved in the uppermost part of Unit 5 (Uličný et al. 1997), and reflect local regression. Detailed biostratigraphical studies based on pollen spectra (Pacltová 1977) dates the Peruc - Korycany Formation to the upper part of the middle Cenomanian.

The Klikov Formation is situated in the basal most position of the South Bohemian Cretaceous Basins. It is composed of three units. According to Slánská (1976) "The sediments are clastic and comprise: (1) light-grey or yellow conglomeratic, course tomedium sandstone beds; (2) generally finer red beds; and (3) gray beds. They alternate in asymmetrical cycles, in succession fining upwards." It is recently accessible in a working quarry near a village of Zliv 14 km North West of České Budějovice. The quarry is situated on a half way between Zliv and Zahájí. Knobloch states the locality as Na Blanech near

Zahájí, Němejc and Z. Kvaček (1975) used the name Řídká Blana near Zliv. We use the later term for this locality. The locality Klikov, Borek, Hrutov and Zliv – creek cut are inaccessible. Petrovice, Haklovy Dvory and Zahájí are sites of boreholes. The locality near Drahotěšice have not been yet inspected.

Studied plant fossils are housed in the National Museum, Praha (NM) and Czech Geological Survey (CGS).

Plant remains are represented by leaf impressions and compressions. Fine details of the venation and morphology are preserved, and the fossil leaves show little evidence of having undergone extended transport or decay prior to burial. Some of the material yields fragments of cuticle.

## METHODS

Leaf impressions were photographed under low angle incident light using 35 mm Ilford FP4 film in a Nikon 400 camera with a Nikkor Sigma 90 mm macro lens. Carbonised material from leaf compressions was carefully picked off with a preparation needle and prepared for cuticle analysis. After sampling, the material was cleaned by treatment in HF and then bleached with a procedure that included maceration with Schulze's reagent: $HNO_3$ + $KClO_3$, neutralisation in water, and treatment in a low concentration solution of KOH. Material from the locality of Praha-Malá Chuchle was only treated in a KOH solution. After chemical treatments, cuticles were washed in water. Material for light microscopy was embedded in glycerine framed by Noyere framing cement. Cuticles prepared for SEM observations were treated in the same way. However, before drying they were removed in a drop of distilled water on an emulsion surface of small sheets of glossy negative film. The sheets were air dried and mounted on SEM stubs.

Cuticle preparations were studied by light microscopy using Nomarski DIC (Olympus BX50) and by SEM (Jeol JSM-6380LV).

## SYSTEMATIC PART

### *Ettingshausenia* Stiehler 1857

TYPE. *Ettingshausenia cuneifolia* (Bronn) Stiehler 1857, p. 67.

DIAGNOSIS. Emended by Maslova et al. (2005).

DISCUSSION. The morphogenus *Ettingshausenia* is generally used for deltoid or diamond-shaped leaves with more or less pronounced lobes and cuneate, peltate or subpeltate bases. The differences between this taxon and other similar platanoid genera, such as *Credneria*, were mentioned by Maslova et al. (2005). The type material described by Bronn (1837) is probably lost, but we continue in our search for it. The type locality Niederhoena provided quite a number of specimens, which are kept in Natural History Museum in Berlin and Dresden. Selection of a neotype should not be a problem.

### *Ettingshausenia cuneifolia* (Bronn) Stiehler

Figs.1a, b

SYN.

*Platanus rhomboidea* Velenovský 1882, p. 11, pl. 3, figs. 2, 3, pl. 4, fig. 1 nom. illegit non Lesquereux 1837
*Credneria geinitziana* Unger 1850, p. 422

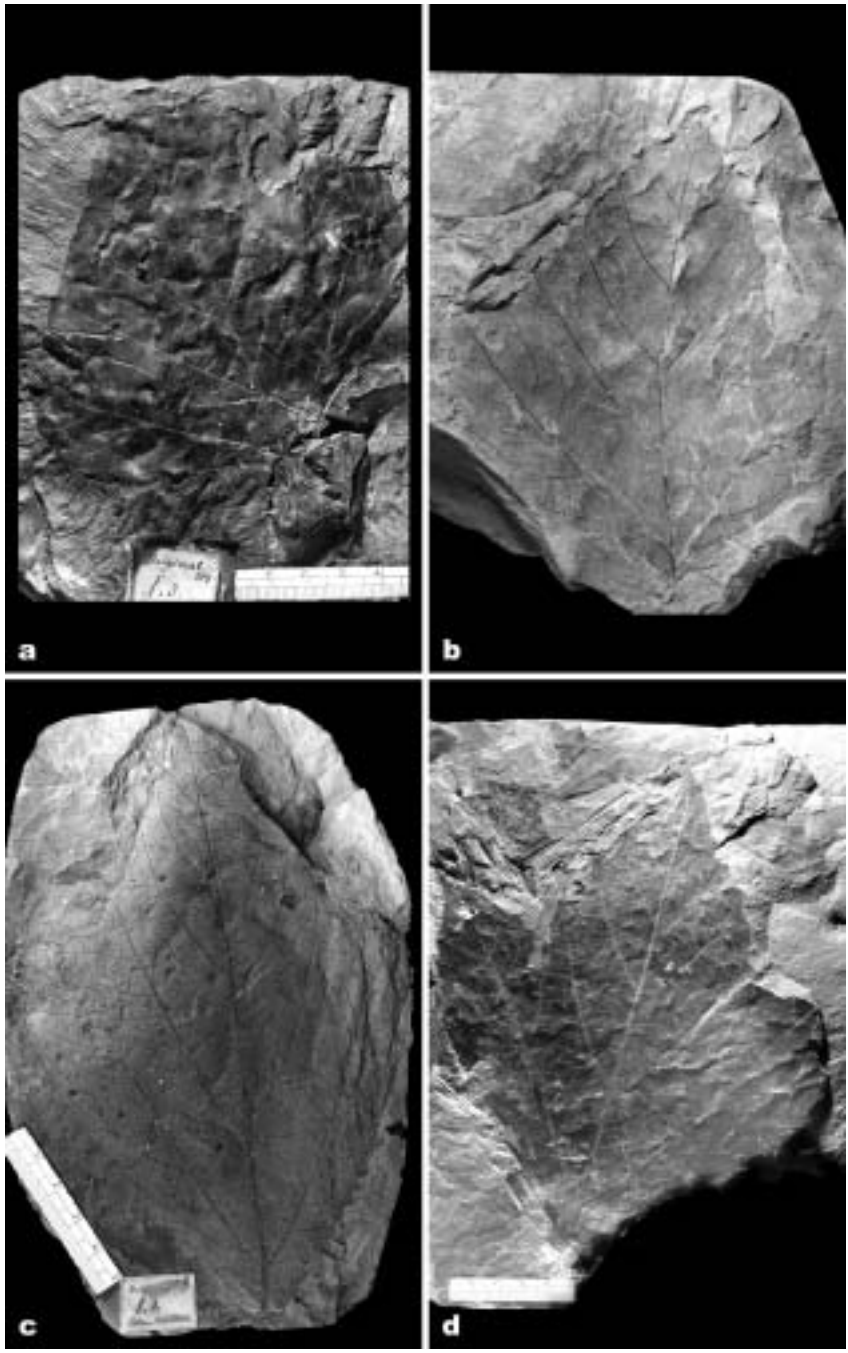


**Fig. 1(a-b):** ***Ettingshausenia cuneifolia*** **(Bronn) Stiehler: a – Specimen described by Velenovský as** ***Credneria rhomboidea*** **Velenovský 1882, pl. 3, fig. 3, Praha-Malá Chuchle, No. F 0829, coll. NM, x 0.6. b – trilobate leaf figured by Knobloch 1995, pl. 2, fig. 4, Praha-Malá Chuchle, No. F 2357, coll. NM, x 1.**
**Fig. 1(c-d):** ***Ettingshausenia bohemica*** **(Velenovský) comb. nov. c – Lectotype, Velenovský 1882, pl. 3, fig. 1, Vyšehořovice, No. F 0280, coll. NM, x 0.5. d – trilobate leaf figured by Knobloch 1997, pl. 1, fig. 1, Vyšehořovice, No. F 2340, coll. NM, x 0.4.**

*Platanus velenovskyana* Krasser 1896, p. 138, pl. 15, fig. 2
*Platanus pseudoguilelmae* Krasser 1896, p. 139, pl. 14, fig. 2
*Platanus moravica* Krasser 1896, p. 140, pl. 13, fig. 3, pl. 15, fig. 3
*Platanus cuneiformis* Krasser 1896, p. 141, pl. 12, fig. 5, pl. 14, fig. 3
*Platanus acute-triloba* Krasser 1896, p. 142, pl. 13, fig. 2
? *Chondrophyllum grandidentatum* Unger, Heer 1869, p. 19, pl. 11, fig. 6
? *Phyllites repandus* Sternberg 1821, p. 29, 1825, index iconum, pl. 25, figs. 1a, b
? *Ettingshausenia sternbergii* Stiehler 1857, p. 67

SYNTYPES: Bronn 1837, pl. 28, fig. 11.

TYPE LOCALITY: Niedershöna, Germany.

TYPE HORIZON: Peruc-Korycany Formation, Cenomanian, Late Cretaceous.

OCCURRENCE: Niedershöna, Germany; Praha-Malá Chuchle, Praha-Slivenec, Kunštát, Maletín

MATERIAL: NM F 281, F 0829, F 2357, F 2358, F 2360, F 2361, F 2363, F 2365, F 2366, F 2367, F 2368, F 2369, F 2371, F 2372, F 2373, F 2864, F 3076 – F 3080.

EMENDED DIAGNOSIS. After Maslova et al. (2005).

DESCRIPTION. Material from the Czech localities is represented by the type material of *Credneria rhomboidea* Velenovský (1882), which exhibits deltoid leaf blades with cuneate bases (Fig. 1a.). The leaf lamina of this species varies in size from 4-12 x 2.5-11 cm. Lobes are missing or very small (Fig. 1b). The terminal part of the lamina is usually dentate and the basal part entire-margined. Venation is craspedodromous or semi-craspedodromous. Five to six pairs of secondary veins arise from the midrib at acute angles. Tertiary venation is quite distinct. Basal veins are inconspicuous or missing.

Cuticle obtained from the well preserved leaf No. F 1425 was observed under SEM. The external surface of the abaxial cuticle shows the distribution and details of stomata and trichome bases (Fig. 2b). Each stoma (22-27 x 27-30 ěm) is surrounded by a rim (Fig. 1c). Remains of subsidiary cells (12-15 x 10-25 ě m) are seen in the internal view of the abaxial cuticle (Fig. 2d).

DISCUSSION. Revision of the type material of *Ettingshausenia cuniefolia* is outside the scope of this paper. Material from the type locality was revised by Knappe and Rüffle (1975). This material was briefly studied in the Natural History Museum in Berlin by the first author. The two syntypes depicted by Bronn (1837) were not located there. Specimens published by Engelhardt (1885) and Krasser (1896), which are housed in the Natural History Museums in Dresden and Vienna, respectively, agree in general gross morphology with each other, and together with the material from the Czech localities they form a well outlined morphotype.

*Ettingshausenia cuneifolia* differs from *E. bohemica* in having a deltoid shape and cuneate base, and from *E. laevis* in lacking distinct lobes and in having a well pronounced tertiary venation. It differs from *E. senonensis* from the Santonian of South Bohemia (Němejc 1961) in lacking distinct lobes and in always having a dentate terminal part of the leaf (see Table 1).

### *Ettingshausenia bohemica* (Velenovský) comb. nov.

Figs. 1c,d

BASIONYM: *Credneria bohemica* Velenovský 1882, Die Flora der böhmischen Kreideformation Theil. I, p. 9, pl. 3, fig. 1, pl. 4, fig. 10

SYN.

*Platanus bohemica* (Velenovský) Knobloch 1997, p. 129, pl. 1, figs. 1-4, pl. 2, figs. 1,2, pl. 3, figs. 1-4, text-figs. 2-10

*Platanus vyserovicensis* Mařík 1901, p. 10, pl. 2, figs 4, 5
*Platanus intermedia* Knappe et Rüffle, Knobloch 1995, p. 9, pl. 1, figs. 1, 2, 4, pl. 2, figs. 1-3, pl. 3, figs. 6, 7, pl. 4, fig. 3, text-figs. 6-8
*Platanus intermedia* Knappe et Rüffle, Knobloch 1999, p. 39, pl. 10, figs. 1, 8
LECTOTYPE: designated by Knobloch 1997, F 0280, here Fig. 1c, (Velenovský 1882, pl. 3, fig. 1).
TYPE LOCALITY: Vyšehořovice.
TYPE HORIZON: Peruc-Korycany Formation, Cenomanian, Late Cretaceous.
OCCURRENCE: Vyšehořovice, Kounice, Březany, Na Rovinách u Kounova, Velké Opatovice.
MATERIAL STUDIED: NM F 2098, F 2335, F 2336, F 2337, F 2338, F 2340, F 2342, F 2347, F 2356, F 2518, F 2527, F 2845, F 3081- F 3109.
EMENDED DIAGNOSIS. Leaves typically lobed, rarely unlobed, diamond-shaped in outline, base typically peltate or pseudopeltate. Margin dentate in terminal part, rarely entire-margined. Venation craspedodromous or semi-craspedodromous, secondary veins arising from midrib at acute angles, tertiary venation scalariform, distinct. Suprabasal veins present.

The lectotype is a leaf impression covered by a shellac film. It is a complete shallowly trilobate leaf with a petiole (163 x 108 mm, Fig. 1c). Its venation is craspedodromous with three well pronounced pairs of secondary veins leaving the main midrib at an angle of 30°. Tertiary veins running perpendicularly to the secondary veins form a scalariform pattern. There are a large number of leaves in the collection from the locality of Vyšehořovice ranging from small entire-margined leaves to large terminally dentate leaves (Fig. 1d). All of the leaf forms and size categories, ranging from 50 to 300 mm long, of this species have a well pronounced tertiary venation. All of the specimens show rounded, peltate or pseudopeltate bases. Suprabasal veins do not form pairs and are present only in some specimens. As a rule, terminal parts of secondary veins of the entire-margined leaves always form loops. Material from Velké Opatavice, assigned by Knobloch (1995, 1999) to *Platanus intermedia*, is here synonymised with *E. bohemica*. The specimens fully agree with the above emended diagnosis of *E. bohemica*. Morphological variation of the leaves was studied by Knobloch (1997) and we refer to this publication for detailed discussion on the leaf morphology of this species.
DISCUSSION. *Ettingshausenia bohemica* is one of the most characteristic fossil platanoid leaves of the Bohemian Cenomanian. It differs from *E. leavis* in the presence of peltate or rounded bases and a well pronounced tertiary scalariform venation, and from *E. cuneiformis* in having diamond-shaped laminae and peltate, pseudopeltate or rounded bases. *E. bohemica* differs from *E. senonensis* from the Santonian of South Bohemia (Němejc 1961) in always having rounded, pseudopeltate or peltate bases, and in typically having dentate leaves and less pronounced lobes (see Tab. 1).

Material described by Knobloch (1995) from the locality of Velké Opatovice as *Platanus intermedia* differs from the material from Vyšehořovice in having more pronounced lobes. Nevertheless, morphological plasticity of platanoid foliage, in addition to an absence of any other more distinguishing character, argue for inclusion of this material in *E. bohemica.*

***Ettingshausenia laevis* (Velenovský) comb. nov.**

Figs.2a, 3a, b

BASIONYM: *Credneria laevis* Velenovský 1882, Die Flora der böhmischen Kreideformation Theil. I, p. 13, pl. 3, fig. 4, pl. 4, figs. 2-6

SYN.:

*Platanus laevis* (Velenovský) Velenovský 1889, p. 16, pl. 1, figs. 1, 2

*Platanophyllum laeve* (Velenovský) Němejc 1961, p. 18, pl. 2, figs. 5-11, pl. 3, figs. 1-8, pl. 4, figs 1-5, text-figs 3, 4

*Credneria purkynei* Velenovský et Viniklář 1927, p. 19, 48, pl. 8, figs. 5-8, pl. 12, fig. 7

*Platanus purkynei* (Velenovský et Viniklář) Knobloch 1997, p. 139

LECTOTYPE: designated here F 0283, Fig. 1c; (Velenovský 1882, pl. 4, fig. 2)

TYPE LOCALITY: Mělník.

TYPE HORIZON: Peruc-Korycany Formation, Cenomanian, Late Cretaceous.

OCCURRENCE: Mělník, Vyšehořovice, Březany, Černíky, Kounice, Pecínov, Praha-Malá Chuchle, Praha-Vidoule, Praha-Slivenec; Klikov, Zliv (Santonian); Grünbach am Schneeberg, Austria (Campanian).

MATERIAL STUDIED: NM F 0284, F 0770, F 0765, F 0768, F 0782, F 0783, F 0784, F 0785, F 01965, F 01967, F 0035, F 0036, F 0038 – 0041, F 0047 – 0058, Fs 0037 (22 samples), F 2519, F 2867, F 2872, F 3054 – F 3075.

EMENDED DIAGNOSIS: Leaves typically lobed, diamond-shaped in outline, base cuneate. Margin typically dentate, but may be entire-margined. Venation craspedodromous or semi-craspedodromous, secondary veins arising at acute angles, tertiary venation including basal veins not pronounced.

DESCRIPTION: The lectotype is represented by a complete trilobate leaf (size 110x 58 mm) with a petiole attached (Fig. 1c). It is glued together from three parts and covered by a shellac film. The leaf has a cuneate base and a dentate margin. Venation is palmate with secondary veins leaving the midrib at acute angles. Although it is a leaf compression, its cuticle is not very well preserved. Slightly different material comes from the locality of Kounice (Fig. 1d). These leaves are usually entire-margined, similar to the material from Vyšehořovice. The type collection consists of two leaves, which completely lack lobes (Velenovský 1882, pl. 3, fig. 4, pl. 4, fog. 6). We consider them as aberrant forms. They are both of small size (21x25 mm Nos. F 765, F 784; 35x67 mm No. F 768). However, having in mind the morphological variability of platanoid foliage, we do not give them a separate status. Material of *Credneria purkynei* Velenovský et Viniklář (1927, pl. 8, figs. 5-8; pl. 12, fig. 7) also shows minor differences, particularly in the number and size of lobes. The lobes are typically three, but we have recorded specimens having four or five lobes (e.g., Knobloch 1999, pl. 10, fig. 6). The central lobe in some specimens is very large in comparison with the two laterals.

The cuticle of the holotype is very delicate. It shows ordinary cells of adaxial cuticle with undulate anticlinal walls. SEM photography documents compound trichome bases covering several cells (Fig. 2a).

DISCUSSION. *Ettingshausenia laevis* is a typical morphospecies, in that it has a very wide range of leaf shape and size. It is based on general characters of fossil platanoid foliage, so a rather large intraspecific variability exists. Small differences in diagnostic characters (number of lobes) leads us to doubt separation of the species *Credneria purkynei* Velenovský et Viniklář. The high similarity of cuticles from *E. laevis* and *C. purkynei* suggests that they are identical (compare Z. Kvaček 1983). Morphological variability

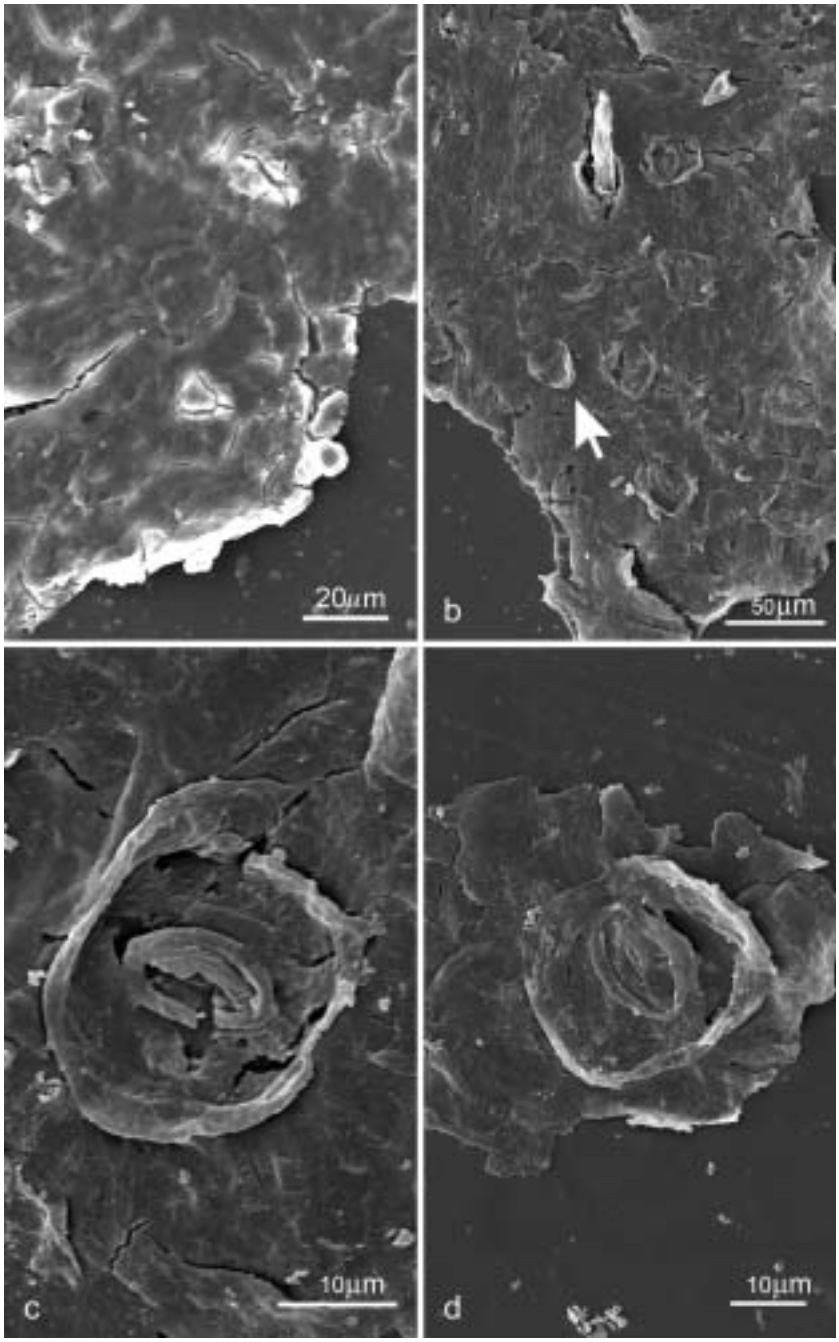


**Fig. 2(a):** ***Ettingshausenia laevis*** **(Velenovský) comb. nov.: a – Outer side of abaxial cuticle, compound trichom base, lectotype, Mělník, No. F 0283b, coll. NM, x 650.**
**Fig. 2(b-d):** ***Ettingshausenia cuneiformis*** **(Bronn) Stiehler: b – Outer side of abaxial cuticle bearing stomata and trichom base, Praha-Malá Chuchle, No. F 1425b, coll. NM, x 300. c – Outer side of abaxial cuticle, detail of stoma, Praha-Malá Chuchle, No. F 1425b, coll. NM, x 1800. d – Inner side of abaxial cuticle, detail of stoma, Praha-Malá Chuchle, No. F 1425b, coll. NM, x 1100.**

within *E. laevis* appears also in material from other Late Cretaceous floras. The material from the Santonian of Klikov (Němejc 1961) and from the Campanian of Grünbach (Herman and J. Kvaček, in press) shows the same diagnostic characters, although there are small differences in minor details, particularly in the slightly more pronounced tertiary venation.

Among other platanoid foliage from the Peruc-Korycany Formation, *Ettingshausenia laevis* differs from *E. bohemica* in the presence of cuneate bases and absence of a conspicuously pronounced tertiary venation. It differs from *E. cuneiformis* in the presence of lobes and absence of a conspicuously pronounced tertiary venation. *E. laevis* differs from *E. senonensis* from the Santonian of South Bohemia (Němejc 1961) in the regular presence of cuneate bases, dentate leaf margins, and absence of a conspicuously pronounced tertiary venation (see Tab. 1).

***Ettingshausenia senonensis* (Knobloch) comb. nov.**

Figs. 3b, c

BASIONYM: *Pseudoprotophyllum senonense* Knobloch1964, Neue Pflanzen aus dem südböhmischen Senon, Jahrb. Staatl. Mus. Mineral. Geol. Dresden, p. 151, text-fig. 13, pl. 1, fig. 3

SYN.

*Araliophyllum nemejcii* Knobloch 1964, p. 141, pl. 3, fig. 4, pl. 4, fig. 1, pl. 5, fig. 5, pl. 6, figs. 1-4, pl. 7, figs. 2, 4, pl. 8, fig. 3, text-figs. 8, 9

*Pseudoprotophyllum senonense* Knobloch 1964, p. 151, pl. 1, figs. 3, 4, pl. 2, figs. 3, 4, pl. 4 fig. 3, text-figs. 13-15

*Platanophyllm* sp. Knobloch 1964, p. 159, pl. 2, fig. 6, text-fig. 6

*Cinnamomophyllum* sp. Knobloch 1964, p. 160, pl. 2, fig. 5, pl. 4, fig. 6, text-fig. 21

*Cerdneria snonensis* Knobloch, Němejc et Kvaček 1975, p. 56, pl. 11, figs. 1, 2, 5, pl. 12, figs. 2, 4-6, 8, pl. 13, figs. 1-3, pl. 23, figs, 1-4, text-figs. 19-22

*Platanus senonensis* Knobloch, Knobloch 1995, p. 12, pl. 4 figs. 4, 5, text-figs. 10-11

HOLOTYPE: designated by Knobloch 1964, pl. 1, fig. 3, pl. 2, fig. 4, coll. CGS, No. P2960, Fig. 3a.

TYPE LOCALITY: Zahájí, borehole No. Za 1, depth 38,50 m.

TYPE HORIZON: Klikov Formation, Santonian – Campanian, Late Cretaceous.

OCCURRENCE: Zahájí, Řídká Blana near Zliv, Zliv – creek cut, Drahotěšice, Haklovy Dvory - borehole, Klikov, Petrovice.

MATERIAL STUDIED: F 1576, F 1582, F 1583, F 1599-1605, F 1619-22, F 1626, F 1627, F 1633-35, F 1637, F 1640, F 1641, F 1700, F 1701, F 1704-27, F 1784-87, F 1790-93, F 1837, F 2253, Fs 38, P 1820, P 1837, P 2960.

EMENDED DIAGNOSIS: Leaves typically lobed, elliptical or rounded in outline, base cuneate, peltate or pseudopeltate. Margin typically entire. Venation craspedodromous, secondary veins arising from the main vein at acute angles, tertiary venation well pronounced and forming loops along the margin.

DESCRIPTION: The holotype shows the basal part of an entire-margined leaf (80 mm x 75 mm) with a peltate base. Secondary veins arise from the primary veins at an acute angle (30˚). The tertiary venation is distinct and well pronounced. It forms characteristic loops along the margin. At the base of the leaf is a fragment of the petiole.

The size of leaves of this species is very variable. Lobes can be distinct, entering a half of the lamina, or indistinct forming only a small projection. There typically are three to

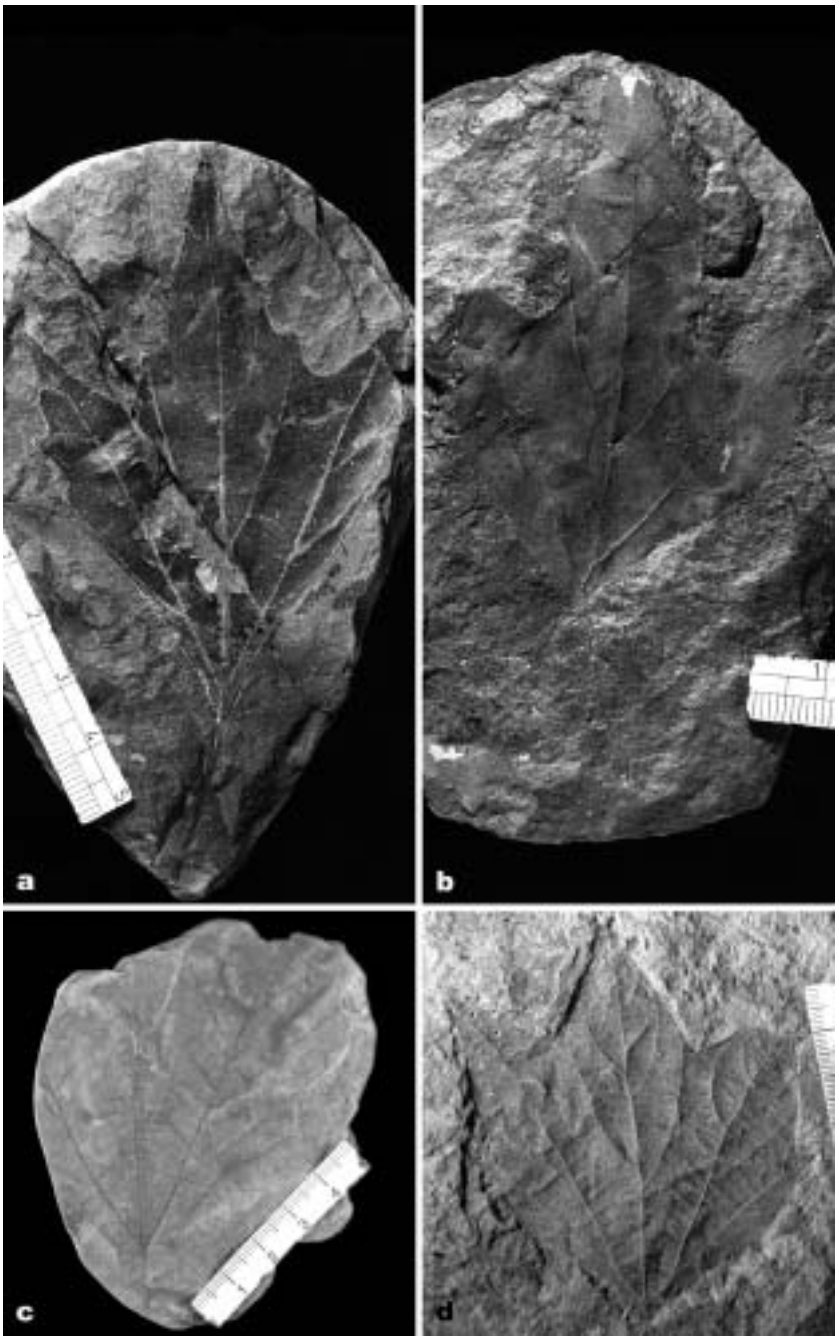


**Fig. 3(a-b):** ***Ettingshausenia laevis*****(Velenovský) comb. nov.: a – Lectotype, Velenovský 1882, pl. 4, fig. 2, Mělník, No. F 0283, coll. NM, x 1. b – Trilobate, entire-margined leaf figured by Velenovský 1882, pl. 4, fig. 3, Vyšehořovice, No. F 0782, coll. NM., x 1.**

**Fig. 3(c-d):** ***Ettingshausenia senonensis*** **(Knobloch) comb. nov.: c – Holotype, Zahájí borehole Za 1, No. P 2960, coll. CGS, x 0.7. d – Trilobate leaf figured by Knobloch 1964, pl. 6, fig. 4, Řídká Blana, Zliv, No. P 1820, coll. CGS, x 0.7.**

Table 1. Differential characters of *Ettingshausenia* species based on gross-morphology of leaves.

| | *E. laevis* | *E. bohemica* | *E. cuneifolia* | *E. senonensis* |
|---|---|---|---|---|
| Blade | lobate, rarely unlobed | diamond-shaped, lobes usually distinct | deltoid, lobes indistinct or slightly distinct | lobate, rarely unlobed |
| Margin | dentate or entire-margined | dentate in terminal part, rarely entire-margined | dentate in terminal part | entire-margined |
| Base | cuneate | peltate, pseudopeltate | cuneate | peltate, pseudopeltate or cuneate |
| Tertiary venation | indistinct | distinct | distinct | distinct |
| Tertiary venation in the margin | indistinct | frequently forming loops | never forming loops | frequently forming loops |

five lobes per lamina. All of the observed leaves are entire-margined. Their petiole is very long, reaching 45 mm in length. The majority of specimens consists of fragments showing only the venation and the margin. Secondary veins arise from primary veins at angles of 25-40˚. The tertiary scalariform venation is well pronounced in most of the samples.

DISCUSSION: *Ettingshausenia senonensis* is known thus far only from the South Bohemian Cretaceous Basins. *E. senonensis* differs from *E. cuneifolia* in usually having well pronounced lobes, in having both cuneate and peltate or pseudopeltate bases, and in always having an entire margin. *E. senonensis* differs from *E. bohemica* in always having entire-margined leaves and in having both cuneate and peltate or pseudopeltate bases. *E. senonensis* differs from *E. laevis* in having a distinct scalariform venation and in always having always entire-margined leaves.

*E. senonensis* includes a number of taxa described by Knobloch (1964), which were already synonymized by Němejc and Z. Kvaček (1975).

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