SBORNÍK NÁRODNÍHO MUZEA V PRAZE
Řada B – Přírodní vědy • sv. 71 • 2015 • čís. 3–4 • s. 315–364

ACTA MUSEI NATIONALIS PRAGAE
Series B – Historia Naturalis • vol. 71 • 2015 • no. 3–4 • pp. 315–364

REVISION OF CENOMANIAN FLORA FROM THE MALETÍN SANDSTONE

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Greguš, J., Kvaček, J. (2015): Revision of Cenomanian flora from the Maletín Sandstone. – Acta Mus. Nat. Pragae, Ser. B, Hist. Nat., 71(3-4): 315–364, Praha. ISSN 0036-5343.

Abstract. Plant fossils from the classical locality Maletín (the Czech Republic) published for the first time by Heer (1869) are revised based on their macromorphology. They come from the fluvial sandstone, a part of the Peruc-Korycany Formation of the Bohemian Cretaceous Basin. The type material by Heer has been studied in detail and lectotypes have been selected to all newly typified species. The flora from Maletín consists purely of leaf and cone impressions. The plant taxa are described in systematical order. In contrast to earlier observations this contribution reports on high number of gymnosperms (12 taxa). Pteridophytes are represented by two taxa, and angiosperms by ten taxa. The following fossil plants are reported from Maletín for the first time: cf. *Microzamia gibba* (A. E. Reuss) Corda in A. E. Reuss; cf. *Zamites bayeri* J. Kvaček in Knobloch et J. Kvaček, *Cunninghamites ubaghsii* Debey ex Ubaghs; *Dammarophyllum* sp., *Thuites alienus* Sternberg; *Conago* sp. 1 and 2, *Masculostrobus* sp. 1 and 2; *Araliaephyllum kowalewskianum* (Saporta et Marion ex Velenovský) Greguš et J. Kvaček comb. nov.; *Dicotylophyllum* sp. 1–4. Following new combinations are published: *Gleicheniaceaephyllum kurrianum* (Heer) Greguš et J. Kvaček comb. nov.; *Myrtoidea geinitzii* (Heer ex Schimper) J. Kvaček et Greguš comb. nov.; *Araliaephyllum formosum* (Heer) Greguš et J. Kvaček comb. nov., *Araliaephyllum kowalewskianum* (Saporta et Marion ex Velenovský) comb. nov. and *Dicotylophyllum macrophyllum* (Heer) Greguš et J. Kvaček comb. nov.

■ Peruc Flora, Maletín, Cenomanian, Late Cretaceous.

Received November 30, 2015
Issued December, 2015

Introduction

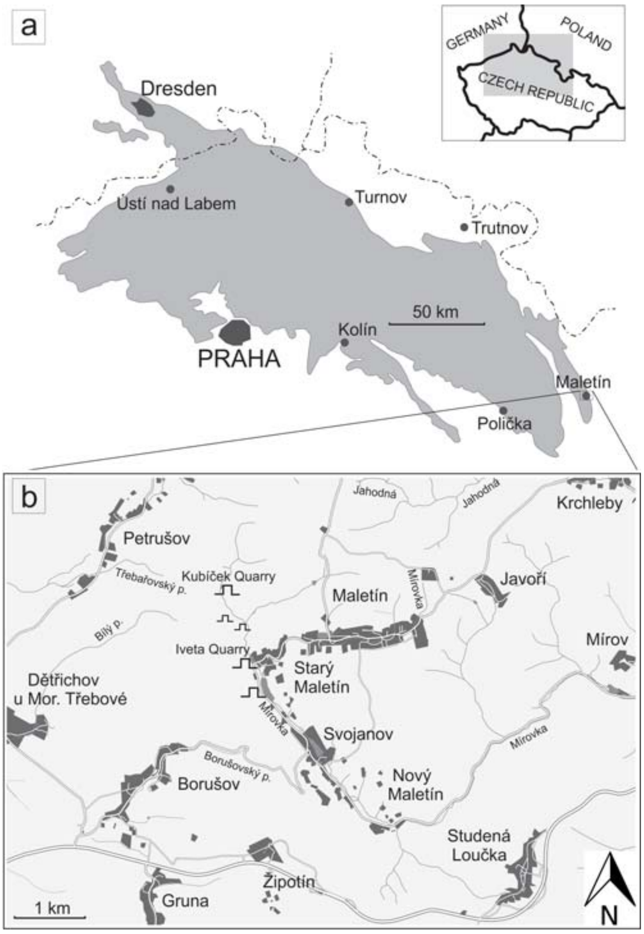
Studies of mid-European Cretaceous floras provides important knowledge of our understanding of evolution of the first angiosperm-dominated palaeoenvironments. With this aim in mind, we present here a study of classical flora of the Maletín Sandstone. The importance of the Cretaceous flora from Maletín was recognized by Oswald Heer, who described it in his work called “Flora von Moletein in Mähren” (Heer 1869). That monograph became the first comprehensive description of the Cenomanian Peruc Flora of the Bohemian Cretaceous Basin, and contains protologues of numerous important plants, like *Pinus quenstedtii, Eucalyptus geinitzii* and *Aralia formosa*. Oswald Heer described 14 new species from Maletín. His investigations were later expanded by Josef Velenovský (Velenovský 1882, 1883, 1884, 1885a, b, 1887, 1888, 1889) and Edvín Bayer (1900, 1914, 1920).

However, there are records of several earlier activities by geologists and palaeobotanists resulting in short publications predating the publication by Heer. It was Ernst Friedrich Glocker who first worked on geology and palaeontology of the Maletín Sandstone (Glocker 1841, 1842). Subsequently, August Emanuel Reuss (1854) and Constantin von Ettingshausen (in Reuss 1854) published short contributions on the topic. Reuss (1854) described sediments from the surroundings of Maletín Cretaceous, which he correctly assigned to the Peruc Member of the Peruc-Korycany Formation. He mentioned occurrence of branches and leaf impressions together with Cretaceous fauna. Short notes on the Maletín Flora were later published by Dionýz Štúr (1870). Krasser (1896) published fossil flora preserved in claystones from the locality of Kunštát situated close to Maletín, showing remarkable similarity to the Maletín Flora.

The early 20th century saw much less interest of the Maletín flora. Johann Tuppy (1914) continued in his palaeontological investigations, which were later included in a publication by Josef Soukup (1940). The Maletín flora was briefly mentioned by Vladimír Strnad (1957). Short contributions were later published by Zdeněk Gába in collaboration with Ilja Pek (Gába 1973, Gába and Pek 1980, 1981, Pek and Gába 1988).

The last report on Maletín plant fossils collected in the field was written by student Vladislav John (1992), under the supervision of Zdeněk Gába. In his manuscript, he described the latest finds of the Maletín Flora, collected in 1990.

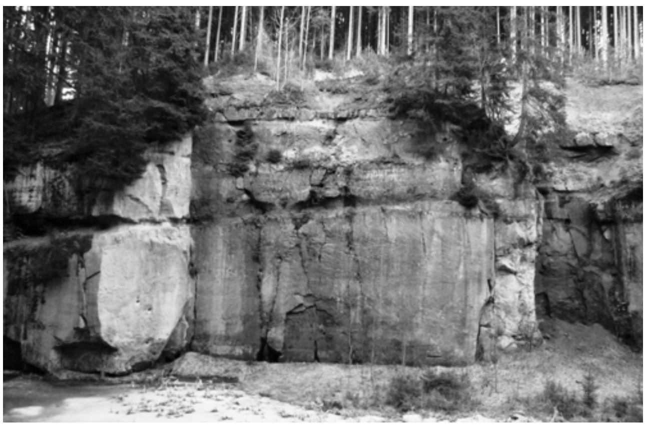
Fossil traces of plant-arthropod interactions were studied in the Maletín Sandstone by Ilja Pek and Radek Mikuláš (1997). Lauroid fossil leaves were revised by Zlatko Kvaček (1992), who studied part of the type material published by Heer that he recovered in a collection from Charles University. After revision in 1992, he returned it to the Tübingen University (Zlatko Kvaček pers. comm. 2015). The genus *Anomozamites* was reported from Maletín by Ervín Knobloch and Jiří Kvaček (1997). The last contribution



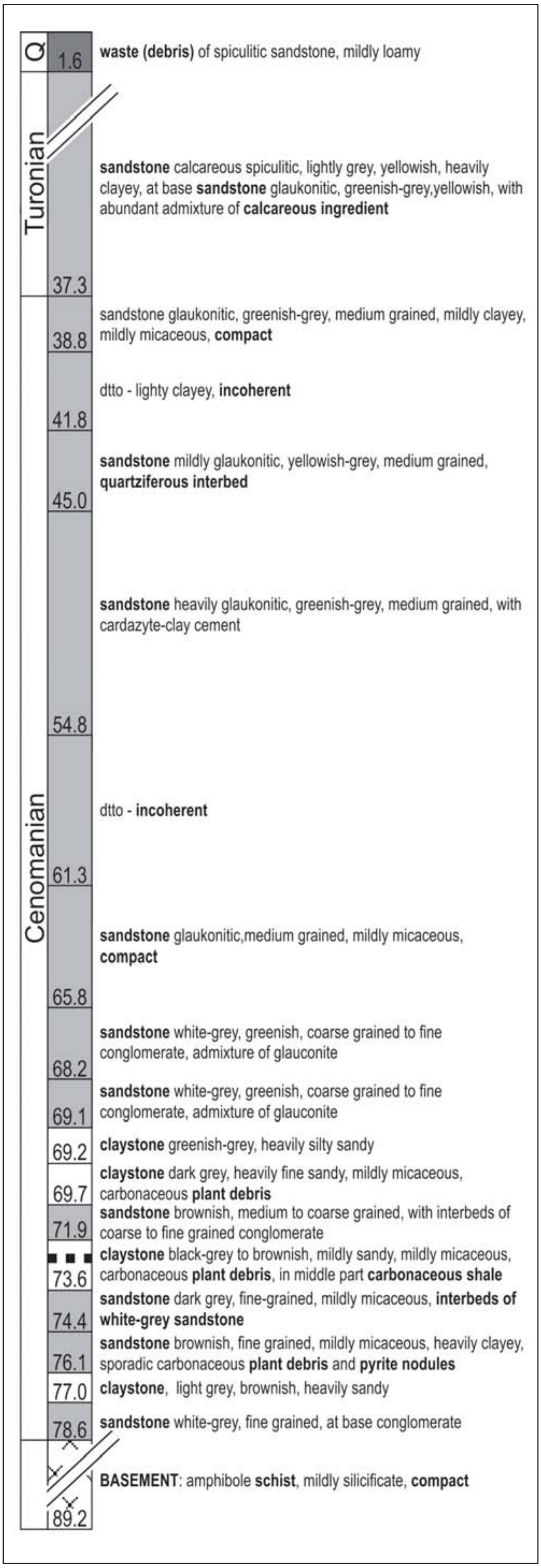
Text-fig. 1. a. Map of Czech Republic with Bohemian Cretaceous Basin (in grey). b. Map of Maletín area with the most important quarries indicated.

dealing with Maletín Flora was published by Knobloch (1999), who described several leaf impressions from there, including *Dicotylophyllum* aff. *nordenskioeldii*.

New interest in study of the flora begun in 2013, when the authors visited all the important collections of the Maletín Flora. They also described a new species of the fern *Protopteris maletinensis* from there (Greguš et al. 2013). In the following text, there is a complete description of the



Text-fig. 2. Kubíček Quarry showing section through the Peruc-Korycany Formation.



Text-fig. 3. Simplified log of borehole VMK-151, drilled near Maletín, showing major stratigraphic units of studied area.

Maletín Flora, which is a modified English version of the Master Thesis by Josef Greguš (2015).

Geological settings

The Bohemian Cretaceous Basin (see Text-fig. 1a) as defined by Čech et al. (1980) and Čech (2011) consists of sediments ranging from the Cenomanian to Santonian. The Bohemian Cretaceous Basin is the largest sedimentary basin in the Czech Republic. It covers a considerable part of the Bohemian Massif across Bohemia, Moravia and Silesia. The basin is situated in the northern part of the Czech Republic, and extends in its marginal parts to Poland and Germany. Detailed biostratigraphical studies based on pollen spectra date the Peruc-Korycany Formation to the upper part of the middle Cenomanian (Pacltová 1977).

In the surroundings of Maletín, the Peruc-Korycany Formation crops out in several old sandstone quarries, where the Maletín Sandstone was excavated. Mining of the sandstone used for sculpture dates back to the 13th century. The peak of this mining was during the end of the 18th and beginning of the 19th centuries (Pek and Gába 1988). The fossils were collected during mining activity, and probably sold by miners to collectors. Many specimens were carefully and skilfully trimmed, reflecting care which was paid to their subsequent preparation.

The best exposure of the Peruc-Korycany Formation near Maletín is preserved in the Kubíček Quarry (N 49°48.324', E 16°45.375'; Text-fig. 2, Pl. 21, Fig. 1), on the slopes of Vysoký vrch (554 m MSL). The profile is 70 m long and 16 m high, and exhibits the marine part of the Peruc-Korycany Formation. Sandstone of the Peruc Member is now completely covered by water of an artificial lake. According to the description of the nearby borehole, the Peruc Member consists of brown to grey sandstone, with lanses of grey claystones. Claystones are partly rich in fossil plant debris. At present, the quarry is abandoned and overgrown by vegetation. The second largest quarry in the area of Maletín sandstone is Iveta Quarry (N 49°47.839', E 16°45.541'; Pl. 21, Fig. 2), about 1 km south-east of the Kubíček Quarry. During a personal visit by JG, no fossil plants were recovered in the field.

Borehole VMK-151 (Text-fig. 3) was drilled five hundred meters north of the Kubíček Quarry, to 89.2 m depth. It is situated 548.96 m above sea level. According to the borehole description, there are four major boundaries: 1.6 m Quaternary / Bílá Hora Formation (Turonian); 37.3 m Bílá Hora Formation / Korycany Member (marine sandstone); 68.20 m marine / fresh water sandstone. The base of the Cretaceous is found at 78.6 m. Vachtl (1968) mentions that fresh water Cenomanian shows very irregular development, driven by irregularities of underlying crystalline bedrock.

Material and Methods

The plants are preserved as leaf impressions in sandstone, which is yellow brown, rarely rather reddish, due to content of hematite. Presence of iron inclusions is a characteristic sign of the Maletín Sandstone (Gába 1994). Gába and Pek (1981) state that Maletín Sandstone was quarried near the villages Starý Maletín, Svojanov and Prklišov (Text-fig. 1b). The material we have used for the present study is labeled "Moletain" – Maletín or "Alt Moletain" – Starý Maletín. At present, due to the number of small quarries in this area, it is difficult to identify exactly where the fossil material came from. The largest collection of fossil plants (150 specimens) is housed in the Geologische Bundesanstalt Wien (GBA). These specimens were probably accumulated by Dionýz Štúr, through Eduard Primavesi (Štúr 1870).

The second largest collection is housed in the Museum in Moravská Třebová (MMT(M) – museum, MMT(Z) – castle). The specimens there were collected by Alois Czerny and Johann Tuppy (Pek and Gába 1988, Gába and Pek 1996). The type collection of Oswald Heer (1869) is now kept in the Geologisch-Paläontologisches Institut of the University in Tübingen (GPIT), and partly housed in Staatliches Museum für Naturkunde, Stuttgart (SMNS). The type collection was gathered by Ernst Friedrich Glocker, who probably got it from the collector known as Keck von Keck (Gába and Pek 1981). Additional study material is housed in the following institutions: Czech Geological Survey (CGS), the Moravian Museum (Moravské zemské muzeum – MZM), the Masaryk University (Ústav geologických věd – UGV), the National Museum Prague (NM), the Regional Museum in Olomouc (Vlastivědné muzeum Olomouc – VMO) and the Naturhistorisches Museum Wien (NHMW).

For terminology of leaf morfology, we used Manual of Leaf Architecture (Ellis et al. 2009). We studied and documented the specimens using an Olympus SZX-12 binocular microscope under oblique light, in order to increase contrast of leaf venation. The specimens were photographed using a Canon (EOS-550D) with macro-lens objective, and a Panasonic Lumix (DMC-FS10). Images were adjusted in Adobe Photoshop CS6; plates were assembled in InDesign CS6; maps and tables were prepared in CorelDRAW Graphics Suite 11.0.

Systematic palaeontology

PTERIDOPHYTA:
Gleicheniaceaephyllum kurrianum (HEER) GREGUŠ et J. KVAČEK comb. nov.
Protopteris maletinensis GREGUŠ et J. KVAČEK

GYMNOSPERMOPHYTA:
Cycadales
cf. *Microzamia gibba* (A. E. REUSS) CORDA in A. E. REUSS

Bennettitales
cf. *Zamites bayeri* J. KVAČEK in KNOBLOCH et J. KVAČEK
cf. *Anomozamites* sp.

Pinales
Dammarophyllum sp.
Cunninghamites lignitum (STERNBERG) J. KVAČEK
Cunninghamites ubaghsii DEBEY ex UBAGHS
Thuites alienus STERNBERG
Pinus quenstedtii HEER
Conago sp. 1
Conago sp. 2
Masculostrobus sp. 1
Masculostrobus sp. 2

ANGIOSPERMOPHYTA:
Magnoliopsida
Myrtoidea geinitzii (Heer ex Schimper) J. Kvaček et Greguš comb. nov.
Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward
Araliaephyllum formosum (Heer) Greguš et J. Kvaček comb. nov.
Araliaephyllum kowalewskianum (Saporta et Marion ex Velenovský) Greguš et J. Kvaček comb. nov.
Ettingshausenia cuneifolia (Bronn) Stiehler
Dicotylophyllum macrophyllum (Heer) Greguš et J. Kvaček comb. nov.
Dicotylophyllum sp. 1
Dicotylophyllum sp. 2
Dicotylophyllum sp. 3
Dicotylophyllum sp. 4

Systematic Palaeontology

Gleicheniaceaephyllum Crabtree emend. Nagalingum et Cantrill, 2006

Type: *Gleicheniaceaephyllum falcatum* Crabtree, 1988, p. 15, pl. 4, fig. 5.

Discussion. The modern genus *Gleichenia* Smith is defined by sori, and the presence of a pseudodichotomous arrangement of compound fronds with resting buds (Tryon and Tryon 1982). Poor preservation of the studied material does not permit detailed observation of sori; however, the presence of resting buds is adequate to place these specimens in the fossil genus *Gleicheniaceaephyllum*.

Gleicheniaceaephyllum kurrianum (Heer) Greguš et J. Kvaček comb. nov.

Pl. 1, Fig. 1–4; Pl. 2, Fig. 1–2

1869 *Gleichenia kurriana* Heer, Kreide Fl. Moletein in Mähren. p. 6, pl. 2, fig. 1–4 (Basionym).
1929 *Dicranopterites gieseckiana* Heer; Domin, p. 241, text-fig. 157.

Lectotype: GPIT/PL_727, Pl. 1, Fig. 1a, b, designated here; Heer 1869, p. 6, pl. 2, fig. 1.

Epitype: MMT(M)/G_438, Pl. 1, Fig. 2a, b, designated here.

Type locality: Maletín.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_25, 157; GPIT/PL_638, 649, 722, 726, 741, 757; MMT(M)/G_335.

Occurrence: only the type locality.

Emended diagnosis. Pseudodichotomous leaf fronds with resting bud in place of dichotomy of main rachis. Leaf fronds 2–3 pinnate, lanceolate to elongated, almost vertical to main rachis, alternately and densely arranged. Leaf pinnae composed of pinnules touching in basal part each other, apices bluntly rounded. Central veins apparent, simple. Sori rounded, on both sides of central veins.

Description. The lectotype (GPIT/PL_727, Pl. 1, Fig. 1a, b) described by Heer (1869, p. 6, pl. 2, fig. 1) as *Gleichenia kurriana* Heer represents a fragment of a bipinnate leaf frond consisting of a main central rachis and almost vertically arranged fertile pinnae. Leaf pinnae are preserved only on one side, 14 mm long and 5 mm wide. On the main rachis, 8 mm along, there is attached a second leaf pinna, 27 mm long and 5 mm wide. Widths of the pinnae are uniform. To the rachis of leaf pinnae are attached, at an obtuse angle, 3–4 mm long and 2–3 mm wide leaf pinnule, with well pronounced central veins. There are 2–3 sori on both sides of the central vein (Pl. 1, Fig. 1b). Leaf pinnules are 2–3 mm apart in the apical parts; in the wider basal parts, the gap is narrower, ocasionally disappearing entirely. The epitype (MMT(M)/G_438, Pl. 1, Fig. 2a, b) is represented by a pseudodichotomous leaf frond, with partially preserved resting bud in the place of division of the main rachis (Pl. 1, Fig. 2b). The leaf frond is 95 mm long, with almost vertically arranged pinnae (28×5 mm). Leaf pinnae are arranged alternately on the main rachis, approximately 10 mm apart, consisting of smaller pinnules. Leaf pinnules are 3–4 mm long and 2–3 mm wide, apex rounded, touching in basal parts. Sori are not observed.

The fertile pinna no. GPIT/PL_722 (Pl. 1, Fig. 3) is approximately 30 mm long and 5 mm wide. The pinna is stable in width throughout its length. Leaf pinnules slightly tending to narrow to the apex, arranged on 1 mm wide rachis, 3 mm long and 2 mm wide, they slightly touch each other in the basal parts. Within each pinnule, there are two to three sori on both sides of the central vein. Fertile pinnae (GPIT/PL_722, Pl. 1, Fig. 3; GPIT/PL_727, Pl. 1, Fig. 1b) are 2–3 mm apart, while sterile pinnae (GPIT/PL_726, Pl. 1, Fig. 4; GPIT/PL_741, Pl. 2, Fig. 1a, b) almost touch. Other specimens from Maletín are mostly sterile or poorly preserved fragments of leaf fronds, with alternately arranged leaf pinnae. Leaf fragments are up to 120 mm wide. Pinnules are obtuse, rounded in apical parts departing from the rachis at a 90° angle. Leaf pinnae are almost alternately arranged on the main rachis (width is 0.5–1 mm).

Discussion. The genus *Gleichenia* is typical in having a pseudodichotomous leaf frond, with a resting bud in the place of division of rachis. This character is present only in the epitype (MMT(M)/G_438, Pl. 1, Fig. 2a, b). *Gleicheniaceaephyllum falcatum* Crabtree, from the Albian of SW Montana (Crabtree 1988) is known only as sterile foliage which does not provide conclusive traits. Individual leaf pinnules of *G. falcatum* are very similar to the leaf pinnules of *G. kurrianum* (Nagalingum and Cantrill 2006). After detailed comparison with the North American species, they might be identified as the same species. In that case, the name *G. kurrianum* would have priority over *G. falcatum*. *Gleicheniaceaephyllum acutum* Nagalingum et Cantrill from the Albian of Alexander Island, has one sorus per pinnule and pointed apices, in contrast with *G. kurrianum* (Nagalingum and Cantrill 2006). Domin (1929) published the specimen from Maletín (MMT(M)/G_438, Pl. 1, Fig. 2a), selected here as the epitype under the name *Dicranopterites gieseckiana* Heer. This species, described from the Lower Cretaceous of Greenland´s Kuk locality, differs from

G. kurrianum in having remarkably backwards bent leaf pinnules (Seward and Conway 1935).

Palmacites horridus Heer (Heer 1869, p. 15, pl. 5, fig. 1) taxon originally interpreted by Heer as a palm remain is probably a remain of fern, most probably poorly preserved frond of *G. kurrianum*. This specimen shows regularly arranged sub-opposite axes, which resemble secondary rachises of pinnae of *G. kurrianum*. A similar specimen (GPIT/PL_649) is depicted in Pl. 2, Fig. 2.

Protopteris Sternberg, 1838

Type: *Lepidodendron punctatum* Sternberg, 1820, p. 20, 23, pl. 4, fig. 1 = *Protopteris punctata* (Sternberg) C. Presl in Sternberg, 1838, p. 170, pl. 65, fig. 1–3.

Discussion. This genus was re-defined to accommodate casts of Mesozoic tree fern stems (Greguš et al. 2013). The genus *Protopteris* has one uninterrupted vascular bundle scar, which distinguishes it from the genus *Protocyathea* O. Feistmantel, where the vascular bundle scars are formed with a few small irregular pits. In this character, *Protopteris* is similar to the recent genus *Cyathea* J. E. Smith. The genus *Protopteris* has leaf scars helically arranged, as opposed to the genus *Oncopteris* Dormitzer in Krejčí, in which leaf scars occur in longitudinal rows. *Protopteris*, in comparison with the Paleozoic genus *Megaphyton* Artis, has more than two lines of leaf scars on the stem. Another Paleozoic genus, *Caulopteris* Lindley et Hutton also has helically arranged leaf scars (Pfefferkorn 1976), just like *Protopteris*. Additionally, both Paleozoic genera have much larger leaf and vascular bundle scars, compared to the genera *Oncopteris* and *Protopteris* (Greguš et al. 2013).

Protopteris maletinensis Greguš et J. Kvaček

Pl. 2, Fig. 3–6

Holotype: NHMW_1878B/0006/7141, Pl. 2, Fig. 3a–c; Greguš et al. 2013, p. 74, pl. 3, fig. 1–3.

Type locality: Maletín.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_2013/019/0001, 0002; UGV/S17_2.

Occurrence: Vyšehořovice.

Diagnosis. See Greguš et al. (2013).

Description. The holotype (NHMW/1878B/0006/7141, Pl. 2, Fig. 3a–c) described by Greguš and J. Kvaček (Greguš et al. 2013, p. 74, pl. 3, fig. 1–3) is an 80 mm wide and 180 mm long cast of a stem, with helically arranged large leaf saccate cushions, 18–27 mm wide and 32–43 mm high. Within each leaf cushion, an oval leaf scar is preserved, containing a horseshoe-shaped vascular bundle scar (Pl. 2, Fig. 3b, c). Leaf scars are generally 18–20 mm wide and 8–13 mm high. Small pits under the leaf scars are probably remnants of aerial roots. Grooves, which run longitudinally through the leaf cushion, may also be aerial root remains. The leaf scar ratio of height to width is 0.4–0.7, and on the stem it appears at an average density of 10/dm^2. Additional material from Maletín consists of poorly preserved specimens (UGV/S17_2, Pl. 2, Fig. 4; GBA_2013/019/0001, Pl. 2, Fig. 5; GBA_2013/019/0002, Pl. 2, Fig. 6), which show helically arranged leaf cushions with leaf scars similar to the holotype. Fragments of stem casts are usually 55–85 mm in diameter. Specimen UGV/S17_2 has well-pronounced leaf cushions 14–26 mm wide and 23–45 mm high. Height to width leaf scar ratio is 0.4. On this specimen, small pits are apparent, which are probably the remnants of aerial roots.

Discussion. *Protopteris maletinensis* has “saccate” leaf cushions (Sternberg 1838, Corda 1845), in comparison with *P. punctata* (Sternberg) C. Presl in Sternberg from the Cenomanian locality Kounice, and *P. punctata* (Sternberg) C. Presl in Sternberg from the Polish locality Żeliszów (Turonian-Coniacian). *P. maletinensis* is very similar to *P. laubei* (Engelhardt) Stenzel from the Late Eocene of Staré Sedlo Formation (Engelhardt 1881, Knobloch et al. 1996), which also has “saccate”, helically arranged leaf cushions on the stem. Leaf scar widths in both species are almost the same. They vary primarily in height, which is 8–13 mm for P. *maletinensis* and 14–19 mm for *P. laubei*. Average height-width ratios are 0.5 for *P. maletinensis*, and 0.8 for *P. laubei*. *P. laubei* has leaf cushions splitting away more from the stem, with wider gaps between cushions than in *P. maletinensis*. Another similar species is *P. witteana* Schenk, from the Early Cretaceous of Germany (Schenk 1871), which has smaller leaf cushions (12–15×17–24 mm) than *P. maletinensis*. Between the cushions, there are 5–7 mm wide gaps. Leaf scars of *P. witteana* have a height-width ratio greater than one, as opposed to *P. maletinensis*, where it is less than one. Height to width leaf scar ratio for *P. witteana* averages 1.2; the same is true for *P. punctata*. Apical parts of leaf cushions of *P. witteana* are more pressed to the stem, and their density is two times higher than in *P. maletinensis.*

Microzamia Corda in A. E. Reuss, 1846

Type: *Conites gibbus* A. E. Reuss, 1844, p. 169 = *Microzamia gibba* (A. E. Reuss) Corda in A. E. Reuss, 1846, p. 85, pl. 46, fig. 1–10.

Discussion. Ovuliferous strobili of the genus *Microzamia* differ from similar strobili of the genus *Bayeritheca* J. Kvaček et Pacltová in having two ovate seeds on the inner side of the ovuliferous scale, not pollen (J. Kvaček 1997, J. Kvaček and Pacltová 2001). The material from the Maletín locality, preserved as an impression in sandstone, is difficult to assess. However, helically arranged scales forming heads with four protuberances in central part are a characteristic feature of the genus *Microzamia*, and therefore allow us to assign the studied material to this genus.

cf. _Microzamia gibba_ (A. E. Reuss) Corda in A. E. Reuss

Pl. 3, Fig. 1a, b

Neotype: NHMW_A. 5953a, J. Kvaček 1997, p. 85, pl. 1, fig. 1.

Type locality: Třebívlice.

T y p e   h o r i z o n : Bílá Hora Formation, Turonian, Upper Cretaceous.

M a t e r i a l   s t u d i e d : GPIT/PL_634.

O c c u r r e n c e : Maletín, Vyšehořovice (Peruc-Korycany Formation).

D e s c r i p t i o n . The specimen from Maletín locality represents a unique (GPIT/PL_634, Pl. 3, Fig. 1a, b) impression of a strobilus (16×82 mm), which is longitudinally ovate, apically acuminate and narrowed in the base. Helically arranged scales represented by hexagonal peltate heads are 5 mm high and 7 mm wide. The heads are covered with protuberances and trichomes. In central parts of some heads there are apparent four larger protuberances (Pl. 3, Fig. 1b).

D i s c u s s i o n . The neotype chosen by J. Kvaček (1997) has different preservation than the specimen from Maletín (GPIT/PL_634). However, numerous of specimens from the locality of Vyšehořovice show a similar mode of preservation (Velenovský 1885b, pl. 3, fig. 5–16, pl. 4, fig. 6), and argue for including the material studied in this taxon, particularly due to the presence of tubercles in central parts of peltate heads. *Bayeritheca hughesii* J. Kvaček et Pacltová from the Cenomanian of Březany locality (J. Kvaček and Pacltová 2001) differs from our material in lacking well pronounced centrally placed tubercles on heads. However, the material studied lacks internal structures, which are important for a definite determination.

Zamites Brongniart, 1828

T y p e : *Zamia gigas* Lindley et Hutton, 1835, p. 45, pl. 165 = *Zamites gigas* (Lindley et Hutton) Morris, 1841, p. 116.

D i s c u s s i o n . The genus *Zamites* is based on the material from Jurassic localities from Yorkshire (Great Britain). The occurrence of this genus is confirmed from the Peruc-Korycany Formation of the Bohemian Cretaceous Basin by Knobloch and J. Kvaček (1997).

cf. *Zamites bayeri* J. Kvaček in Knobloch et J. Kvaček

Pl. 3, Fig. 2–7

1900 *Podozamites latipennis* Heer; Bayer, p. 26, pl. 2, fig. 3.
1914 *Podozamites latipennis* Heer; Bayer, p. 23, text-fig. 11.
1920 *Podozamites latipennis* Heer; Bayer, p. 26, text-fig. 11.
1997 *Zamites bayeri* J. Kvaček in Knobloch et J. Kvaček, p. 569, text-fig. 2a.

H o l o t y p e : NM-F2353, Knobloch and J. Kvaček 1997, p. 569, text-fig. 2a.

P a r a t y p e : NM-F2167, Knobloch and J. Kvaček 1997, p. 569, text-fig. 2b.

T y p e   l o c a l i t y : Praha-Malá Chuchle.

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

O c c u r r e n c e : Maletín, Velké Opatovice.

D e s c r i p t i o n . Studied specimens from Maletín are represented by four partially preserved, simply pinnate leaf impression, with rachis and several fragments of isolated leaflets. On approximately 5 mm wide rachis, there are leaflets arranged sub-alternately. The best preserved specimen, no. GBA_4 (Pl. 3, Fig. 2b) shows leaflets up to 165 mm long. Leaflets are lanceolate, up to 11 mm wide, and 5–10 mm apart. Their apex is rounded or slightly narrowing, frequently seemingly missing; base is slightly constricted (Pl. 3, Fig. 2a). Simple veins run parallel with leaflet margin; they are typically 2–3 per mm. Two poorly preserved specimens show pinnate leaves (GBA_134, Pl. 3, Fig. 5; MMT(M)/G_431, Pl. 3, Fig. 6), with leaflets typically constricted in basal parts. Despite the missing apex, leaflets are up to 90 mm long. Other specimens show fragments of leaflets up to 12 mm wide, with parallel venation. An isolated fragment of leaflet (MZM/118_18, Pl. 3, Fig. 4) and its negative MZM/118_23 show a preserved rounded to obtuse apex. Specimen no. GBA_66 (Pl. 3, Fig. 3) shows a well preserved base with typical basal constriction.

D i s c u s s i o n . *Zamites bayeri* is similar to *Dioonites cretosus* (Reich) Schimper (= *Pterophyllum saxonicum* Reich) from the Cenomanian of Saxony (Schimper 1870). In the Bohemian Cenomanian, this type of foliage was first discovered by Bayer (1900) in sandstones from Hořice. *D. cretosus* has folioles more regularly, densely arranged, with the base gradually narrowing and more decurrent (Viniklář 1933). Distance between leaflets on the rachis is only 2 mm; for *Z. bayeri* it is up to 10 mm. Leaflets of *C. cretosus* are 15–20 mm wide, showing only 11–13 veins, while leaflets of *Z. bayeri* are 10–12 mm wide and show 30–36 veins. *Zamites* cf. *bayeri* is known from the locality Velké Opatovice (Knobloch and J. Kvaček 1997), which is close to the locality Maletín. Also, this specimen lacks anatomical evidence, and its determination is based only on morphological characters.

Specimen no. GBA_5 (Pl. 3, Fig. 7) is rather different from the rest of the material, having decurrent bases of leaflets. Based on this character, we assign this specimen to cf. *Zamites bayeri* with question mark.

Anomozamites Schimper, 1870, emend. Pott et McLoughlin, 2009

T y p e : *Anomozamites nilssonii* (Phillips) Harris, 1969, p. 79.

D i s c u s s i o n : Due to the conflict in the definition of the genus *Anomozamites*, Pott and McLoughlin (2009) emended this genus, and chose *A. nilssonii* as a type of the genus. The genus *Anomozamites* has leaflets at most two times longer than wide contrary to the genus *Pterophyllum* Brongniart. Genus *Anomozamites* has veins numerous and parallel, simple or once dichotomously branched, ending in the apex (Pott and McLoughlin 2009).

cf. *Anomozamites* sp.

Pl. 3, Fig. 8; Pl. 4, Fig. 1–3

1997 *Anomozamites* sp. 2, Knobloch and J. Kvaček, p. 581, text-fig. 8a, b.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_127, 128; NHMW_28; NM-F2521.

Occurrence: Maletín.

Description. Four specimens show relatively large pinnate leaves up to 300 mm in length, with several preserved leaflets on both sides of rachis. Leaflets are rectangular in shape, usually two times longer than wide. Simple veins run parallel with leaflet margins to the apex (Pl. 4, Fig. 2b). Apical parts of leaflets are incompletely preserved. Specimen NM-F2521 (Pl. 4, Fig. 2a) is 215 mm long, with 13 preserved fragments of leaflets on one side of the 5 mm wide rachis. Sub-opposite rectangular leaflets are 12–18 mm long, 11–12 mm wide, with parallel margins, not narrowing to the base. Partly preserved apices are truncate. Distance between leaflets is 3–5 mm. Specimen no. GBA_128 (Pl. 4, Fig. 1) is an 80 mm long and represents a fragment of pinnate leaf, with five preserved rectangular leaflets on one side of 5 mm wide rachis. Leaflets are 16–17 mm long, 11–12 mm wide. Specimen no. GBA_127 (Pl. 3, Fig. 8) shows two leaflets, which are clearly longer than wide (24×11 mm and 20× 11 mm), compared to specimen no. NHMW_28 (Pl. 4, Fig. 3), which has leaflets wider (up to 13 mm) and shorter (up to 8 mm).

Discussion. *Anomozamites* is based on *Anomozamites nilssonii* (Phillips) Harris, from the Jurassic of Yorkshire (Pott and McLoughlin 2009). *Anomozamites* is similar to *Pterophyllum,* based on *P. longifolium* Brongniart (= *P. filicoides* (Schlotheim) Zeiller) described from the Carnian (Upper Triassic) of Neuewelt, Basel, Switzerland (Pott et al. 2007), which shows veins dichotomously divided, and leaflets two times longer than wide. Harris (1932) points out that *Anomozamites* has leaflets as long as wide. However, specimens from the Maletín locality show leaflets 16–18 mm long, and only 11–12 mm wide. Pott and McLoughlin (2009) added in their emended diagnosis, that the length to width ratio in *Anomozamites* should be at most 2:1. Based on this, we assign the material studied from Maletín to the genus *Anomozamites*.

***Dammarophyllum* Velenovský ex J. Kvaček, 2003**

Type: *Podozamites striatus* Velenovský, 1885b, p. 10, pl. 2, fig. 8. = *Dammarophyllum striatum* Velenovský ex J. Kvaček, 2003, p. 14, fig. 1a.

Discussion. The generic name *Dammarophyllum* was first published by Velenovský (1889) in combination *Dammarophyllum striatum* (Velenovský) Velenovský nom. nud. without any diagnosis or description, so it was invalidly published. However it was commonly used in further publications (Frič and Bayer 1901, 1903, Seward 1919, Hluštík 1980). The genus was later validated by J. Kvaček (2003).

The difference between genera *Dammarophyllum*, *Podozamites* C. F. W. Braun and *Lindleycladus* Harris is based on the epidermal leaf structure (see J. Kvaček 2003). *Dammarites* Presl has, in contatrast to *Dammarophyllum*, long linear leaves without any petiole. It differs remarkably in having stems short and cone-shaped (Hluštík 1976). The genus *Nageiopsis* Fontaine shows venation ending in leaf margin, and does not convert to the apex, which is typical for the genus *Dammarophyllum.* From all mentioned genera, the genus *Dammarophyllum* differs in venation pattern: between wider veins there are typically present intersecondary veins (J. Kvaček 2003).

***Dammarophyllum* sp.**

Pl. 4, Fig. 4

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: MMT(M)/G_338.

Occurrence: Maletín.

Description. Single specimen no. MMT(M)/G_338 (Pl. 4, Fig. 4) from Maletín is a 160 mm long and 25 mm wide leaf impression. The leaf lamina is entire-margined, elliptic to lanceolate, with obtuse apex. Abruptly narrowing base runs to relatively wide, and 30 mm long petiole. Dense parallel venation converts to the apex consisting of two types of veins: primary veins and intersecondary veins. Overall number of veins is up to 30 in the widest part of leaf lamina. Density is approximately 12 veins per cm.

Discussion. Based on the shape of the leaf lamina and venation pattern, the studied material is assigned to the genus *Dammarophyllum*. This genus has uncertain systematic affinity, and probably belongs to the family Araucariaceae (J. Kvaček 2003). It differs in shape and size of leaf lamina from morphologically similar *D. striatum* (Velenovský) Velenovský ex J. Kvaček, from the Cenomanian of Bohdánkov. The specimen described here has elliptic to lanceolate lamina, 160 mm long and 25 mm wide, while the holotype of *D. striatum* (NM-F241), described by J. Kvaček (2003), is smaller (61×21 mm), and more ovate to rhombic in shape. Additionally, *D. sriatum* is defined by cuticle, which is not preserved in the specimen from Maletín.

***Cunninghamites* C. Presl in Sternberg, 1838**

Type: *Cunninghamites oxycedrus* C. Presl in Sternberg 1838, p. 203, pl. 49, fig. 1a–b.

Discussion. The genus *Cunninghamites* was emended by Bosma et al. (2012). It is similar to *Elatocladus* Halle in length and shape of needles, but differs in having leaf cushions bearing needle-like leaves with constricted bases. It also differs in number of ribs. *Cunnighamites* has 3 to 5 ribs (resin canals) compared to the genus *Elatocladus*, which has only one rib (J. Kvaček 1999).

***Cunninghamites lignitum* (Sternberg) J. Kvaček**

Pl. 4, Fig. 5–8

1825 *Lycopodiolites lignitum* Sternberg, Flora der Vorwelt, vol. I, p. 8.

1846 *Cunninghamia elegans* Corda in Reuss; Corda in Reuss, p. 93, pl. 49, fig. 29–31.
1846 *Cunninghamia planifolia* Corda in Reuss; Corda in Reuss, p. 93, pl. 50, fig. 1–3.
1847 *Cunninghamites elegans* (Corda in Reuss) Endlicher, p. 305.
1847 *Cunninghamites planifolius* (Corda in Reuss) Endlicher, p. 305.
1869 *Cunninghamites elegans* (Corda in Reuss) Endlicher; Heer, p. 12, pl. 1, fig. 14.
1885b *Cunninghamia elegans* Corda in Reuss; Velenovský, p. 14, pl. 4, fig. 5, pl. 5, fig. 1, 7, pl. 6, fig. 5.
1885b *Cunninghamia stenophylla* Velenovský, p. 15, pl. 5, fig. 2, 4, 10, 16.
1926a *Kettneria elegans* (Corda in Reuss) Velenovský et Viniklář, p. 11, 38, pl. 1 fig. 12–15, pl. 3, fig. 6.
1997 *Lycopodiolites lignitum* Sternberg; J. Kvaček et Straková, fig. 94.
1999 *Cunninghamites lignitum* (Sternberg) J. Kvaček, p. 131, fig. 4–6.
2012 *Cunninghamites lignitum* (Sternberg) J. Kvaček; Bosma et al., p. 22, pl. 1, fig. 3–4, pl. 2, fig. 5–6.

Lectotype: NM-F636, selected by J. Kvaček 1999.

Epitype: NM-F2708a, selected by Bosma et al. 2012, p. 22, pl. 2, fig. 6.

Type locality: Mšené Lázně.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GPIT/PL_755; MMT(M)/G_319, 320, 484; UGV_22.

Occurrence: Maletín, Vyšehořovice, Horoušany, Pecínov, Praha-Hloubětín, Praha-Hloubětín, Hutě, Praha-Vidoule.

Description. Specimen no. GPIT/PL_755 (Pl. 4, Fig. 5a, b) described by Heer (1869, p. 12, pl. 1, fig. 14) as *Cunninghamites elegans* (Corda in Reuss) Endlicher is a 225 mm long and 8 mm wide simple shoot. On the main axis of the branch, there are helically arranged leaf cushions of rhombic to obovate shape (5–6 mm long and 2–3 wide). Linear to lanceolate needle-like leaves grow out of the leaf cushions at a 45° angle. Needles have acute apex and poorly preserved base. The specimen no. GPIT/PL_755 (Pl. 4, Fig. 5b) shows the only completely preserved needle 25 mm long and 2–3 mm wide. Three poorly preserved ribs run through the entire length of the needle. Shoot no. MMT(M)/G_319 (Pl. 4, Fig. 7) is 160 mm long and up to 10 mm wide, with helically arranged leaf cushions of rhombic to obovate shape. Leaf cushions are 5–6 mm long and 2–4 mm wide. Linear needles, 25 mm long and 3 mm wide, are not well preserved, their apex not apparent. Specimen no. UGV_22 (Pl. 4, Fig. 6) is an approximately 280 mm long and 10 mm wide shoot, with helically arranged leaf cushions of rhombic to obovate shape. Leaf cushions are 5–6 mm high and 2–4 mm wide. The main shoot axis is branched, showing approximately 3 mm wide and up to 50 mm long secondary axes. Other material from Maletín is represented by fragments of shoots, which are up to 150 mm long and 12 mm wide with apparent, helically arranged leaf cushions. Leaf cushions are of rhombic to obovate shape, 5–6 (7) mm long and 3–4 mm wide. Specimen no. MMT(M)/G_320 (Pl. 4, Fig. 8) shows partially preserved fragments of needles, which are up to 2 mm wide, without apices leaving shoot at a 45° angle.

Discussion. *Cunninghamites lignitum* is morphologically similar to *C. oxycedrus* C. Presl in Sternberg from the German Cretaceous (Niederschöna). Corda (in Reuss 1845) mentioned differences between them in gross morphology, such as length and width. As Harris (1979) points out, widths of needles are a misleading character. Lengths of needles of *C. lignitum* were probably variable, as stated by Bosma et al. (2012). However, differences between *C. lignitum* and *C. oxycedrus* are expressed in the cuticle pattern. A common occurrence of *C. lignitum* in the Bohemian Cretaceous Basin, and other minor morphological differences (3 ribs per needle) leads us to identify the studied material as *C. lignitum*. This name also has priority in nomenclature aspects.

C. lignitum has very short needles, compared to *C. ubaghsii* Debey ex Ubaghs from the Late Cretaceous of the Netherlands (locality Kunrade) which has needles up to 120 mm long (van der Ham et al. 2004). *C. squamosus* Heer from the German Upper Cretaceous (locality Altenburg) has, compared to *C. lignitum*, needles up to 65 mm long (Bosma et al. 2012).

Cunninghamites ubaghsii Debey ex Ubaghs

Pl. 4, Fig. 9; Pl. 5, Fig. 1–2

1869 *Pinus quenstedti* Heer, p. 13, pl. 2, fig. 5–9, pl. 3, fig. 1.
1885 *Cunninghamites ubaghsii* Debey ex Ubaghs, p. 28.
2004 *Cunninghamites ubaghsii* (Debey ex Ubaghs); van der Ham and van Konijnenburg-van Citter, p. 28, fig. 7.
2004 *Cunninghamites ubaghsii* (Debey ex Ubaghs); van der Ham et al., p. 94, fig. 3–6.
2012 *Cunninghamites ubaghsii* (Debey ex Ubaghs); Bosma et al., p. 25, pl. 2, fig. 1.
2013 *Cunninghamites ubaghsii* (Debey ex Ubaghs); Halamski, p. 8, fig. 5J, 6B.

Holotype: No. b4318 (housed in the Royal Belgian Institute of Natural Sciences), (Ubaghs 1885, p. 28; van der Ham et al. 2004, fig. 3).

Type locality: Kunrade, province Limburg (the Netherlands).

Stratigraphy: Maastrichtian, Late Cretaceous.

Material studied: GPIT/PL_654, 730, 757.

Occurrence: Maletín; Krasnobród, Poland (Campanian-Maastrichtian).

Description. Specimen no. GPIT/PL_730 (Pl. 5, Fig. 1a, b) described by Heer (1869, p. 13, pl. 2, fig. 5) as *Pinus quenstedtii* Heer is a 75 mm long and 12 mm wide fragment of a shoot, with helically arranged, clearly visible leaf cushions of obovate rhombic shape. Leaf cushions are 4–5 mm long and 2–3 mm wide (Pl. 5, Fig. 1b). Linear leaves up to 100 mm long leave the leaf cushions at a 45° angle. Apex of the needle is not as well apparent as the base. In the central part of the needle, there is one pronounced groove/keel. Leaf cushions bearing needles are apparent only in the upper half of the axis fragment. In the lower half of the axis, remains of leaf cushions form small helically arranged 2–3 mm wide pits. Specimen no. GPIT/PL_757 (Pl. 5, Fig. 2a, b) described by Heer (1869, p. 13, pl. 3, fig. 1–3) is a 200 mm long and 12 mm wide shoot, with helically arranged, clearly visible leaf cushions of obovate to rhombic shape (5–6 mm long and 3–4 mm wide) bearing needles up to 200 mm. Specimen no. GPIT/PL_654 (Pl. 4, Fig. 9) is a fragment of longitudinally broken shoot bearing helically arranged needles. Due to lack of apical parts of needles, their length has to be more than 40 mm.

Discussion. The studied specimens determined here as *C. ubaghsii* were originally described by Heer (1869) as *Pinus quenstedtii.* They have needles growing out of leaf cushions separately. Needles arranged in brachyblasts are a typical distinctive character of the genus *Pinus* Linnaeus. Within the Bohemian Cretaceous Basin, the genus *Pinus* is known from the Cenomanian locality of Lanšperk as *Pinus landsbergensis* J. Kvaček, showing typical brachyblasts (J. Kvaček 2013). *C. ubaghsii* differs from other species of the genus *Cunninghamites* in having very long needle-like leaves (Bosma et al. 2012).

Thuites Sternberg, 1825

Type: *Thuites alienus* Sternberg, 1825, p. 38, pl. 45, fig. 1.

Emended diagnosis. Sterile shoot helically covered with rhombic leaf cushions. Needles slightly protruding, imbricate, in terminal part acuminate. Needles longer than width of leaf cushions. In longitudinal section, needles of sigmoid shape.

Discussion. Sternberg (1825) defined the genus *Thuites* only on the basis of a sterile branch. He did not established type of the genus, which was done later by J. Kvaček and Straková (1997). As was shown by Kendall (1949), and Cleal and Rees (2003), other species described by Sternberg (1825) from the British Jurassic belong to *Brachyphyllum expansum*. The modern genus *Sequoia* Endlicher is not suitable for sterile fossil material as used by Velenovský (1885b) or Knobloch (1971), because it is also characterized by reproductive organs (Farjon 2005). Here we suggest using the genus *Thuites* for sequoia-like sterile foliage. The genus *Brachyphyllum* Lindley et Hutton ex Brongniart has, compared to genus *Thuites*, length of needles shorter or equal to the length of leaf cushions, and not sigmoid in longitudinal section. The genus *Pagiophyllum* Heer has, like the genus *Thuites*, length of needles longer than leaf cushions, but they are not sigmoid in longitudinal section. From a nomenclature aspect, the genus *Thuites* even has priority over the genus *Pagiophyllum*. According to Herman and J. Kvaček (2010), the genus *Geinitzia* Endlicher, in contrast with the genus *Thuites* has needles falcate, not sigmoid, curved towards the terminal part of the shoot. The genus *Cyparissidium* Heer has needles more adpressed to the shoot, and slightly flattened.

Thuites alienus Sternberg

Pl. 5, Fig. 3; Pl. 6, Fig. 1–4; Pl. 7, Fig. 1–8

1825 *Thuites alienus* Sternberg, vol. I, 4, p. 40, 38, pl. 45, fig. 1.
1828 *Juniperites aliena* (Sternberg) Brongniart, p. 108.
1833 *Caulerpites fastigiatus* Sternberg, vol. II, 5/6, p. 23, nom. illegit.
1847 *Widdringtonites fastigiatus* (Sternberg) Endlicher, p. 272, nom. illegit.
1869 *Sequoia fastigiata* (Sternberg) Heer, p. 11, pl. 1, fig. 10–13, nom. illegit.
1869 *Sequoia reichenbachii* (Geinitz) Heer, p. 7, pl. 1, fig. 1–9.
1971 *Sequoia aliena* (Sternberg) Knobloch, p. 44.

Lectotype: NM-F3675, Pl. 5, Fig. 3, designated here (Sternberg 1825, pl. 45, fig. 1).

Type locality: Smečno (“Smetschna”).

Type horizon: Turonian, Upper Cretaceous.

Material studied: GBA_24, 58, 74; GPIT/PL_642, 645, 646, 650, 661, 716, 723a,c723b, 725, 737, 751; MMT(M)/G_320, 321, 351, 376, 429, 432, 433, 444, 445, 453, 447; MMT(Z)/G_447; MZM/118_35, 47; NHMW_6; NM-F344; SMNS/650_16; UGV_24.

Occurrence: Maletín.

Emended diagnosis. Shoot helically covered with leaf cushions of rhombic shape with apparent groove in the middle. Leaf cushions bearing slightly protruding, accuminate, imbricate needles.

Description. The lectotype (NM-F3675, Pl. 5, Fig. 3) originally described by Sternberg (1825, p. 38, pl. 45, fig. 1) as *Thuites alienus* Sternberg is a 125 mm long fragment of a shoot, with four alternately arranged secondary branches (up to 70 mm), departing in an acute angle. The main shoot is 4–5 mm wide, the secondary branch is 2–3 mm wide. Secondary branches are covered with helically arranged rhombic depressions, which are interpreted as leaf cushions. Rhombic depressions have a groove in the middle, interpreted here as a keel. Imbricate needles (7 mm long) which are acute in the terminal part grow out from leaf cushions. The second specimen from the locality of Smečno (NM-F344, Pl. 6, Fig. 1), which comes from the type collection, shows two shoots. Left shoot is 50 mm long, bearing shorter secondary shoots, all covered with helically arranged needles, 7 mm long.

The material from the locality of Maletín is represented by approximately thirty sterile shoots. They are simple, once or several times branched, usually 2–5 mm (up to 7 mm) wide. Main branches are on average 100 mm long (GPIT/PL_737, Pl. 6, Fig. 4). Narrower branches are covered with helically arranged slightly protruding rhombic scale-like needles, 4–5 mm (up to 7 mm) long, sigmoid and acute in the terminal part. In wider branches, there are apparent leaf cushions (2×2 mm), sometimes with longitudinal groove. Specimen no. GPIT/PL_650 (Pl. 6, Fig. 2) shows well-preserved wider shoots with leaf cushions and narrower shoots, with scale-like needles.

We assign to this species branches bearing ovuliferous cones, which may not be quite correct, because *Thuites alienus* is typified by only sterile branches. Fertile specimens (GPIT/PL_716, Pl. 7, Fig. 1; GPIT/PL_725, Pl. 7, Fig. 2; UGV_24, Pl. 7, Fig. 3) are represented by 30–75 mm long branches bearing ovuliferous cones in their terminal parts. These shoots are helically covered with rhombic leaf cushions (2×2 mm), each with a longitudinal groove. Ovuliferous cones are ovate to shortly cylindrical (10×16 mm, 16×26 mm and 18×27 mm), and singly borne in terminal parts of shoots. Two cones (GPIT/PL_725; UGV_24) are preserved in the rock as longitudinally fractured fragments. Their axes are 1–2 mm long, consisting of helically arranged peltate cone scales. Specimen no. GPIT/PL_716 shows a complete terminally borne ovuliferous cone, with rhombic-shaped scales on its surface (5–6 mm wide and 3–4 mm high), with poorly preserved longitudinal groove. In some specimens (GPIT/PL_723a, Pl. 7, Fig. 4; SMNS/650_16, Pl. 7, Fig. 6; MMT(Z)/G_447, Pl. 7, Fig. 7; NHMW_6, Pl. 7, Fig. 8), there are similar ovuliferous cones borne on shoots. The ovuliferous cone GPIT/PL_723b (Pl. 7, Fig. 5) is preserved in the rock as transversally broken, showing pelate cone scales.

Remarks on nomenclature. From the type collection of Kaspar Sternberg, we have chosen the lectotype (NM-F3675) figured by Sternberg (1825, pl. 45, fig. 1). The Sternberg type collection is recognized by old evidence numbers, which were written by František Xaver Maximilian Zippe. The type specimens, which were found in collections of the National Museum, have original numbers 353 (Sternberg 1825, pl. 45, fig. 1, NM-F3675) and 355 (NM-F344), respectively.

Discussion. The closest taxon to *Thuites alienus* is a fossil species *Geinitzia reichenbachii* (Geinitz) Hollick et Jeffrey, described from the locality of Hudcov (Hundorf) from the Teplice Formation (Turonian) of the Bohemian Cretaceous Basin (Kunzmann 2010, Geinitz 1842). *G reichenbachii* has falcate needles (Hollick and Jeffrey 1909), in contrary to *T. alienus*. *T. gramineus*, described by Sternberg (1825) from the Peruc locality (Cenomanian) was assigned by Knobloch (1971) to the genus *Widringtonia* (*Widringtonia graminea* (Sternberg) Knobloch). Other Sternberg species, such as *T. cupressiformis*, *T. articulatus*, *T. expansus* and *T. divaricatus* (described from the British Jurassic, locality Stonesfield) were removed in the first half of 20th century to *Brachyphyllum* i. e. *B. expansum* (Sternberg) Seward (Cleal and Rees 2003). Fertile specimens of ovuliferous cones attached to branches, and simple ovuliferous cones are assigned to the species with a question mark as cf. *Thuites alienus*, because *T. alienus* is defined by sterile axes. We prefer to identify sole, poorly preserved ovuliferous cones the genus *Conago.*

Pinus Linnaeus, 1753

Type: *Pinus sylvestris* Linnaeus, 1753, p. 1000.

Discussion. The genus *Pinus* is characteristic in bearing two seeds per ovuliferous cone scale. This character is also apparent in the fossil record. There are numerous species of the genus *Pinus* described from the European Cretaceous (e. g. Alvin 1960, J. Kvaček 2013). The earliest record appears to be *Pinus yorkshirensis* Ryberg, Stockey, Hilton, Mapes, Riding et Rothwell from the Early Cretaceous Wealden Formation of Yorkshire (Ryberg et al. 2012). The ovuliferous cones of the genus *Pinus* show hexagonal ovuliferous scales, with a prominent apophysis and umbo, in which it differs from the ovuliferous cone of the genus *Picea* A. Dietrich and other members of the Pinaceae (Farjon 1990, 2005).

Pinus quenstedtii Heer

Pl. 7, Fig. 9–10; Pl. 8, Fig. 1–6

1869 *Pinus quenstedtii* Heer, p. 13, pl. 2, fig. 5–9.
1885b *Pinus quenstedtii* Heer; Velenovský, p. 32, pl. 6, fig. 4, pl. 7, fig. 7–8, pl. 8, fig. 10.
1901 *Pinus quenstedtii* Heer; Frič and Bayer, p. 99, fig. 52.
?1869 *Magnolia amplifolia* Heer, p. 21, pl. 8, fig. 2.

Lectotype: GPIT/PL_736, Pl. 7, Fig. 10, designated here; Heer 1869, p. 13, pl. 2, fig. 7.

Paralectotype: GPIT/PL_739, Pl. 8, Fig. 1, designated here; Heer 1869, p. 13, pl. 2, fig. 9.

Type locality: Maletín.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_52, 67, 110, 111, 112, 129; GPIT/PL_636, 639, 641, 643, 644, 648, 651, 652, 653, 656, 658, 659, 660, 672, 674, 675, 678, 690, 729, 732, 742; MMT(M)/G_331, 407, 408, 409, 410, 411, 412, 413, 414, 415, 426, 430, 467; MZM/118_16, 42, 71; NHMW_3, 4, 16, 17, 29, 30; SMNS/650_18, 19, 20, 21, 22; UGV_1, 5, 16, 19, 20; VMO_8098, 8099, 8100.

Occurrence: Maletín.

Emended diagnosis: Ovuliferous cones cylindrical, longitudinally ovate, with slightly pointed apex and rounded base. Ovuliferous scales helically arranged on central axis. Each scale showing two seeds in basal part, terminally with hexagonal apophysis bearing prominent oval umbo with centrally placed mucro.

Description. The lectotype no. GPIT/PL_736 (Pl. 7, Fig. 10) described by Heer (1869, p. 13, pl. 2, fig. 7) represents an impression of a long cylindrical ovuliferous cone (116×20 mm), without a basal part. In the terminal part of each ovuliferous cone scale is an apophysis, rhombic to hexagonal in shape, with prominent umbo. A transversal groove divides the apophysis into two approximately equal parts. Helically arranged scales are 10 mm wide and 8 mm high. The paralectotype (GPIT/PL_739, Pl. 8, Fig. 1) also described by Heer (1869, p. 13, pl. 2, fig. 9) is represented by a transversally fractured oval ovuliferous cone (70×40 mm), with preserved oval base and missing terminal part. Ovuliferous scales without apparent apophysis are dorso-ventrally flattened. In this specimen, there are several scales with two seeds (7×3 mm) born in pairs on the adaxial side of the ovuliferous scale.

Morphologically similar seeds (5×2 mm) are preserved only in the transversally fractured specimen no. NHMW_4 (Pl. 8, Fig. 2). Specimen no. GPIT/PL_674 (Pl. 7, Fig. 9) shows ovuliferous cone from abaxial part. Impressions of ovuliferous scales with preserved apophyses, including prominent umbo are shown in specimens no. GPIT/PL_732 (Pl. 8, Fig. 5) and no. MZM/118_16 (Pl. 8, Fig. 4). Specimen UGV_20 (Pl. 8, Fig. 6) shows both modes of preservation of ovuliferous cone scales. The longitudinally fractured apical part of the cone shows dorso-ventrally flattened scales. The basal part of the cone shows an outer surface of cone scales, showing rhombic to hexagonal apophyses with prominent umbo in the central part. Size of ovuliferous cone no. GPIT/PL_742 (Pl. 8, Fig. 3) is 50×30 mm, showing relatively long (44 mm) peduncle. Other material from Maletín is represented by approximately 40 specimens of fractured ovuliferous cones with dorso-ventrally flattened scales, and approximately 25 specimens of ovuliferous cone impressions preserving outer surface of ovuliferous scales with apparent apophysis.

D i s c u s s i o n . Ovuliferous cones of *P. quenstedtii* are similar to *P. longissima* Velenovský from the Cenomanian of Kralupy nad Vltavou. *P. quenstedtii* differs in size, being only third of size of ovuliferous cones of *P. longissima* Velenovský, which can be up to 310 mm in length. Compared with *P. protopicea* Velenovský from the Cenomanian of Vyšehořovice, *P. quenstedtii* has clearly prominent apophyses of ovuliferous cone scales with prominent oval umbo (Velenovský 1885b). In comparison with *P. vyserovicensis* Velenovský et Viniklář 1927 from the Cenomanian of Vyšehořovice, *P. quenstedtii* is narrower and shorter. It also differs in shape of apophysis, which is in *P. vyserovicensis* more rhombic and divided by longitudinal and transversal grooves. *P. kettneri* Velenovský et Viniklář from Vyšehořovice has ovuliferous cone scales with longer mucro (Velenovský and Viniklář 1926b).

Coniferae incertae sedis

Conago Miller et Hickey, 2010

T y p e : *Conago tonsifera* Miller et Hickey, 2010, p. 77, pl. 39, fig. A–C.

D i s c u s s i o n . This genus was introduced by Miller and Hickey (2010) for accommodation of ovuliferous cones of uncertain systematic affinity. It was designated on purpose, to substitute the genus *Conites* Sternberg typified by *Conites bucklandii* Sternberg from the Jurassic Stonesfield in Great Britain (Sternberg 1823). *C. bucklandii* is a part of a stem assigned to the Bennettitales (Watson and Sincock 1992, J. Kvaček and Straková 1997), and therefore it cannot be used for accommodation of ovuliferous cones of conifers any longer. The genus *Conites* was newly emended by Cleal and Rees (2003).

Conago sp. 1

Pl. 8, Fig. 7–9

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_79; GPIT/PL_724; MMT(M)/G_439, 478; NHMW_31a, 31b.

O c c u r r e n c e : Maletín.

D e s c r i p t i o n . Ovuliferous cones of ovoid shape with main central axis bearing 2–3 pairs of distally peltate ovuliferous scales with mucronate projections. Specimen no. GPIT/PL_724 (Pl. 8, Fig. 7) described by Heer (1869, p. 11, pl. 1, fig. 12) as *Sequoia fastigiata* is a longitudinally fractured ovoid ovuliferous cone 15×11 mm large. On the main axis, there are two pairs of peltate ovuliferous scales. Ovuliferous scales are 6 mm long and 3.5 mm wide at their widest part. Due to the longitudinal fracture, the mucronate projection is not apparent.

Specimen NHMW_31 (part and counterpart NHMW_31a, b, Pl. 8, Fig. 8) shows three pairs of ovuliferous scales, arranged on the main axis in various angles. Size of ovuliferous cones is 27×18 mm and 22×18 mm. Ovuliferous cone scales are peltate up to 8 mm long and up to 5 mm wide at their widest part. Uppermost pair of cone scales is tilted at an angle of 60–70° to the main axis, middle pair is vertical to the axis and lower pair is again tilted at an angle of 60–70° to the base. In the apical part, there is a terminal scale with similar shape and size. Both ovuliferous cones are borne on a 13–15 mm long peduncle. The ovuliferous cone no. GBA_79 (Pl. 8, Fig. 9) is transversally fractured.

D i s c u s s i o n . This species is classified by Heer (1869) together with coniferous shoots of the genus *Sequoia*. However, its isolated occurrence precludes its attribution to either *Sequoia* or *Thuites*. *Conago* sp. 1 differs from *Conago* sp. 2 in having elliptical shape of cone and oppositely arranged scales. This character distinguishes them also from microsporangiate cones of *Masculostrobus* Seward, 1911 emend. Grauvogel-Stamm et Schaarschmidt, 1978. Peltate ovuliferous scales and their opposite arrangement suggest that the ovuliferous cones may be assigned to the family Cupressaceae.

Conago sp. 2

Pl. 8, Fig. 10

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_47.

O c c u r r e n c e : Maletín.

D e s c r i p t i o n . Specimen no. GBA_47 (Pl. 8, Fig. 10) is two impressions of ovuliferous cones of spheroid shape, preserved in the slab next to each other. The left ovuliferous cone (12×11 mm) is clearly attached to the 17 mm long peduncle. The right ovuliferous cone (11×11 mm) is at the same distance from peduncle as the left one. Both cones were originally probably attached to the same axis. Poorly preserved peltate cone scales are rhombical, arranged helically on the central axis of the cone. Its cone scales are 3–4 mm wide and 2–3 mm high.

D i s c u s s i o n . *Conago* sp. 2 differs from sp. 1 in having a spheroid shape of the cone, and cones scales arranged helically. It differs from microsporangiate cones of the genus *Masculostrobus* in having spheroid shape and in larger cone scales.

Masculostrobus Seward, 1911, emend. Grauvogel-Stamm et Schaarschmidt, 1978

Type: *Masculostrobus zeilleri* Seward 1911, p. 686, text-fig. 11A (a–c).

Discussion: As recommended by Cleal and Rees (2003) the genus *Masculostrobus* is used for microsporangiate cones of uncertain family (Grauvogel-Stamm and Schaarschmidt 1978, 1979). Specimens from Maletín are preserved as impressions in sandstone and do not contain any pollen; therefore their affinities remain dubious.

Masculostrobus sp. 1

Pl. 8, Fig. 11

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_78.

Occurrence: Maletín.

Description. Specimen no. GBA_78 (Pl. 8, Fig. 11) is a 56 mm long and 17 mm wide microsporangiate (pollen) cone of longitudinal ovate shape in its apical and basal parts. Its surface is covered by helically arranged rhombical to hexagonal microsporophyls which are very subtle (2×2 mm). On the right side of the specimen, there are peltate sporophylls with elongated needle-like mucro.

Discussion. The microsporangiate cone *Masculostrobus* sp. 1 differs from the microsporangiate cone *Masculostrobus* sp. 2 in having longitudinal ovate shape with larger rhombical to hexagonal microsporophylls. Both species of the genus *Masculostrobus* differ from the genus *Conago* in having considerably smaller and densely arranged sporophylls.

Masculostrobus sp. 2

Pl. 8, Fig. 12a, b

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_10.

Occurrence: Maletín.

Description. The single specimen no. GBA_10 (Pl. 8, Fig. 12a, b) represents a microsporangiate (pollen) cone of conical shape (20×6 mm). The microsporangiate cone is widest at its lower part, narrowing to the upper part and obtusely terminated. The cone is borne on a 20 mm long and 3 mm wide peduncle. This microsporangiate cone consists of numerous helically arranged microsporophylls borne on one central axis. Microsporophylls are irregularly hexagonal in shape, 0.7×0.7 mm in size.

Discussion. The pollen cone *Masculostrobus* sp. 2 differs from the pollen cone *Masculostrobus* sp. 1 in having a conical shape and smaller microsporophylls. It differs from the genus *Conago* in having small densely arranged hexagonal microsporophylls.

Myrtoidea Passalia, Romero, Panza, 2001

Type: *Myrtoidea patagonica* Passalia, Romero, Panza, 2001, p. 74, fig. 2A–E.

Discussion. When describing the genus *Myrtophyllum*, Heer (1869) described two species: *M. geinitzii* and *M. schuebleri*. However, he did not publish a generic diagnosis of the genus. Due to the description of two species, diagnosis *generico specifica* is ruled out. A generic diagnosis of the genus *Myrtophyllum* was published later by Schimper (1874), who validated the name *Myrtophyllum*, and both species *M. geinitzii* and *M. schuebleri*. The situation was seemingly solved; however, Z. Kvaček (1992) discovered that the genus *Myrtophyllum* Heer is a younger homonym of the recent genus *Myrtophyllum* Turczaninow 1863 from the family Flacourtiaceae (Farr et al. 1979). This fact precludes use of the genus *Myrtophyllum*, and it is therefore necessary to find a new genus for plants sharing characters of fossil *Myrtophyllum* Heer ex Schimper.

The genus *Myrtoidea* described by Passalia et al. from the Late Cretaceous of Bajo de los Corrales, Santa Cruz Province, Argentina (Passalia et al. 2001) is suggested here as an adequate name that could substitute for homonymous *Myrtophyllum*. First, it is preserved as a leaf impression, its cuticle is not known. Secondly, it possesses a clearly distinguished intramarginal vein. As already pointed out by Passalia et al. (2001) an intramarginal vein cannot be used as a character for identification of a family. For example, *Myrtoidea patagonica* is thought to have affinities to Myrtaceae, while our material is probably of lauralean affinity. But due to its poor preservation, without knowledge of its cuticle, *Myrtoidea* is a suitable fossil genus for leaf impressions of unknown systematic affinity bearing intramarginal veins. However, there are more genera similar to *Myrtoidea*/*Myrtophyllum*. *Daphnophyllum* Heer is semi-homonymous with *Daphniphyllum* Blume (see Z. Kvaček 1992). The genus *Eucalyptophyllum* Fontaine is based on *E. oblongifolium*, material from the Early Cretaceous of the Potomac Formation (Fontaine 1889). It is a fragment of a leaf with poorly developed secondary veins, and lacking any sign of an intramarginal vein. Finally, the genus *Eucalyptolaurus* Coiffard, Gomez, Thiébaut et J. Kvaček in Coiffard et al. 2009 differs from *Myrtoidea* in the presence of paracytic stomata and other epidermal details, which indicate its systematic affinity to the Laurales.

Myrtoidea geinitzii (Heer ex Schimper) J. Kvaček et Greguš comb. nov.

Pl. 9, Fig. 1–3; Pl. 10, Fig. 1–5

1869 *Myrtophyllum geinitzii* Heer, p. 22, pl. 11, fig. 3–4, nom. inval.
1869 *Myrtophyllum schuebleri* Heer, p. 23, pl. 11, fig. 2, nom. inval.
1874 *Myrtophyllum geinitzii* Heer ex Schimper, p. 30.
1874 *Myrtophyllum schuebleri* Heer ex Schimper, p. 30.
1882 *Eucalyptus geinitzii* (Heer ex Schimper) Heer, p. 93, pl. 19, fig. 1c, pl. 46, fig. 12c, 13.
1992 "*Eucalyptus*" *geinitzii* (Heer ex Schimper) Heer; Z. Kvaček, p. 346, pl. 1, fig. 1, 2, 6, pl. 2, fig. 1, 2, pl. 3, fig. 1, pl. 4, fig. 1, 3.

L e c t o t y p e : GPIT/PL_750, Pl. 9, Fig. 1a, b; designated by Z. Kvaček 1992, p. 346, pl. 1, fig. 1–2; Heer 1869, p. 22, pl. 11, fig. 3.

T y p e l o c a l i t y : Maletín.

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous

M a t e r i a l s t u d i e d : GBA_13, 16, 30, 34, 35, 37, 38, 46, 76, 105, 117, 118, 122, 123, 133, 145, 146, 147, 148, 149, 150, 151, 152, 158, 159; GPIT/PL_633, 733, 744; MMT(M)/G_345, 346, 362, 366, 455, 457, 487; MMT(Z)/G_343, 347, 361, 454, 466; MZM/118_1, 26, 28, 63, 69, 72; NHMW_16, 23, 27; UGV_6, 15.

O c c u r r e n c e s : Vyšehořovice, Praha-Malá Chuchle, Kounice.

E m e n d e d d i a g n o s i s . Simple, entire-margined leaf, broadly elongate to widely lanceolate, widest at 1/3 to 1/2 of the leaf lamina. Venation pinnate, brochidodromous. Terminal parts of secondary veins forming intramarginal vein. Intersecondary veins distributed irregularly among secondaries.

D e s c r i p t i o n . The lectotype (GPIT/PL_750, Pl. 9, Fig. 1a, b) described by Heer (1869, p. 22, pl. 11, fig. 3.) as *Myrtophyllum geinitzi* is a 150 mm long impression of simple, entire-margined leaf, without preserved base and apex. Lanceolate leaf is widest at its midpoint (27 mm), gently narrowing to its base and apex. The midvein is clearly apparent, slightly protruding to the apical part of the leaf. Venation is pinnate, with delicate secondary veins running out at a 40° angle from the midvein. Secondary veins join in a series of prominent arches, forming an intramarginal vein (Pl. 9, Fig. 1b). Third order venation is not apparent. The second type specimen no. GPIT/PL_744 (Pl. 9, Fig. 3) described by Heer (1869, p. 22, pl. 11, fig. 4) as *M. geinitzi* is a 130 mm long impression of a simple, entire-margined leaf, without preserved apical part. Leaf lanceolately elongate, widest at the midpoint (23 mm), gently narrowing to both its base and apex. Base is cuneate, with relatively wide petiole (3 mm wide, 17 mm long). Midvein is slightly protruding to the apical part of the leaf. Secondary veins brochydodromous, and poorly preserved, departing from midvein at a 35° angle. The intramarginal vein is clearly apparent. Specimen (GPIT/PL_733, Pl. 9, Fig. 2) described by Heer (1869, p. 22, pl. 11, fig. 2) as *Myrtophyllum schuebleri* is a fragment of a middle part of a leaf, 65 mm long and 35 mm wide. No apical or basal parts are preserved. It is an entire-margined leaf, with well-preserved venation: pinnate primary venation, brochidodromous secondary venation. Secondary veins depart from the midvein at a 40° angle. In terminal parts, they form an intramarginal vein. Tertiary venation forms a reticulate – percurrent pattern.

Other material from Maletín consists of 49 pieces of complete and almost complete lauroid leaf impressions. These impressions are always entire-margined, lanceolately elongate, widest at 1/3–1/2 of their length. Bases are narrowly to longitudinally cuneate. Apices are acute to acuminate (GBA_133, Pl. 10, Fig. 1a; GBA_145, Pl. 10, Fig. 4). Specimen (NHMW_27, Pl. 10, Fig. 2a) has the base sharply convex. Some specimens have a preserved petiole (up to 15 mm long), which is relatively wide compared with the main midvein (UGV_6, Pl. 10, Fig. 3b). On average, leaves are 185 mm long (from 83 mm to 240 mm) and 30 mm wide (from 12 mm to 45 mm), with an average length to width ratio of 6.4 (ranging from 4.6 to 9.8). Specimen no. MMT(Z)/G_343 (Pl. 10, Fig. 5), despite missing its apex, is 275 mm long. Leaf impressions have a relatively wide midvein, which gently protrudes towards the leaf apex. Delicate brochidodromous secondary veins depart at an angle of 30–40° from the midvein, forming an intramarginal vein (GBA_133, Pl. 10, Fig. 1b; NHMW_27, Pl. 10, Fig. 2b; UGV_6, Pl. 10, Fig. 3a). Percurrent venation of higher order is apparent.

D i s c u s s i o n . We classify all entire-margined leaf impressions with lancolately elongate leaf lamina with pronounced intramarginal vein as *Myrtoidea geinitzii*. *M. geinitzii* shows wider leaves and overall bigger size of lamina with acuminate apex, compared to *M. patagonica* described from the Cenomanian of Argentina. *M. geinitzii* has leaves widest at 1/3 to 1/2 of their length, with length to width ratio between 4–9.8, while *M. patagonica* is widest at 2/3 of its length, and length to width ratio is 2–4.5 (Passalia et al. 2001). *M. geinitzii* differs from *M. angustum* in larger size, and in length to width ratio, which is 7–13 in *M. angustum*. Classification of other material described as *Ficus krausiana* and *Ficus mohliana* is problematic. *F. krausiana* Heer and *F. mohliana* Heer have L/W ratio (3.7–4), which is lower than in *M. geinitzii*. This observation is in agreement with statement of Frič and Bayer (1901), who suggested that *F. krausiana* and *F. mohliana* are just wider forms of leaves of genus *M. geinitzii*. This hypothesis is possible, however, the above-mentioned species of *Ficus* described by Heer (1869) lack an intramarginal vein, which is the most important diagnostic character of the genus *Myrtoidea.*

Magnoliaephyllum Krasser ex Seward, 1927

T y p e : *Magnolia alternans* Heer in Capellini et Heer, 1866, p. 20, pl. 3, fig. 2–4, pl. 4, fig. 1–2 = *Magnoliaephyllum alternans* (Heer in Capellini et Heer) Seward, 1927, p. 120.

D i s c u s s i o n . The genus name *Magnoliaephyllum* was used for the first time by Krasser (1896) in his publication on Cretaceous fossil flora from Kunštát in Moravia. But it was published with a question mark, and its type species was missing. Due to this, the genus name *Magnoliaephyllum* sensu Krasser (1896) is invalid. Genus *Magnoliaephyllum* was validated for the first time by Seward (1927), who assigned the species *Magnolia alternans* Heer in Capellini et Heer to this genus, which was described from the Cretaceous locality Tekamah, Nebraska (Capellini and Heer 1866). It is not possible to use the genus *Magnoliphyllum* Conwentz for determination of our specimens, because the Tertiary genus *Magnoliphyllum balticum* Conwentz (Conwentz 1886) was first described as a *Laurus princeps* Heer, and it is formally assigned to the genus *Laurophyllum* from the family Lauraceae (Krassilov 1979). The genus *Magnoliaestrum* Goeppert from Java Tertiary differs from genus *Magnoliaephyllum* in apparent and regular second order venation. *Magnoliaephyllum* often has apparent third order venation, and visible intersecondary veins (Goeppert 1854).

A number of leaves similar to the recent genus *Magnolia* Linnaeus was described from Cretaceous. Fritel (1913) recognized that recent magnolia leaves differ considerably in shape as opposed to a quite stable venation pattern. With regard to this fact, Fritel (1913) assigned a number of Cretaceous leaves to the species *Magnolia alternans* Heer in Capellini et Heer. Fritel (1913) assigned there *Ficus* Linnaeus (*F. krausiana* Heer), *Daphnophyllum* Heer (*D. crassinervium* Heer, *D. ellipticum* Heer and *D. fraasii* Heer), *Juglans* Linnaeus (*J. crassipes* Heer), *Persea* Miller (*P. hayana* Lesquereux), *Magnolia* Linnaeus (*M. amplifolia* Heer, *M. capellinii* Heer, *M. speciosa* Heer) and other (Fritel 1913, p. 289).

Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward

Pl. 11, Fig. 1–5; Pl. 12, Fig. 1–7; Pl. 13, Fig. 1–5; Pl. 14, Fig. 1–2

1866 *Magnolia alternans* Heer in Capellini et Heer, p. 20, pl. 3, fig. 2–4.
1866 *Magnolia capellinii* Heer in Capellini et Heer, p. 21, pl. 3, fig. 5–6.
1869 *Ficus krausiana* Heer, p. 15, pl. 5, fig. 3–6.
1869 *Ficus mohliana* Heer, p. 15, pl. 5, fig. 2.
1869 *Daphnophyllum fraasii* Heer, p. 17, pl. 6, fig. 1–2.
1869 *Daphnophyllum crassinervium* Heer, p. 18, pl. 7, fig. 2, pl. 11, fig. 5.
1869 *Magnolia speciosa* Heer, p. 20, pl. 7, fig. 1, pl. 9, fig. 2, pl. 10, fig. 1–2, pl. 11, fig. 1.
1869 *Magnolia amplifolia* Heer, p. 21, pl. 8, fig. 1–2, pl. 9, fig. 1.
1869 *Juglans crassipes* Heer, p. 23, pl. 6, fig. 3.
1874 *Magnolia capellinii* Heer in Capellini et Heer; Heer, p. 115, pl. 33, fig. 1–4.
1874 *Magnolia alternans* Heer in Capellini et Heer; Heer, p. 116, pl. 33, fig. 5–6, pl. 34, fig. 4.
1913 *Magnolia alternans* Heer in Capellini et Heer; Fritel, p. 289, text-fig. 3–8.
1927 *Magnoliaephyllum alternans* (Heer in Capellini et Heer) Seward, p. 120, text-fig. 25.
1999 *Dicotylophyllum* cf. *alternans* (Heer in Capellini et Heer) Knobloch, p. 41, pl. 13, fig. 8.

Lectotype: Pl. 11, Fig. 1, designated here; Capellini and Heer 1866, p. 20, pl. 3, fig. 3.

It will be necessary to choose a lectotype from Oswald Heer's collection, which were not available to the present study.

Type locality: Tekamah, Nebraska, USA.

Type horizon: Dakota Formation, Cenomanian, Upper Cretaceous (Knowlton 1898, Upchurch and Dilcher 1990).

Material studied: GBA_2, 3a, 6, 7, 8, 9, 11, 12, 17, 18, 19, 22, 23, 26, 27a–c, 28, 29, 33, 41, 42, 44, 45, 48, 49, 50, 51, 53, 54, 55, 56, 57, 60a, b, 61, 62, 63, 64, 65, 68, 69, 71, 72, 73, 75, 80, 81, 82, 83, 84, 85, 86, 88, 89, 90, 91, 92, 93, 94, 97, 99, 100, 101, 102, 103, 104, 113, 116, 121, 130, 131, 135, 137, 144, 153, 154, 155, 156; GPIT/PL_623, 626, 628, 635, 637, 647, 655, 663, 664, 665, 666, 668, 669, 670, 677, 679, 683, 688, 689, 693, 694, 695, 696, 697, 698, 699, 700, 701, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 719, 734, 735, 746, 747, 748, 752, 753, 754, 756; MMT (M)/G_323, 325, 326, 352, 353, 354, 357, 358, 365, 367, 375, 381, 382, 384, 385, 388, 390, 393, 394, 400, 404, 405, 406, 425, 434, 435, 436, 437, 442, 446, 449, 452, 463, 465, 475, 476, 477, 480, 482, 490; MMT (Z)/G_317, 327, 355, 359, 374, 383, 386, 387, 389, 451; MZM/118_3, 7, 8, 9, 11, 13, 15, 17, 20, 21, 23, 24, 27, 29, 35, 36, 38, 39, 43, 45, 47, 54, 55, 56, 57, 59, 61, 64, 65; NHMW_8, 10, 13, 14, 15, 18, 19, 20, 21, 22, 24, 26; SMNS/650_1, 2, 5, 8, 9, 10, 11, 13, 14, 15; UGV_2, 3, 4, 7, 9, 10, 11, 12, 13, 14, 17, 18, 21; VMO_30.104, 6296, 8088, 8089, 8092, 8093.

Occurrence in Czech Republic: Maletín, Kunštát, Rudka, Březina, Vyšehořovice, Slivenec (Peruc-Korycany Formation).

Emended diagnosis. Leaves entire-margined medium to large, ovate and longitudinally to widely elliptic. Apex acute to attenuate, base cuneate. Venation pinnate, brochidodromous to eucamptodromous. Occasional shorter and straight intersecondary veins present. Venation of higher order subtle, often not apparent.

Description. The suggested lectotype (Pl. 11, Fig. 1) described by Heer (Heer in Capellini and Heer 1866) from Dakota Cretaceous Formation (Tekamah locality, Nebraska). The lectotype is an elliptical leaf with petiole, without preserved uppermost part of apex. Entire-margined leaf shows a cuneate base. Fragment of apical part tapers into an attenuate apex. Secondary veins brochidodromous, departing from relatively robust midvein at 40° angle. Short and subtle intersecondary veins occur between secondary veins, they arise approximately in the middle of the leaf lamina. The specimens described by Heer (1869) as *D. crassinervium* (GPIT/PL_719, Pl. 11, Fig. 5; SMNS/650_9, Pl. 11, Fig. 4), *D. ellipticum* (GPIT/PL_734, Pl. 11, Fig. 3) and *Daphnophyllum fraasii* (SMNS/650_8, Pl. 11, Fig. 2) are entire-margined, elliptical to wide elliptical leaf impressions with cuneate base. They are widest at one-third or one-half of their length. Acute apex is preserved only in specimen no. GPIT/PL_734. All leaf impressions have fragmentarily preserved petioles. Relatively small leaf impression no. GPIT/PL_734 is only 118 mm long and 58 mm wide (L/W=2). The second almost preserved leaf impression no. SMNS/650_8 is 182 mm long and 65 mm wide (L/W=2.8). Secondary veins run from the relatively robust midvein at 35–40° angles. Leaf impression no. GPIT/PL_734 shows in the right side of the leaf lamina an apparent dichotomous branching of secondary veins (Pl. 11, Fig. 3). Similar branching is also apparent to the right upper side of specimen no. GPIT/PL_719 (Pl. 11, Fig. 5). This atypical forking is not apparent in the rest of the specimens. Specimens no. GPIT/PL_719 and GPIT/PL_734 show an apparent suprabasal vein, which runs almost parallel with the cuneate base. On the left half of leaf impression no. GPIT/PL_734 veins of third order run out from the first secondary vein, which are connected to the suprabasal vein. Occasional intersecondary veins are present.

Leaf impression no. SMNS/650_5 (Pl. 12, Fig. 1), described by Heer (1869) as *Ficus mohliana* is a 217 mm long and 52 mm wide, entire-margined impression of longitudinally elliptic leaf, with narrow cuneate base and attenuate apex. This leaf impression is the widest in its middle part. Length to width ratio is 4.2. A well pronounced midvein is remarkably narrowed in the direction of the apical part. Poorly preserved secondary veins run out from the primary vein at an angle of 40°. Other specimens described by Heer (1869) as *Ficus krausiana* are two impressions of entire-margined elliptical leaves. These impressions are widest in their lower half. The first impression (SMNS/650_2, Pl. 12, Fig. 2) has an acute apex. A small part of the missing base suggests a cuneate shape. Estimated length of the impression is 200 mm. Width is 53 mm; length to width ratio is 3.7. The primary midvein is relatively wide. Poorly preserved secondary veins depart from midvein at an angle of 35–40°. Near the margin of the leaf lamina, some veins show brochidodromous loops. Another, better preserved specimen (SMNS/650_1, Pl. 12, Fig. 3) is an approximately 175 mm long and 46 mm wide leaf impression, with a cuneate base and oblong attenuate apex. Length to width ratio is 3.8. Small parts of the base and apex are not preserved. Brochidodromous secondary veins depart the midvein at a 40° angle. Leaf impression (GPIT/PL_746, Pl. 12, Fig. 4), described by Heer (1869) as *Juglans crassipes* is entire-margined, elliptic with a cuneate base and not preserved apical part. It is widest in its middle part. Estimated length of the leaf impression is 165 mm, and width is 63 mm; length to width ratio is 2.6. The leaf shows a cuneate base with relatively long (50 mm) and wide petiole, and missing apex. Secondary venation is brochidodromous. Intersecondary veins are present.

The leaf impressions described by Heer (1869) as *Magnolia speciosa* is entire-margined, widely elliptical with cuneate bases and attenuate apices (GPIT/PL_735, Pl. 12, Fig. 7; GPIT/PL_747, Pl. 12, Fig. 6; GPIT/PL_752, Pl. 13, Fig. 1; GPIT/PL_754, Pl. 13, Fig. 2; GPIT/PL_756, Pl. 12, Fig. 5). The largest leaf impression no. GPIT/PL_756 is 250 mm long and 92 mm wide (L/W=2.7). Other leaf impressions are approximately 20 mm long and 8 mm wide (L/W=2.5). Primary venation pinnate; secondary venation of brochidodromous type departing from relatively wide midvein at a 45–50° angle. All impressions have at least partially preserved petiole. Specimen no. GPIT/PL_754 has a well pronounced long petiole (41 mm).

Leaf impressions of magnolioid-type described by Heer (1869) as *Magnolia amplifolia* (GPIT/PL_753, Pl. 13, Fig. 4; SMNS/650_13, Pl. 13, Fig. 3) are entire-margined, widely elliptic to obovate with cuneate base. The leaves are widest in the first third of their length. Apical parts are not preserved; judging by the convergent margins of leaf lamina, they were probably attenuate. Specimen (GPIT/PL_753) could be originally up to 220 mm long and 106 mm wide (L/W=2.1). Secondary venation of brochidodromous to eucamptodromous type with veins depart a relatively wide midvein at a 40° angle. Some veins do not reach the margin, and end at approximately 2/3 of length of other veins. Intersecondary veins are sometimes present. The newly discovered counterpart (GPIT/PL_666, Pl. 13, Fig. 5) to Heer's (1869) original (GPIT/PL_753, Pl. 13, Fig. 4) shows a clearly cuneate base and roughly sinuate margin. Other material from Starý Maletín consists of approximately 200 specimens of complete and nearly complete leaf impressions, and 25 fragments. All specimens are entire-margined, elliptic and widely elliptic to ovate. The best preserved specimens are 115–280 mm long and 42–150 mm wide (average: L=202 mm, W=84 mm). Length to width ratio is 1.5–3.7 (average: 2.5). Venation is in most cases well preserved. Venation is pinnate, with secondary veins showing brochidodromous loops. Intersecondary veins are present. A few specimens have venation poorly preserved or missing. However, a number of specimens also show third order venation, which is percurrent (GBA_18, Pl. 14, Fig. 1a, b; GBA_29, Pl. 14, Fig. 2a, b). Most leaf impressions have preserved at least fragments of the petiole. Specimens no. GPIT/PL_746 (Pl. 12, Fig. 4) and no. GPIT/PL_754 (Pl. 13, Fig. 2) show very long petiole.

D i s c u s s i o n . Heer (Capellini and Heer 1866, Heer 1869) described eight new species of magnolioid-type leaf impressions, which he classified under the genera *Daphnophyllum*, *Ficus*, *Juglans* and *Magnolia*. Leaf impressions described by Heer are entire-margined, with similar elliptical shape, with cuneate base and attenuate apex. During his life, the leaf impressions were freshly collected, so the venation was more apparent. Despite this, he described only secondary venation. Today, higher order venation is seen on only a few specimens. Venation of these leaf impressions has very similar or identical architecture. Because Heer had only a few specimens, he classified the species according to their variable secondary characters, such as a moderately elongated apical part. In this case, we studied and compared almost 200 specimens, and concluded that among these leaf impressions, there is great variability, with smooth transitions in shape, size (including length to width ratio) and venation. This is confirmed by Fritel (1913), who described and illustrated the modern species *Magnolia grandiflora* Linnaeus, which has clear variability in elliptical leaf, with transition to ovate leaf, but also obovate leaf. With regards to great variability, Fritel (1913) synonymised the species *Ficus krausiana* Heer, *Daphnophyllum crassinervium* Heer, *D. ellipticum* Heer, *D. fraasii* Heer, *Juglans crassipes* Heer, *Magnolia amplifolia* Heer, *M. capellinii* Heer, *M. speciosa* Heer to the species *Magnolia alternans*. Knobloch (1999) is also inclined to regard these as the same species. Knobloch classifies these impressions to the artificial genus *Dicotylophyllum* Saporta. Due to the character of these impressions from Maletín, it is not possible to determine systematic position in recent botanical classification.

Leaf impressions from the Nebraska Cretaceous described by Heer (Capellini and Heer 1866) as *Magnolia alternans* are, with their shape and simple type of venation, morphologically identical to the Cenomanian species *Magnolia amplifolia*, which Heer (1869) described from the Bohemian Cretaceous Basin.

Fossil leaves of the magnolioid-type, with preserved epidermal anatomy were described by Upchurch and Dilcher (1990) from the SE Nebraska Cretaceous (Rose Creek, USA). For this fossil material, a new genus *Pandemophyllum*

Upchurch et Dilcher was established, with the type species *Pandemophyllum kvacekii* Upchurch et Dilcher.

Upchurch and Dilcher (1990) remark in their publication that there is a possible relationship between the new genus *Pandemophyllum* and Heer's (1869) genera. As Z. Kvaček (1983) mentions, *Magnolia amplifolia*, *Daphnophyllum crassinervium* and *D. ellipticum* (in this paper classified in genus *Magnoliaephyllum*) are very similar in their anatomical features to *Myrtophyllum geinitzii* Heer, which in this paper we describe as *Myrtoidea geinitzii* (Heer) J. Kvaček et Greguš comb. nov. *Myrtoidea geinitzii* is defined by an intramarginal vein, which is missing in leaves of *M. alternans.*

High-quality and complete leaf impressions of *M. alternans* are very typical of the Maletín plant assemblage, and quite numerous compared to other species. This situation is, beside frequent occurrence of this leaf type in the Maletín sandstone, caused by human factor: during intensive quarrying of Maletín sandstone, it was easy for quarry workers to collect fossil impressions, and naturally, they only selected the best pieces.

As Pek and Mikuláš (1997) mention, leaves of *M. alternans* are curved, waved and have cross grooves and ridges, and even structures similar to recent insect burrows, although this observation is not new – Heer (1869) observed these same structures ("Insektengallen") over a century earlier.

Araliaephyllum Fontaine, 1889

T y p e : *Araliaephyllum obtusilobum* Fontaine, 1889, p. 317, pl. 163, fig. 1, 4; pl. 164, fig. 3 (selected by Andrews 1970).

E m e n d e d d i a g n o s i s . Leaves entire-margined or serrate, palametly dissected, formed by 3–9 lobes per leaf, with long petiole, divided by deeply cut sinusoidal incisions between lobes. Individual lobes elliptical, narrowing to apical part with medial lobe as the largest. Venation actinodromous to palinactinodromous.

D i s c u s s i o n . *Araliaephyllum* is established on Cretaceous *A. obtusilobum* from the Lower Cretaceous of Virginia, USA. It appears to be more suitable for our material than *Araliophyllum* Ettingshausen, with type species *Araliophyllum dubium* Ettingshausen from the Miocene of Germany, locality Münzenberg (Ludwig 1859). *A. dubium* is represented by pentalobate to pentasectate leaves, with widely elliptical to ovate lobes. Individual lobes are narrowly cuneate at the base. *Araliaephyllum* differs from *Araliophyllum* Ettingshausen in having lobes divided by sinusoidal incisions between lobes. Němejc (1975) introduces other names for these pentalobate leaves: *Araliopsis* Saporta et Marion and *Araliopsoides* Berry. The genus *Araliopsis* Saporta et Marion is based on *Sassasafras cretaceum* Newberry in Dana, 1863, from the Cretaceous of Nebraska, USA (Lesquereux 1874) (It is homonymous with *Araliopsis* Berry, 1911). It differs from *Araliaephyllum* in having leaves showing percurrent (platanoid) secondaries.

Araliopsoides Berry is based on *A. breviloba* Berry from the Raritan Formation, Late Cretaceous of Maryland, USA (Berry 1916). It differs from *Araliaephyllum* in having percurrent (platanoid) secondaries.

Araliphyllum Nathorst is based on type *A. raumannii* Nathorst from the Miocene of Japan (Nathorst 1888). It is a simple widely elliptic leaf without any lobes.

Genera *Debeya* Miquel and *Dewalquea* Saporta et Marion (Halamski 2013) differ from *Araliaephyllum* in having palmately compound leaves with leaflets showing petiolules.

Araliaephyllum formosum (Heer) Greguš et J. Kvaček comb. nov.

Pl. 14, Fig. 3; Pl. 15, Fig. 1–4

1869 *Aralia formosa* Heer, p. 18, pl. 8, fig. 3.
1889 *Araliphyllum formosum* (Heer) Velenovský, p. 50, 54, 59, fig. 116.
1999 *Dicotylophyllum formosum* (Heer) Knobloch, p. 42, pl. 16, fig. 12, 13, 14, 18.

H o l o t y p e : GPIT/PL_728, Pl. 14, Fig. 3; Heer 1869, p. 18, pl. 8, fig. 3.

T y p e l o c a l i t y : Maletín.

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_1, 107, 108, 109, 124, 125, 126; MMT(M)/G_350, 423; MMT(Z)/G_349; MZM/118_49; NHMW_9, 25.

O c c u r r e n c e i n t h e C z e c h r e p u b l i c : Bohdánkov, Lipenec, Na Rovinách u Kounova, Otruby, Rudka, Peruc, Praha-Hloubětín, Praha-Vidoule, Trubějov, Velké Opatovice.

R e m a r k s o n n o m e n c l a t u r e : Heer (1869), when describing this new species as *Aralia formosa,* mentioned only one specimen in the protologue, which is therefore understood to be the holotype.

E m e n d e d d i a g n o s i s . Trilobately palmate leaves with lanceolate lobes, entire-margined in basal parts, dentate to serrate in apical parts with acute or rounded apices. Leaf base cuneate; venation actinodromous.

D e s c r i p t i o n . The holotype (GPIT/PL_728, Pl. 14, Fig. 3) described by Heer (1869, p. 18, pl. 8, fig. 3) is an impression of a trilobate leaf, 68 mm long and 88 mm wide. Individual lobes (measured in incision: medial 42×20 mm, lateral 50×19 mm) divided by two deep (up to 2/3 of leaf lamina) sinusoidal incisions. Lobes entire-margined in basal parts, serrate in apical parts. Lobes lanceolate, widest at their midpoints. Base of leaf lamina cuneate to acute, with 15 mm long petiole. Apical parts of lobes rounded to slightly acute. Three relatively wide primary veins run out run out at an angle of 35° radially from one point near base terminating in apical parts at an angle of 35° radially from one point near base terminating in apical parts of lobes. Second and third order venation is not observed.

Other material from Maletín consists of 13 pieces of leaf impressions, morphologically similar to the holotype. Leaves are always trilobate with lobes separated by deep sinusoidal incisions. Second and higher order venation is not always observed. Specimen no. GBA_107 (Pl. 15, Fig. 1a) shows elliptical to obovate lobes (measured in incisions: medial 70×26 mm, lateral 57×22 mm); lobes are widest in their upper half. Specimen no. MMT(M)/G_350 (Pl. 15, Fig. 4) shows entire-margined lobes, obtusely serrated in the terminal part. The basal part of the leaf impression (NHMW_25, Pl. 15, Fig. 2) is acute, with 18 mm long petiole. Specimen no. MMT(M)G_423 (Pl. 15, Fig. 3) has a cuneate base.

Apical parts of leaf impressions of this species are rounded to shortly acute. Three primary veins run out at an angle of 35° radially from one point near base. These relatively pronounced veins terminate in apical parts of the lobes.

Specimen no. GBA_107 (Pl. 15, Fig. 1b) shows well preserved venation. Secondary veins run out at a 40° angle from each primary vein. They occasionally dichotomise in the marginal part of the leaf. Intersecondary veins are present between secondary veins. Close to the midvein, there is venation rather percurrent which is gradually changing to reticulate pattern near the margin of the leaf lamina.

Discussion. *Araliaephyllum formosum* differs from *Araliaephyllum kowalewskianum* (Saporta et Marion) Greguš et J. Kvaček comb. nov. (Saporta 1879, 1881) from Vyšehořovice (Cenomanian) in having serrate apical parts of lobes and always trilobate leaves.

Very close to *A. formosum* stands "*Aralia*" *triloba* Velenovský from the Cenomanian of Praha-Malá Chuchle and Vyšehořovice (Velenovský 1882). It has morphologically very similar leaves, but it differs in having individual lobes completely, very delicately serrate (not only in terminal parts, as it is characteristic for *A. formosum*). *A. formosum* is similar to "*Aralia*" *decurrens* Velenovský from Vyšehořovice (Velenovský 1884), but *A. formosum* differs in having broader and shorter lobes. Lobes of *A. decurrens* are typically narrow in their bases. *A. formosum* differs from "*Aralia*" *minor* Velenovský from Vyšehořovice (Velenovský 1882) in having more delicate and regular serration of lobes. Lateral lobes of *A. minor* are up to 50% smaller than the medial lobes, and the leaf is not cuneate in its basal part. Leaves of *A. minor* can be even pentalobate. *A. formosum* differs from *A. elegans* Velenovský from Vyšehořovice (Velenovský 1884) in having serrate, trilobate leaves with cuneate base, with third order venation. *A. formosum* differs remarkably from *A. daphnophyllum* Velenovský, *A. propinqua* Velenovský and *A. transitiva* Velenovský from Vyšehořovice and Kounice localities (Velenovský 1882), which have simple, entire-margined, and rounded to ovate and lanceolate leaves. These leaves, classified as *Aralia* by Velenovský (1882) and later by Frič and Bayer (1903), do not belong by their morphology to *Araliaephyllum*.

Araliaephyllum kowalewskianum (Saporta et Marion ex Velenovský) Greguš et J. Kvaček comb. nov.

Pl. 15, Fig. 5–6

1879 *Aralia kowalewskiana* Saporta et Marion; Saporta, p. 199, text-fig. 28_1, nom. nud.

1881 *Aralia kowalewskiana* Saporta et Marion; Saporta, p. 197, text-fig. 28_1, nom. nud.

1882 *Aralia kowalewskiana* Saporta et Marion ex Velenovský, p. 24, pl. 6, fig. 1–6, pl. 5, fig. 1. ("*Aralia kowaleswskiana*")

1889 *Araliphyllum kowalewskianum* (Saporta et Marion ex Velenovský) Velenovský, p. 50, 54, 57.

1892 *Aralia kowalewskiana* Saporta et Marion ex Velenovský; Engelhardt, p. 106.

1903 *Aralia kowalewskiana* Saporta et Marion ex Velenovský; Frič and Bayer, p. 148, text-fig. 118.

Lectotype: NM-F897, Pl. 15, Fig. 5 and NM-F896 (part and counterpart), designated here; Velenovský 1882, p. 24, pl. 5, fig. 1.

Type locality: Vyšehořovice.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: GBA_106.

Occurrence: Maletín, Kounice, Lipenec, Horoušany.

Remarks on nomenclature. *A. kowalewskianum* was first illustrated by Saporta (1879), but he did not give a diagnosis, or even any descriptive text, so the name was invalidly published, but later validated by Velenovský (1882). A specimen with the most preserved characters (Velenovský 1882, pl. 5, fig. 1) is chosen as the lectotype.

Emended diagnosis. Leaves palmate, number of lobes varies from three to nine. Each lobe elliptical, widest at its midpoint, rapidly narrowing towards apex, entire-margined with deep sinusoidal incisions between lobes. Leaf base rounded, long petiolated; venation actinodromous.

Description. The lectotype (NM-F897, Pl. 15, Fig. 5, NM-F896), described by Velenovský (1882) from Vyšehořovice shows part and counterpart of long petiolated, entire-margined leaf 160 mm wide. The petiole (length up to 50 mm) is not completely preserved in basal part. Other leaf impressions from Vyšehořovice are palmate, with up to seven lobes of elliptical shape, with deep sinusoidal incisions. Lobes at least as long as half of primary vein, widest (28 mm) at their midpoints. Lobes narrow towards base and apex. Apical parts of lateral lobes are preserved only in specimen no. NM-F897. Venation is actinodromous, relatively thick primary veins run to apex. Secondary and higher order venation is not preserved.

A single specimen from Maletín (GBA_106, Pl. 15, Fig. 6) represents a fragment of impression of a pentalobate leaf, with entire-margined lobes. The leaf is 135 mm long, and might be originally up to 170 mm long. Its medial lobe is 95 mm long (1/3 of the length of the primary vein), lateral lobes are 80 and 43 mm long. Width of the medial lobe is 30 mm in its widest part. The lobes are elliptical to obovate, the widest in upper half, with obtuse apices. Relatively thick actinodromous primary veins run towards apex. Second and higher order venation is not present.

Discussion. *Araliaephyllum kowalewskianum* differs from *Araliaephyllum formosum* in having entire-margined leaves. It also differs in having five, seven or nine lobes per leaf but there are also forms with only three lobes per leaf. *A. kowalewskianum* is always entire-margined, in contrast with "*Aralia*" *triloba* from the Cenomanian localities of Praha-Malá Chuchle and Vyšehořovice (Velenovský 1882), *A. decurrens* from Vyšehořovice (Velenovský 1884), *A. anisiloba* from the Cenomanian locality Lanšperk (Velenovský 1882) and *A. minor* from Vyšehořovice (Velenovský 1882). *A. kowalewskianum* has palmate leaves divided by deep incisions, while entire-margined species "*Aralia*" *transitiva*, *A. propinqua* and *A. daphnophyllum* from Vyšehořovice and Kounice (Velenovský 1882) are compact in shape. *A. kowalewskianum* has palmate leaves with elliptical lobes, their primary veins never dichotomise, in contrast to *A. elegans* from Vyšehořovice (Velenovský 1884).

Ettingshausenia Stiehler, 1857

Type: *Credneria cuneifolia* Bronn, 1837, p. 583, Pl. 28, Fig. 11 = *Ettingshausenia cuneifolia* (Bronn) Stiehler, 1857, p. 67.

Discussion. Genus *Ettingshausenia* is based on *E. cuneifolia* (Bronn) Stiehler from the Cenomanian locality of Niederschöna in Germany. This genus is used for accommodation of platanoid leaves of triangular or rhombic shape, with reduced lobes and cuneate or peltate base (Maslova et al. 2005), characterised by craspedodromous venation, and mainly percurrent third order venation. *Ettingshausenia* was revised by Golovneva (2011), who has also chosen the neotype.

Ettingshausenia cuneifolia (Bronn) Stiehler

Pl. 16, Fig. 1–5; Pl. 17, Fig. 1–3

1837 *Credneria cuneifolia* Bronn, p. 583, pl. 28, fig. 11 (1/2).
1849 *Credneria grandidentata* Unger, p. 348, pl. 5, fig. 5.
1857 *Ettingshausenia cuneifolia* (Bronn) Stiehler, p. 67.
1869 *Chondrophyllum grandidentatum* (Unger) Heer, p. 19, pl. 11, fig. 6.
1882 *Platanus rhomboidea* Velenovský, p. 11, pl. 3, fig. 2, 3, pl. 4, fig. 1. nom. illegit. non Lesquereux
1896 *Platanus acute-triloba* Krasser, p. 142, pl. 13, fig. 2.
1896 *Platanus cuneiformis* Krasser, p. 141, pl. 12, fig. 5, pl. 14, fig. 3.
1896 *Platanus moravica* Krasser, p. 140, pl. 13, fig. 3, pl. 15, fig. 3.
1896 *Platanus pseudoguilelmae* Krasser, p. 139, pl. 14, fig. 2.
1896 *Platanus velenovskyana* Krasser, p. 138, pl. 15, fig. 2.
1995b *Platanus velenovskyana* Krasser; Knobloch, p. 8, pl. 3, fig. 1.
2011 *Ettingshausenia cuneifolia* (Bronn) Stiehler; Golovneva, p. 150, pl. 2, fig. 2.

Neotype: MMG/PB_26 (housed in the Senckenberg Museum, Dresden), Pl. 16, Fig. 1; Golovneva 2011, p. 150, pl. 2, fig. 2.

Type locality: Niederschöna (Germany).

Type Horizon: Niederschöna Formation, Cenomanian, Upper Cretaceous.

Material studied: CGS/EK_256; GBA_3b, 77, 119, 120, 136, 138, 139, 140, 141, 142, 143; GPIT/PL_718; MMT(M)/G_368; MMT(Z)/G_392, 473; UGV_23.

Occurrence: Maletín, Kunštát, Praha-Malá Chuchle, Praha-Slivenec (Peruc-Korycany Formation).

Description. The neotype (MMG/PB_26, Pl. 16, Fig. 1) chosen by Golovneva (2011, p. 150, pl. 2, fig. 2) is a deltoid fossil leaf, 90 mm long and 105 mm wide. Cuneate base preserved in upper half is slightly deformed, and leaf could be actually longer. It is a long petiolated leaf (length of petiole 45 mm). Basal part of leaf is entire-margined, apical serrate. Serration is deeply incised. Primary vein relatively thick and clearly pronounced. Secondary craspedodromous venation well preserved. Three to four pairs of upward bent secondary veins depart from midvein at a 35–40° angle. Agrophic veins run in acute angle from lateral veins. Third order venation is percurrent. Specimen no. GPIT/PL_718 (Pl. 16, Fig. 2), described by Heer (1869, p. 19, pl. 11, fig. 6) as *Chondrophyllum grandidentatum* (Unger) Heer is a leaf impression of deltoid to triangular shape, without distinctive lateral lobes. Leaf impression is shortly petiolated (petiole 15 mm long), 76 mm long, width 52 mm. Base is cuneate and entire-margined, more or less serrate in terminal part. Venation craspedodromous, three pairs of secondary veins depart from midvein at acute angles. Primary vein appears divided at the 1/3 point; however, this damage probably took place prior to fossilisation. Venation of third order is percurrent.

Leaf impressions of *E. cuneifolia* from Maletín are highly variable in terms of size and shape. Size of leaf lamina varies from 40 to 130 mm in length and from 25 to 115 mm in width. There are also variations in shape: such as triangular leaves with a partially pronounced medial lobe, and partially pronounced lateral lobes (GBA_138, Pl. 17, Fig. 3a); deltoid, without lateral lobes (MMT(Z)/G_473, Pl. 16, Fig. 5; UGV_23, Pl. 16, Fig. 4); rhombic, with divided lamina and with three fully-developed lobes (GBA_139, Pl. 17, Fig. 1a; GBA_140, Pl. 17, Fig. 2). The leaf apex is typically acute, with terminal part incise to serrate, basal part often entire-margined, cuneate or truncate. Petiole, if preserved, is approximately 25–30 mm long (42 mm). Venation craspedodromous, sometimes palinactinodromous, is always well preserved. Three to six pairs of secondary veins depart from midvein at an angle of 30°. Leaf base is typically cuneate. Suprabasal vein is sometimes present. First pair of secondaries is often agrophic (CGS/EK_256, Pl. 16, Fig. 3a). Third order venation, typically percurrent to branched percurrent. Very well preserved third order percurrent venation is seen in specimens no. CGS/EK_256 (Pl. 16, Fig. 3b), no. GBA_138 (Pl. 17, Fig. 3b), no. GBA_139 (Pl. 17, Fig. 1b) and GBA_140 (Pl. 17, Fig. 2). One specimen of this species from Maletín was depicted by Knobloch (1995b, pl. 3, fig. 1) under the name *Platanus velenovskyana* Krasser.

Discussion. *Platanus rhomboidea* was described by Velenovský (1882), but the same epitethon was used by Lesquerex (1874). This homonymy was mentioned by Krasser (1896), who therefore designated a new name

Platanus velenovskyana Krasser. Krasser (1896) in his publication described eight new species of *Platanus* from the Kunštát locality, approximately 35 km SW from Maletín, which were synomymized by Knobloch (1995b), and later by Golovneva (2011) in *E. cuneifolia*. Various sizes, shapes and types of leaf lamina of *E. cuneifolia* described by Golovneva (2011), and Golovneva and Nosova (2012) have the same epidermis, which argues for high morphological variability of this species. The same result was stated by Z. Kvaček (1983). Due to this, the classification of species based only on gross morphology is very difficult. Therefore we suggest assigning all the platanoid leaves from Maletín to *E. cuneifolia* (Bronn) Stiehler. *E. cuneifolia* differs from *E. laevis* (Velenovský) J. Kvaček et Váchová from the Cenomanian locality of Mělník nad Sázavou in having serration only in the terminal part of the leaf, and having pronounced third order venation. *E. laevis* also almost always shows well-developed lateral lobes. *E. cuneifolia* differs from *E. senonesis* (Knobloch) J. Kvaček et Váchová from the Turonian-Santon locality of Zahájí (South Bohemia) and *E. onomasta* (Bayer) J. Kvaček et Halamski from the Coniacian of Idzików (Halamski and J. Kvaček 2015) in having a serrate terminal part of the leaf, and secondary venation lacking arches in the leaf margin. Leaf impressions of *E. cuneifolia* from Maletín locality frequently show ichnofossils. Pek and Mikuláš (1997) suggest that the numerous semi-circled pits on specimen no. MMT(Z)/G_473 (Pl. 16, Fig. 5) are insect grooves, but they do not exclude inorganic origin. Specimen no. GBA_138 (Pl. 17, Fig. 3a) shows filling of original grooves very well, and is interpreted in agreement with (Pek and Mikuláš 1997) as vermicular animal trace fossil.

Dicotylophyllum Saporta, 1894

Type: *Dicotylophyllum cerciforme* Saporta, 1894, p. 147, pl. 26, fig. 14. (selected by Andrews 1970).

Discussion. For a detailed discussion of the genus, see Halamski (2013) and J. Kvaček and Vodrážka (2015).

Dicotylophyllum macrophyllum (Heer) Greguš et J. Kvaček comb. nov.

Pl. 18, Fig. 1–6; Pl. 19, Fig. 1–3

1869 *Credneria macrophylla* Heer, p. 16, pl. 4, fig. 1 (Basionym).

1999 *Dicotylophyllum* aff. *nordenskioeldii* (Heer) Knobloch, p. 44, pl. 15, fig. 5.

1999 *Dicotylophyllum* sp. 7; Knobloch, p. 48, pl. 8, fig. 4.

Holotype: GPIT/PL_749, Pl. 18, Fig. 1 and GPIT/PL_692, Pl. 18, Fig. 3 (part and counterpart); Heer 1869, p. 16, pl. 4, fig. 1.

Type locality: Maletín.

Stratigraphy: Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

Material studied: CGS/EK_254, 255; GBA_20, 40, 70, 98; GPIT/PL_667, 692.

Emended diagnosis: Leaves large entire-margined cordate. Apex acute to obtuse, base cordate. Primary venation pinnate, first three pairs of secondary veins decusate, dichotomously dividing at 2/3 of distance to leaf margin, ending before completely reaching margin. Suprabasal veins often run out towards the base. Other decusately arranged secondaries depart from midrib at wide angles. Finer and shorter intersecondary veins occur irregularly among secondaries.

Description: The holotype (GPIT/PL_749, Pl. 18, Fig. 1) described by Heer (1869, p. 16, pl. 4, fig. 1) as *Credneria macrophylla* Heer is a 215 mm wide leaf impression of cordate shape, without preserved apical part. This leaf impression is entire-margined and petiolated. Primary venation is pinnate. The first observed pair of secondary veins is decusately arranged departing at almost right angle from midvein. Third order veins depart from second pair of secondaries at wide angles, and at approximately their midpoints, turn towards the apex. Leaf impression no. GPIT/PL_692 (Pl. 18, Fig. 3) without preserved basal and apical part is counterpart of specimen illustrated by Heer (1869). Specimen no. CGS/EK_254 (Pl. 18, Fig. 2) is an entire-margined cordate leaf impression, showing first three descusatelly arranged secondaries. This leaf impression is 155 mm long and 155 mm wide, and has clearly cordate base with rounded apical part, forming an obtuse apex. Entire-margined leaf impression no. GBA_20 (Pl. 18, Fig. 6) is 165 mm wide a 192 mm long, with cordate base and acute apex. First two pairs of secondaries are decustaelly arranged. Secondary veins do not reach leaf margin, and sometimes dichotomise at 2/3 of their length, forming poorly preserved third order reticulate venation in marginal part of leaf. Intersecondary veins present, irregularly distributed. Leaf impression no. GBA_40 (Pl. 18, Fig. 4) is morphologically similar to the previous specimen, but is 170 mm wide and 270 mm long. This leaf impression has long narrow grooves. Specimen no. GPIT/PL_667 (Pl. 18, Fig. 5) is preserved only as a fragment of leaf base. Its better preserved right part is 64 mm wide. Poorly preserved base suggests it was originally cordate. Typically, first three pairs of secondaries are almost opposite to each other, departing at obtuse angles. Other secondaries are arranged alternately on the midvein. The fragmentarily preserved leaf impression no. GBA_98 (Pl. 19, Fig. 2) is rhombical in shape, showing robust veins (midvein up to 4 mm). This impression is 145 mm wide, lacking its basal part. Secondaries alternate, at obtuse angle to the midvein. The specimen is covered by ridges caused probably by burrowing activities of worm-like organisms. Poorly preserved specimen no. CGS/EK_255 (Pl. 19, Fig. 1) is an impression of entire-margined leaf, with cordate shape and acute apex, approximately 130 mm wide and 130 mm long. An entire-margined leaf impression, no. GBA_70 (Pl. 19, Fig. 3) is widely elliptic in shape, and does not have preserved leaf base. Its secondaries are often dichotomously divided, especially in apical parts, forming poorly preserved reticulate venation. Its widely elliptic shape of lamina and absence of basal part makes its classification difficult, but its identical venation pattern allow us to identify it as *D. macrophyllum*.

D i s c u s s i o n . Knobloch (1999) identified leaf impressions of this type as *Dictotylophyllum* aff. *nordenskioeldii* (Heer) Knobloch, based on their morphology. However, this species was described as *Apeibopsis nordenskioldii* Heer from the Late Cretaceous of Puilasok in Greenland (Heer 1874, Seward 1927) having the same secondary venation and shape of lamina, but lacking acute apex. Apical part of *A. nordenskioldii* is likely emarginated (Heer 1874, pl. 5, fig. 6). Leaf impressions of similar morphology and the same type of venation were described by Heer (1869) as *Credneria macrophylla* Heer. This name therefore has priority, and we suggest using it in new combination *Dicotylophyllum macrophyllum* Greguš et J. Kvaček comb. nov. It clearly differs from *Credneria*, which has typical percurrent third order venation. This type of venation was not observed on any specimen of the studied taxon. Seward (1927) and Knobloch (1995a) classified specimens of similar leaf morphology as the studied taxon to the genus *Menispermites* Lesquereux. However, this taxon differs from the studied material in having peltate base, palmate venation and lobate leaf lamina. Leaf impression (CGS/EK_255, Pl. 19, Fig. 1) from Maletín is briefly described as *Dicotylophyllum* sp. 7 by Knobloch (1999). This poorly preserved leaf impression has cordate base with acute apex. Midvein is relatively wide. First pairs of secondaries are decussate and depart from midvein at wide angles. *D. macrophyllum* differs from *Dicotylophyllum* sp. 1, *Dicotyllophyllum* sp. 2, *Dicotyllophyllum* sp. 3 and *Dicotyllophyllum* sp. 4 described here in having cordate base and larger size of leaf lamina.

Dicotylophyllum sp. 1

Pl. 19, Fig. 4

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_115.

O c c u r r e n c e : Maletín.

D e s c r i p t i o n . Single specimen no. GBA_115 (Pl. 19, Fig. 4) is a leaf impression of widely elliptic shape, with cuneate base and widely acute apex, and long petiole (34 mm). Primary venation is pinnate, secondaries often dichotomously divided near the leaf margin. Intersecondary veins present. Pronounced short suprabasal vein in the basal part.

D i s c u s s i o n . *Dicotylophyllum* sp. 1 differs from *D. macrophyllum* in having clearly cuneate base. It differs from *Dicotylophyllum* sp. 2, *Dicotyllophyllum* sp. 3 and *Dicotyllophyllum* sp. 4 in having elliptic leaf lamina with pronounced secondary venation, dichotomously divided near the margin.

Dicotylophyllum sp. 2

Pl. 20, Fig. 1

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : NHMW_7.

O c c u r r e n c e : Maletín.

D e s c r i p t i o n . Specimen no. NHMW_7 (Pl. 20, Fig. 1) is an entire-margined leaf impression of narrow deltoid shape, with wide cuneate base. Leaf lamina is widest in its 1/3 (30 mm), and narrows longitudinally and symmetrically towards apical part. Leaf impression is 93 mm long. The primary vein is relatively robust (up to 3 mm wide near base), and slightly narrows towards the apex. Secondaries are finer, but still relatively robust, terminating in leaf margin. Third order venation not observed.

D i s c u s s i o n . *Dicotylophyllum* sp. 2 differs from *D. macrophyllum*, *Dicotylophyllum* sp. 1, *Dicotyllophyllum* sp. 3 and *Dicotyllophyllum* sp. 4 in having deltoid leaf lamina and relatively robust midvein.

Dicotylophyllum sp. 3

Pl. 20, Fig. 2–4

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_14; MMT(M)/G_489, 492.

O c c u r r e n c e : Maletín.

D e s c r i p t i o n . Three entire-margined leaf impressions of obovate shape. Specimens are approximately 100 mm long and 30 mm wide. Their base is narrow and longitudinally cuneate. Apical part is rounded, with a suggested incision (MMT(M)/G_492, Pl. 20, Fig. 4). Leaves are shortly petiolated (GBA_14, Pl. 20, Fig. 2 and MMT(M)/G_489, Pl. 20, Fig. 3). Petiole continues as relatively robust midvein, narrowing towards apex.

D i s c u s s i o n . *Dicotylophyllum* sp. 3 differs from *D. macrophyllum*, *Dicotylophyllum* sp. 1, *Dicotyllophyllum* sp. 2 and *Dicotyllophyllum* sp. 4 in having obovate shape of leaf lamina and round apex with suggested incision.

Dicotylophyllum sp. 4

Pl. 20, Fig. 5

S t r a t i g r a p h y : Peruc-Korycany Formation, Cenomanian, Upper Cretaceous.

M a t e r i a l s t u d i e d : GBA_114.

O c c u r r e n c e : Maletín

D e s c r i p t i o n . Single leaf impression of linear pinnatisect leaf (NHMW_114, Pl. 20, Fig. 5). Leaf lamina 88 mm long and 8 mm wide, divided into alternately arranged segments, dissected almost to the midvein. Base longitudinally and narrowly cuneate, segments begin at 1/3 of length. Approximately 7 mm long segments depart run out at 30° angle, wider at base, and obtuse in apical parts. Midvein relatively robust. Primary venation pinnate, secondary not observed.

D i s c u s s i o n . *Dicotylophyllum* sp. 4 differs from *D. macrophyllum*, *Dicotylophyllum* sp. 1, *Dicotyllophyllum* sp. 2 and *Dicotyllophyllum* sp. 3 in having linear pinnatisect shape of leaf lamina.

Dicotylophyllum sp. 4 is morphologically similar to "*Dryandra*" *cretacea* VELENOVSKÝ, but differs in having an undivided base, and also in shape of segments, which are long convergent to rounded apex. "*Dryandra*" *cretacea* shows triangular shape of segments with acute apex (Velenovský 1883). For classification of this taxon, genus *Dryandrophyllum* VELENOVSKÝ, 1889 would seem to be a better choice, but it was unfortunatelly not validly published.

Conclusions

The Maletín Sandstone yields widely known Cenomanian flora, which material is housed in many museums and other institutions of Central Europe. This summary provides a survey of all the available material, particularly the type material by Heer (1869), but also further historical material, including descriptions of species new for this locality. It comprises numerous well-known taxa, which are described in light of contemporary knowledge of European Cenomanian flora. *Myrtoidea geinitzii* and *Araliaephyllum formosum* are of particular interest, representing typical taxa of the Maletín taphocoenosis. The presence of ovuliferous cones of *Pinus quenstedtii* argues for the existence of pine forests in mesic to xeric habitats of Cenomanian vegetation from the Maletín area. By contrast, large leaves of *Magnoliaephyllum alternans* and *Dicotylophyllum macrophyllum* probably belonged to trees from wet habitats of river flood plains. Revision of the Maletín flora after more than 100 years provides a base for additional palaeoecological studies, planned by the authors for future publications.

Acknowledgments

Our warmest thanks go to Zlatko Kvaček, Zdeněk Gába, Vladislav John, Bohuslav Vítámvás, Radovan Jeřábek and Rostislav Morávek for valuable discussions. The described collections were studied through the courtesy of the following curators: Tomáš Lehotský (VMO), Eva Kadlecová (CGS), Marika Polechová (CGS), Irene Zorn (GBA), Philippe Havlik (GPIT), Jindřich Kos (MMT(Z)), Jana Martínková (MMT(M)), Růžena Gregorová (MZM), Nela Doláková (UGV), Andreas Kroh (NHMW), Anita Roth-Nebelsick (SMNS). We are also grateful to Lutz Kunzmann (Senckenberg Museum, Dresden), Bernard Gomez (University Claude Bernard, Lyon) for supporting us with literature and photographs of the type material. Zuzana Lipovská and Petr Daneš are acknowledged for English translation. The study was supported by the Ministry of Culture of the Czech Republic (grant no. DKRVO 2015/05, 00023272).

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Explanations of the plates

PLATE 1

Gleicheniaceaephyllum kurrianum (Heer) Greguš et J. Kvaček comb. nov., Maletín, all scale bars: 10 mm

1a. Lectotype, fragment of leaf frond, fertile specimen, Heer 1869, pl. 2, fig. 1, no. GPIT/PL_727.
1b. Magnified detail of Pl. 1, Fig. 1a leaf pinnules with sori, no. GPIT/PL_727.
2a. Epitype, pseudodichotomous leaf frond with partially preserved resting bud in the place of division, Domin 1929, text-fig. 157, no. MMT(M)/G_438.
2b. Magnified detail of Pl. 1, Fig. 2a resting bud in in the place of division, no. MMT(M)/G_438.
3. Fertile leaf pinna, no. GPIT/PL_722.
4. Sterile leaf frond, no. GPIT/PL_726.

PLATE 2

Gleicheniaceaephyllum kurrianum (Heer) Greguš et J. Kvaček comb. nov., Maletín, all scale bars: 20 mm

1a. Sterile leaf frond, no. GPIT/PL_741.
1b. Sterile leaf pinnae, detail of Pl. 2, Fig. 1a, no. GPIT/PL_741.
2. Axis of leaf frond with regularly arranged sub-oppositely arranged secondary axes, no. GPIT/PL_649.

Protopteris maletinensis Greguš et J. Kvaček, Maletín

3a. Holotype, part of stem with helically arranged large leaf cushions, Greguš et al. 2013, pl. 3, fig. 1, no. NHMW_1878B/0006/7141, scale bar: 20 mm.
3b. Magnified detail of Pl. 2, Fig. 3a leaf cushion with outlined undivided horse-shoe shaped scar of vascular bundle, no. NHMW_1878B/0006/7141, scale bar: 10 mm.
3c. Magnified detail of Pl. 2, Fig. 3a leaf cushion with poorly preserved undivided horse-shoe shaped scar of vascular bundle, no. NHMW_1878B/0006/7141, scale bar: 10 mm.
4. Part of stem with helically arranged leaf cushions, no. UGV/S17_2, scale bar: 20 mm.
5. Part of stem with helically arranged leaf cushions, no. GBA 2013/019/0001, scale bar: 20 mm.
6. Part of stem with helically arranged leaf cushions, no. GBA 2013/019/0002, scale bar: 20 mm.

PLATE 3

cf. *Microzamia gibba* (A. E. Reuss) Corda in A. E. Reuss, Maletín, all scale bars: 20 mm

1a. Longitudinally ovate impression of ovuliferous cone with helically arranged peltate cone scales, no. GPIT/PL_634.
1b. Magnified detail of Pl. 3, Fig. 1a helically arranged peltate ovuliferous cone scale of hexagonal shape with protuberances and trichomes, no. GPIT/PL_634.

cf. *Zamites bayeri* J. Kvaček in Knobloch et J. Kvaček, Maletín, all scale bars: 20 mm

2a. Leaflet with constricted base in insertion point showing parallel venation, detail of Pl. 3, Fig. 2b, no. GBA_4.
2b. Impression of pinnate leaf fragment showing rachis with several lanceolate leaflets, no. GBA_4.
3. Isolated fragment of leaflets with constricted base showing parallel venation, no. GBA_66.
4. Isolated fragment of leaflets with rounded to obtuse apex and parallel venation, no. MZM/118_18.
5. Fragment of simply pinnate leaf, no. GBA_134.
6. Fragment of compound leaf, no. MMT(M)/G_431.
7. Fragment of compound leaf with leaflets at base decurrent, no. GBA_5.

cf. *Anomozamites* sp., Maletín, scale bar: 20 mm

8. Impression of simply pinnate compound leaf fragment, no. GBA_127.

PLATE 4

cf. *Anomozamites* sp., Maletín, all scale bars: 20 mm

1. Impression of simple pinnate leaf fragment with five preserved rectangular leaflets with truncate apex, no. GBA_128.
2a. Fragment of pinnate leaf, rectangular leaflets with parallel venation and truncate apex, no. NM-F2521.
2b. Magnified detail of Pl. 4, Fig. 2a rectangular leaflets with parallel venation, no. NM-F2521.
3. Fragment of simply pinnate leaf, no. NHMW_28.

Dammarophyllum sp., Maletín, scale bars: 20 mm

4. Impression of entire-margined leaf of eliptic to lanceolate shape with obtuse apex and abruptly narrowing base to short petiole, no. MMT(M)/G_338.

Cunninghamites lignitum (Sternberg) J. Kvaček, Maletín, all scale bars: 20 mm

5a. Fragment of shoot with helically arranged leaf cushions of rhombic to obovate shape and linear-lanceolate, needle-like leaves, no. GPIT/PL_755.
5b. Magnified detail Pl. 4, Fig. 5a, arrows point to linear-lanceolate needles with acute apex, no. GPIT/PL_755.
6. Branched shoot with helically arranged leaf cushions of rhombic to obovate shape and not very apparent linear needles, no. UGV_22.
7. Unbranched fragment of a shoot with helically arranged leaf cushions of rhombic to obovate shape and linear-lanceolate needles, no. MMT(M)/G_319.
8. Unbranched fragment of a shoot with partially preserved fragments of needles, no. MMT(M)/G_320.

Cunninghamites ubaghsii Debey ex Ubaghs, Maletín, scale bars: 20 mm

9. Fragment of longitudinally fractured shoot impression with partially preserved needles (up to 40 mm), no. GPIT/PL_654.

PLATE 5

Cunninghamites ubaghsii Debey ex Ubaghs, Maletín, all scale bars: 20 mm

1a. Fragment of shoot with helically arranged, clearly visible leaf cushions of obovate rhombic shape and typically long linear leaves, no. GPIT/PL_730.
1b. Magnified detail of Pl. 5, Fig. 1a shoot with helically arranged leaf cushions of obovate rhombic shape and typically long linear leaves, no. GPIT/PL_730.

2a. Fragment of shoot with helically arranged, clearly visible leaf cushions of obovate to rhombic shape and typically long linear needles, no. GPIT/PL_757.
2b. Magnified detail of Pl. 5, Fig. 2a a shoot with helically arranged, leaf cushions of obovate to rhombic shape, no. GPIT/PL_757.

Thuites alienus STERNBERG, Smečno, scale bars: 20 mm
3. Lectotype, impression of sterile shoot fragment helically covered with leaf cushions of rhombic shape with apparent groove in the middle and imbricate needles with acute apex, Sternberg 1825, pl. 45, fig. 1, no. NM-F3675.

PLATE 6

Thuites alienus STERNBERG, all scale bars: 20 mm
1. Two fragmentary shoots with helically arranged imbricate needles, Smečno, no. NM-F344.
2. Two fragmentary shoots, wider with visible leaf cushions and narrower with scale-like needles, Maletín, no. GPIT/PL_650.
3. Connection of wider and narrower type of shoot, Maletín, no. GPIT/PL_751.
4. Several fragments of narrow shoot (up to 100 mm long) with scale-like needles, Maletín, no. GPIT/PL_737.

PLATE 7

Thuites alienus STERNBERG, Maletín
1. Fertile twig with ovuliferous cone in the terminal part, no. GPIT/PL_716, scale bar: 20 mm.
2. Fertile twigs with ovuliferous cone, no. GPIT/PL_725, scale bar: 20 mm.
3. Fertile twig with ovuliferous cone in the terminal part, no. UGV_24, scale bar: 20 mm.
4. Longitudinally fractured ovuliferous cone with smooth peduncle, no. GPIT/PL_723a, scale bar: 20 mm.
5. Transversally fractured ovuliferous cone, no. GPIT/PL_723b, scale bar: 10 mm.
6. Longitudinally fractured ovuliferous cone with smooth peduncle, no. SMNS/650_16, scale bar: 20 mm.
7. Longitudinally fractured ovuliferous cones borne/attached to branches, no. MMT(Z)/G_447, scale bar: 20 mm.
8. Longitudinally fractured ovuliferous cone attached to shoot, no. NHMW_6, scale bar: 20 mm.

Pinus quenstedtii HEER, Maletín, all scale bars: 20 mm
9. Ovuliferous cone showing scale from abaxial part, no. GPIT/PL_674.
10. Lectotype, long cylindrical ovuliferous cone without basal part with helically arranged ovuliferous scale of hexagonal shape with prominent umbo, Heer 1869, pl. 2, fig. 7, no. GPIT/PL_736.

PLATE 8

Pinus quenstedtii HEER, Maletín, all scale bars: 20 mm
1. Paralectotype, longitudinally fractured ovuliferous cone of oval shape with ovuliferous scale bearing two ovoid seeds, Heer 1869, pl. 2, fig. 9, no. GPIT/PL_739.
2. Impression of longitudinally fractured ovuliferous cone of oval shape with ovuliferous scales and seeds, no. NHMW_4.
3. Ovuliferous cone with long peduncle, GPIT/PL_742.
4. Ovuliferous cone with well-preserved apophyses, including prominent umbo, no. MZM/118_16.
5. Ovuliferous cone with well-preserved apophyses, including prominent umbo, no. GPIT/PL_732.
6. Ovuliferous cone with dorso-ventrally flattened scales and scales with thickened apophyses having prominent umbo in central part, no. UGV_20.

Conago sp. 1, Maletín
7. Longitudinally fractured ovuliferous cone of ovoid shape, consisting of central axis with oppositely arranged pairs of distally peltate ovuliferous scales with mucronate projection, no. GPIT/PL_724, scale bar: 20 mm.
8. Longitudinally fractured ovuliferous cone of ovoid shape, consisting of central axis with oppositely arranged pairs of distally peltate ovuliferous scales and scale in terminal part, no. NHMW_31b, scale bar: 20 mm.
9. Transversally fractured ovuliferous cone with 3 pairs of peltate ovuliferous cone scales in almost regular 120° distances, no. GBA_79, scale bar: 10 mm.

Conago sp. 2, Maletín, scale bar: 20 mm
10. Impressions of two ovuliferous cones of spheroid shape with helically arranged ovuliferous scales of rhombical shape, no. GBA_47.

Masculostrobus sp. 1, Maletín, scale bar: 20 mm
11. Impression of microsporangiate cone of longitudinal ovate shape with helically arranged microsporophylls of tetragonal to hexagonal shape, no. GBA_78.

Masculostrobus sp. 2, Maletín, scale bar: 20 mm
12a. Impression of microsporangiate cone of conical shape, no. GBA_10.
12b. Magnified detail of Pl. 8, Fig. 12a impression of microsporangiate cone with helically arranged microsporophylls of irregularly hexagonal shape, no. GBA_10.

PLATE 9

Myrtoidea geinitzii (HEER ex SCHIMPER) J. KVAČEK et GREGUŠ comb. nov., Maletín, all scale bars: 20 mm
1a. Lectotype, almost complete simple entire-margined leaf, no. GPIT/PL_750.
1b. Magnified detail of Pl. 9, Fig. 1a, arrows point to intramarginal vein, Heer 1869, pl. 11, fig. 3, Z. Kvaček 1992, pl. 1, fig. 1–2, no. GPIT/PL_750.
2. Middle part of leaf with well-preserved venation, no. GPIT/PL_733.
3. Simple lanceolately elongated, entire-margined leaf with long petiole, apparent grooves and ridges probable result of plant-arthropod interaction, see Pek and Mikuláš 1997, no. GPIT/PL_744.

PLATE 10

Myrtoidea geinitzii (Heer ex Schimper) J. Kvaček et Greguš comb. nov., Maletín, all scale bars: 20 mm

1a. Leaf with longitudinally cuneate base and acute to acuminate apex, no. GBA_133.
1b. Magnified detail of Pl. 10, Fig. 1a with intramarginal vein, no. GBA_133.
2a. Impression of leaf with base sharply convex, no. NHMW_27.
2b. Magnified detail of Pl. 10, Fig. 2a, arrows point to intramarginal vein, no. NHMW_27.
3a. Magnified detail of Pl. 10, Fig. 3b, arrows point to intramarginal vein, no. UGV_6.
3b. Impression of leaf with short petiole, no. UGV_6.
4. Impression of leaf with cuneate base and acuminate apex, no. GBA_145.
5. 275 mm long impression of leaf with cuneate base and missing apex, no. GBA_MMT(Z)/G_343.

PLATE 11

Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward, all scale bars: 20 mm

1. Lectotype, line drawing of entire-margined elliptic leaf with cuneate base, Capellini and Heer 1866, pl. 3, fig. 3, Tekamah, Nebraska, USA.
2. Entire-margined, elliptic leaf with short petiole, Maletín, no. SMNS/650_8.
3. Elliptic leaf with short petiole and acuminate apex, arrows point to dichotomous branching of secondary vein and suprabasal vein, no. GPIT/PL_734.
4. Elliptic leaf basal part, arrows point to dichotomous branching of secondary vein, no. SMNS/650_9.
5. Elliptic leaf basal part, arrows point to dichotomous branching of secondary vein, no. GPIT/PL_719.

PLATE 12

Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward, Maletín, all scale bars: 20 mm

1. Longitudinally elliptic leaf impression, no. SMNS/650_5.
2. Longitudinally elliptic leaf impression, no. SMNS/650_2.
3. Elliptic leaf impression with cuneate base and oblong attenuate apex, no. SMNS/650_1.
4. Elliptic leaf impression with cuneate base and long petiole, no. GPIT/PL_746.
5. Elliptic leaf impression with cuneate base, no. GPIT/PL_756.
6. Widely elliptic asymmetrical leaf impression with petiole, no. GPIT/PL_747.
7. Elliptic leaf impression with fragmental petiole, no. GPIT/PL_735.

PLATE 13

Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward, Maletín, all scale bars: 20 mm

1. Fragment of elliptic leaf impression, no. GPIT/PL_752.
2. Ovate to widely elliptic asymmetrical leaf impression with long petiole, no. GPIT/PL_754.
3. Widely elliptic leaf impression, without the right basal part, no. SMNS/650_13.
4. Widely elliptic asymmetrical leaf impression, without the apical part, no. GPIT/PL_753.
5. Counter part to GPIT/PL_753 (Pl. 13, Fig. 4) widely obovate leaf impression, without apex, no. GPIT/PL_666.

PLATE 14

Magnoliaephyllum alternans (Heer in Capellini et Heer) Seward, Maletín, all scale bars: 20 mm

1a. Elliptic leaf impression with preserved percurrent veins of third order and long petiole, no. GBA_18.
1b. Magnified detail of Pl. 14, Fig. 1a showing third order percurrent veins, no. GBA_18.
2a. Widely elliptic leaf impression without preserved apex, no. GBA_29.
2b. Magnified detail of Pl. 14, Fig. 2a showing third order veins, no. GBA_29.

Araliaephyllum formosum (Heer) Greguš et J. Kvaček comb. nov., Maletín, scale bars: 20 mm

3. Holotype, trilobate leaf with cuneate to acute base and rounded to slightly acute apical parts of lobes, Heer 1869, pl. 8, fig. 3, no. GPIT/PL_728.

PLATE 15

Araliaephyllum formosum (Heer) Greguš et J. Kvaček comb. nov., Maletín, scale bars: 20 mm

1a. Palmately trilobate leaf, lobes elliptic to obovate, no. GBA_107.
1b. Magnified detail of Pl. 15, Fig. 1a showing dichotomous branching of secondary veins, intersecondary veins present, lateral venation brochidodromous, no. GBA_107.
2. Leaf impression with acute base and 18 mm long petiole, no. NHMW_25.
3. Leaf impression with cuneate base, no. MMT(M)/G_423.
4. Impression of trilobate leaf, lobes entire-margined at base, apex obtusely serrated, no. MMT(M)/G_350.

Araliaephyllum kowalevskianum (Saporta et Marion ex Velenovský) Greguš et J. Kvaček comb. nov., all scale bars: 20 mm

5. Lectotype, impression of long petiolated (50 mm), entire-margined leaf with seven lobes, Vyšehořovice, Velenovský 1882, pl. 5, fig. 1, no. NM-F897.
6. Incomplete palmately penta-lobed, entire-margined leaf, Maletín, no. GBA_106.

PLATE 16

Ettingshausenia cuneifolia (Bronn) Stiehler, all scale bars: 20 mm

1. Neotype, long petiolated deltoid leaf with cuneate entire-margined base, apical serration is deeply incised,

clearly visible percurrent venation of third order, Niederschöna, Germany, Golovneva 2011, pl. 2, fig. 2, no. MMG/PB_26. Foto: Lutz Kunzmann.

2. Deltoid to triangular leaf with cuneate base, Maletín, no. GPIT/PL_718.
3a. Deltoid leaf impression with agrophic venation and preserved venation of third order, Maletín, no. ČGS/EK_256.
3b. Magnified detail of Pl. 16, Fig. 3a showing third order percurrent to branched percurrent venation, Maletín, no. ČGS/EK_256.
4. Deltoid leaf impression without significant lateral lobes, Maletín, no. UGV_23.
5. Deltoid leaf impression without significant lateral lobes showing numerous semi-circled pits on leaf lamina (probably trace fossils of plant-insect interactions, comparable with recent insect galls, according to Pek and Mikuláš 1997), Maletín, no. MMT(Z)/G_473.

PLATE 17

Ettingshausenia cuneifolia (Bronn) Stiehler, Maletín, all scale bars: 20 mm

1a. Leaf impression of rhombic shape with three fully-developed lobes, no. GBA_139.
1b. Magnified detail of Pl. 17, Fig. 1a showing percurrent venation of third order, no. GBA_139.
2. Leaf impression of rhombic shape with three developed lobes and percurrent venation of third order, no. GBA_140.
3a. Leaf impression of triangular shape with cuneate base and with a partially pronounced lobes, showing grooves (probably vermicular animal trace fossil, Pek and Mikuláš 1997), no. GBA_138.
3b. Magnified detail of (Pl. 17, Fig. 3a) showing percurrent venation of third order, no. GBA_138.

PLATE 18

Dicotylophyllum macrophyllum (Heer) Greguš et J. Kvaček comb. nov., Maletín, all scale bars: 20 mm

1. Holotype, entire-margined leaf basal part of cordate shape with petiole, Heer 1869, pl. 4, fig. 1, no. GPIT/PL_749.
2. Entire-margined leaf of cordate shape with rounded apex, showing first three descusatelly arranged secondaries, no. ČGS/EK_254.
3. Counterpart of the specimen GPIT/PL_749 (Pl. 18, Fig. 1), leaf fragment, no. GPIT/PL_692.
4. Entire-margined leaf of elongate to cordate shape showing long narrow grooves (probably vermicular arthropod trace fossil, Pek and Mikuláš 1997), no. GBA_40.
5. Basal part of entire-margined, cordate leaf, no. GPIT/PL_667.
6. Entire-margined, cordate leaf with acute apex, apparent intersecondary veins, no. GBA_20.

PLATE 19

Dicotylophyllum macrophyllum (Heer) Greguš et J. Kvaček comb. nov., Maletín, all scale bars: 20 mm

1. Poorly preserved entire-margined cordate leaf with acute apex, showing grooves (probably vermicular arthropod trace fossil, Pek and Mikuláš 1997), no. ČGS/EK_255.
2. Leaf fragment of rhombical shape with robust veins, probably medial part of a larger leaf, no. GBA_98.
3. Entire-margined widely elliptic leaf without base, secondary veins often dichotomously divided, no. GBA_70.

Dicotylophyllum sp. 1, Maletín, scale bar: 20 mm

4. Entire-margined, widely elliptic leaf with cuneate base and acute apex, secondaries often dichotomously divided near the leaf margin, no. GBA_115.

PLATE 20

Dicotylophyllum sp. 2, Maletín, scale bar: 20 mm

1. Entire-margined leaf of narrow deltoid shape with wide cuneate base, primary vein is relatively robust, no. NHMW_7.

Dicotylophyllum sp. 3, Maletín, all scale bars: 20 mm

2. Entire-margined obovate leaf with narrow and longitudinally cuneate basal part, petiole continues as relatively robust midvein, narrowing towards apex, no. GBA_14.
3. Entire-margined obovate leaf with narrow and longitudinally cuneate basal part, with relatively robust primary vein, narrowing towards apex, no. MMT(M)/G_489.
4. Entire-margined obovate leaf with narrow and longitudinally cuneate basal part, with relatively robust primary vein, narrowing towards apex, no. MMT(M)/G_492.

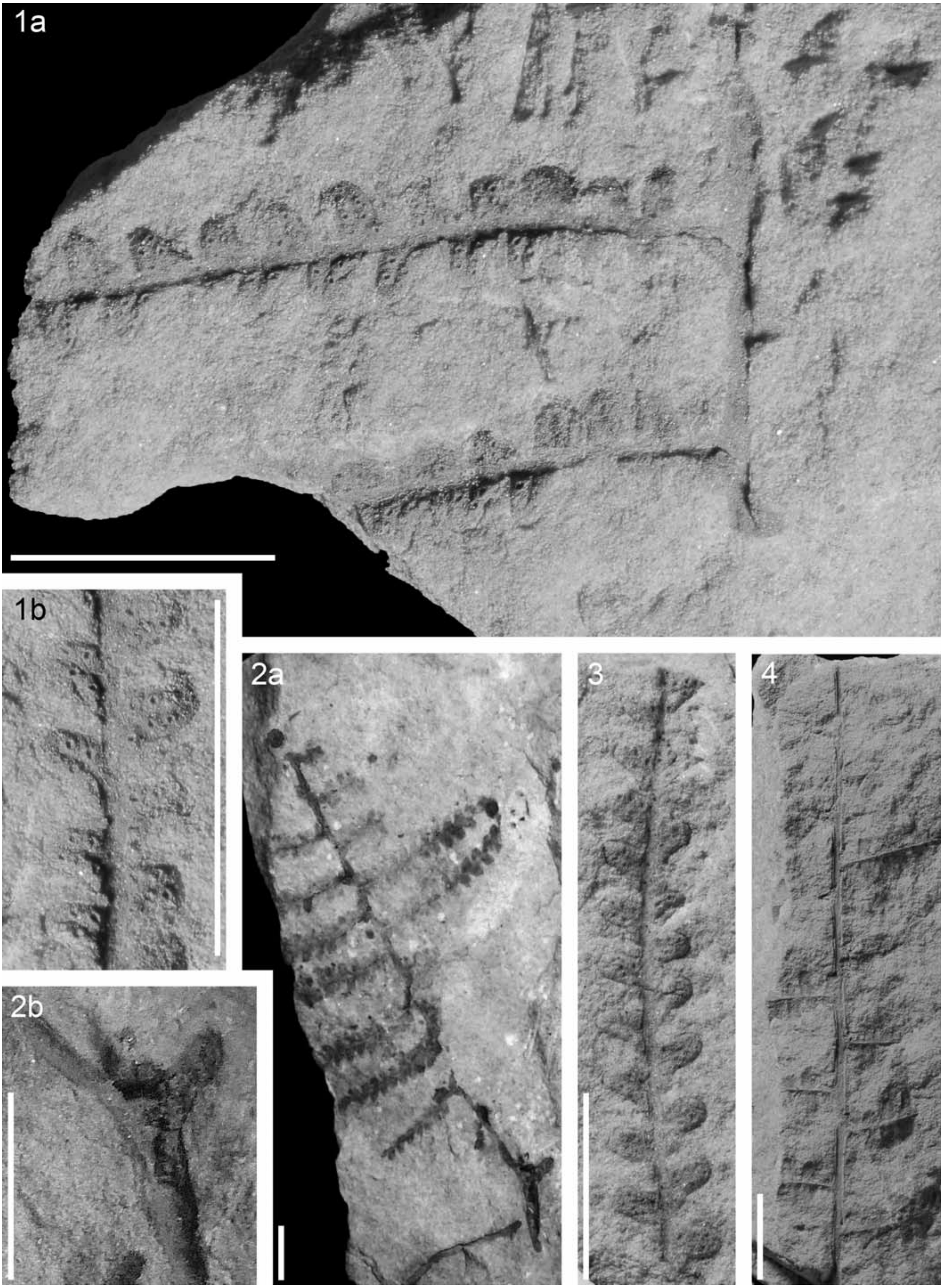
Dicotylophyllum sp. 4, Maletín, scale bar: 20 mm

5. Linear pinnatisect leaf with longitudinally and narrowly cuneate base showing pinnate venation, no. GBA_114.

PLATE 21

1. Additional view of Kubíček Quarry, Maletín, Peruc-Korycany Formation, (person cca: 180 cm high, arrow), photo Petr Dleštík.
2. Second largest Iveta Quarry, about 1 km south east of Kubíček Quarry, Maletín, (persons cca: 180 cm), photo Zuzana Lipovská.

PLATE 1



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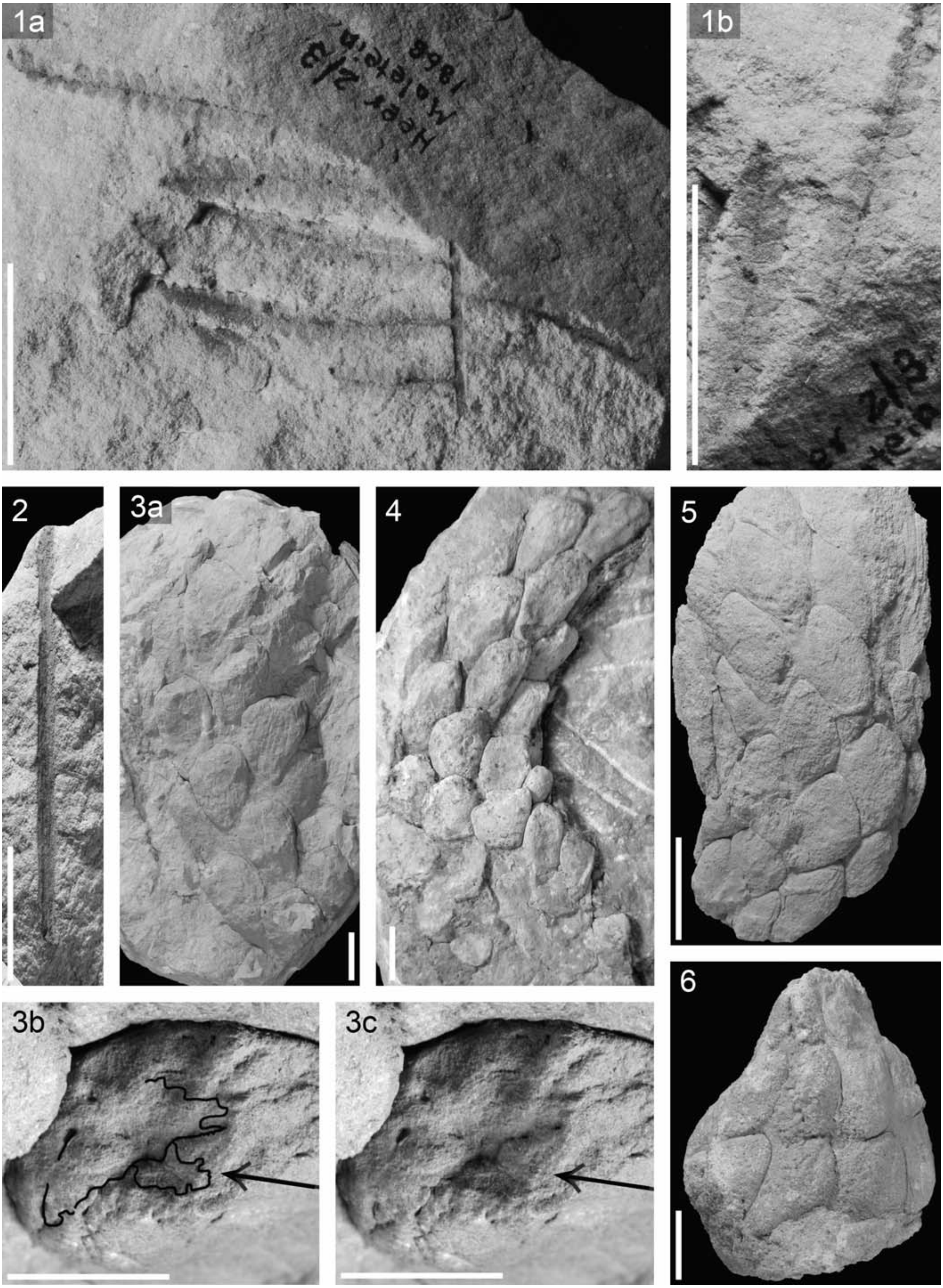

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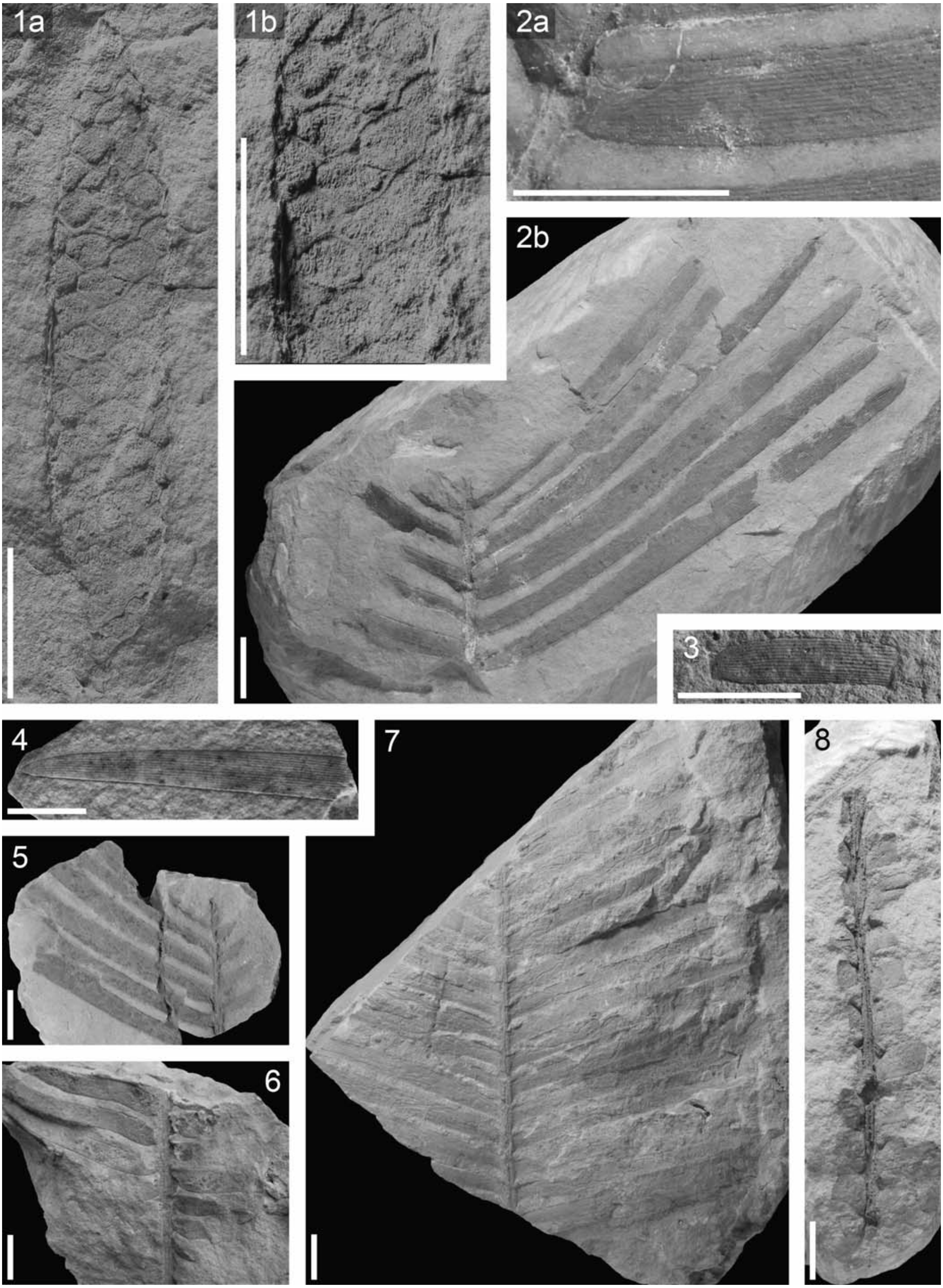

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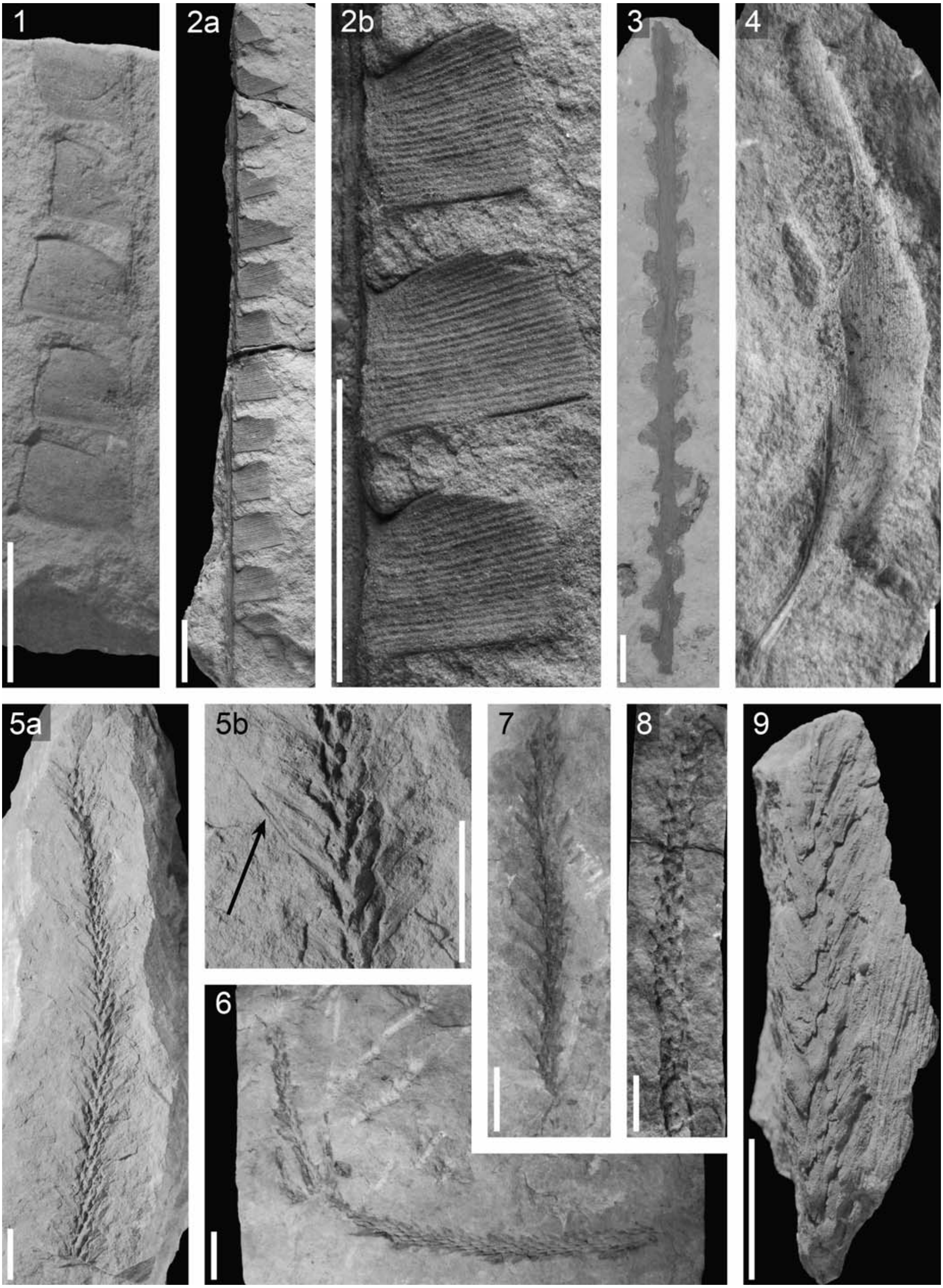

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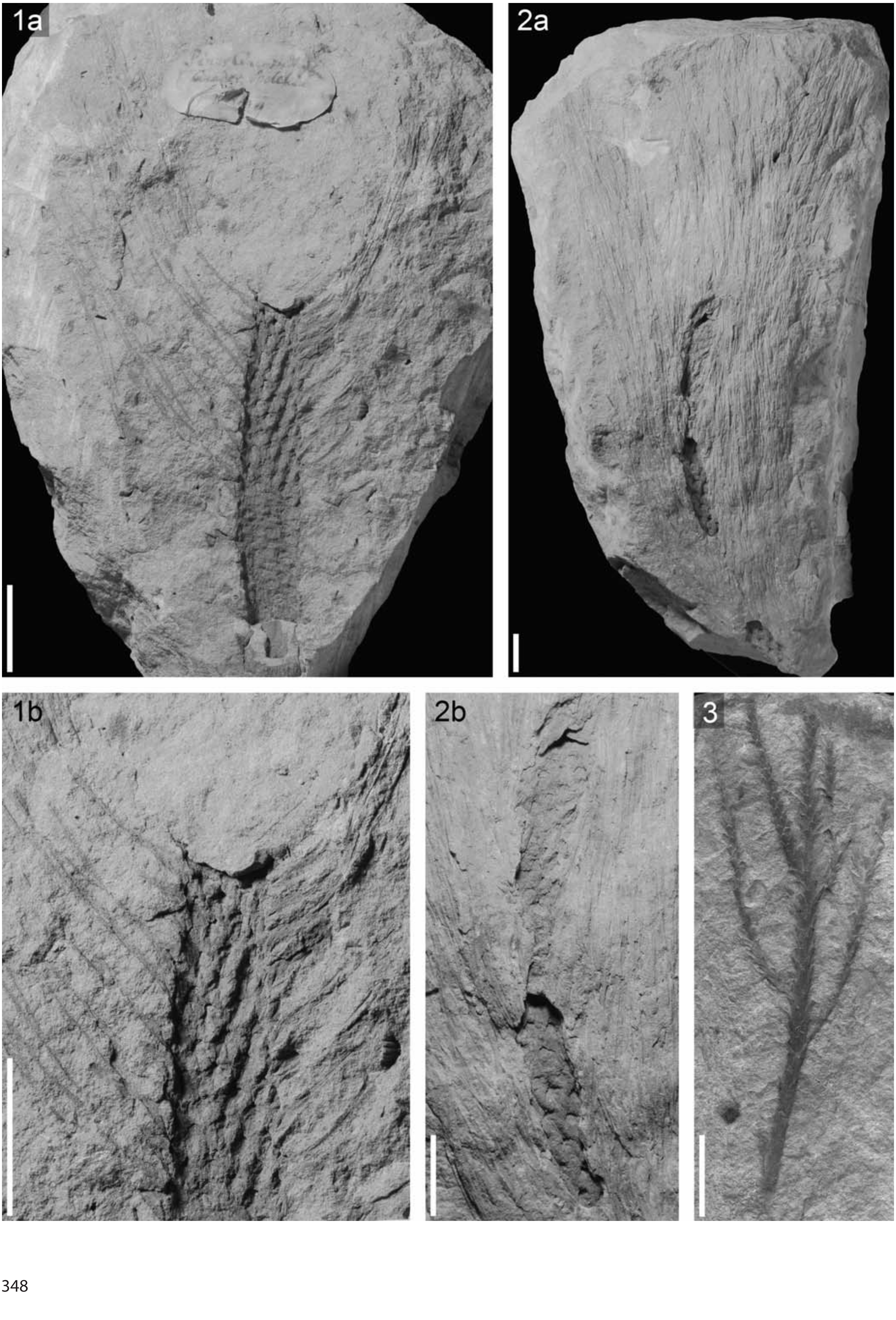

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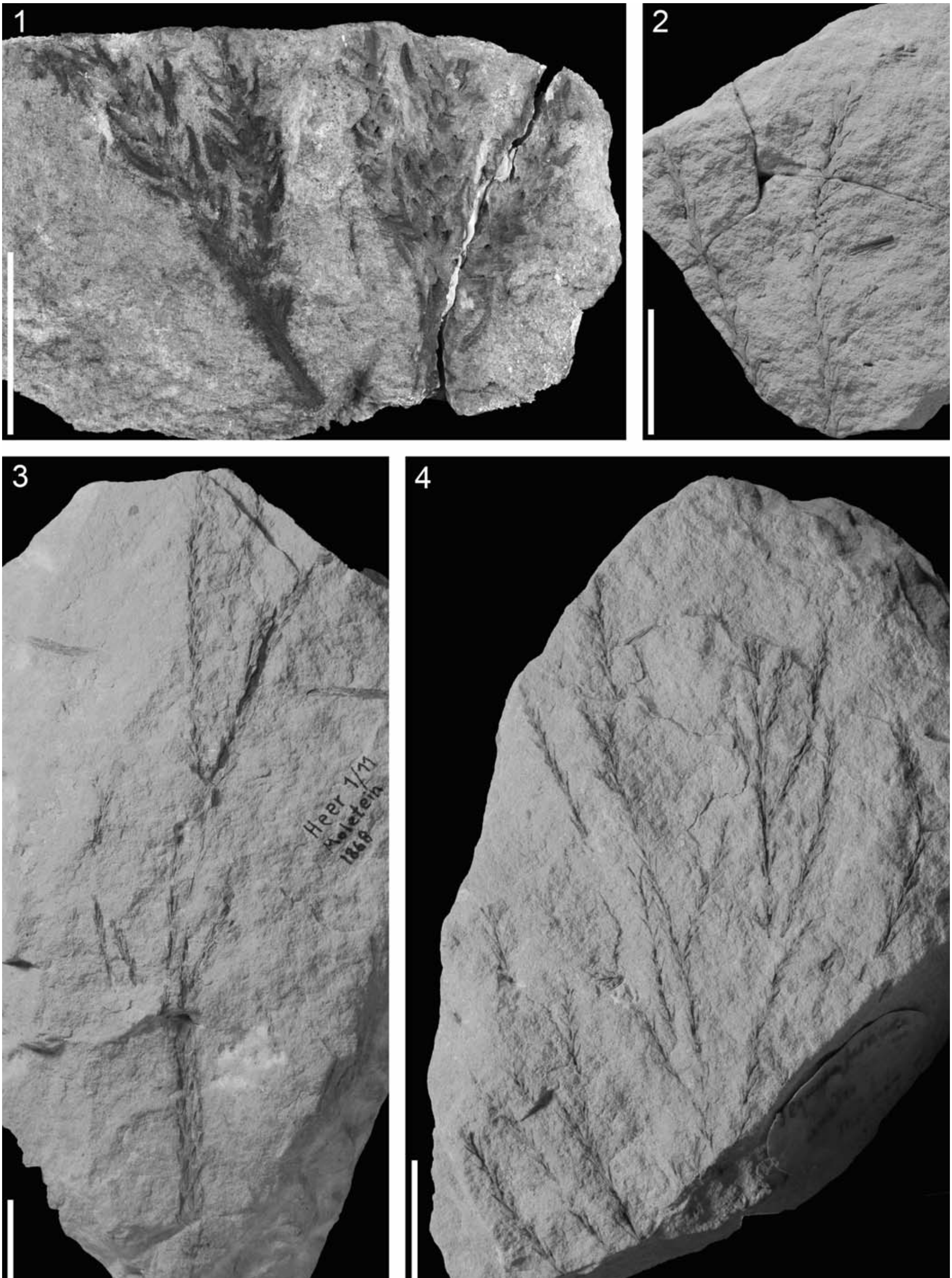

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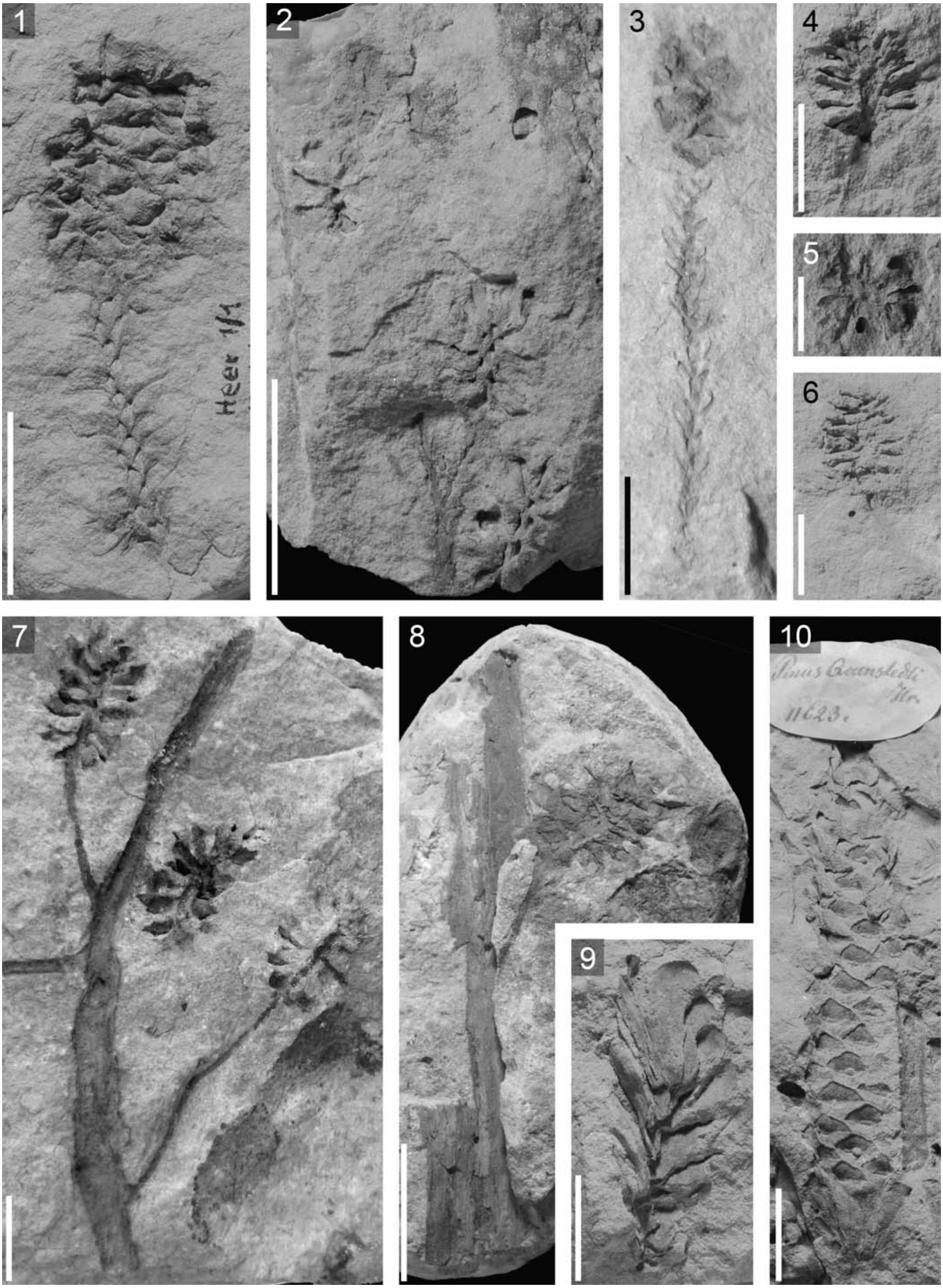

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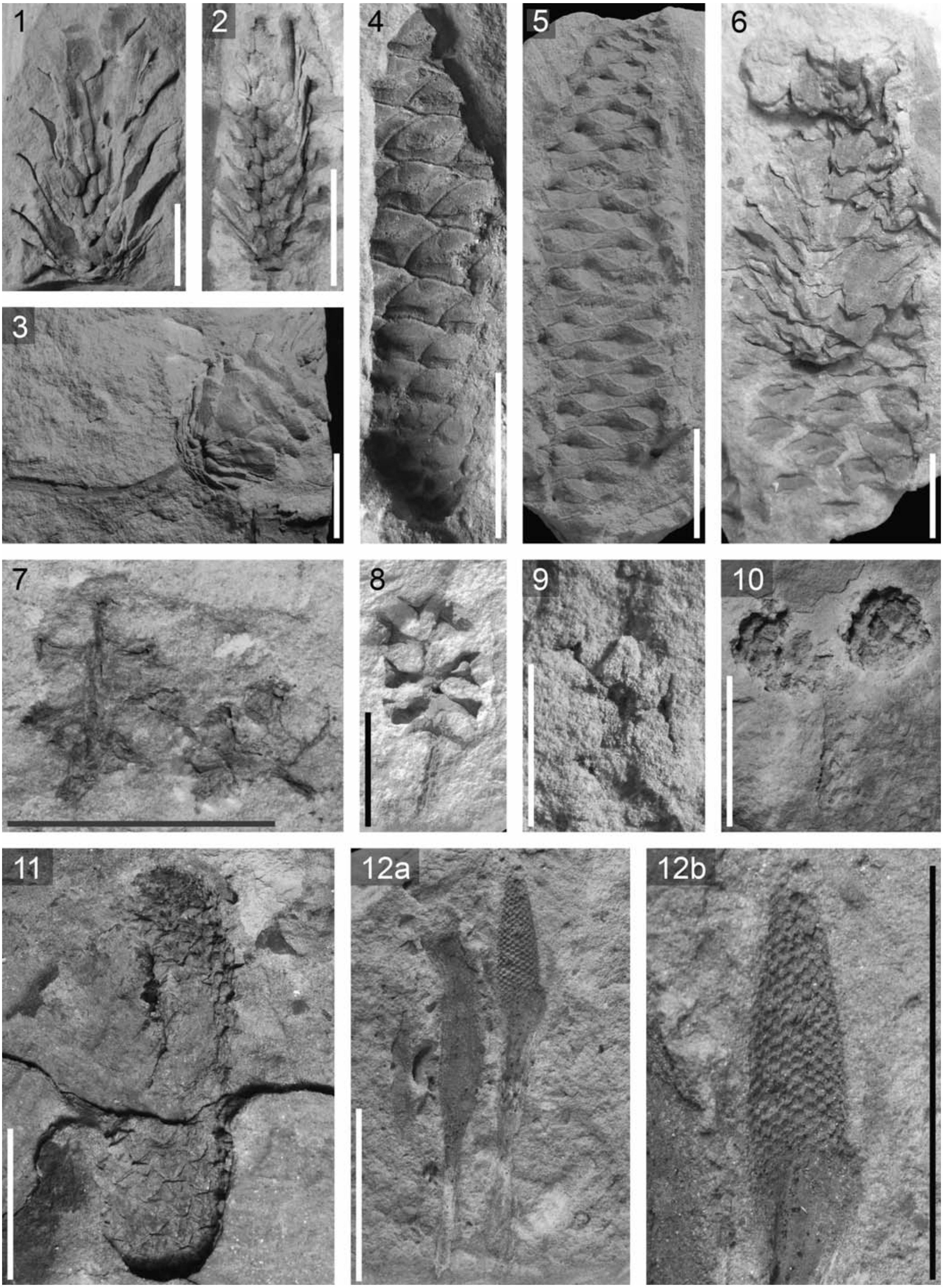

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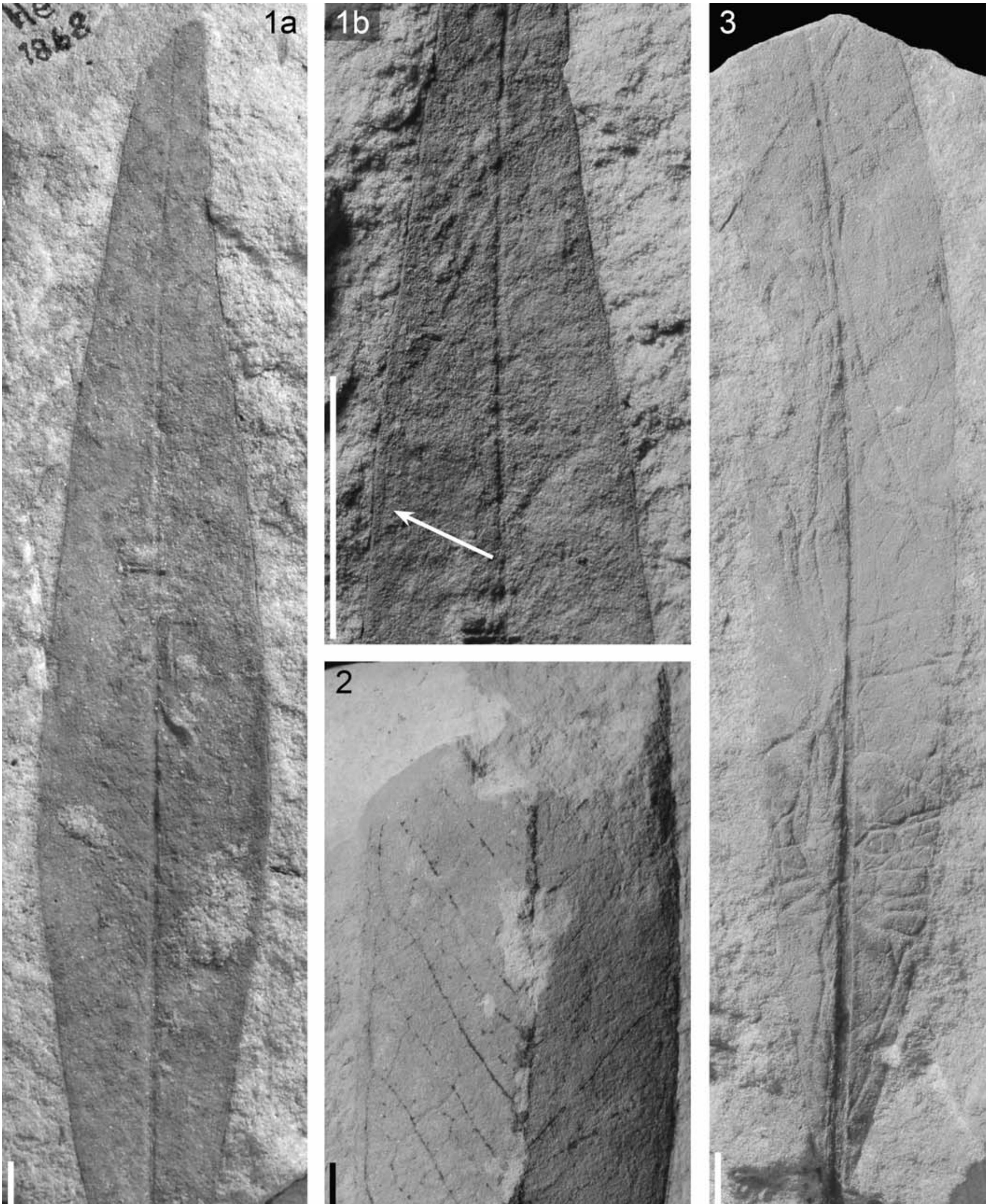

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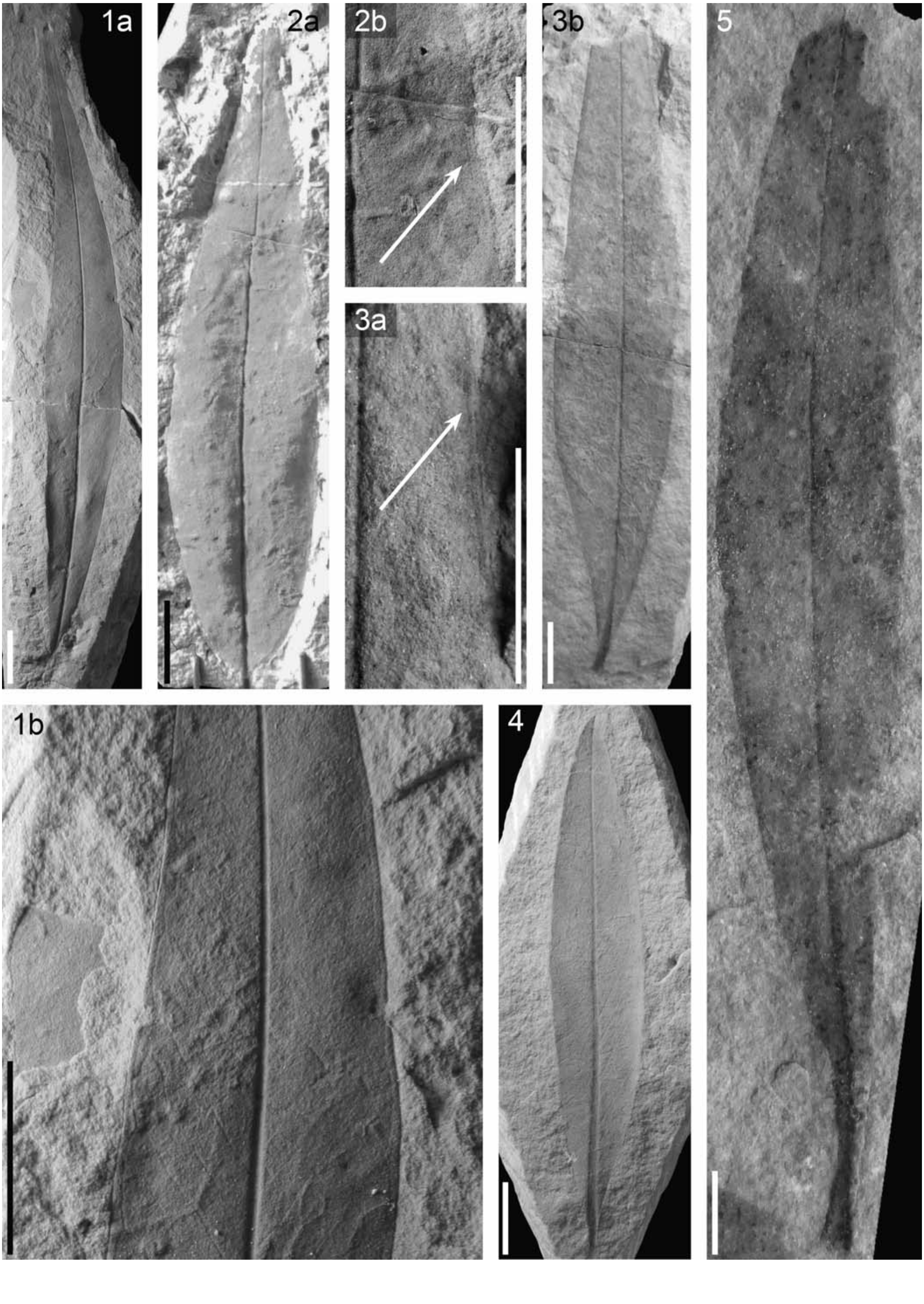

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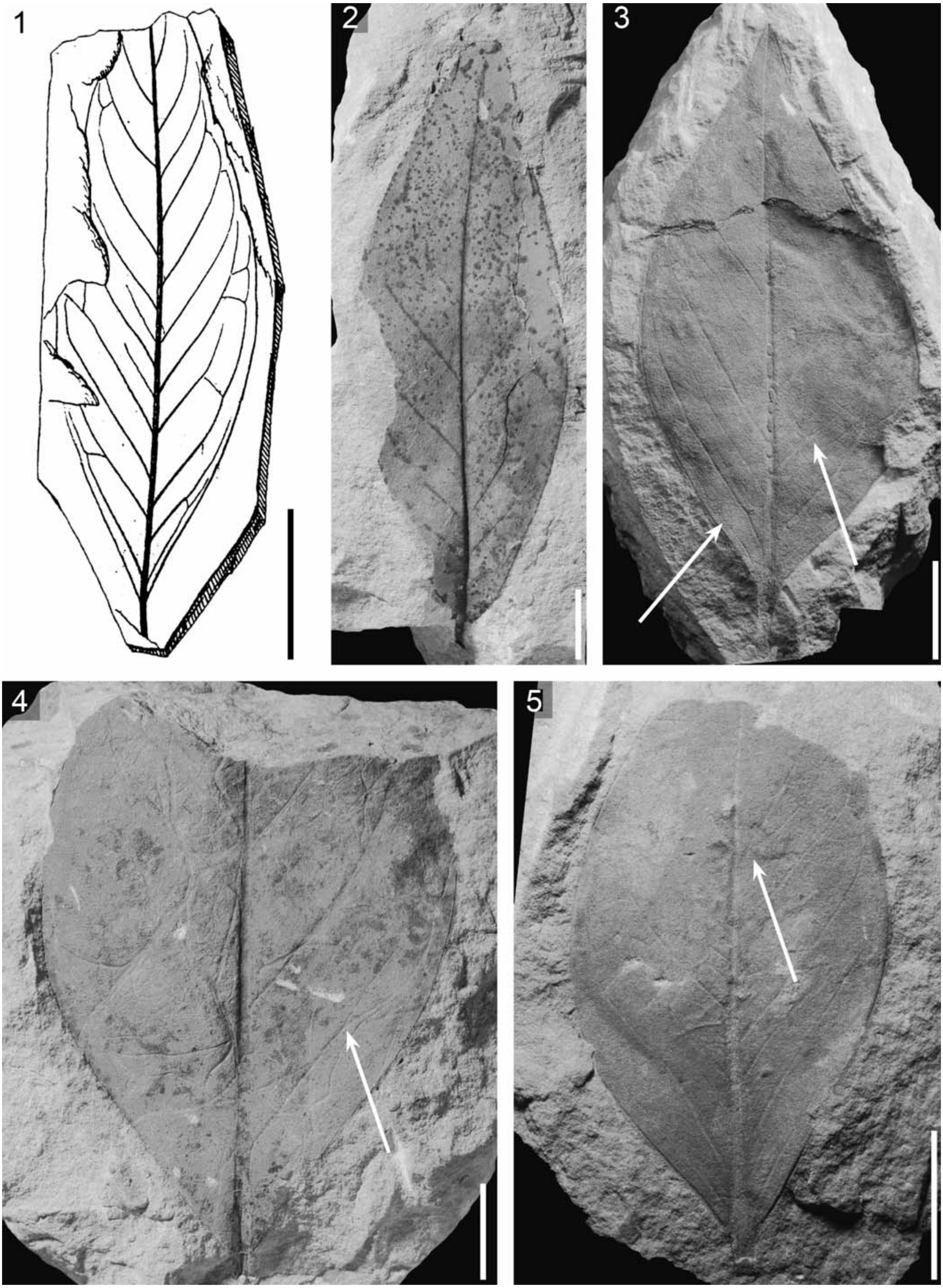

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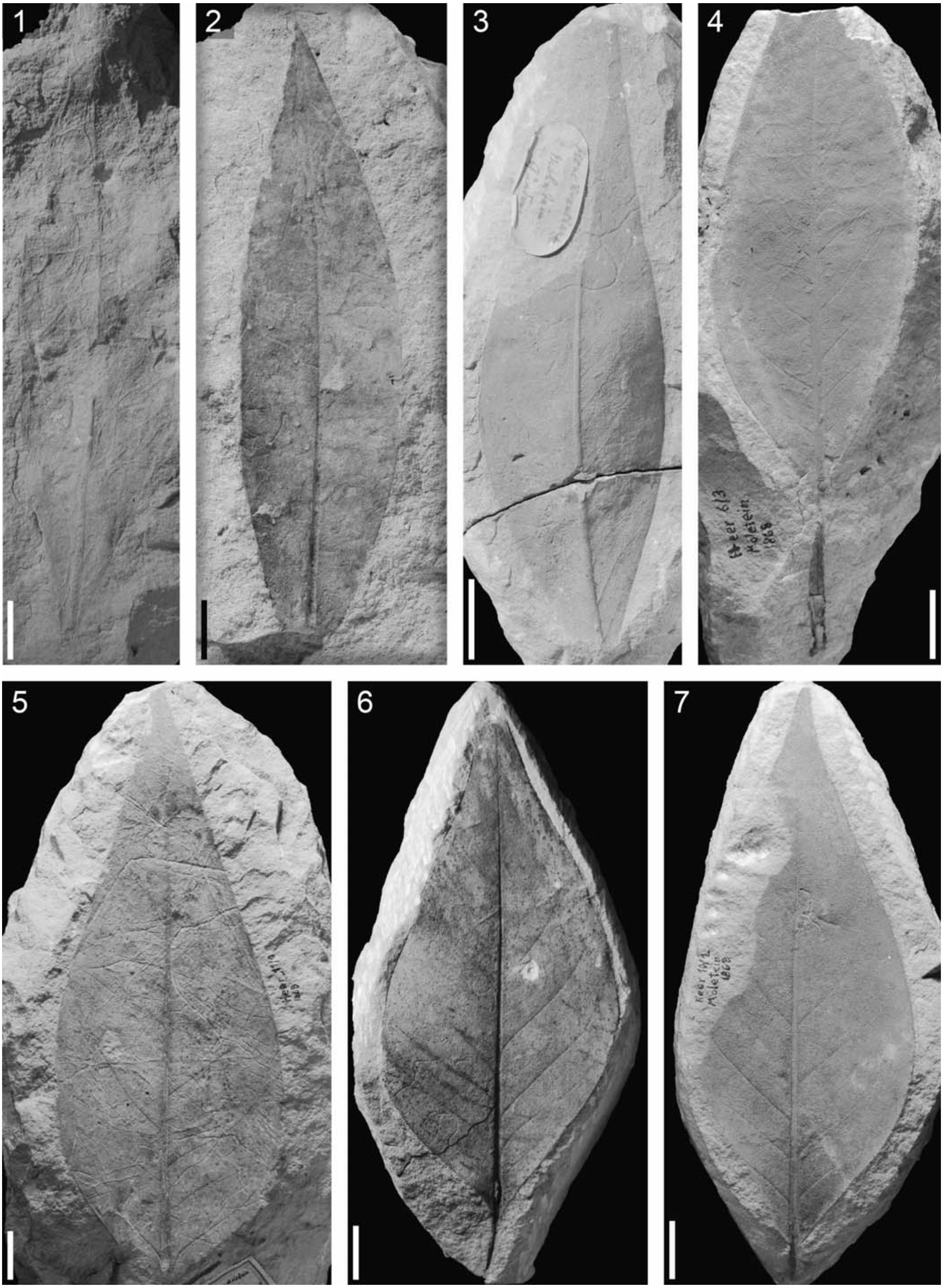

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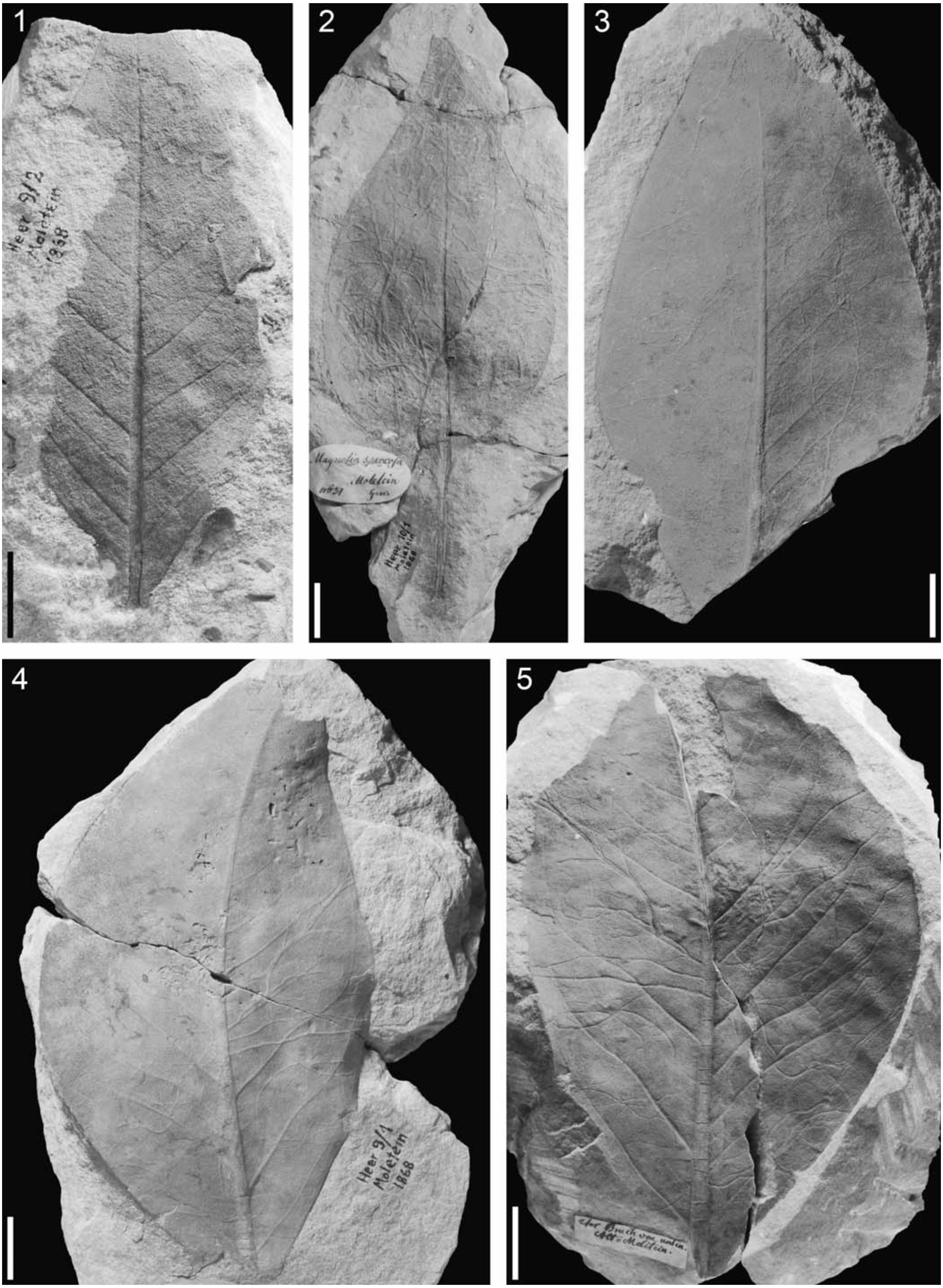

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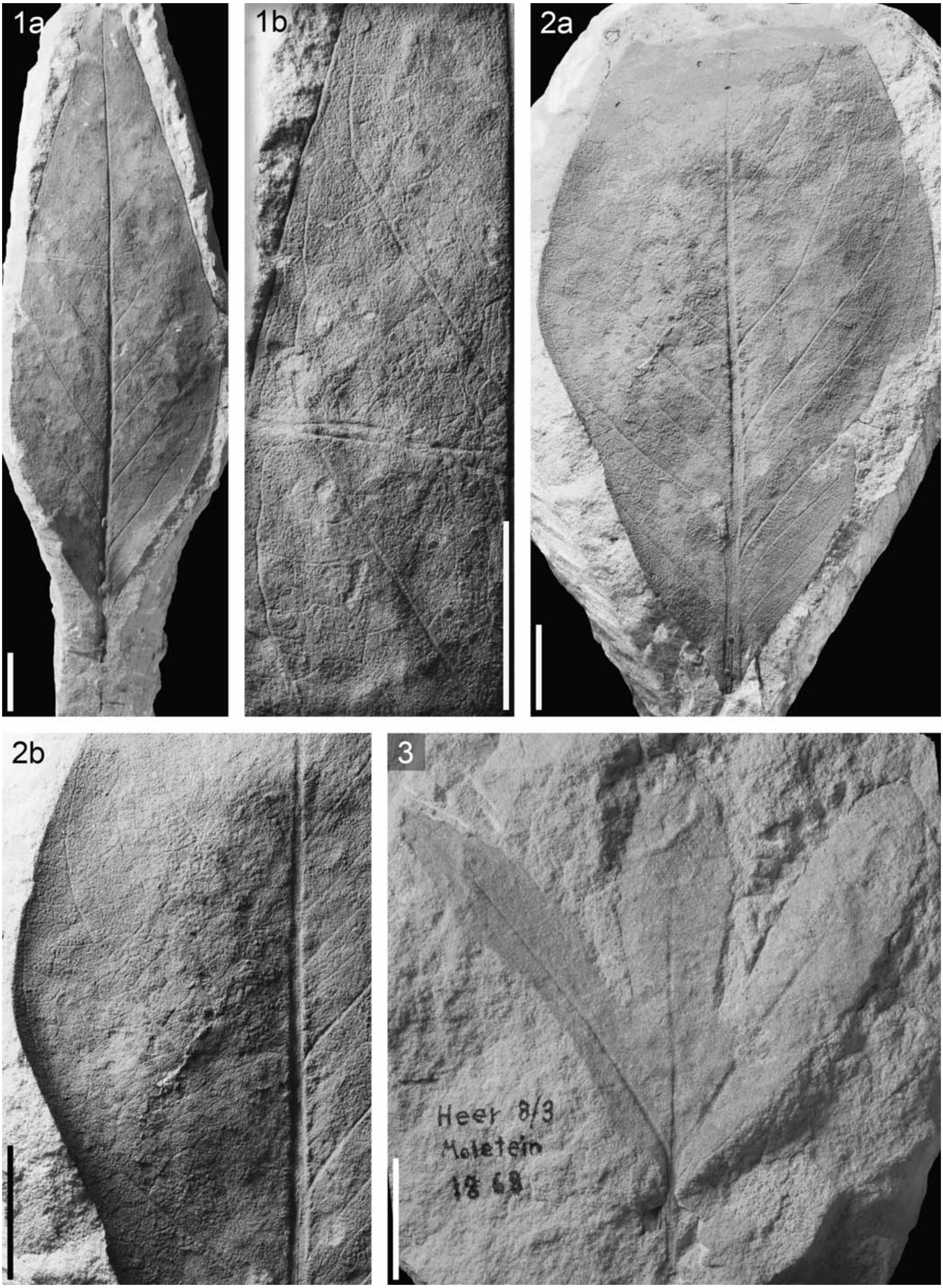

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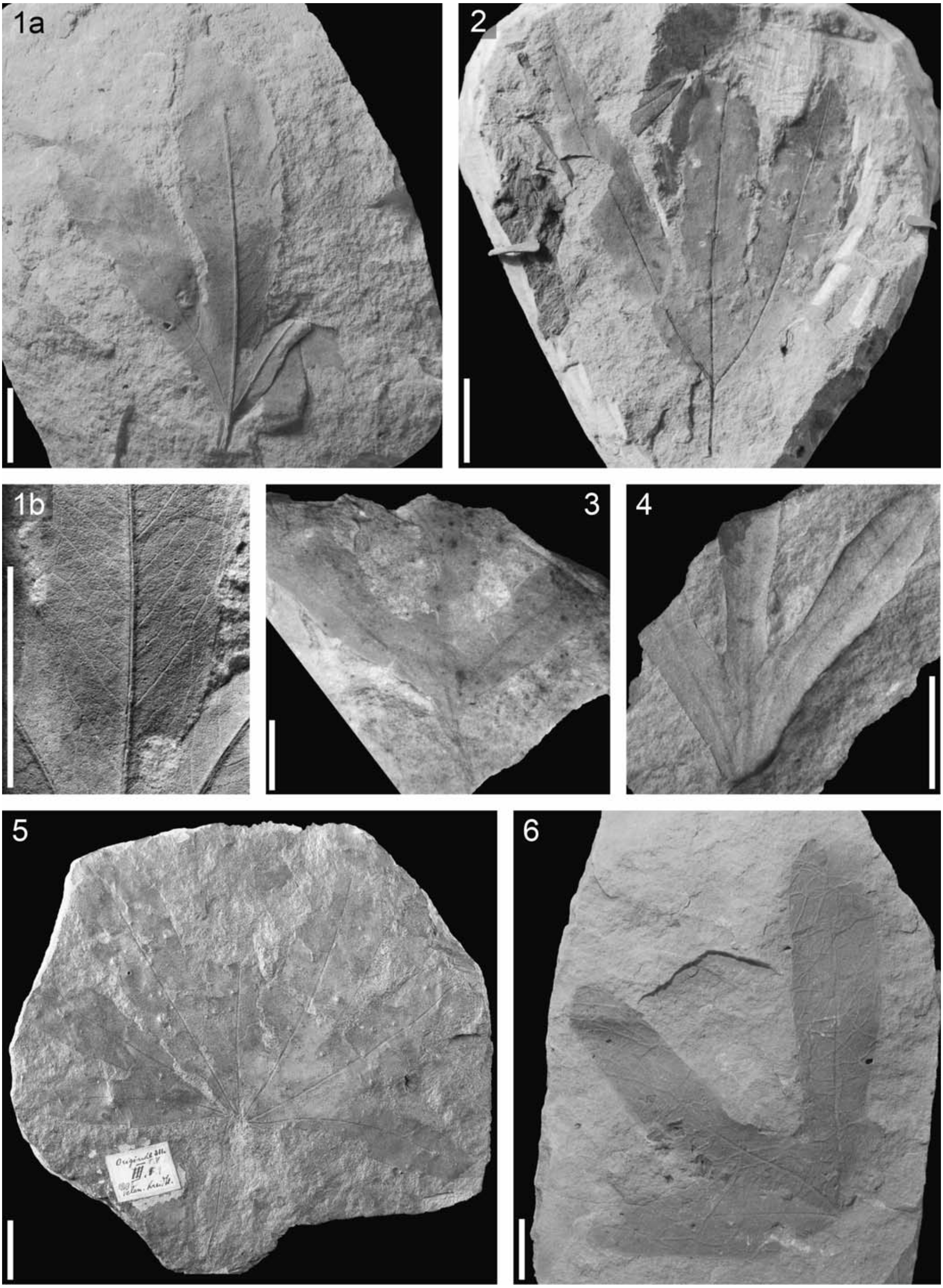

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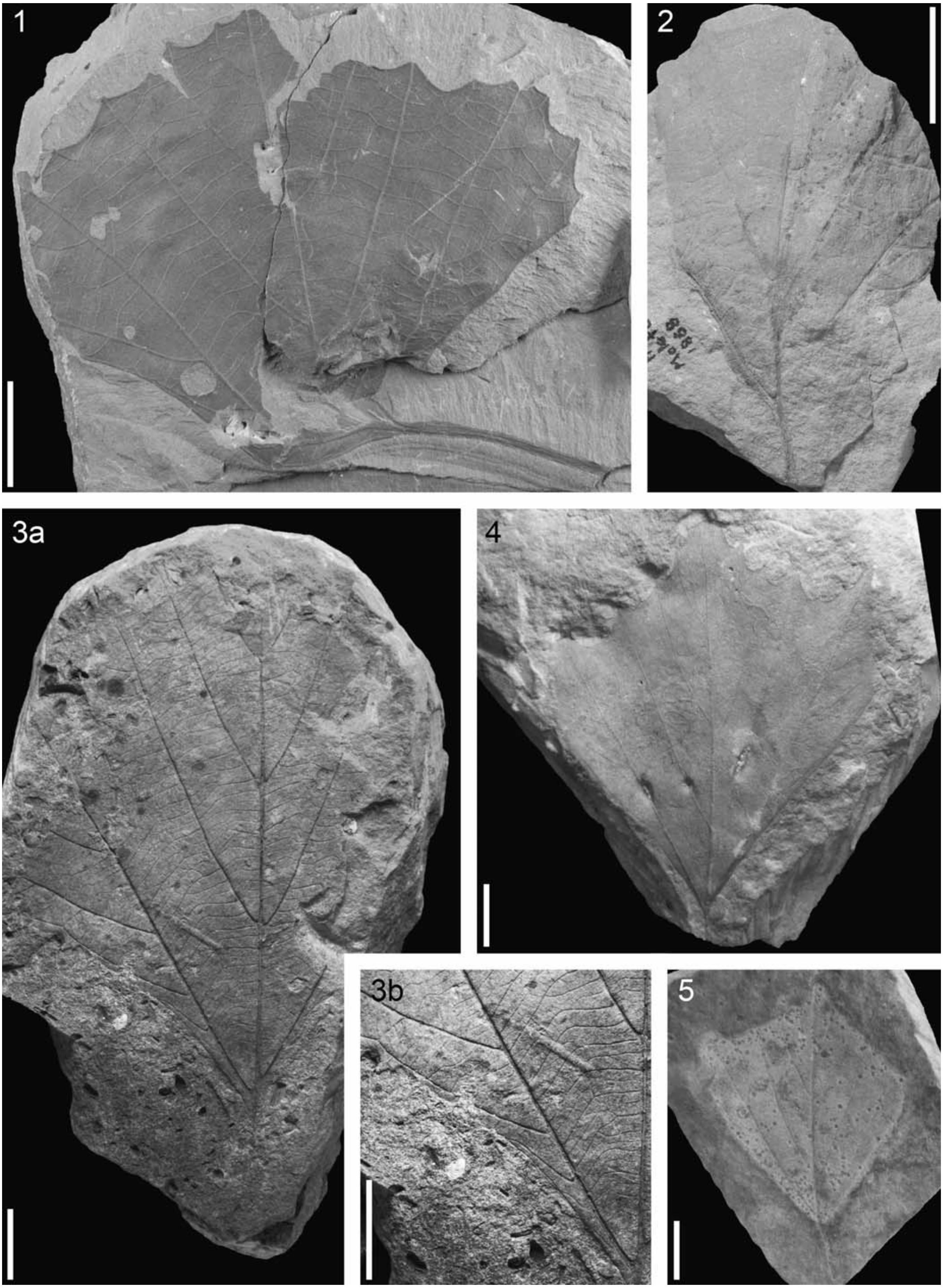

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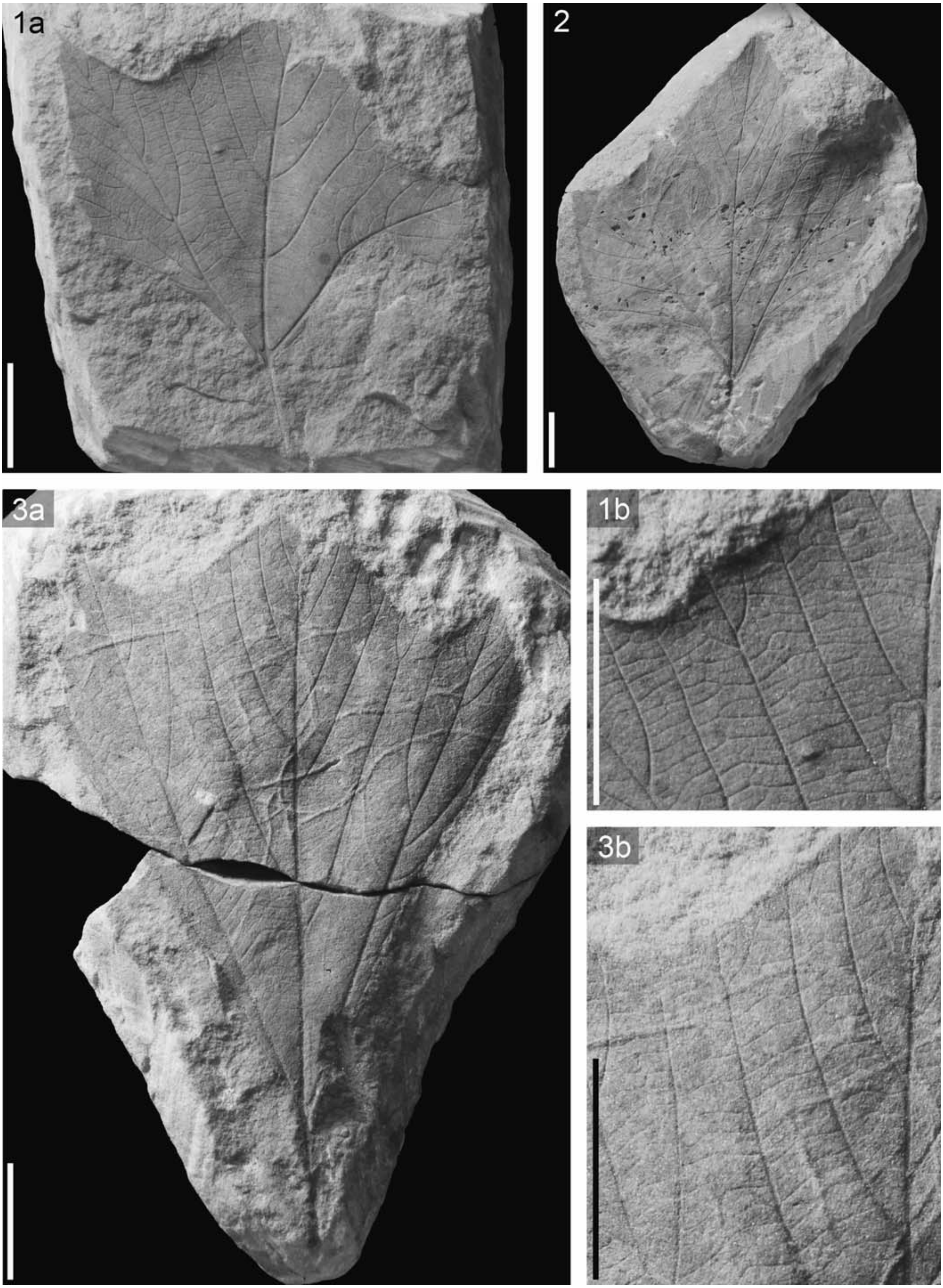

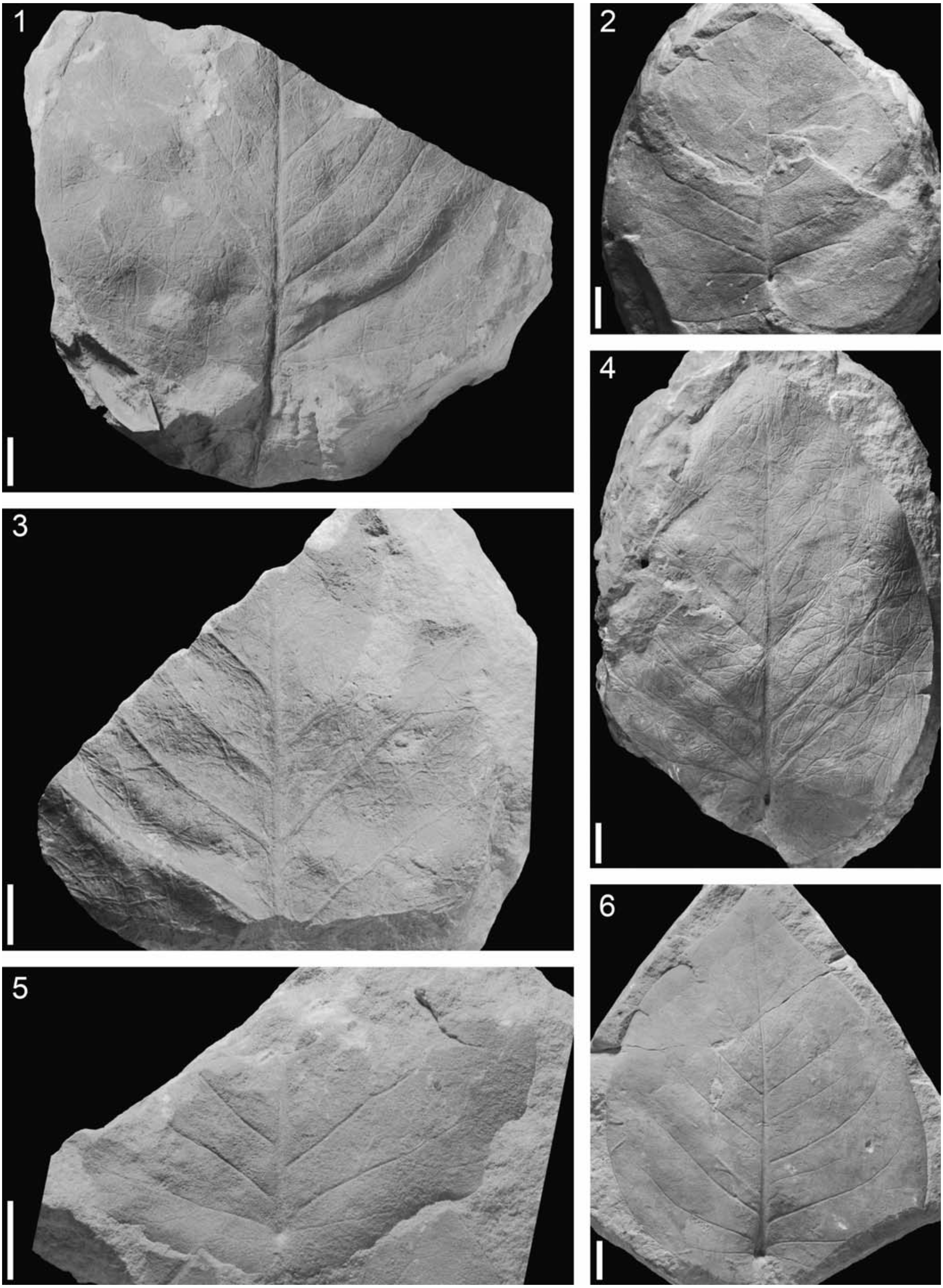
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PLATE 19

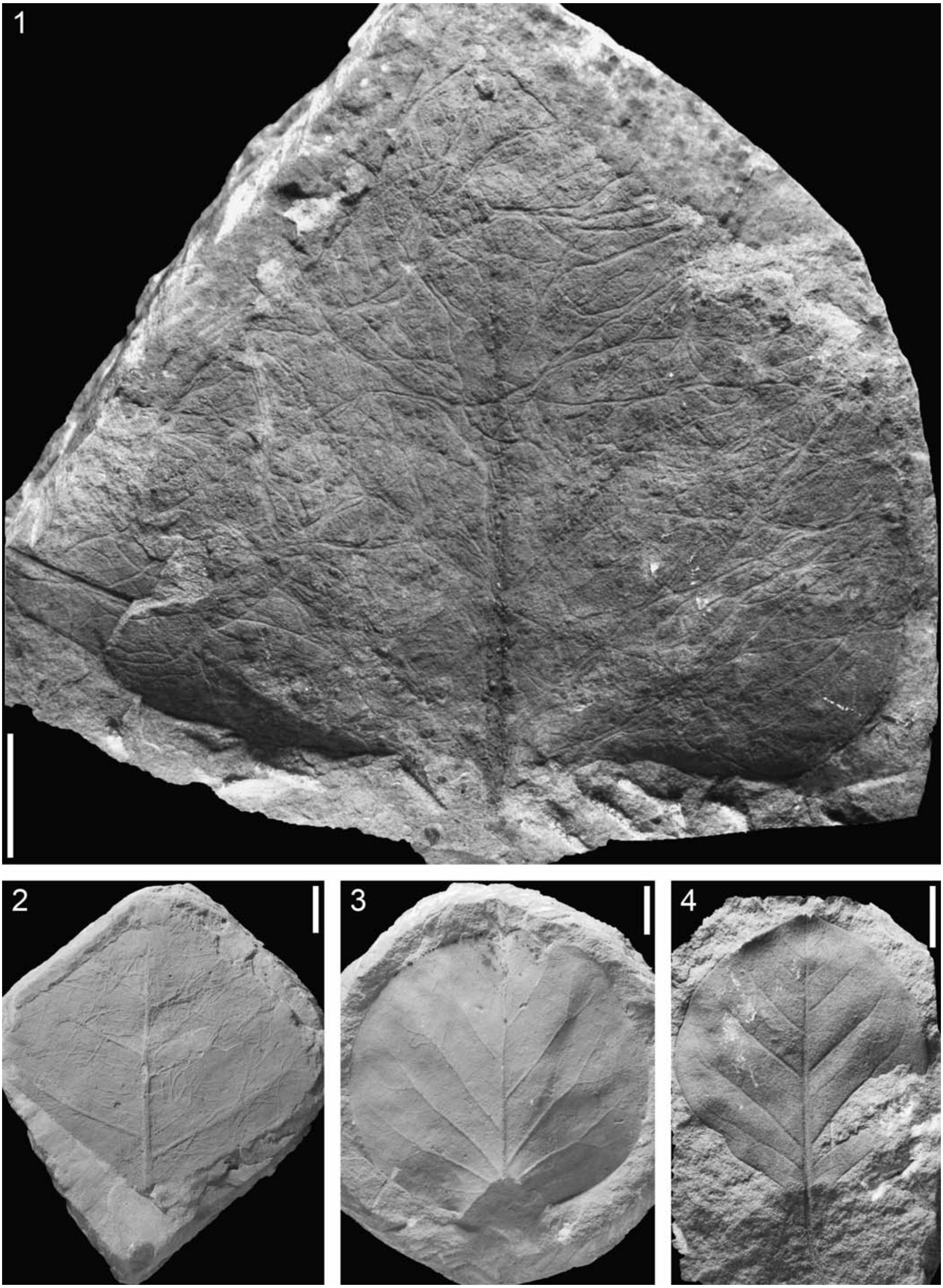

PLATE 20

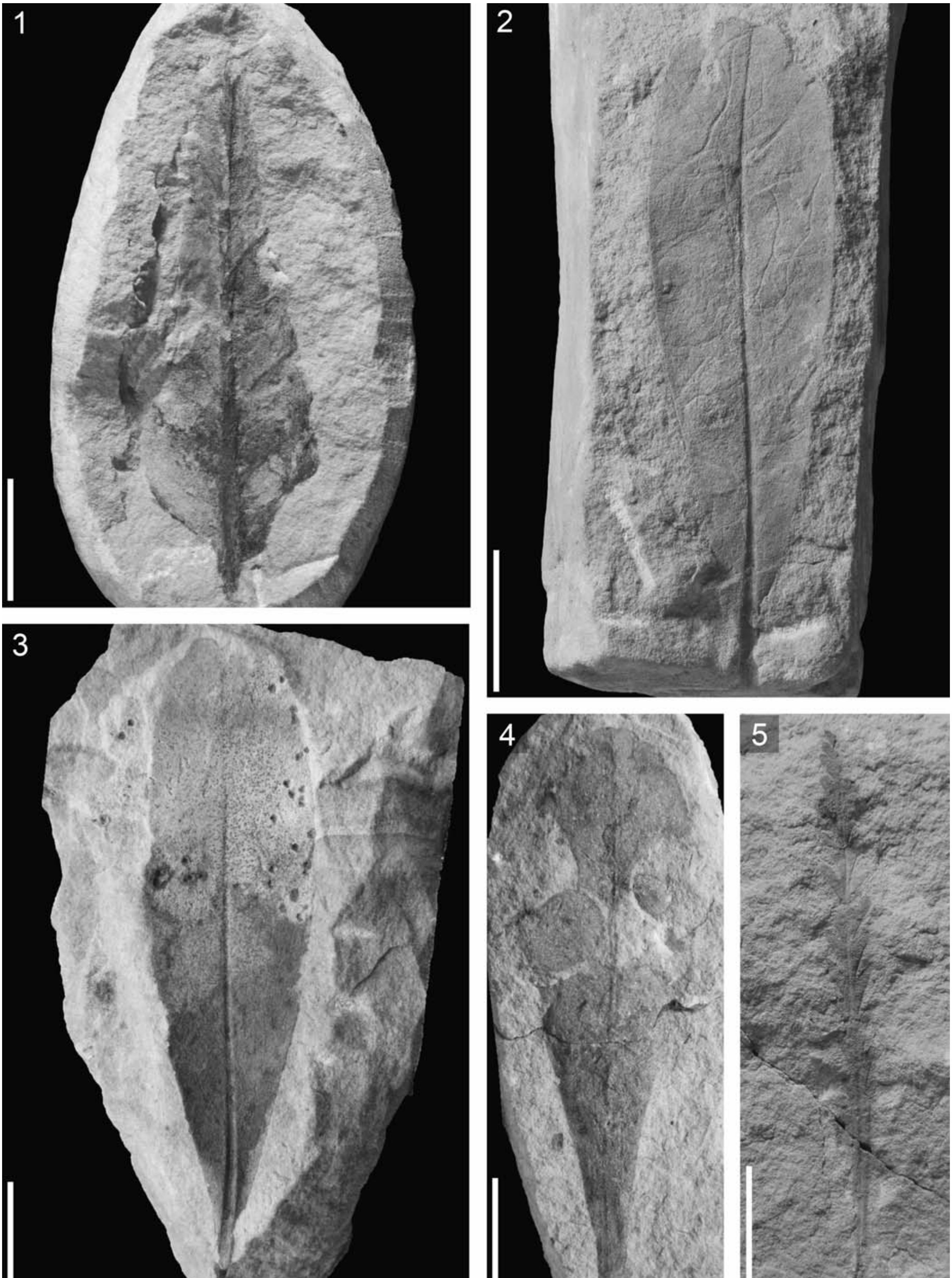

PLATE 21