The Coniacian leaf flora from the northeastern part of the Bohemian Cretaceous Basin

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The "Chlomek Beds" (an informal designation of the psammitic facies of the Březno Formation, north-eastern part of the Bohemian Cretaceous Basin) yielded a poorly preserved megaflora, dated as Coniacian on the basis of co-occurring inoceramid bivalves. The flora is interpreted to have grown on the West Sudetic Island, a palaeohigh of the Central European Archipelago. Ferns are diverse both in terms of specimens and of taxa: *Monheimia chlomekiana*, *Sphenopteris dubia*, "*Pteridoleimma*" *durum*, and two unnamed species of *Korallipteris*. Conifers are very rare: only two twigs of *Geinitzia reichenbachii* have been found. Angiosperms are represented by 14 dicot fossil-taxa. Two of them, *Debeya* (*Dewalquea*) sp. and *Dalbergites atavius*, are referable to eudicots. The remaining 12 taxa are described as dicots *incertae sedis*: *Laurophyllum*? *melanophyllum*, *L. acuminatum*, *Laurophyllum* sp., *Apocynophyllum fractum*, *Ettingshausenia superstes*, *Ettingshausenia* sp., *Celastrinites engelhardtii*, *Salicites petzeldianus*, *Dryophyllum geinitzianum*, "*Dryandroides*" *quercinea*, *Dicotylophyllum bohemicum*, and *Dicotylophyllum* sp. 1. In comparison with the better-preserved coeval flora of the East Sudetic Island (Idzików Beds), ferns are more diverse and conifers are less diverse. Angiosperm flora is of similar physiognomy and is interpreted as representing riparian forests dominated by laurophylls and trees with serrate leaves. Local differentiation of riparian forests is attested by mutual exclusion of two serrate-leaved species, either *Dryophyllum geinitzianum* (relatively common at Robeč and Jedlová, absent at Česká Lípa) or "*Dryandroides*" *quercinea* (relatively common at Česká Lípa, absent at Robeč and Jedlová). • Key words: Czech Republic, fossil plants, taxonomy, palaeobotany, palaeocommunities, Cretaceous, Coniacian.

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The monographic study of a Coniacian megaflora contained in the Idzików Beds cropping out in the vicinity of Kłodzko in the Polish part of the Sudetes and originally coming from the East Sudetic Island undertaken by the present authors (Halamski & Kvaček 2015, Kvaček *et al*. 2015) quite naturally resulted in their attention being drawn by approximately coeval leaf floras from the West Sudetic Island. Those floras are known thanks to several outcrops of the "Chlomek Beds" situated in the northeastern part of the Bohemian Cretaceous Basin. The two areas are now separated by a distance of about 150 km (Fig. 1B) and their spatial arrangement during the Late Cretaceous must not have been significantly different (Fig. 1A). The Coniacian floras of the two neighbouring palaeoislands are compared in terms of floristic composition, presumed palaeocommunities, and palaeoclimatology. It must be stressed that the floras from the West Sudetic Island could not be redescribed before the revision of the Cretaceous plants from the East Sudetic Island was completed. In effect, it was possible to identify several taxa from the "Chlomek Beds" only by reference to plants from the Idzików Beds. This is due to the generally poor state of preservation of the material studied herein.

The first part of the collection described in the present paper was made at Česká Lípa and Jedlová localities in the second half of the nineteenth century, mainly by A. Frič, and then studied by Velenovský (1882, 1883, 1885a, b, 1888) and Bayer (1896). The following taxa with types coming from the "Chlomek Beds" were introduced: *Credneria superstes* Vel., *Aralia chlomekiana* Vel. (Velenovský 1882), *Dryandroides quercinea* Vel. (Velenovský 1883), *Cassia melanophylla* Vel., *Pisonia atavia* Vel., *Phillyrea engelhardti* Vel., *Rhus cretacea* Vel., *Cissites crispus* Vel. (Velenovský 1885a), *Asplenites dubius* Vel. (Velenovský 1888), and *Pteridoleimma durum* Bayer (Bayer 1896) from Česká Lípa and *Quercus*

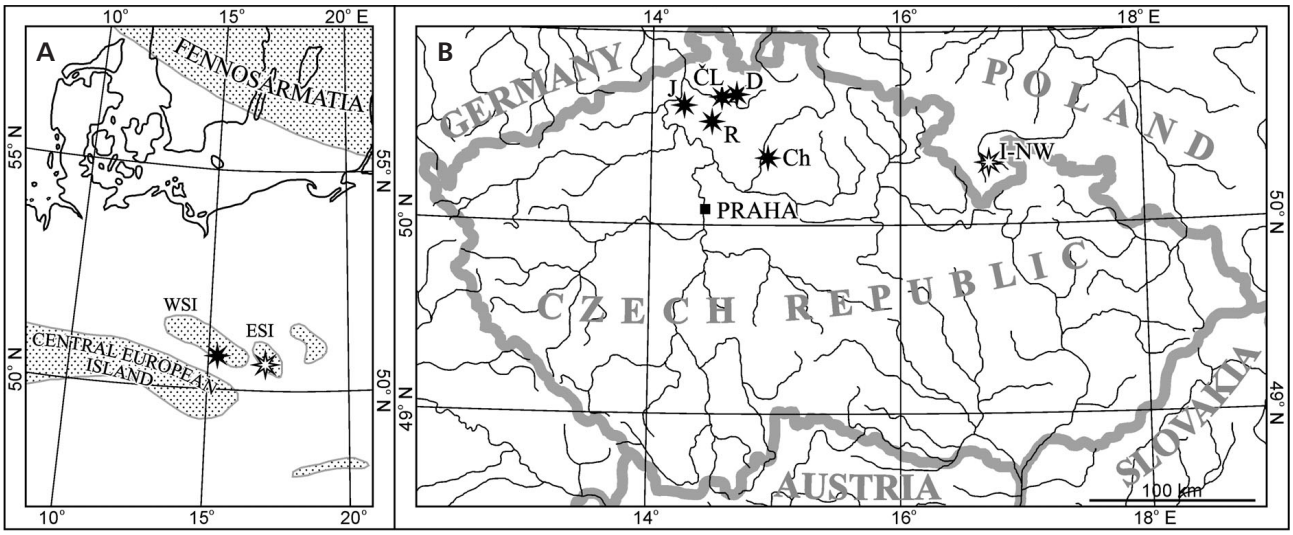

Figure 1. Palaeogeographic and geographic context of the studied flora. • A – present-day geography of central Europe compared to Coniacian palaeogeography (stippled – land, white – sea; after Janetschke & Wilmsen 2014, modified). ESI – East Sudetic Island; WSI – West Sudetic Island. The black asterisk denotes the presumed place in which the plants studied were living; the white asterisk denotes the presumed origin of the plants known from the Idzików Beds coeval to the flora studied. • B – geography of the Czech Republic. Black asterisks show the localities described in text: Ch – Chlomek (Chloumek); ČL – Česká Lípa; D – Dobranov; J – Jedlová; R – Robeč. The white asterisk shows the Idzików and Nowy Waliszów localities, that yielded a coeval flora that served for comparison with the Chlomek flora.

pseudodrymeja Vel. from Jedlová (Velenovský 1883). The second part of the material studied herein consists of previously unpublished specimens, partly coming from an early collection from Chlomek (packed by F. Němejc in 1925, apparently not studied by J. Velenovský) and partly sampled by E. Knobloch at Dobranov and Robeč in the 1950s (acquired by the National Museum in Prague in 1958). Specimens coming from the two latter localities are of even poorer quality than those from Česká Lípa, Jedlová, and Chlomek.

Geologic setting

Stratigraphy. – The material studied comes from the sandstones of the lower to middle Coniacian Březno Formation of the Lužice-Jizera part of the Bohemian Cretaceous Basin (Čech *et al*. 1980), the stratigraphy of which is based largely on inoceramid bivalves. As stated by Nádaskay & Uličný (2014), the base of the Březno Formation (unit CON 1) in the study area is defined as lower Coniacian marked by the index species *Cremnoceramus deformis erectus* (Walaszczyk & Cobban 2007, Walaszczyk *et al*. 2010). *Volviceramus koeneni* reported from borehole Vf-1 (Čech *et al*. 1987) dates the unit CON 2/3 (Nádaskay & Uličný 2014) as middle Coniacian.

Lithologically, the Březno Formation is variable, particularly in the Lužice-Jizera subbasin. It comprises three principal facies: (1) coarse-grained facies with typically coarsening-upward cycles, (2) fine-grained, mudstone-dominated facies, and (3) heterolithic ("flyschoid") facies (Valečka 1979). Nádaskay & Uličný (2014) interpreted the depositional system as dominated by coarse-grained delta deposits that prograded from the faulted northern basin margin, the present-day Lužice Fault Zone. The deltaic systems were formed by clastic sediments entering the basin, but the deposits of the delta and the prodeltaic facies were further reworked by tidal currents. Nádaskay & Uličný (2014) were able to correlate the nearshore sandstone units to their fine-grained time-equivalents in the mud-dominated offshore realm. They also formulated a genetic sequence-stratigraphic framework and applied it for a time-slice reconstruction of regional palaeogeography from the latest Turonian to the middle Coniacian. They deciphered a transgressive-regressive history of the study area during that time, revealing three major transgressions: (1) approximately at, or immediately prior to, the Turonian/Coniacian boundary, (2) at the base of CON 2 sequence (base of *Cremnoceramus crassus crassus* Zone), and (3) at the base of CON 3 sequence, within the *Volviceramus koeneni* Zone (Nádaskay & Uličný 2014).

Palaeogeography and plant-bearing beds. – The Bohemian Cretaceous Basin is an intracontinental basin situated within the Proterozoic to Palaeozoic Bohemian Massif in Central Europe (Čech *et al*. 1980, Čech 2011). Its sediments were deposited during the Late Cretaceous, first during the Cenomanian in fluvial environment and then during the Turonian and the Santonian in a narrow seaway between the Tethys and the North Sea bordered by the islands

Table 1. Floristic composition of the fossil assemblage at each locality studied. "?" stands for unconfirmed data, "*" for specimens questionably referred to that taxon; see text for further explanation. Con. – conifers.

	Taxonomy	Chlomek Beds											
		Localities										Total	
		Česká Lípa		Dobranov		Robeč		Jedlová		Chlomek			
Ferns	*Monheimia chlomekiana*	2 (4%)		–		–		–		–		2 (2%)	
	Sphenopteris dubia	6 (11%)		3 (25%)		2 (17%)		–		–		11 (12%)	
	"*Pteridoleimma*" *durum*	3 (6%)	35 (65%)	–	9 (75%)	–	4 (33%)	–	–	–	–	3 (3%)	48 (52%)
	Korallipteris sp. 1	19 (35%)		2 (17%)		2 (17%)		–		–		23 (25%)	
	Korallipteris sp. 2	5 (9%)		4 (33%)		–		–		–		9 (10%)	
Con.	*Geinitzia reichenbachii*	–		1 (8%)		–		1 (25%)		–		2 (2%)	
Angiosperms	*Dryophyllum geinitzianum*	–		–		5 (42%)		2 (50%)		1 (10%)		8 (9%)	
	Debeya (*Dewalquea*) sp.	1 (2%)		–		–		–		–		1 (1%)	
	Dalbergites atavius	1 (2%)		–		–		–		–		1 (1%)	
	Ettingshausenia sp.	1 (2%)		–		–		–		–		1 (1%)	
	Laurophyllum? *melanophyllum*	4 (7%)		–		–		1 (25%)		–		5 (5%)	
	Laurophyllum acuminatum	6 (11%)		–		2 (17%)		–		4 (40%)		10 (11%)	
	Laurophyllum sp.	–	19 (35%)	–	2 (17%)	–	8 (67%)	–	3 (75%)	4 (40%)	10 (100%)	4 (4%)	42 (46%)
	Apocynophyllum fractum	1 (2%)		–		–		–		–		1 (1%)	
	Ettingshausenia superstes	3 (6%)		–		1* (8%)		–		–		4 (4%)	
	Salicites petzeldianus	–		–		–		–		1 (10%)		1 (1%)	
	"*Dryandroides*" *quercinea*	5 (9%)		–		–		–		–		5 (5%)	
	Celastrinites engelhardtii	1 (2%)		–		–		–		–		1 (1%)	
	Dicotylophyllum bohemicum	5 (9%)		1* (8%)		–		–		–		2 (2%)	
	Dicotylophyllum sp. 1	–		1 (8%)		–		–		–		1 (1%)	
Total of identifiable specimens		55 (100%)		12 (100%)		12 (100%)		4 (100%)		10 (100%)		92 (100%)	

of the Central European Archipelago. The main islands include the Central European Island in the south and the West and East Sudetic Islands in the north (Fig. 1A). These palaeohighs were the source areas from which siliciclastic sediments were derived. The fossil fauna contained in the Turonian to the Santonian strata, including ammonites, rudists and colonial hexacorals, is clearly marine. Nonetheless, remains of land plants may also be found in particular (more proximal) geological contexts like that of the Idzików Beds from the Nysa Graben (north-eastern margin of the Bohemian Cretaceous Basin) or the "Chlomek Beds" studied here.

The "Chlomek Beds" was first introduced (Chlumský pískovec kvádrový *sensu* Krejčí 1867, Chlomeker Schichten *sensu* Krejčí 1869, Frič 1898) as a lithostratigraphic unit for the Bohemian Cretaceous Basin. It is now treated as partly representing the psammitic (proximal) facies of the Březno Formation and partly corresponding to the Merboltice Formation. The "Chlomek Beds" interfinger with the Březno Formation and are developed as claystones and marlstones along the northeastern and southeastern margins of the basin (Čech *et al*. 1980, p. 293; Čech 2011, fig. 1). This informal designation will be used throughout the text, in quotation marks in the present stratigraphic part of the text and without in the palaeontological part.

The Březno Formation is mid-early Coniacian to earliest Santonian in age (Čech 2011, Nádaskay & Uličný 2014). This corresponds more or less to the informal Xe unit used by Soukup (1963, see also Soukup 1955). According to a section presented by Frič (1898, text-fig. 13), the plant fossils are found in the lowermost part of the "Chlomek Beds", so the age of the flora may be considered as Coniacian. The Santonian Merboltice Formation consists mostly of coarse clastics that did not yield any plant remains (those reported by Čech 1980, p. 295, probably come from silty intercalations).

Material and methods

Taphonomy. – The material studied consists of leaf imprints in hard quartzitic sandstones. The imprints are darker than the matrix rock, which is probably caused by the bacteria-mediated iron oxides deposition (see Halamski 2013). The preservation of the material in coarse psammites is far from excellent. Besides fragmentation, venation patterns can be observed only imperfectly. Tertiary veins were noted in a few specimens, whereas usually only the secondary veins and, in some cases, only the midvein is visible. Cuticles are never observed.

The plant fossils from the "Chlomek Beds" are predominantly fragmentary. Frequently, they are so fragmentary that the leaf is unidentifiable. The largest leaf fragment is *ca* 8 cm long and 1.5 cm wide. This is in striking contrast with the coeval deposits at Idzików and Nowy Waliszów (Kvaček *et al.* 2015, Halamski & Kvaček 2015 and references therein) that yielded a certain number of complete and/or large leaves as well as compound leaves with leaflets attached. This difference may be easily interpreted if palaeogeographic context is considered. Idzików and Nowy Waliszów localities are situated 1–3 km from the presumed Coniacian coast (arguably broadly corresponding to the fault separating the Cretaceous of the Nysa Graben from the metamorphic rocks of the Śnieżnik Massif), whereas Česká Lípa is about 20 km from the presumed southern shore of the West Sudetic Island. This reasoning is based on the assumption that the present border between the crystalline basement and the Cretaceous sedimentary cover corresponds more or less to the Cretaceous shoreline. This is the situation at least at Idzików. This situation seems to extend to Česká Lípa given that the deposition of coarse-grained clastics took place in deltas that prograded from the faulted northern basin margin (Nádaskay & Uličný 2014). However, the degree of fragmentation of the plant material is not necessarily a linear correlation to the distance between the source area and the deposition site. In effect, Idzików and Nowy Waliszów were situated in a narrow channel with a strong palaeocurrent (Wojewoda *et al*. 2011, fig. 12), whereas the Česká Lípa site, if located in more open sea, must not have experienced such strong and destructive water strength. The late Campanian Krasnobród site in southeastern Poland with intact compound leaves (Halamski 2013, fig. 2) may well have been situated further offshore than Idzików.

Localities and plant assemblages. – The material studied comes from several localities (Fig. 1B). The best-preserved plant fossils come from the vicinities of Česká Lípa (Böhmisch Leipa), a historical town situated about 80 km north of Prague at the Ploučnice (Pulsnitz, Polzen) River. Apparently the bulk of the collection resulted from a single sampling. The picturesque description of the circumstances of this event is worth quoting.

"In 1865 we found such a boulder, washed out from the Chlomek Beds, on a field between Česká Lípa and Písník. It was rich in plant imprints and we much profited from its breaking. A serious controversy with the owner of the above-mentioned field resulted; it was ended only through the kind intervention of Dr. Watzl." (Frič 1898)

Three other localities are situated not far from Česká Lípa. The closest locality, about 4 km eastwards, is the kiln brick clay pit at Dobranov. The kiln brick clay pit at Robeč lies about 15 km southwestwards from Česká Lípa, and Jedlová (Tannenberg) 15 km northwards from Česká Lípa. Specimens from Dobranov (sometimes labelled Stará Lípa) and Robeč were collected by Erwin Knobloch in 1957 and 1958. The Jedlová section (Frič 1898, fig. 13) is situated in the western slope of a hill near the railway station, about 2.5 km south of the village of Jedlová. Chlomek (now Chloumek) near Vinařice, the type locality of the "Chlomek Beds", is situated about 4 km southwards from Mladá Boleslav. The section was described by Frič (1898, fig. 1) but at present it is covered by vegetation. Soukup (1963) reported that unidentified or unidentifiable plant material was also found in three other localities, namely Žandov near Česká Lípa, Václavice near Hrádek nad Nisou, and Mojžíř near Ústí nad Labem.

The composition of the assemblages at each of the five localities is given in Table 1. It should be noted that the totals given refer to the number of identifiable specimens, whereas the major part of the collections consists of plant fossils that have been considered by the present authors as unidentifiable. The amount of unidentifiable specimens at the three localities from which the most extensive collections were assembled (Česká Lípa, Dobranov, and Robeč) may be estimated as certainly over $^1/_2$ and in some cases over $^3/_4$ of the entire collection from that locality.

All these localities, now inaccessible, are situated in the northeastern part of the Lužice-Jizera subbasin, in a zone broadly parallel to the presumed southern shore of the West Sudetic Island. For those of the localities for which the data on the ratio of animal *vs* plant fossils found are known, fossils of marine animals are much more diversified than those of land plants.

Repositories and special taxonomic questions. – The entire material studied is housed in the National Museum in Prague (NMP), Czech Republic (collection numbers given in the systematic part).

The taxonomic terminology follows the recent monograph on the better-preserved coeval Idzików flora (Halamski & Kvaček 2015), to which the readers may refer for a longer discussion of the techniques and principles of systematic arrangement of taxa. In general, synonymy is limited to the original publication, the papers dealing with the material from the "Chlomek Beds", and to a single recent authority in which a full synonymy is given (most often Halamski & Kvaček 2015).

Systematic palaeontology

Infrakingdom Cormophyta (Endlicher, 1836)
Cavalier-Smith, 1988
Division Tracheophyta Sinnott *ex* Cavalier-Smith, 1988
Subdivision Euphyllophytina auct.
Infradivision Moniliformopses auct.
Class Leptosporangiatae von Goebel, 1881

Order Gleicheniales A.B. Frank *in* Leunis, 1877
Family Matoniaceae C. Presl, 1847

Genus *Monheimia* Debey & Ettingshausen, 1859

Type. – *Monheimia polypodioides* Debey & Ettingshausen, Denkschr. Akad. Wiss. Wien, math.-naturwiss. Kl. 17, p. 221, pl. 3, figs 34–36, pl. 4, figs 1, 2, 21 (1859). Aachen, Germany; Late Cretaceous.

***Monheimia chlomekiana* (Velenovský, 1882) Halamski & J. Kvaček comb. n.**
Figure 2I

Basionym. – *Aralia chlomekiana* Velenovský, 1882, p. 20, pl. 5, fig. 3.

Holotype. – NMP F906, leaf fragment, figured by Velenovský (1882, pl. 5, fig. 3), refigured herein in Fig. 2I; Česká Lípa.

v* 1882 *Aralia Chlomekiana* sp. n.; Velenovský, p. 20 [13], pl. 5 [3], fig. 3.
v. 1896 *Aralia Chlomekiana* Vel. – Bayer, p. 26.

Material. – NMP F3787, leaf fragment from Česká Lípa.

Description. – The available specimens are two fragments of pinnules, the larger of which is *ca* 4 cm long and 2 cm wide. Pinnules irregularly dichotomising, of varying width, 4–11 mm, with a strong midvein. Pinnule base, apex and lateral veins not observed. Margin entire, straight.

Remarks. – The peculiar branching pattern cannot be found in any comparable angiosperms, except perhaps the problematic *Halyserites reichii* Sternb. from the Cenomanian of central Bohemia, which has, however, several veins running along the margins of the leaf segments (Knobloch 1978). In contrast, it is in entire agreement with that of the matoniacean fern *Monheimia*. Representatives of this genus were common in Late Cretaceous floras of Central Europe. The coeval flora of Idzików Beds contains a different species with undulating or finely denticulate leaf margins. *Monheimia ungeri* J. Kvaček & Herman from the Campanian of Grünbach (Herman & Kvaček 2010) is apparently more similar to *M. chlomekiana*, but the material studied here does not provide sufficient characters for a detailed comparison.

Order and family unknown

Genus *Sphenopteris* (Brongniart, 1822) Sternberg, 1825

Type. – *Filicites* (*Sphenopteris*) *elegans* Brongniart, Mém. Mus. nat. His. nat. 8, p. 33 (1822) = *Sphenopteris elegans* (Brongniart) Sternberg, Vers. geogn. bot. Darstellung Fl. Vorwelt, p. 15 (1825). Waldenburg [Wałbrzych], Lower Silesia; Late Carboniferous.

***Sphenopteris dubia* (Velenovský, 1888) J. Kvaček & Halamski comb. n.**
Figure 2A–C

Basionym. – *Asplenites dubius* Velenovský, 1888, p. 16, pl. 2, figs 17–19.

Lectotype. – NMP F354, lectotype designated herein, figured by Velenovský (1888, pl. 2, fig. 17), refigured herein in Fig. 2A; Česká Lípa.

* 1888 *Asplenites dubius* m.; Velenovský, p. 16, pl. 2, figs 17–19.
v 2015 cf. *Anemia fremontii* Knowlton, 1918. – Halamski & Kvaček, p. 11, pl. 2, fig. 3.

Material. – NMP F355, 356, former syntypes of *Asplenites dubius* Vel., figured by Velenovský (1888, pl. 2, figs 18, 19); NMP F3793ab, 3823ab; all the above from Česká Lípa. NMP F3840ab, 3841 from Robeč. NMP F3795ab, 3822, 3842 from Dobranov.

Description. – The available specimens are small frond fragments never exceeding 3 cm. The holotype is a single pinna departing from a rachis 18 mm long and *ca* 0.5 mm wide at an angle of *ca* 60°. Pinnule subdivided into subcuneiform lobes up to 10 mm long and attaining their maximal width of *ca* 2 mm distally. Median part of the pinna *ca* 1 mm wide. Branching catadromous, lobes departing at an angle of *ca* 30°. Only the midvein preserved.

Other specimens represent smaller fragments, the placement of which within the entire frond is uncertain; the median part is often wider and the form of the lobes varies from sublinear to narrowly subtriangular.

Remarks. – The genus *Asplenites* Goepp. is based on fertile Carboniferous fern foliage and seems thus inappropriate for our material. However, our material is so fragmentary that its affinity to the recent genus *Anemia,* proposed for this kind of Cretaceous foliage by Knobloch (1999) and Halamski & Kvaček (2015), is also very questionable, contrarily to *Anemia fremontii* from the late Albian to Cenomanian (dating after Crabtree 1988) of Wyoming, described first on the basis of the sterile foliage by Knowlton (1917), but the identity of which was afterwards confirmed thanks to fertile specimens (Andrews & Pearsall 1941). The presumably conspecific material from the Chlomek and Idzików Beds may therefore be best described under the purely morphographic fossil-genus *Sphenopteris*. Taxonomic difficulties of describing fern foliage of this kind were discussed by Crabtree (1988, p. 13).

Genus *Pteridoleimma* Debey & Ettingshausen, 1859

Type. – *Pteridoleimma elisabethae* Debey & Ett., Denkschr. Akad. Wiss. Wien 17, p. 222 (1859). Aachen; Late Cretaceous.

Remarks. – The genus *Pteridoleimma* was introduced by Debey & Ettingshausen (1859) as a broadly understood (this is evident from the etymology, *pteris*, a fern, and *leimma*, a rest) form taxon for fragmentary fern fronds. The description of the new genus is quite vague with no diagnosis provided. It is clear, however, that it is intended to replace Palaeozoic-based form genera like *Pecopteris*, *Alethopteris*, and *Neuropteris*. No type was selected for the genus and 22 species from the Late Cretaceous of Aachen were originally included under this genus. Some of them may prove to be synonymous, but more than one morphotype is indeed present.

More precisely, among the above-mentioned 22 species at least three groups may be distinguished: (1) taxa based on fertile material: *Pteridoleimma elisabethae* Debey & Ettingsh., *Pteridoleimma koninckianum* Debey & Ett., *Pteridoleimma benincasae* Debey & Ett.; (2) taxa based on sterile material, characterised by small pinnules, like *Pteridoleimma michelisi* Debey & Ett.; (3) taxa based on sterile material, characterised by elongate pinnules: *Pteridoleimma pecopteroides* Debey & Ett., *Pteridoleimma orthophyllum* Debey & Ett.

It is thus clear that *Pteridoleimma*, as originally circumscribed, is heterogeneous. Two attempts of a narrower circumscription were proposed. The description given by Potonié (1900, p. 496) insists on the long-linear pinnules like those of *Alethopteris* and the position of the sori. Andrews (1970) selected *P. elisabethae* as the type species, following his usual method of designating the first species described under a given generic heading. In these two cases the genus would be limited to fern leaves preserved in a fertile state, which seems contrary to the *intentio auctoris*. The typification by Andrews (1970) followed "a largely mechanical method of selection" and thus may (and should) be overturned. However, the revision of *Pteridoleimma* is outside the scope of the present paper. We use the name in a conventional sense.

"*Pteridoleimma*" *durum* Bayer, 1896
Figure 2D–F, H

Lectotype. – Pinna fragment, NMP F594, lectotype selected herein, figured by Bayer (1896, text-fig. 3), refigured herein in Fig. 2E; Česká Lípa.

v* 1896 *Pteridoleimma durum* m.; Bayer, p. 5, text-figs 3, 4.
v? 1896 *Myrica acutiloba* Brongn. – Bayer, p. 9, text-fig. 21.

Material. – Fragment of a pinna NMP F595, former syntype of *P. durum*, figured by Bayer (1896, text-fig. 3); NMP F726, figured by Bayer (1896, text-fig. 21) as *Myrica acutiloba*; all the above from Česká Lípa.

Description. – The available specimens are small fragments of pinnae with up to seven pinnules. Pinnules elliptic in shape, up to 8 mm long and 5 mm wide, integrimarginate, the angle between their midveins and the rachis of *ca* 30–45°.

Remarks. – This species, based on poorly preserved material, is treated here widely. It is reported under the conventionally treated generic heading *Pteridoleimma*.

Genus *Korallipteris* Vera & Passalia, 2012

Type. – *Korallipteris argentinica* (Berry) Vera & Passalia, 2012, p. 423, figs 1a–d, 2 = *Gleichenia argentinica* Berry, 1924, p. 18, pl. 1, figs 1–5. Santa Cruz Province, Patagonia, Argentina; Late Cretaceous.

Remarks. – It might be useful to clarify what "pinnae" and "pinnulae" mean in describing the two following species. Pinnulae are the smallest distinguishable elements, be they partly (*Korallipteris* sp. 2) or nearly entirely (*Korallipteris* sp. 1) fused. A frond fragment consisting of fused pinnulae is a pinna of n-th (last) order, although the fusion of pinnulae (as understood here) in *Korallipteris* sp. 1 is so pronounced that this entire element might be called a pinnula as well; using the same terminology for the two species is preferred. A single specimen of *Korallipteris* sp. 1 shows three pinnae of the n-th order presumably forming a pinna of the (n-1)-th (first?) order.

Korallipteris sp. 1
Figure 3F–I

v 1896 *Gleichenia comptoniaefolia* Heer (Deb. & Ett. sp.). – Bayer, pp. 7, 32, text-fig. 2.

Figure 2. A–C – *Sphenopteris dubia* (Velenovský, 1888) J. Kvaček & Halamski comb. n.; A – lectotype NMP F354; B – NMP F356, Česká Lípa; C – NMP F3795a, Dobranov. • D–F, H – "*Pteridoleimma*" *durum* Bayer, 1896. Česká Lípa; D – NMP F595; E – lectotype NMP F594; F – NMP F593; H – NMP F726. • G – *Geinitzia reichenbachii* (Geinitz, 1842) Hollick & Jeffrey, 1909. Twig NMP F3824a. Dobranov. • I – *Monheimia chlomekiana* (Velenovský, 1882) Halamski & J. Kvaček comb. n. Holotype NMP F906. Česká Lípa.


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1 cm
I

Material. – NMP F548, figured by Bayer (1896, text-fig. 2) as *Gleichenia comptoniaefolia*; NMP F3769, 3797, 3798, 3800ab, 3801, 3802–3814; all the above from Česká Lípa. NMP F3791, 3839 from Robeč. NMP F3792, 3796 from Dobranov.

Description. – The available material consists of basal, median, and terminal fragments of pinnae. Pinnae 4–5 mm wide, with the same width for the major part of their length, except when gradually tapering at both ends. Margins undulating or finely serrate, the undulations or serrations less than 1 mm high and with the basiscopic side longer than the acroscopic one, pinnulae thus being nearly completely fused. In each pinnula a single median vein departing from the midvein of the pinna at an angle of *ca* 30–45° and pinnately arranged lateral veinlets.

Remarks. – The arrangement of pinnae of the specimen NMP F3792 is reminiscent of a palmate disposition, which, in connection with venation, suggests a relationship to the Matoniaceae. The frond may be imagined as having an organisation similar to that of either *Matonidium americanum* Berry from the Lower Cretaceous of Colorado (Berry 1919, Brown 1950) or *Knowltonella maxoni* Berry from the Patapsco Formation of Maryland (Berry 1911, p. 233, pls 25–27). They both differ in their pinnae being not fused. However, the systematic position of the specimens from Česká Lípa cannot be confirmed in view of fragmentary and sterile character of the material, so the fossil-genus *Korallipteris* has been used. *Didymosorus comptoniaefolius* Debey & Ett. from the Late Cretaceous of the Aachen area is based on fertile material.

***Korallipteris* sp. 2**
Figure 3B–E

Material. – NMP F3815ab, 3816–3818; all the above from Česká Lípa. NMP F3819–3821, 3849 from Dobranov.

Description. – The available material consists of median and terminal fragments of pinnae of the last order. Pinnulae subtriangular, departing from the rachis subperpendicularly and then markedly curving acroscopically, rather variable as far as the length-to-width ratio is concerned, sometimes fused up to $^1/_2$ of their length, sometimes nearly free.

Remarks. – *Korallipteris* sp. 2 differs from *Korallipteris* sp. 1 in having less fused pinnulae (*cf.* supra, Remarks to the genus). Some specimens were referred by Bayer (1896) to the Cenomanian species *Pecopteris zippei* Corda *in* Reuss (Corda 1846, p. 95, pl. 49, figs 2, 3; type NMP F223 examined). However, the latter is different in having completely free pinnulae, although the variation of this character can hardly be estimated on such a fragmentary material.

Infradivision Radiatopses auct.
Subinfradivision Gymnospermae (Lindley, 1830) Prantl, 1874
Class Coniferae (Jussieu, 1789) Engler, 1892
Order Pinales Gorožankin, 1904
Family unknown

Genus *Geinitzia* (Endl.) Harris, 1979

Type. – *Geinitzia reichenbachii* (Geinitz) Hollick & Jeffrey, p. 38, pl. 5, figs 7–10, pl. 8, figs 3, 4, pl. 16, figs 2–4, pl. 17, figs 1–4, pl. 18, figs 1–4 (1909) = *Araucarites reichenbachii* Geinitz, p. 98, pl. 24, fig. 4 (1842). Saxony, Germany; Cretaceous.

***Geinitzia reichenbachii* (Geinitz, 1842) Hollick & Jeffrey, 1909**
Figures 2G, 3A

vp 1885b *Sequoia Reichenbachi* Geinitz sp. – Velenovský, pp. 19–21, pl. 9, fig. 14, pl. 8, figs 8, 9, pl. 9, figs 5, 5a, 6a, 7a, 10a, 12, 13.
2010 *Geinitzia reichenbachii* (Geinitz, 1842) Hollick & Jeffrey, 1909. – Kunzmann, pp. 126–134, text-figs 3, 4, pls 1–4 [*ubi syn.*].
v. 2015 *Geinitzia reichenbachii* (Geinitz, 1842) Hollick & Jeffrey, 1909. – Halamski & Kvaček, p. 1234, pl. 2, fig. 6, pl. 3, figs 4–6.

Material. – NMP F3824a, a short twig fragment from Dobranov. NMP F4133a, b, branched leafy twig from Jedlová (Tannenberg).

Description. – Two available specimens are short twig fragments, that from Jedlová is branched with the main axis 35 mm long. Needles shortly decurrent, keeled, arranged helically, emerging from the twig at an angle of about

Figure 3. A – *Geinitzia reichenbachii* (Geinitz, 1842) Hollick & Jeffrey, 1909. Twig NMP F4133a. Jedlová. • B–E – *Korallipteris* sp. 2; B – NMP F3818, Česká Lípa; C – NMP F3815a, Česká Lípa; D – NMP F3816, Česká Lípa; E – NMP F3821, Dobranov. • F–I – *Korallipteris* sp. 1; F – NMP F3796, Dobranov; G – NMP F548, Česká Lípa; H – NMP F3792, Dobranov; I – NMP F3791, Robeč.


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1 cm

30–40°, 4–5 mm long and 0.6–1.0 mm broad, rhomboidal in cross section.

Remarks. – The specimens belonging to this taxon are fragmentary and few in number; this suggests small extent of coniferous back swamps in the coastal area. The material has been identified as *G. reichenbachii* on the basis of falcate leaves spreading abruptly from the axis similarly as in better-preserved specimens (Kunzmann 2010, Halamski & Kvaček 2015).

Subinfradivision Angiospermae A. Brown & Doell *ex* Doell, 1857
Class Dicotyledoneae de Candolle, 1817

Remarks. – The systematic arrangement of the dicot taxa described follows the morphological system designed by Krassilov (1979) with a few subsequent modifications by Crabtree (1987). The necessity of such an artificial system was aptly summarised by Maslova & Herman (2015, see also Maslova *et al.* 2005). However, we do not share the radical viewpoint of Maslova & Herman (2015) that can be summarised in saying that no isolated leaves can be attributed to a natural taxon other than the Angiospermae. On the contrary, it is evident that most isolated angiosperm leaves can be assigned to one of the two classes, either the Dicotyledoneae or the Monocotyledoneae. Moreover, following Halamski (2013, see also Jud & Hickey 2013, Passalia *et al.* 2015) we consider compound leaves as diagnostic for eudicots. Consequently, *Debeya* and *Dalbergites* are referred to the Eudicotyledoneae, whereas all the remaining fossil-taxa are considered as Dicotyledoneae *incertae sedis*. Such a prudent approach seem prudent for a poorly preserved flora like the ours, even if inferences on the systematic placement of some of the discussed taxa were made previously (Halamski & Kvaček 2015).

The characters distinguishing the fossil-taxa of dicots from the Chlomek Beds are summarised below in form of an identification key. The entries have been aligned on those from the key given by Halamski & Kvaček (2015) as much as possible. In some cases, however, changes of the order of the entries have been made, so as to show that the distinction of some taxa close to each other may not be evident.

I. Leaves simple, trilobate ..... *Ettingshausenia superstes*

II. Leaves (or leaflets) ovate, obovate, elliptic, or oblong.
1. Leaves (or leaflets) integrimarginate.
A. Leaf (leaflet?) large, secondaries brochidodromous, their course partly subperpendicular to the midvein, tertiaries and quaternaries reticulate .....*Dicotylophyllum* sp. 1
B. Leaf compound, leaflets oblong, much longer than wide, with subparallel margins ..... *Debeya* (*Dewalquea*) sp.
C. Combination of characters not as above.
a. Leaves or leaflets small, (sub)coriaceous.
α. Leaflets ovate, asymmetric ..... *Dalbergites atavius*
β. Leaflets elliptic, symmetric ..... *Dicotylophyllum bohemicum*
b. Leaves middle-sized, not coriaceous.
γ. Secondaries brochidodromous, dense and regular ..... *Apocynophyllum fractum*
δ. Secondaries, even if brochidodromous, neither very dense nor particularly regularly disposed.
*. Leaves ovate.
‡. Venation brochidodromous ..... *Laurophyllum*? *melanophyllum*
‡‡. Venation craspedodromous ..... *Laurophyllum acuminatum*
**. Leaves oblong ..... *Laurophyllum* sp.
***. Leaves elliptic ..... *Salicites petzeldianus*
2. Leaves (or leaflets) serrate or dentate.
D. Dentation dense (distances between successive teeth smaller than the width of a single tooth ..... *Ettingshausenia* sp.
E. Serration moderately dense to very rare (distances between successive teeth greater than the width of a single tooth).
c. Leaflets oblong to elliptic, secondaries (semi)craspedodromous ..... *Dryophyllum geinitzianum*
d. Leaves or leaflets ovate, secondaries brochidodromous ..... *Celastrinites engelhardtii*

The distinction of the 13 fossil-taxa listed above is relatively simple, except perhaps that of the two species of *Laurophyllum*, which may be distinguished only on account of their secondary venation pattern which is not always preserved. However, it should be stressed that their naming is often based on the assumption that they represent the same species as those from the better-preserved coeval flora of the Idzików Beds. In other words, leaves from the Chlomek Beds not differing from those from the Idzików Beds in any observable character have been assigned to the species defined in the latter area, even if the number of the observed characters of specimens coming from the Chlomek Beds would sometimes be hardly sufficient for a detailed description.

Supersublass Eudicotyledoneae Doyle & Hotton *ex* Halamski, 2013
Subclass, order, and family unknown

Figure 4. A, B, D, E – "*Dryandroides*" *quercinea* Velenovský, 1883. Česká Lípa; A – lectotype NMP F372; B – NMP F3739; D – NMP F3740; E – NMP F374. • C – *Celastrinites engelhardtii* (Velenovský, 1885a) Halamski & J. Kvaček comb. n. Lectotype NMP F3788a. Česká Lípa. • F–I – *Dryophyllum geinitzianum* (Goeppert, 1848) Halamski & J. Kvaček, 2015, F – NMP F3845, Robeč; G – NMP F3846, Česká Lípa; H – NMP F3843a, Česká Lípa; I – NMP F3844, Robeč.


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1 cm
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Genus *Debeya* Miquel, 1853

Type. – *Debeya serrata* Miquel, Verhand. Comm. Geol. Beschr. Kaart Nederl. 1, p. 38, pl. 1, fig. 1 (1853). Kunrade, Limburg, the Netherlands; Maastrichtian, Late Cretaceous.

Subgenus *Debeya* (*Dewalquea*) (de Saporta & Marion, 1889) Halamski, 2013

Type. – *Debeya* (*Dewalquea*) *haldemiana* (Debey *ex* Sap. & Marion) Halamski, Acta Palaeont. Pol. 58, pp. 420, 422, figs 7b, g, 8, 9c–e, 10c (2013a) = *Debeya haldemiana* (Debey *ex* Sap. & Marion) Roemer, Zeitschr. Deutsch. geol. Ges. 41, p. 143 (1889) = *Dewalquea haldemiana* Debey *ex* Sap. & Marion, Mém. couronnés autres Mém. Ac. Roy. Sci. Belgique 37, p. 60, pl. 7, fig. 1 (1873). Haldem, Westphalia, Germany; Campanian, Late Cretaceous.

***Debeya* (*Dewalquea*) sp.**
Figure 5G

vp 1884 *Hymenaea elongata* m.; Velenovský, pp. 10–11 [57–58], pl. 5 [20], fig. 5, non fig. 3.
v. 1896 *Hymenaea elongata* Vel. – Bayer, p. 23.

Material. – NMP F3832, fragmentary compound leaf, figured by Velenovský (1884, pl. 5, fig. 3) from Česká Lípa.

Description. – The available specimen is a fragment of a compound leaf, showing one bifurcation and bases of two leaflets. Leaflets subsessile, bases cuneate; observed margins entire; only the midvein preserved.

Remarks. – Velenovský (1884) described *Hymenaea elongata* on the basis of two fragmentary specimens, one from the Cenomanian of Kuchelbad and the other from the Coniacian of Česká Lípa. In our opinion, their conspecificity, admitted by Velenovský (1884) and by Bayer (1896), is by no means assured. The better-preserved specimen from the Cenomanian of Kuchelbad is available for a lectotype. The specimen from Česká Lípa is interpreted herein as a fragmentarily preserved pedate leaf of *Debeya* (*Dewalquea*) (see Halamski 2013, Halamski & Kvaček 2013) and not an element of pinnately bifoliolate leaf of *Hymenaea* (Leguminosae).

Debeya (*Dewalquea*) sp. from Idzików has serrate margins, so it probably represents another species, although a preservation artefact cannot be excluded either.

Genus *Dalbergites* (Kuntze, 1904) Halamski & J. Kvaček, 2015

Type. – *Dalbergites atavius* (Vel.) Halamski & J. Kvaček = *Cassia atavia* Vel., Beitr. Paläont. Oester.-Ung. 5(1), p. 6 [67], pl. 8 [31], figs 3–7, 10 (1885a). Idzików; Upper Idzików Beds, Coniacian, Late Cretaceous.

***Dalbergites atavius* (Velenovský, 1885) Halamski & J. Kvaček, 2015**
Figure 5E

v* 1885a *Cassia atavia* m.; Velenovský, p. 6 [67], pl. 8 [31], figs 3–7, 10.
v. 1885a *Pisonia atavia* m.; Velenovský, p. 6 [67], pl. 8 [31], figs 13, 14.
v. 2015 *Dalbergites atavius* (Velenovský, 1885a) Halamski & J. Kvaček comb. n. – Halamski & Kvaček, p. 18, text-fig. 6, pl. 6, figs 3, 4, 7 [*ubi syn.*].

Material. – NMP F3790ab (part and counterpart), holotype of *Pisonia atavia* Vel., figured by Velenovský (1885a, pl. 8, figs 13, 14, as two separate leaves); Česká Lípa.

Description. – The holotype, the only specimen of *Pisonia atavia* Vel., is an incomplete leaf.

Leaf nanophyll (preserved width 9 mm, length 1.8 cm; estimated total width *ca* 1.5 cm, length 2.5 cm). Blade attachment marginal, laminar shape ovate with median and basal asymmetry. Apex not preserved. Margin entire. Primary venation poorly preserved, probably pinnate camptodromous.

Remarks. – *Pisonia atavia* Vel. was described on the basis of a single poorly preserved leaf (two specimens, part and counterpart) allegedly distinguished from *Cassia atavia* Vel. [= *Dalbergites atavius* (Vel.) Halamski & J. Kvaček] in having a rounded apex. As a matter of fact, the apex is not preserved in either specimen. Otherwise both species cannot be distinguished by any consistent feature, so *Pisonia atavia* Vel. is considered herein as

Figure 5. A, B, F – *Laurophyllum acuminatum* (Goeppert, 1848) J. Kvaček & Halamski *in* Halamski & Kvaček, 2015; A – NMP F3852; B – NMP F3847, Česká Lípa; F – NMP F3824b, Dobranov. • C, D – *Laurophyllum* sp. Chlomek; C – NMP F3861; D – NMP F3863. • E – *Dalbergites atavius* (Velenovský, 1885) Halamski & J. Kvaček, 2015. Incomplete leaf NMP F3790a (holotype of *Pisonia atavia* Velenovský, 1885). Česká Lípa. • G – *Debeya* (*Dewalquea*) sp. Fragmentary compound leaf NMP F3832. Česká Lípa. • H–K – *Laurophyllum*? *melanophyllum* (Velenovský, 1885) J. Kvaček & Halamski comb. n.; H – NMP F3848, Robeč; I – NMP F3835, Česká Lípa; J – lectotype NMP F3828, Česká Lípa; K – NMP F3829, Česká Lípa.


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K
1 cm

synonymous with *Cassia atavia* Vel.; it might be a juvenile specimen.

Supersubclass, subclass, order, and family unknown
Form group Magnoliaephylls Crabtree, 1987

Genus *Laurophyllum* Goeppert, 1854

Type. – *Laurophyllum beilschmiedioides* Göpp., Tertiärfl. Java, p. 45, pl. 10, fig. 65a, pl. 11, figs 66, 68 (1854). Java, Eocene.

Remarks. – A large part of the material from Česká Lípa consists of material unidentifiable specifically but with some probability referable to the broadly taken genus *Laurophyllum*. This should be kept in mind when reading the quantitative analysis (Tables 1 and 2).

***Laurophyllum*? *melanophyllum* (Velenovský, 1885) J. Kvaček & Halamski comb. n.**
Figure 5H–K

Basionym. – *Cassia melanophylla* Velenovský, 1885a, Die Flora der böhmischen Kreideformation IV, p. 275, pl. 8, figs 1, 9, 8, an figs 2, 11, 12.

Lectotype. – NMP F3828, lectotype selected herein, figured by Velenovský (1885a, pl. 8, fig. 8), refigured herein in Fig. 5J; Česká Lípa.

v*p 1885a *Cassia melanophylla* m.; Velenovský, p. 275, pl. 8, figs 1, 9, 8, an figs 2, 11, 12.

Material. – NMP F3829, 3835, former syntypes, figured by Velenovský (1885a, pl. 8, figs 9, 1). NMP F3741, all three from Česká Lípa. NMP F3848 from Robeč.

Diagnosis. – Leaves ovate, estimated length up to *ca* 8 cm. Base shape cuneate, apex probably weakly acuminate. Venation pattern pinnate brochidodromous, secondaries departing at 40–60°, then curving towards the apex.

Description. – The lectotype is a fragmentary leaf (apical part) 40 mm long and 24 mm broad (Fig. 5J). Leaves ovate, presumably much longer than wide, entire-margined. Venation pinnate brochidodromous observed in the lectotype and in a specimen from Robeč (Fig. 5H).

Remarks. – *Laurophyllum*? *melanophyllum* is tentatively separated from *L. acuminatum* on the basis of secondary venation pattern, brochidodromous in the former and camptodromous in the latter. It is unclear to what extent such a distinction of two morphotaxa otherwise similar corresponds to either an actual difference between species or is a matter of intraspecific variability or preservation. Most of the material lacks clear venation pattern.

Three of the former syntypes of *Laurophyllum*? *melanophyllum* (NMP F3830, 3831, and 3836, figured by Velenovský 1885a, pl. 8, figs 2, 11, 12) are specifically unidentifiable due to poor preservation. Fragmentary entire-margined leaf earlier determined as *Dryandoides quercina* (Velenovský 1883, pl. 2, fig. 14) is also assigned to this species.

***Laurophyllum acuminatum* (Goeppert, 1848) J. Kvaček & Halamski *in* Halamski & Kvaček, 2015**
Figure 5A, B, F

Holotype. – MGUWr 7491p figured by Goeppert (1841, pl. 51, fig. 4), and Halamski & Kvaček (2015, pl. 8, fig 1); Idzików, Coniacian.

v* 1848a *Phyllites acuminatus* Goeppert, p. 275.
v. 2015 *Laurophyllum acuminatum* (Goeppert, 1848a) J. Kvaček & Halamski comb. n. – Halamski & Kvaček, pp. 20–22, text-fig. 8B, pl. 8, figs 1–3, 7–9, pl. 9, figs 2, 4.

Material. – NMP F3824b from Dobranov, NMP F3847, 3850–3853 from Česká Lípa. NMP F3858 from Robeč. NMP F3865–3868 from Chloumek (Chlomek).

Description. – Leaves ovate to lanceolate, entire-margined, sometimes asymmetric, up to 7 cm long and 2 cm wide. Apex typically attenuate, base cuneate. Venation pattern pinnate, eucamptodromous; secondaries not always visible, variously placed usually in angles about 30° to the rachis.

Remarks. – This species is distinguished from *Laurophyllum*? *melanophyllum* by the venation pattern (camptodromous and not brochidodromous).

***Laurophyllum* sp.**
Figure 5C, D

v 2015 *Laurophyllum* sp. 1; Halamski & Kvaček, pp. 22–23, text-fig. 8A, pl. 8, figs 4, 6, pl. 9, figs 1, 6–8 [*ubi syn.*].

Material. – NMP F3861–3864 from Chloumek (Chlomek). NMP F4095–4097 from Dobranov. NMP F4102 from Česká Lípa.

Description. – The material consists solely of leaf fragments. Leaves entire-margined, elliptic to lanceolate, with

symmetric or asymmetric cuneate base. Venation pinnate with well pronounced robust midvein, secondary veins poorly visible, sometimes missing.

Remarks. – This material differs *from Laurophyllum acuminatum* in lacking attenuate apex and vaguely preserved venation. Fragments of this species are difficult to assign to any of the above-mentioned species of *Laurophyllum*.

Group Ficofolia Krassilov, 1979

Genus *Apocynophyllum* Unger, 1850

Type. – *Apocynophyllum seyfriedii* Braun *in* Unger; Radoboj, Croatia; Miocene.

***Apocynophyllum fractum* (Velenovský, 1885) J. Kvaček & Halamski *in* Halamski & Kvaček, 2015**
Figure 6F

Holotype. – NMP F721, figured by Velenovský (1885a, pl. 8, fig. 15) and Halamski & Kvaček (2015, pl. 12, fig. 2, text-fig. 13); Idzików, Coniacian.

v* 1885a *Ficus fracta* m.; Velenovský, p. 10 [71], pl. 8 [31], fig. 15.
v. 2015 *Apocynophyllum fractum* (Velenovský, 1885a) J. Kvaček & Halamski comb. n. – Halamski & Kvaček, p. 28, text-fig. 13, pl. 12, fig. 2.

Material. – Leaf fragment NMP F3833 from Česká Lípa.

Description. – The single available specimen is a fragment of the middle part of a leaf.

Preserved length *ca* 1.5 cm, width *ca* 3.5 cm (estimated total width 4 cm, length >8 cm). Venation pinnate brochidodromous with straight, strong, parallel secondaries, departing at an angle of *ca* 60°, spaced each *ca* 4.5 mm on one side of the midvein and each *ca* 6 mm on the other. Margin most probably entire.

Remarks. – This leaf fragment is referable to the poorly known species *Apocynophyllum fractum* from Idzików on account of characteristic dense and regular brochidodromous venation (Halamski & Kvaček 2015, text-fig. 13). The presence of marginal vein could not be checked due to preservation state.

Group Platanofolia Krassilov, 1979

Genus *Ettingshausenia* Stiehler

Type. – *Ettingshausenia cuneifolia* (Bronn) Stiehler, Palaeontographica 5, p. 67 (1857) = *Credneria cuneifolia* Bronn, Lethaea geogn., p. 583, pl. 28, fig. 11 (1837). Niederschöna, Saxony, Germany; Cenomanian, Late Cretaceous.

***Ettingshausenia superstes* (Velenovský, 1882) J. Kvaček & Halamski comb. n.**
Figure 6I–K

Basionym. – *Credneria superstes* Vel. 1882, Die Flora der böhmischen Kreideformation, I. pp. 15–16 [8–9], pl. 4 [2], figs 7–9.

Lectotype. – NMP F382, 383 (part and counterpart) lectotype designated herein, figured by Velenovský (1882, pl. 4, figs 8, 9), refigured herein in Fig. 6I; Česká Lípa.

v* 1882 *Credneria superstes* sp. n.; Velenovský, pp. 15–16 [8–9], pl. 4 [2], figs 7–9.

Other material. – NMP F784. NMP F3834 figured by Velenovský (1882, pl. 4, fig. 7); all from Česká Lípa.

Emended diagnosis. – Leaves small, obovate-rhombic, simple, often asymmteric, entire-margined, petiolate. Leaf base narrow cuneate, apex unknown. Venation pinnately brochidodromous. Secondary veins obliquely emerging from primary vein and curving upwards. Tertiary veins probably percurrent.

Description. – The lectotype represents the most complete (although still incomplete) leaf (50 mm long and 30 mm wide). Other material consists of fragments of marginal parts of lamina 30 to 40 mm. Lamina obovate-rhombic in shape; lobes none. Apex missing in all specimens. Base of the lectotype fragmentary but clearly cuneate, that of the specimen NMP F383 (Fig. 6K) better preserved, cuneate. Venation of the lectotype pinnately brochidodromous without any clearly distinguised suprabasal pair of veins. Tertiary veins generally poorly preserved, percurrent. Venation best preserved in the specimen NMP F3834 (Fig. 6J): secondary veins connected with percurrent or oblique tertiaries forming loops along leaf margin.

Remarks. – *Ettingshausenia superstes* represents a very particular taxon within the genus. It does not possess any lobes and therefore differs from most representatives of *Ettingshausenia*. The lamina shape is rhombic. *E. cuneifolia*, the type of the genus, described from the Cenomanian of Niederschöna (Bronn 1837, Maslova *et al.* 2005, Golovneva 2011) differs from *E. superstes* in having a large deltoid lamina with clearly pronounced tertiary venation. *E. onomasta* from the Campanian of Idzików

(Halamski & Kvaček 2015) is probably the most similar species, but it differs in having lobes. *E. gruenbachiana* from the Campanian of Grünbach (Herman & Kvaček 2010) differs from *E. superstes* in possessing well pronounced tertiary venation and small lobes. *E. superstes* differs from *E. senonensis* from the Turonian–Santonian of the Klikov Formation (South Bohemia) and *E. bohemica* and *E. laevis* from the Cenomanian of the Peruc-Korycany Formation in lacking teeth and lobes and having inconspicuous tertiary venation of second order, except for *E. laevis* which has tertiary venation also inconspicuous (Kvaček & Váchová 2006). *E. superstes* is also comparable to *Credneria denticulata* from the Santonian of Quedlinburg (Tschan *et al*. 2008). From that taxon it differs in having a cuneate base, a small entire-margined lamina and less pronounced tertiary venation.

***Ettingshausenia* sp.**
Figure 6H

v* 1885a *Cissites crispus* m.; Velenovský, p. 12 [74], pl. 4 [27], fig. 6.
v 2015 *Ettingshausenia* sp.; Halamski & Kvaček, p. 26, pl. 6, fig. 1.

Material. – Incomplete juvenile leaf NMP F3825a, b (part and counterpart), holotype of *Cissites crispus* designated by Velenovský (1885a, pl. 4, fig. 6), from Česká Lípa.

Description. – The single available specimen is a presumably juvenile leaf *ca* 1 cm wide and 0.8 cm long (basal part lacking). Original lamina shape probably suborbicular. Margin probably dentate, with densely packed teeth. Venation pattern pinnate craspedodromous with secondaries departing at angles different on both sides of the midvein, varying between 30° and 60°.

Remarks. – The characteristic venation pattern and margin dentation allow considering two fragmentarily preserved specimens, one from Idzików and the other from Česká Lípa, as belonging to the same juvenile type of *Ettingshausenia* foliage.

Group Fagofolia Krassilov, 1979

Genus *Dryophyllum* (Debey *ex* de Saporta, 1865) Jones, Manchester & Dilcher, 1988

Type. – Dryophyllum subcretaceum Debey ex Sap., Ann. Sci. nat., Bot. (5^{e} sér.) 4, p. 46 (1865). Sézanne, France; Eocene.

Remarks. – Following Halamski & Kvaček (2015), this genus may be considered as belonging to an unknown family of the order Fagales.

***Dryophyllum geinitzianum* (Goeppert, 1848) Halamski & J. Kvaček, 2015**
Figure 4F–I

Lectotype. – MGUWr 7485p, figured by Goeppert (1848b, pl. 37, fig. 5) and Halamski & Kvaček (2015, pl. 4, fig. 8); Idzików, Polish part of the Sudetes; Idzików Beds, Coniacian.

v* 1848a *Phyllites Geinitzianus* Goeppert, p. 275.
v. 1883 *Quercus pseudodrymeja* sp. n.; Velenovský, p. 17 [42], pl. 2 [10], figs 21, 22.
v. 2015 *Dryophyllum geinitzianum* (Goeppert, 1848) Halamski & J. Kvaček comb. n. – Halamski & Kvaček, pp. 16–17, text-fig. 4, pl. 4, figs 1–8, pl. 5, figs 1–8, pl. 13, fig. 6 [*ubi syn.*].

Material. – NMP F3843ab, 3844, 3845, 3856 from Robeč. NMP F3846 from Česká Lípa, NMP F3666, former syntype of *Q. pseudodrymeja*, figured by Velenovský (1883, pl. 2, fig. 22); from Jedlová. NMP F3859 from Chloumek (Chlomek).

Description. – Leaves microphyll, maximal recorded length 5 cm, estimated length *ca* 10 cm; elliptic (Fig. 4I) to elliptically oblong (Fig. 4H), estimated length-to-width ratio being about 4. Base not preserved, apex acute. Margin serrate. Teeth 1–2 per cm, usually rounded; more or less anteriorly directed; the proximal side usually straight to concave, the distal side usually straight to convex. Venation pattern pinnate craspedodromous, in a single case asymmetric (craspedodromous on one side, brochidodromous on the other); secondaries departing at *ca* 45°, straight though most of their course, curving gently near the margin, sometimes bifurcating, and entering the teeth.

Remarks. – For comparison with "*Dryandroides*" *quercinea* Vel., see the latter species.

Genus *Dryandroides* Unger, 1850

Type. – Non designatus.

"*Dryandroides*" *quercinea* Velenovský, 1883
Figure 4A, B, D, E

Lectotype. – NMP F372, lectotype selected herein, illustrated by Velenovský (1883, pl. 2, fig. 12), refigured herein in Fig. 4A; Česká Lípa.

v. 1883 *Dryandroides quercinea* sp. n.; Velenovský, p. 8 [33], pl. 2 [10], figs 8a–15.
v. 1896 *Dryandroides quercina* Vel. – Bayer, pp. 15–18, text-figs 13–16.
v. 1898 *Dryandroides quercina* Vel. – Frič, p. 75, text-fig. 106 [for Velenovský 1885a].

Material. – NMP F374, 3739, 3740 former syntypes, illustrated by Velenovský (1883, pl. 2, figs 9, 11, 15); all the above from Česká Lípa.

Description. – Leaves microphyll, maximal recorded length 8 cm, oblong, estimated length-to-width ratio varying from 6 to 8. Base preserved in juvenile specimens, cuneate; apex acute. Margin serrate. Teeth 2–3 per cm, in adult specimens mostly acute; variously directed (either subperpendicular to midvein or anteriorly directed); the proximal side usually straight to concave, the distal side usually straight to convex. Venation pattern poorly preserved, pinnate craspedodromous; the single well preserved secondary departing at *ca* 60, strongly curving and entering a tooth.

Remarks. – "*Dryandroides*" *quercinea* is distinguished from *Dryophyllum geinitzianum* by narrower leaves as well as stronger, more acute, and irregularly placed teeth. The two species do not co-occur, the former being present at Česká Lípa, and the latter at Robeč, Jedlová, and Chloumek. The generic placement is purely conventional.

The type material of *Dryandroides quercinea* Vel. consists of eight specimens (syntypes; seven extant), figured by Velenovský (1883, pl. 2, figs 8a–15), all coming from Česká Lípa. The material is clearly heterogenous. The specimen NMP F372 (Velenovský 1883, pl. 2, fig. 12; selected herein as the lectotype) has strong teeth, whereas the specimen NMP F373 (Velenovský 1883, pl. 2, fig. 10) is entire-margined (Velenovský's figure is false) and belongs probably to *Laurophyllum acuminatum*. The brochidodromous venation illustrated by Velenovský (1883, pl. 2, fig. 12) cannot be traced on the poorly preserved lectotype. On the contrary, in every case the venation has been found, it was consistently craspedodromous.

"*Quercus*" *pascui* Petrescu from the Upper Cretaceous of Transylvania (Petrescu 1973) is similar to the discussed species in its elongate shape and anteriorly directed teeth. The dentation of "*Q.*" *pascui* is, however, denser and less regular.

Group Rosifolia Krassilov, 1979

Genus *Celastrinites* de Saporta, 1865

Type. – *Celastrinites* (*Evonymus*?) *venulosus* Sap., Ann. Sci. nat., Bot., 5^{e} sér. III, p. 52 (first illustrated by de Saporta 1868, pl. 15 [36], figs 12, 13). Sézanne, Marne, France, lower Eocene.

Remarks. – The genus *Celastrinites* was introduced by de Saporta (1865) for leaves comparable with recent representatives of Celastraceae. It is, however, clear from a more detailed description of the same fossil flora that the genus was intended as a form genus for forms comparable to Celastraceae, Staphyleaceae, and Iliciaceae (de Saporta 1868, p. 412). In the protologue the diagnosis was given jointly for the genus and the only included species, *C. venulosus*. An emended diagnosis was given by Krassilov (1979, p. 62), Cretaceous reports of this genus include, for example, Bell (1957, p. 58, pl. 44, fig. 2, contrarily to the description, the venation is brochidodromous), Herman & Lebedev (1991, p. 99), and Herman (2013). Representatives of *Celastrophyllum* Goeppert, 1854 have craspedodromous secondaries (Samylina 1984).

***Celastrinites engelhardtii* (Velenovský, 1885) Halamski & J. Kvaček comb. n.**
Figure 4C

Basionym. – *Phillyrea englehardti* Velenovský, 1885a, p. 7 [68], pl. 4, fig. 3.

Lectotype. – NMP F3788a, b lectotype selected herein, figured by Velenovský (1885a, pl. 4, fig. 3), refigured herein in Fig. 4C; Česká Lípa.

v* 1885a *Phillyrea Engelhardti* sp. n.; Velenovský, p. 7 [68], pl. 4 [27], figs 2–5.

Material. – Fragmentary leaf; NMP F3789, former syntype, figured by Velenovský (1885a, pl. 4, fig. 5); from Česká Lípa (*cf.* infra, Remarks, for the status of the other former syntypes).

Description. – The lectotype is a leaf fragment *ca* 1.5 cm long and 1.2 cm wide. Lamina shape possibly longer than wide but neither base nor apex preserved. Margin possibly serrate with rounded anteriorly directed teeth; their proximal side longer than the distal one, both straight. Venation pinnate brochidodromous, the position of the preserved loops suggesting a festooned brochidodromous pattern.

Remarks. – This species is based on particularly poorly preserved material. The other specimen does not reveal any additional characters in comparison to the lectotype. However, the brochidodromous venation and the undulating margin clearly distinguish the lectotype from the other taxa from both Chlomek and Idzików Beds. On the contrary,

the specimens NMP F3826 and 3827 (former syntypes; Velenovský 1885a, pl. 4, figs 2, 4) are unidentifiable (the venation of the former is indistinguishable and the alleged serrate margin of the latter may be a preservation artefact).

Form group unknown

Genus *Dicotylophyllum* auct.

Type. – Unknown (see discussion by Halamski 2013, p. 429).

***Dicotylophyllum bohemicum* nom. nov.**
Figure 6A–E

Lectotype. – Nearly complete leaf NMP F387a, b lectotype selected herein, illustrated by Velenovský (1885a, pl. 4, fig. 10), refigured herein in Fig. 6D; Česká Lípa.

v* 1885a *Rhus cretacea* sp. n.; Velenovský, p. 7 [68], pl. 4 [27], figs 7–12.
v. 2015 *Dicotylophyllum* sp. 2. – Halamski & Kvaček, p. 31, pl. 9, fig. 3, pl. 14, figs 2, 3, 6.

Material. – NMP F384, 385, 386, former syntypes of *Rhus cretacea* Vel., illustrated by Velenovský (1885a, pl. 4, figs 9, 11, 12); NMP F3854; all the above from Česká Lípa. Tentatively assigned: NMP F3838 from Dobranov.

Description. – Leaf nanophyll, elliptic-oblong to slightly ovate in shape, sometimes weakly asymmetric, not exceeding 3 cm in length, width to length ratio 2.5–3; base cuneate, apex acute to acuminate. Margin entire, midvein thick, petiole not preserved. Secondaries camptodromous, excurrent?, delicate, departing at an angle of *ca* 45°, spaced *ca* 0.5 cm.

Remarks. – This species was originally described as *Rhus cretacea* Vel. (Velenovský 1885a). The assignment to *Rhus* is unwarranted, especially that the margin is entire and not serrate as interpreted by Velenovský (1885a, pl. 4, fig. 10). Instead, the transfer to *Dicotylophyllum* is proposed; the arguably conspecific material (despite minor differences in shape) has already been described as *Dicotylophyllum* sp. 2 from the Idzików Beds (Halamski & Kvaček 2015). However, the combination *Dicotylophyllum cretaceum* cannot be made, being preoccupied by *Dicotylophyllum cretaceum* (Vel.) Knobloch from the Cenomanian Peruc Formation (basionym: *Dryandra cretacea* Vel.; Velenovský 1883, Knobloch 1999). The new name *Dicotylophyllum bohemicum* is therefore proposed herein as the replacement.

***Dicotylophyllum* sp. 1**
Figure 6G

Material. – Leaf fragment NMP F3837 from Dobranov.

Description. – The single available specimen is a 4.5 cm long and 1.5 cm wide (total dimensions at least twice the preserved size) leaf fragment torn along the midvein.

Margin unknown. Secondaries departing at an angle of 50–70° and forming subtriangular loops near the presumed margin. Tertiaries and quaternaries reticulate.

Remarks. – This apparently large leaf is suggestive of representatives of *Juglandiphyllites* (Herman & Kvaček 2010, p. 77; Halamski & Kvaček 2015, p. 17) in size and secondary venation pattern (especially Herman & Kvaček 2010, fig. 34a). The tertiaries, however, are reticulate and not percurrent as it is the case in *J. pelagicus* from the Campanian of Grünbach. The tertiaries of *Juglandiphyllites* cf. *pelagicus* from Idzików (Halamski & Kvaček 2015, text-fig. 5) are unknown. Poor preservation precludes further identification.

Comparison of Coniacian floras from West and East Sudetic Islands

The first observation is the difference in the overall composition (*i.e.*, high rank taxa content) of the fossil floras from the Chlomek and Idzików Beds, as summarised in Table 2.

The over-representation of ferns in the quantitative comparison is partly due to a taphonomic bias. In effect, even very small fragments of fern pinnae may be identified, whereas an angiosperm leaf having experienced a similar degree of fragmentation will most often be considered as unidentifiable. The material studied is indeed more fragmented than that from Idzików. On the other hand, taphonomy alone most certainly cannot account for such a difference in both specimen number and percentage (Table 2). It is suggested that a fern-rich community is better represented in the material from the Chlomek Beds than in that from the Idzików Beds. Consequently, with usual reservations, such a community may have been better developed on the West Sudetic Island than on the East Sudetic Island.

The near absence of conifers in the flora studied cannot be accounted for by any taxonomic bias. In effect, conifer twigs are less fragile and thus more resistant to transport (among others, due to presence of resins) and a fossil assemblage deposited farther from the coast should contain proportionally more conifers if the original plant community were alike. It may therefore be safe to infer that a community containing conifers, present on the East Sudetic

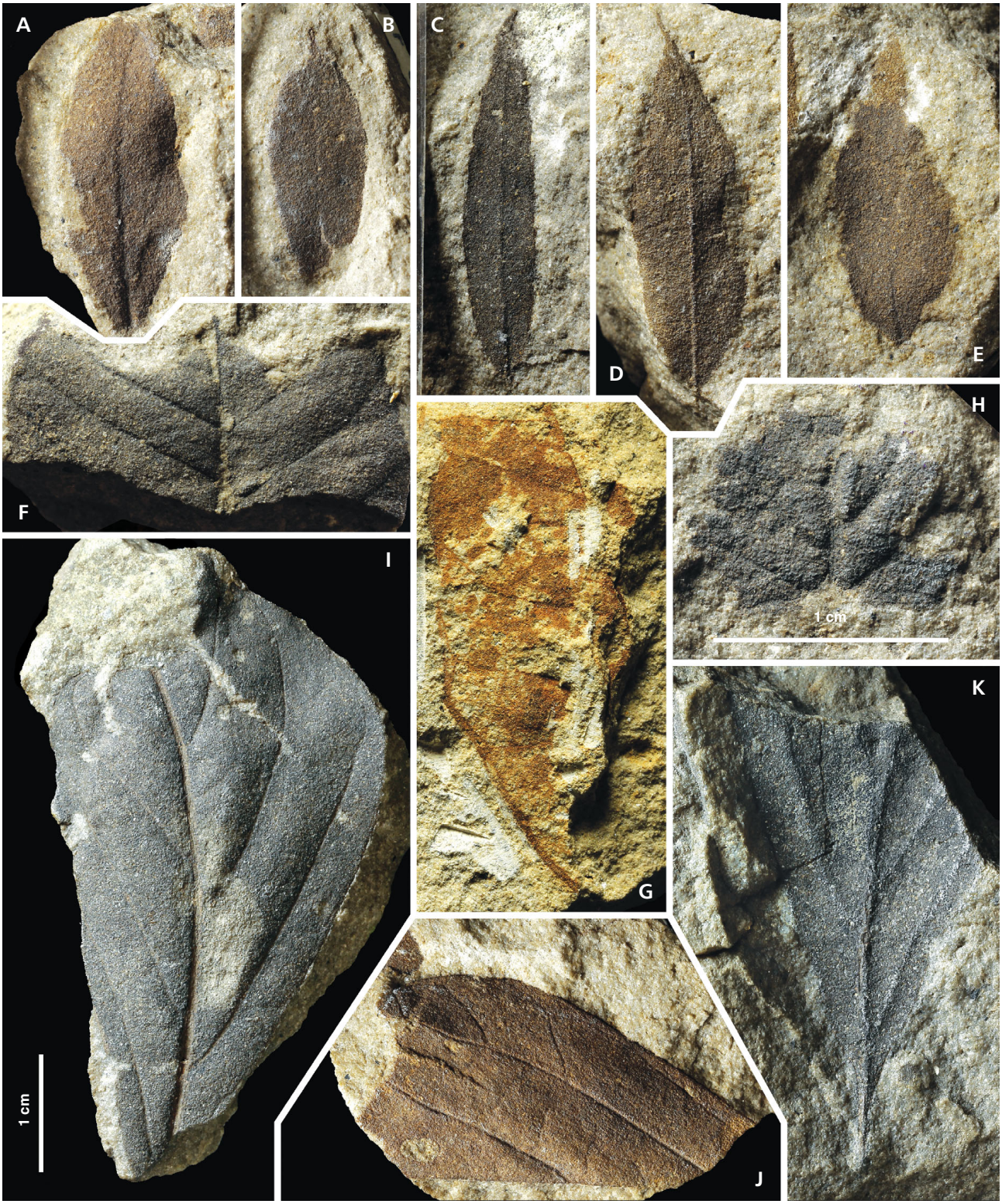

Figure 6. A–E – *Dicotylophyllum bohemicum* nom. nov; A – NMP F384, Česká Lípa; B – NMP F386; C – NMP F3854; D – lectotype NMP F387a; E – NMP F385. • F – *Apocynophyllum fractum* (Velenovský, 1885) J. Kvaček & Halamski *in* Halamski & Kvaček, 2015. Leaf fragment NMP F3833, Česká Lípa. • G – *Dicotylophyllum* sp. 1. NMP F3837, Dobranov. • H – *Ettingshausenia* sp. Juvenile leaf NMP F3825a, Česká Lípa. • I–K – *Ettingshausenia superstes* (Velenovský, 1882) J. Kvaček & Halamski comb. n., Česká Lípa; I – lectotype NMP F382; J – NMP F3834; K – lectotype NMP F383.

Table 2. Overall comparison of Coniacian leaf floras from the Chlomek Beds and the Idzików Beds. Data counted twice, either for specimens (A – in Roman typeface) or for taxa (B – in italics); see text for further explanation. Data for the latter after Halamski & Kvaček (2015).

Localities	Chlomek Beds		Idzików Beds	
Taxonomy	A	*B*	A	*B*
Ferns	48 (52%)	*5 (25%)*	6 (2%)	*5 (17%)*
Conifers	2 (2%)	*1 (5%)*	21 (6%)	*2 (7%)*
Angiosperms	42 (46%)	*14 (70%)*	316 (92%)	*23 (76%)*
Total	92 (100%)	*20 (100%)*	343 (100%)	*30 (100%)*

Island, was more or less unrepresented in the source area of the fossil flora studied.

Another inference is based on the observation that species interpreted (at Idzików) to have dwelt in palaeocommunities other than the riparian forest (*Amelanchites cerasiformis* and *Dryophyllum montis-nivium* from a mesophilous forest; *Frenelopsis* sp. and *Pandanites* cf. *spinatissimus* from a coastal swamp) are wholly absent from the material studied. It may be thus supposed that these plant associations were absent from the source area of the Chlomek Beds and that the entire fossil assemblage studied may be referred solely to riparian forests of character broadly similar to those in the East Sudetic Island. The physiognomic type of a forest dominated by entire-margined laurophylls and a plant with serrate-margined leaves was the same on both West and East Sudetic Islands. However, there may be local variations within this broadly considered community. The serrate-leaved plant is either *Dryophyllum geinitzianum* (at Robeč and Jedlová) or *Dryandroides quercinea* (at Česká Lípa). These two species do not co-occur. The laurophylls are represented either by *Laurophyllum*? *melanophyllum*, *Laurophyllum acuminatum*, or *Laurophyllum* sp. with less clear, if any, distribution pattern.

The relationship between the two Coniacian floras studied, namely overall similarity of the vegetation type coupled with significant differences in floristic composition is quite alike that among three Campanian floras from central and northern Europe (Halamski *et al.* in press).

Conclusions

1. The "Chlomek Beds" (the psammitic facies of the Březno Formation) cropping out in the northeastern part of the Bohemian Cretaceous Basin contain moderately diverse fossil plant assemblage (20 fossil-taxa) preserved as imprints in coarse clastic rocks. The plants are Coniacian in age and have originated from the West Sudetic Island belonging to the Central European Archipelago.

2. Ferns are relatively abundant in terms of numer of specimens numerous and are represented by *Monheimia chlomekiana* (Matoniaceae), *Sphenopteris dubia*, *Koralipteris* spp., and "*Pteridoleimma*" *durum* (*incertae sedis*).

3. Angiosperms are represented by 14 leaf morphotypes, with two only referable to the eudicots and 12 to dicots *incertae sedis*. Eudicots include *Debeya* (*Dewalquea*) sp. and *Dalbergites atavius*, whereas dicots *incertae sedis* are represented by three species of *Laurophyllum*, two of *Ettingshausenia*, two of *Dicotylophyllum*, and single species of *Apocynophyllum*, *Celastrinites*, *Salicites*, *Dryophyllum*, and *Dryandroides*.

4. The following new combinations are introduced: *Monheimia chlomekiana* (Vel.) Halamski & J. Kvaček comb. n. (basionym: *Aralia chlomekiana* Vel.); *Sphenopteris dubia* (Vel.) J. Kvaček & Halamski (basionym: *Asplenites dubius* Vel.); *Laurophyllum*? *melanophyllum* (Vel.) J. Kvaček & Halamski (basionym: *Cassia melanophylla* Vel.); *Ettingshausenia superstes* (Vel.) J. Kvaček & Halamski comb. n. (basionym: *Credneria superstes* Vel.); *Celastrinites*? *engelhardtii* (Vel.) Halamski & J. Kvaček comb. n. (basionym: *Phillyrea engelhardti* Vel.). *Dicotylophyllum bohemicum* Halamski & J. Kvaček nom. nov. is introduced as a replacement name for *Rhus cretacea* Vel. [non *Dicotylophyllum bohemicum* (Vel.) Knobloch].

5. In comparison with the approximately coeval flora of the Idzików Beds, the angiosperm assemblages are rather similar in general character, dominated in both cases by laurophylls and a serrate-leaved plant. Some local difference in serrate-leaved trees is clear. For example, the two species, *Dryophyllum geinitzianum* and *Dryandroides quercinea*, never co-occur at a locality. On the contrary, ferns are much more abundant and diverse in the "Chlomek Beds" than in the Idzików Beds. The conifers are very rare in the "Chlomek Beds" but are common in the Idzików Beds.

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References

Andrews, H.N. Jr. 1970. Index of generic names of fossil plants, 1820–1965. *US Geological Survey Bulletin 1300*, 1–354.

Andrews, H.N. & Pearsall, C.S. 1941. On the flora of the Frontier Formation of southwestern Wyoming. *Annals of the Missouri Botanical Garden 28*, 165–192. DOI 10.2307/2394269

Bayer, E. 1896. Die Flora der Chlomeker Schichten. *Sitzungsberichte der Königlich böhmischen Gesellschaft der Wissenschaften, Mathematisch-naturwissenschaftliche Klasse 27*, 1–36.

Bell, W.A. 1957. Flora of the Upper Cretaceous Nanaimo Group of Vancouver Island, British Columbia. *Geological Survey of Canada, Memoir 293*, 1–84.

Berry, E.W. 1911. Systematic paleontology, Lower Cretaceous, Pteridophyta, 214–312. *In* Clark, W.B. (ed.) *Maryland Geological Survey, Lower Cretaceous*. The Johns Hopkins Press, Baltimore.

Berry, E.W. 1919. A new *Matonidium* from Colorado, with remarks on the distribution of the Matoniaceae. *Bulletin of the Torrey Botanical Club 46*, 285–295. DOI 10.2307/2480401

Bronn, H.G. 1837. *Lethaea geognostica oder Abbildung und Beschreibung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen, vol I.* 560 pp. Schweizerbart'sche Verlagshandlung und Druckerei, Stuttgart.

Brown, R.W. 1950. Cretaceous plants from southwestern Colorado. *U.S. Geological Survey Professional Paper 221-D*, 45–66.

Čech, S. 2011. Palaeogeography and stratigraphy of the Bohemian Cretaceous Basin – an overview. *Geologické výzkumy na Moravě a Slezsku 18(1)*, 18–21.

Čech, S., Hercogová, J., Knobloch, E., Pacltová, B., Pokorný, V., Sajverová, E., Slavík, J., Švábenická, L. & Valečka, J. 1987. Svrchní křída ve vrtu Volfartice Vf-1. *Sborník geologických věd, Geologie 42*, 113–159.

Čech, S., Klein, V., Kříž, J. & Valečka, J. 1980. Revision of the Upper Cretaceous stratigraphy of the Bohemian Cretaceous Basin. *Věstník Ústředního ústavu geologického 55*, 277–296.

Corda, A.J. 1846. Pflanzen, 81–96. *In* Reuss, A.E. *Die Versteinerungen der böhmischen Kreideformation*. E. Schweizerbart'sche Verlagsbuchhandlung und Druckerei, Stuttgart.

Crabtree, D.R. 1987. Angiosperms of the Northern Rocky Mountains: Albian to Campanian (Cretaceous) Megafossil Floras. *Annals of the Missouri Botanical Garden 74*, 707–747. DOI 10.2307/2399448

Crabtree, D.R. 1988. Mid-Cretaceous ferns in situ from the Albino Member of the Mowry Shale, southwestern Montana. *Palaeontographica, Abteilung B 209(1–3)*, 1–27.

Debey, M.H. & Ettingshausen, C. 1859. Die urweltlichen Acrobryen des Kreidegebirges von Aachen und Maestricht. *Denkschriften der kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse 17*, 183–248.

Frič, A. 1898. Studie v oboru českého útvaru křídového. Palaeontologický výzkum jednotlivých vrstev. VI. Chlomecké vrstvy. *Archiv pro přírodovědné prozkoumání Čech 10(4)*, 3–84.

Goeppert, H.R. 1848a. Zur Flora der Quader-Sandsteins in *Schlesien* als Nachtrag zu der Abhandlung in N. Acta Caes. Leop. Nat. Cur. Vol. XIX, P. II, 1841, 99–134, m. 8 Taf. *Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde 1848*, 269–278.

Goeppert, H.R. 1848b. Zur Flora der Quadersandsteins in Schlesien. Als Nachtrag zu der früher erschienenen Abhandlung über denselben Gegenstand. *Nova Acta Academiae Caesareae Leopoldinae Naturae Curiosorum 22(1)*, 355–365.

Goeppert, H.R. 1854. *Die Tertiärflora auf der Insel Java. A*. 162 pp. Martini and Grüttefien, Elberfeld.

Golovneva, L.B. 2011. Rod *Ettingshausenia* (Platanaceae) v tsenoman-turonskikh florakh Evroazii, 127–163. *In* Golovneva, L.B. *et al.* (eds) *Paleobotanika, Tom 2*. Marafon, Sankt Peterburg.

Halamski, A.T. 2013. Latest Cretaceous leaf floras from southern Poland and western Ukraine. *Acta Palaeontologica Polonica 58*, 407–443.

Halamski, A.T. & Kvaček, J. 2013. The type specimen of *Debeya* (*Dewalquea*) *haldemiana* rediscovered. *Acta Musei nationalis Pragae, Series B – historia naturalis 69*, 83–86.

Halamski, A.T. & Kvaček, J. 2015. The Late Cretaceous (Coniacian) leaf and cone flora from the Sudetes. *Palaeontographica, Abteilung B 292*, 81–157.

Halamski, A.T., Kvaček, J. & Vajda, V. in press. Late Cretaceous (Campanian) leaf and palynoflora from southern Skåne, Sweden. *In* Kear, B.P., Lindgren, J., Hurum, J.H., Milàn, J. & Vajda, V. (eds) *Mesozoic Biotas of Scandinavia and its Arctic Territories. Geological Society of London, Special Publications 434*. DOI 10.1144/SP434.16

Herman, A.B. 2013. Albian–Paleocene flora of the North Pacific: systematic composition, palaeofloristics and phytostratigraphy. *Stratigraphy and Geological Correlation 21(7)*, 689–747. DOI 10.1134/S0869593813070034

Herman, A.B. & Kvaček, J. 2010. *Late Cretaceous Grünbach flora of Austria.* 143 pp. Naturhistorisches Museum, Wien.

Herman, A.B. & Lebedev, E.L. 1991. Stratigrafiya i flora melovykh otlozhenii severo-zapadnoi Kamchatki (Stratigraphy and flora of the Cretaceous deposits of north-west Kamchatka). *Transactions of the Geological Institute, Academy of Sciences of the USSR 468*, 1–189.

Janetschke, N. & Wilmsen, M. 2014. Sequence stratigraphy of the lower Upper Cretaceous Elbtal Group (Cenomanian–Turonian of Saxony, Germany). *Zeitschrift der Deutschen Gesellschaft für Geowissenchaften 165*, 179–208. DOI 10.1127/1860-1804/2013/0036

Jud, N.A. & Hickey, L.J. 2013. *Potomacapnos apeleutheron* gen. et sp. nov., a new Early Cretaceous angiosperm from the Potomac Group and its implications for the evolution of eudicot leaf architecture. *American Journal of Botany 100(12)*, 2437–2449. DOI 10.3732/ajb.1300250

Knobloch, E. 1978. On some primitive Angiosperm leaves from the Upper Cretaceous of Bohemian Massif. *Palaeontographica, Abteilung B 166*, 83–98.

Knobloch, E. 1999. Neue oder wenig bekannte Pflanzenarten aus den Perucer Schichten (Cenoman) der Böhmischen Masse. *Acta Musei nationalis Pragae, Series B – historia naturalis 55(1–2)*, 25–60.

Knowlton, F.H. 1917. A fossil flora from the Frontier Formation of Southwestern Wyoming. *U.S. Geological Survey Professional Paper 108*, 73–94.

Krassilov, V.A. 1979. *Melovaya flora Sakhalina* (*The Cretaceous flora of Sakhalin*). 183 pp. Nauka, Moskva.

Krejčí, J. 1867. Zpráva odboru pro geologii pro rok 1865 a 1866. *Druhá roční zpráva o činnosti obou komitétů pro přírodovědecký výzkum země České roku 1865 a 1866*, 27–66.

Krejčí, J. 1869. Studien im Gebiete der böhmischen Kreideformation. I. Allgemeine und orographische Verhältnisse, sowie Gliederung der böhmischen Kreideformation. *Archiv für naturwissenschaftliche Landesdurchforschung von Böhmen 1*, 41–179.

Kvaček, J., Halamski, A.T., Svobodová, M. & Durska, E. 2015. Coniacian flora of the Sudetes (south-western Poland): Palaeoecological and palaeoclimatic interpretations. *Palaeogeography, Palaeoclimatology, Palaeoecology 436*, 178–187. DOI 10.1016/j.palaeo.2015.06.041

Kvaček, J. & Váchová, Z. 2006. Revision of platanoid foliage from the Cretaceous of the Czech Republic. *Journal of the National Museum, Natural History Series 175*, 77–89.

Kunzmann, L. 2010. *Geinitzia reichenbachii* (Geinitz, 1842) Hollick and Jeffrey, 1909 and *Sedites rabenhorstii* Geinitz, 1842 (Pinopsida; Late Cretaceous) reconsidered and redescribed. *Review of Palaeobotany and Palynology 159*, 123–140. DOI 10.1016/j.revpalbo.2009.11.006

Maslova, N.P. & Herman, A.B. 2015. Approach to identification of fossil angiosperm leaves: applicability and significance of Krassilov's morphological system. *Botanica Pacifica 4(2)*, 103–108. DOI 10.17581/bp.2015.04105

Maslova, N.P., Moiseeva, M.G., Herman, A.B. & Kvaček, J. 2005. Did plane trees exist in the Cretaceous? *Paleontological Journal 39*, 440–453.

Nádaskay, R. & Uličný, D. 2014. Genetic stratigraphy of Coniacian deltaic deposits of the northwestern part of the Bohemian Cretaceous Basin. *ZDGG, German Journal of Geosciences 165(4)*, 547–575.

Passalia, M.G., Llorens, M. & Páez, M. 2015. First megafloristic record for the Chubut Group at Somuncurá-Cañadón Asfalto Basin: An angiosperm dominated flora from the Upper Cretaceous Puesto Manuel Arce Formation, Patagonia Argentina. *Cretaceous Research 56*, 200–225. DOI 10.1016/j.cretres.2015.04.016

Petrescu, J. 1973. *Quercus pascui* n. sp. du Crétacé supérieur de Roumanie. *Bulletin mensuel de la Société linnéenne de Lyon 42(4)*, 35–37.

Potonié, R. 1900. Über die fossilen Filicales im allgemeinen und die Reste derselben zweifelhafter Verwandtschaft, 473–515. *In* Engler, A. (ed.) 1898–1902. *Die natürlichen Pflanzenfamilien, nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen. I. Teil, 4. Abteilung [Pteridophyta]*. Wilhelm Engelmann, Leipzig.

Samylina, V.A. 1984. Pozdnemelovaya flora r. Tap (severnoe Priokhot'e). *Ezhegodnik vsesoyuzhnogo paleontologicheskogo obshchestva 27*, 236–246.

Saporta, G. de 1865. Études sur la végétation du sud-est de la France à l'époque tertiaire. Deuxième partie. *Annales des Sciences naturelles, Botanique, 5^{e} série 3*, 5–152.

Saporta, G. de 1868. Prodrome d'une flore fossile des travertins anciens de Sézanne. *Mémoires de la Société géologique de France, 3^{e} série 8*, 289–436.

Soukup, J. 1955. Úprava stratigrafického členění a otázka hranice mezi turonem a senonem v české křídě. *Sborník Ústředního ústavu geologického 21(2)*, 633–673.

Soukup, J. 1963. Křídový útvar, 43–74. *In* Kopecký, L. (ed.) *Vysvětlivky k přehledné geologické mapě ČSSR 1 : 200 000, M-33-IX Děčín*. 176 pp. Nakladatelství Československé akademie věd, Praha.

Tschan, G.F., Denk, T. & Balthazar, M. 2008. Swedish *Credneria* and *Platanus* (Platanaceae) from the Late Cretaceous (Santonian) of Quedlinburg, Germany. *Review of Palaeobotany and Palynology 152*, 211–236. DOI 10.1016/j.revpalbo.2008.05.004

Valečka, J. 1979. Paleogeografie a litofaciální vývoj severozápadní části křídové pánve. *Sborník geologických věd, Geologie 33*, 47–88.

Velenovský, J. 1882. Die Flora der böhmischen Kreideformation. I. Theil. Credneriaceae und Araliaceae. *Beiträge zur Paläontologie Österreich-Ungarns 2(1)*, 8–32.

Velenovský, J. 1883. Die Flora der böhmischen Kreideformation. II. Theil. Proteaceae, Myricaceae, Cupuliferae, Moreae, Magnoliaceae, Bombaceae. *Beiträge zur Paläontologie Österreich-Ungarns 3(1)*, 26–47.

Velenovský, J. 1884. Die Flora der böhmischen Kreideformation. III. Theil. Laurineae, Ebenaceae, Verbenaceae, Magnoliaceae, Combretaceae, Sapindaceae, Camelliaceae, Ampelideae, Mimoseae, Caesalpineae, Araliaceae. *Beiträge zur Paläontologie Österreich-Ungarns 4(1)*, 26–47.

Velenovský, J. 1885a. Die Flora der böhmischen Kreideformation. IV. Theil. *Beiträge zur Paläontologie Österreich-Ungarns 5(1)*, 62–75.

Velenovský, J. 1885b. *Die Gymnospermen der böhmischen Kreideformation*. 34 pp. Ed. Grégr, Prag. DOI 10.5962/bhl.title.109999

Velenovský, J. 1888. Die Farne der böhmischen Kreideformation. *Abhandlungen der königlichen böhmischen Gesellschaft der Wissenschaften, VII. Folge 2*, 3–32.

Vera, E.I. & Passalia, M.G. 2012. *Korallipteris*, a new genus for Mesozoic *Gleichenia*-like fern fronds. *Geobios 45*, 421–428. DOI 10.1016/j.geobios.2011.09.002

Walaszczyk, I. & Cobban, W.A. 2007. Inoceramid fauna and biostratigraphy of the upper Middle Coniacian-lower Middle Santonian of the Pueblo Section (SE Colorado, US Western Interior). *Cretaceous Research 28(1)*, 132–142. DOI 10.1016/j.cretres.2006.05.024

Walaszczyk, I., Wood, C.J., Lees, J.A., Peryt, D., Voigt, S. & Wiese, F. 2010. The Salzgitter-Salder quarry (Lower Saxony, Germany) and Słupia Nadbrzeżna river cliff section (Central Poland): a proposed candidate composite global boundary stratotype section and point for the Coniacian stage (upper Cretaceous). *Acta Geologica Polonica 60(4)*, 445–477.

Wojewoda, J., Białek, D., Bucha, M., Głuszyński, A., Gotowała, R., Krawczewski, J. & Schutty, B. 2011. Geology of the Góry Stołowe National Park – selected issues, 1–198. *In* Chodak, T., Kabała, C., Kaszubkiewicz, J., Migoń, P. & Wojewoda, J. (eds) *Geoekologiczne warunki środowiska przyrodniczego Parku Narodowego Gór Stołowych*. WIND, Wrocław.