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Schenkiella genus novum, thorny disseminules of unknown affinities from the Lower Miocene of central Europe

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ABSTRACT. A new fossil genus *Schenkiella* Wójcicki & Z. Kvaček is installed to accommodate thorny/horny disseminules called "*Trapa*" *credneri* Schenk. This plant, *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček comb. nov., is an index fossil for the middle Early Miocene Floral Assemblage ("Florenkomplex") Bílina – Brandis sensu Mai of central Europe. It is distributed from the Most Basin, North Bohemia, to the north-western Saxonian peripheral basins, occurring only at a few localities. It is usually associated with aquatic vegetation in coal facies and may also represent an aquatic plant. Its systematic position remains uncertain. It is similar to disseminules called *Palaeotrapa triangulata* Golovneva from the Late Cretaceous (Maastricht) of the Russian Far East.

KEY WORDS: fossil fruits, *Trapa*, *Palaeotrapa*, new genus, new combination, neotypification, Neogene, Bohemia, Saxony, Russian Far East

INTRODUCTION

Contrary to vegetative organs, angiosperm fruits belong to the fossil remains, which usually reveal diagnostic characters important for tracing their systematic position and phylogeny of parent plants. Yet in many cases, the position of even disseminules of distinct morphology resists deciphering their nature and relationship. Those with thorny/horny surface have been usually assigned to the genus *Trapa* L. or *Hemitrapa* Miki (Trapaceae). Besides true remains of this family (e.g. Miki 1941, 1952 a, b, Vassilev 1954, Gregor 1982, Mai 1985, Wójcicki & Bajzáth 1997, Wójcicki & Zastawniak 1998, 2002, Wójcicki et al. 1999, Kovar-Eder & Wójcicki 2001, Wójcicki & Wilde 2001, Wójcicki & Kvaček 2002), several undoubtedly belong to different plant groups, e.g. "*Trapa*" *zapfei* Berger [= *Ceratostratiotes sinjanus* (Kerner) Bůžek forma *zapfei* (Berger) Bůžek (Bůžek 1982) = *Ceratostratiotes zapfei* (Berger) Gregor (Gregor 1980)] indicating another distinct type of thorny fossil fruits, as well as those treated herein and described as *Trapa credneri* by Schenk (1877). The latter is an index fossil of the middle Early Miocene Floral Assemblage ("Florenkomplex") Bílina – Brandis sensu Mai (1995). So far only very few localities in central Europe have yielded this plant, known only as disseminules (Fig. 1). Their nature has not been elucidated so far, yet no special study has been devoted to this subject requiring a broader comparative study. Kirchheimer (1937, 1957) was the first who expressed serious doubts about the correctness of the generic relationship of *Trapa credneri* to *Trapa*, a view later shared by several other authors.

The present paper is based on studies of new materials from the north-western Saxonian peripheral basins, Germany (Mai & Walther 1991), Bílina, Most Basin, Czech Republic (Bůžek et al. 1992, Kvaček 1998) and original material from Engelhardt and Menzel collections rediscovered in the Staatliche Sammlun-

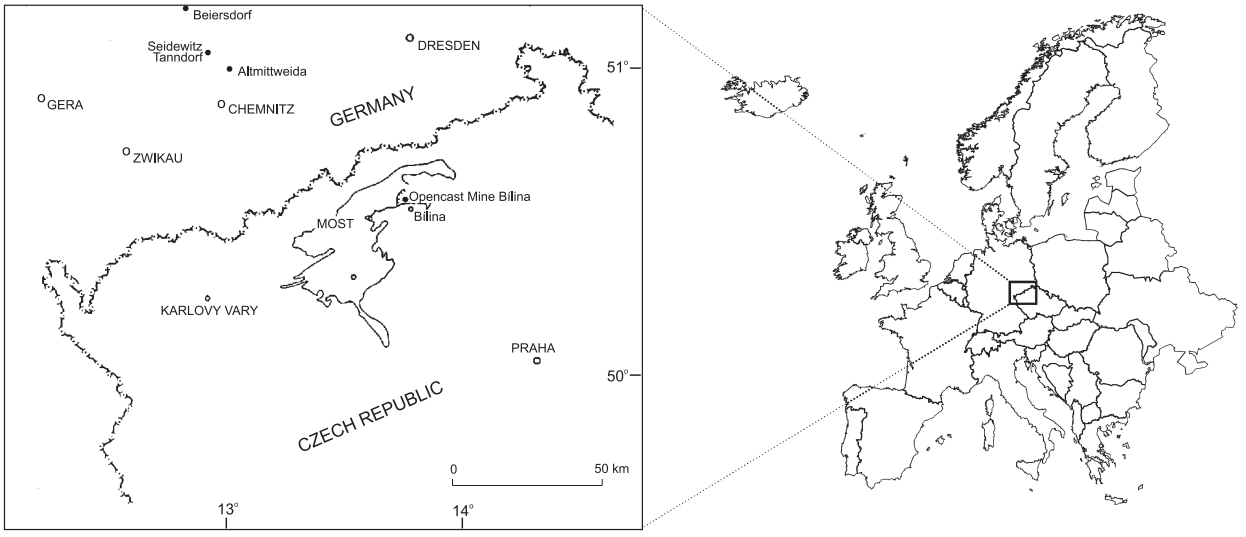


Fig. 1. Geographical position of the so far known localities of *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček gen. et comb. nov.

gen, Museum für Mineralogie und Geologie zu Dresden. It aims at re-studying this enigmatic fossil and attempts to newly circumscribe, typify and elucidate its affinities.

MATERIAL AND METHODS

Fruits of "*Trapa" credneri* have been available as impressions and carbonized compressions. The syntypes from Thümmlitzwald between Tanndorf and Seidewitz near Grimma in Saxony (Schenk 1877, 1890) are missing (Mai in Mai & Walther 1991), but the figured specimens from Mittweida (Beck 1882) and other parts of the peripheral basins (Mai & Walther 1991) are available in the collections of Bergakademie, Freiberg (GFE), Staatliche Sammlungen, Museum für Mineralogie und Geologie, Dresden (MMG) and Museum für Naturkunde, Humboldt University, Berlin (Mai coll.). The impression material from the Bílina area has been recovered in the Menzel collection (MMG – Břešťany/Preschen) and new numerous specimens are available from the Open-cast Mine Bílina (former Maxim Gorkij) in the collections of the Bílina Mines (DB), National Museum, Praha (NM) and Charles University, Faculty of Science, Praha.

The photographic documentation was done using Kodak Academy (200 ASA) film, a Minolta X700 camera with 1:1 Kenko converter and Minolta Rokkor-X 50 mm lens.

PREVIOUS INTERPRETATIONS OF "*TRAPA*" *CREDNERI*

Already Schenk (1877), who brought anatomical details of the endocarp, stressed the aberrant position of his *Trapa credneri* within the Trapaceae: "Wenn nun aus der Untersuchung von *Trapa Credneri* sich ergibt, das sie einer Gattung der Trapeen oder einer Abteilung der Gattung *Trapa* angehört, welche ausgestorben ist, ihre Nachkommen nur durch ihre Form, nicht aber durch ihre Struktur die Abstammung von der Art der Tertiärzeit verrathen..." This view survived (Beck 1882, Menzel 1906, Gams 1926, Kirchheimer 1937). Kirchheimer (1957) definitely excluded this plant fossil from this genus on account of only three horns and different symmetry of the fruits as well as differences in anatomical structure of the endocarp (see also Němejc 1975, Mai in Mai & Walther 1991, Gregor & Mehl 1987 – anatomy of *Trapa*).

It should be noted that primarily according to Schenk (1877), *Trapa credneri* was characterized by having two horns, as he expressed in the original Latin diagnosis (*Trapa Credneri achenia cornubus duobus ornata, cornua oposita, recta horizontaliter patentia acuta*) and German description of the species. Later, being influenced by Beck (1882) who proposed the first correct reconstruction of the fruit, Schenk (1890) corrected his opinion and reported, without a special discussion, that the fruits of *T. credneri* bear three horns.

According to Schenk (1877) his *T. credneri* should be closely related to the "bicornis" *Trapa* species. He assumed that characteristic porous (alveolate) surface of the fruit is probably related to the climatic conditions in the

Miocene. This opinion, however, is not supported by fossil material both of *Trapa* and *Hemitrapa* because in representatives of both these genera the surface of the endocarp is smooth. Also no extant taxon is known to date to possess such a porous surface of the fruits. Hence, an attribution of the fossils in question to *Trapa* is no more valid. To avoid misunderstandings about the affinities of "*Trapa*" *credneri*, a new fossil genus is to be created.

Angiospermae
ordo & family indeterminate

Schenkiella Wójcicki & Z. Kvaček **gen. nov.**

Type (designated here): *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček comb. nov. = *Trapa credneri* Schenk (Figs 2–4).

Diagnosis. Fruit obtrullate in outline, 10–15 mm long from the base to the apex and 8–14 mm broad along horns (measured on compression/impression), three-plane symmetrical, with three equal stout short divergent horns thickened on edges and sharpened to a point, inserted in ca. 2/3 from the fruit base and passing towards the fruit base into three protruding longitudinal ribs; fruit body between the ribs slightly depressed; apical aperture closed with conical to shallowly conical cap-like structure; endocarp covered by probably leathery covering; surface of endocarp characteristically finely alveolate (secondarily porous); fruit base acute, sometimes slightly truncate, probably with a very small scar.

Derivation of the name. This monospecific genus based on fossil fruits with doubtful affinities is named in honour of the German botanist and palaeobotanist Joseph August Schenk (17 April 1815 – 30 March 1891), the author of the species.

Schenkiella credneri (Schenk) Wójcicki & Z. Kvaček **comb. nov.**

Figs 2–5

1877 *Trapa credneri* Schenk sp. nov.; Schenk, p. 396–398, 402, Pl. 4, figs 3–4.
1882 *Trapa credneri* Schenk; Beck, p. 765, Pl. 32, fig. 21.
1890 *Trapa credneri* Schenk; Schenk in Zittel, p. 632, Fig. 345.11.
1909 *Trapa credneri* Schenk; Gothan, p. 925, Fig. 100/1.
1921 *Trapa credneri* Schenk; Menzel, p. 395, Fig. 316/1–2.
1926 *Trapa credneri* Schenk; Gams, p. 883, Fig. 2262c.
1937 *Trapa credneri* Schenk; Kirchheimer, p. 86.
1950 *Trapa credneri* Schenk; Bubnoff, p. 540, Pl. 58, fig. 16.
1957 *Trapa credneri* Schenk; Kirchheimer, p. 327, 437.
1962 *Trapa credneri* Schenk; Pietzsch, p. 459.
1983 "*Trapa*" *credneri* Schenk; Mai & Walther, p. 74.
1991 "*Trapa*" *credneri* Schenk; Mai in Mai & Walther, p. 144, Pl. 18, figs 11–14.
1992 "*Trapa*" *credneri* Schenk; Bůžek et al., p. 125, Pl. 2, fig. 5.
1998 "*Trapa*" *credneri* Schenk; Kvaček, p. 116, Pl. 2, fig. 3.

Neotype (designated here). Staatliche Sammlungen, Museum für Mineralogie und Geologie, Dresden (Engelhardt coll. file No. Sei 3), illustrated in Figs 2, 3a and 4a, b. Seidewitz, coal mine of the Thümmlitzwald.

Further material. Open-cast Mine Bílina: National Museum, Prague, coll. file Nos G 7796–7815a, G 7817–7821, G 7824–7836, G 7841–7843, G 7847–7852a, G 7853a, G 7918; Headquarters of the Bílina Mine, coll. file Nos DB 21-10 to 21-23, DB 24-8 and 9 (and several specimens, s.n., from horizons 2, 21, 24, 30 and 52); Charles University, Faculty of Science, Prague, s.n. (about 5 specimens). Břešťany/Preschen: Staatliche Sammlungen, Museum für Mineralogie und Geologie, Dresden, Menzel coll. file No. Bn 415. Seidewitz: Staatliche Sammlungen, Museum für Mineralogie und

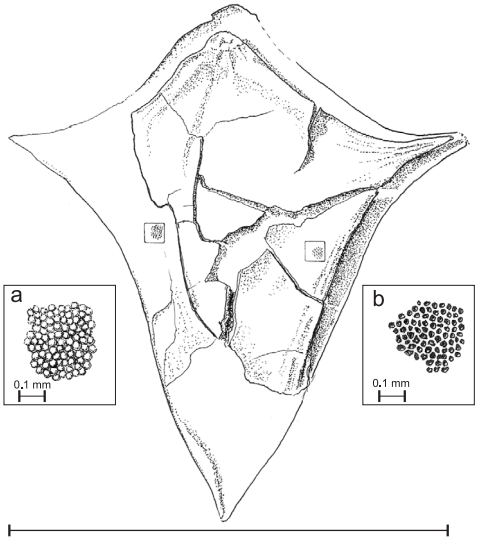


Fig. 2. *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček gen. et comb. nov. – neotype of *Trapa credneri* Schenk (Engelhardt coll., MMG coll. No. Sei 3). **a** – impression of surface of endocarp, **b** – surface of endocarp. Scale bar 1 cm

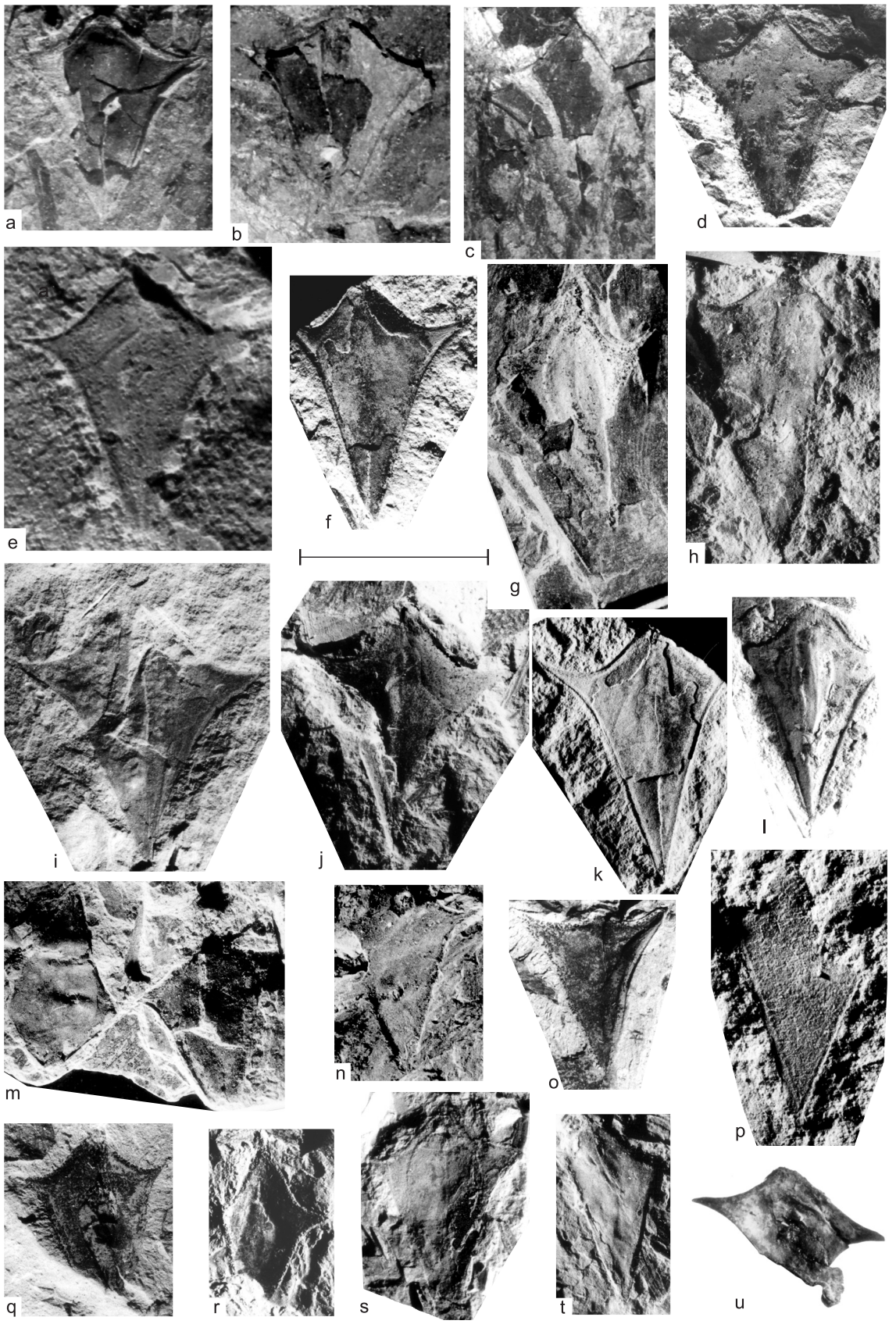
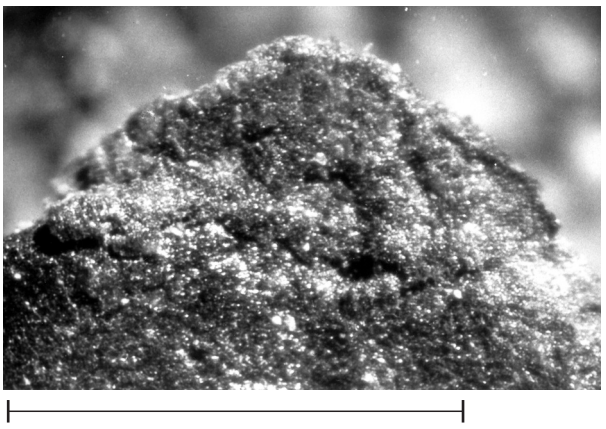


Fig. 3. *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček gen. et comb. nov. Seidewitz: **a** – neotype, Engelhardt coll., MMG No. Sei 3, **b** – Engelhardt coll., MMG No. Sei 2; **c** – Engelhardt coll., MMG No. Sei 1; Bílina: **d** – DB No. 21-10; Preschen (Břešťany): **e** – Menzel coll., MMG No. Bn 415; Bílina: **f** – DB No. 21-13, **g** – DB No. 21-20, **h** – DB No. 21-22, **i** – DB No. 24-9, **j** – DB No. 21-15, **k** – DB No. 21-11, **l** – DB No. 21-16, **m** – DB No. 21-21, **n** – DB No. 21-18, **o** – DB No. 21-17, **p** – DB No. 24-8, **q** – DB No. 21-19, **r** – DB No. 21-12, **s** – DB No. 21-14, **t** – DB No. 21-23, **u** – compression of complete endocarp, NM No. G 7918. Scale bar 1 cm

a



b

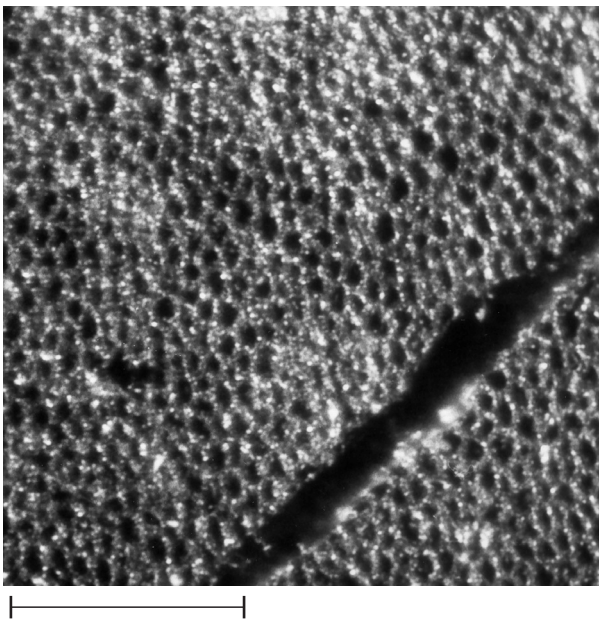


Fig. 4. *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček gen. et comb. nov. fruits. **a** – apical cup-like structure (scale bar 1 cm), **b** – surface of endocarp; (scale bar 0.5 mm) (Engelhardt coll., MMG No. Sei 3)

Geologie, Dresden, Engelhardt coll. file Nos Sei 1, 2.

Neotypification. Because all syntypes described by Schenk (1877) from Tümmlitzwald (presently Thümmlitzwald) near Tanndorf and transferred to the collections of the Botanical Institute of the University of Leipzig (see Kirchheimer 1957) are missing at the moment (cf. Mai in Mai & Walther 1991) a neotype should be installed, in accordance with Art. 9.6 of ICBN (Greuter et al. 2000). The neotype is selected here from three specimens rediscovered in the original Engelhardt's collection housed in the Museum für Mineralogie und Geologie in Dresden. This material was collected from the neighbourhood of Seidewitz (as indicated on the label) from the same stratum as that described by Schenk (1877) from Thümmlitzwald. The coal mines of Thümmlitzwald were situated between Tanndorf and Seidewitz and it is very probable that the specimens from the Engelhardt's collection have been used by Schenk (1877) for figures given in the species protologue (D.H. Mai pers. comm.).

CHARACTARISTICS, OCCURRENCES AND ASSOCIATED VEGETATION

The characteristics given in the generic diagnosis of *Schenkiella* fully applies to the only species. Fruits of *Schenkiella credneri* are not too variable and variation concerns mainly the fruit size. Some other shape variability observed is in our opinion due to fossilisation. From the material studied it is evident that it bears three horns what is well seen in the specimen no. NM G 7918 from Bílina (Fig. 3u). This specimen is also important, because it shows also characters of a fruit (not a seed). There is a small fragment of a more or less smooth probably leathery covering peeling off the surface, which we interpret as the epicarp. A thin mesocarp can be expected between this layer and the typically sculptured endocarp body. The present studies of abundant, variously preserved material permit a new, more objective three-dimensional reconstruction of the extinct species (Fig. 5).

Schenkiella crenderi has been known so far from three areas in north-western Saxony, Germany, and one in North Bohemia (Fig. 1). It seems to be endemic to the Lower Miocene of central Europe. The different populations are not distinguishable from each other (Fig. 3).

NORTH-WESTERN SAXONY

Thümmlitzwald near Tanndorf (type locality) and Seidewitz (to be treated as the same locality) – the flora includes only a limited number of plant elements preserved in coal clay (Mai & Walther 1991, partly corrected): *Schenkiella credneri* together with *Salvinia reussii, Daphnogene cinnamomifolia, Laurophyllum* sp., *Salix varians, Myrica integerrima, Nyssa ornithobroma, Spirematospermum wetzleri, Typha* sp., Monocotyledonae.

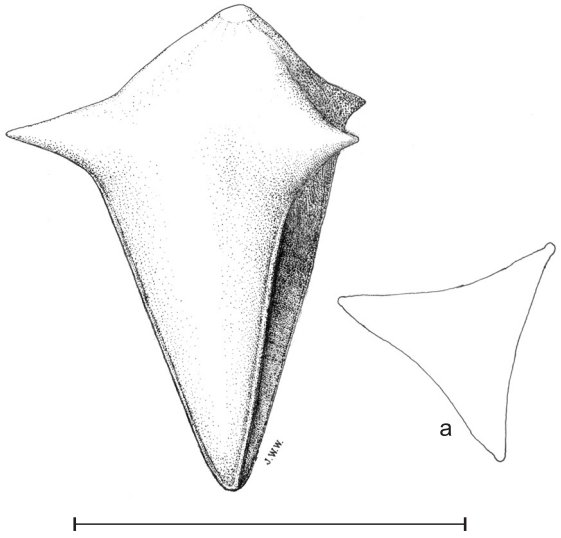


Fig. 5. Reconstruction of *Schenkiella credneri* (Schenk) Wójcicki & Z. Kvaček gen. et comb. nov. fruit. a – outline probable of cross section. Scale bar 1 cm

The reconstructed plant cover corresponds to aquatic free-floating and rooting herbaceous vegetation intermixed with broad-leaved swamp forest with shrubby undergrowth (hammocks).

Altmittweida – the flora was shortly described and only partly revised (Beck 1882, Mai & Walther 1991, partly corrected): rare *Schenkiella credneri* together with *Salvinia reussii, Woodwardia muensteriana, Blechnum dentatum, Glyptostrobus europaeus, Alnus julianiformis, Carya ventricosa, Myrica integerrima, Dombeyopsis lobata, Vaccinioides lusatica, Salix varians, Populus populina, Nyssa ornithobroma, Koelreuteria margaritifera, Acer tricuspidatum, Calamus daemonorhops, Caricoidea jugata*. The vegetation may be interpreted as a mixed taxodiaceous and broad-leaved deciduous swamp forest with fern, palm and ericaceous undergrowth, intermixed with patches of aquatic vegetation on free water table.

Beiersdorf – Seelingstadt – Altenhain (Pietzsch 1962, Mai & Walther 1991, partly corrected) – florula with *Schenkiella credneri, Quasisequoia couttsiae, Calamus daemonorhops, Spirematospermum wetzleri* corresponding to aquatic/swamp vegetation within the taxodiaceous swamp forest.

NORTH BOHEMIA

Břešťany/Preschen – the flora was embedded in a ceramic clay just above the delta facies overlying the main coal seam, now largely removed by mining activity of the Bílina Mine (Mai & Walther 1991, Boulter et al. 1993, Knobloch & Kvaček 1995, corrected): a single specimen of *Schenkiella credneri* associated with a very diversified assemblage dominated by *Glyptostrobus europaeus, Taxodium dubium, Quasisequoia couttsiae, Pinus engelhardtii/Pinus rigios, Daphnogene polymorpha, Laurophyllum pseudoprinceps, Cercidiphyllum crenatum, Liquidambar europaea, Alnus julianiformis, Quercus rhenana, Trigonobalanopsis rhamnoides, Ulmus pyramidalis, Zelkova zelkovifolia, Comptonia difformis, Myrica lignitum, Engelhardia macroptera/E. orsbergensis, Craigia bronnii/Dombeyopsis lobata, Podocarpium podocarpum, Nyssa haidingeri, Acer tricuspidatum, Fraxinus bilinica, Sabal major* and many other broad-leaved woody plants. Vegetation reconstruction reflects a mixture of the taxodiaceous and broad-leaved swamp forest and mixed mesophytic pine and evergreen oak-laurel forest on oligotrophic substrates.

Bílina Mine – horizons 21 and 24 were clay lenses within sandy delta deposits rich in aquatic plants (Bůžek et al. 1992, Kvaček 1998, in press): abundant remains of *Schenkiella credneri* together with *Salvinia reussii, Azolla* sp., *Limnobiophyllum expansum, Zingiberoideophyllum liblarense,* Monocotyledonae. The assemblage is connected with the richest representation of *Schenkiella* in Europe and reflects free-floating and partly rooting aquatic vegetation dominated by *Salvinia* mats.

M. Gorkij Mine (now known as the Bílina Mine) – roof of the main coal seam included beds of carbonized leaf compressions (Kvaček & Holý 1974): a single compression of *Schenkiella credneri* with foliage of *Taxodium dubium, Glyptostrobus europaeus, Alnus julianiformis, Betula* sp., *Nyssa haidingeri, Ulmus pyramidalis, Salix varians, Acer tricuspidatum*. The assemblage is similar to a riparian swamp forest with taxodioid and deciduous broad-leaved trees.

DISCUSSION AND CONCLUSIONS

Schenkiella is a well-defined extinct genus, represented by only one known species *S. credneri*. Its affinity to the known fossil and extant families remains doubtful. It resembles some-

how Trapaceae, e.g. in the shape and presence of horns, but fruits of this family differ dramatically in symmetry, sculpture and anatomy (Schenk 1877, 1890, Beck 1882).

In gross morphology *Schenkiella crednerii* shows some similarity to another extinct species of doubtful affinity, *Palaeotrapa triangulata*, described by Golovneva (1991, 1994) on the basis of a single collection from the Late Cretaceous correlated to the Maastricht (Rarytskaya svita) of the Koryak Upland, north-easternmost Russia. Like in *Schenkiella crednerii*, the fruit of *Palaeotrapa triangulata* is obtrullate in outline, with protruding ribs and horns located in 2/3 from its base or above. On the surface of some specimens a sculpture slightly resembling that in *S. credneri* is also visible, and on at least two specimens of *P. triangulata* (palaeobotanical collection of the Botanical Institute RASc., St. Petersburg, coll. No. 967A/562 and 566) traces of probable additional third horn are marked. We doubt that *P. triangulata* is congeneric with two other species of *Palaeotrapa* described by Golovneva (1991). Unfortunately, it is hard to deduce from poorly preserved available impressions whether the fruit bears two, three or four horns (personal observation JJW). Despite of obvious differences concerning presence of e.g. elongated pedunculate base, probably small neck and relatively long horns, it is suggestive that *S. crednerii* and *P. triangulata* share some morphological characteristics and *P. triangulata* might be seen as an ancestral taxon to *S. credneri* (of the same evolutionary lineage ?). However, convergent morphology of the disseminules is also not excluded.

A similar case of related taxa from the Palaeogene of the Russian Far East and the Neogene of Europe is known in e.g. *Limnobiophyllum* Krassilov (Kvaček 1995, Stockey et al. 1997), what makes speculation on close relations of *Schenkiella credneri* and *Palaeotrapa triangulata* even more probable.

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