

Hemitrapa fruits (Trapaceae) in the late Early Miocene Lom Coal Seam, Most Formation, North Bohemia

JAN J. WÓJCICKI¹ and ZLATKO KVAČEK²

¹W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, 31-512 Kraków, Poland;
e-mail: wojcicki@ib.pan.krakow.pl

²Charles University, Faculty of Science, Albertov 6, 128 43 Praha 2, Czech Republic; e-mail: kvacek@natur.cuni.cz

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ABSTRACT. Fruits of *Hemitrapa heissigii* Gregor (Trapaceae) have been recognized in the weathered Lom Coal Seam in the northern part of the Most Basin, North Bohemia. This is one of earliest records of this species in Eurasia. The fossil-bearing level is assumed to be of late Early Miocene age (approximately late Eggenburgian to Karpatian of the Paratethys regional stratigraphy). All the other megafossils from the Most Basin, which have been determined as belonging to *Trapa*, are either poorly preserved, not determinable to the generic level, or not belonging to the Trapaceae.

KEY WORDS: fossil fruit, *Hemitrapa*, morphology, Neogene, Most Formation, Czech Republic, Eurasia

INTRODUCTION

Hemitrapa Miki and *Trapa* L. fruits (Trapaceae) were widely distributed in the late Cenozoic of Eurasia and were under revisions of the first author (e.g. Wójcicki & Bajzath 1997, Wójcicki & Zastawniak 1998, 2002, Wójcicki et al. 1999, Kovar-Eder & Wójcicki 2001, Wójcicki & Wilde 2001, Kovar-Eder et al. 2002). One of the earliest records was reported from the Lower Miocene of the Most Basin as *Trapa silesiaca* Goeppert by Hurník (1961). Because this species, according to the current knowledge (Wójcicki & Zastawniak 2002) occurred in Europe mainly in the Upper Miocene, the record from the Lower Miocene seemed to be an anomaly and should be re-investigated. This is the aim of the present paper. Fortunately, all the specimens collected by Hurník are available. Besides this record, only one similar but poorly preserved fruit compression seen from the base from the Most Formation (the former open-cast mine Ležáky, Most) was discovered by Hurník since (Figs 1, 2). In some morphology it resembles *Hemitrapa* but does not show distinct characters to be deter-

mined to the generic and species level more precisely. The specimen was recovered in yellowish grey clay about 10 m above the roof of the main coal seam. The spiny fruits from aquatic plant horizons in the Bílina area, which

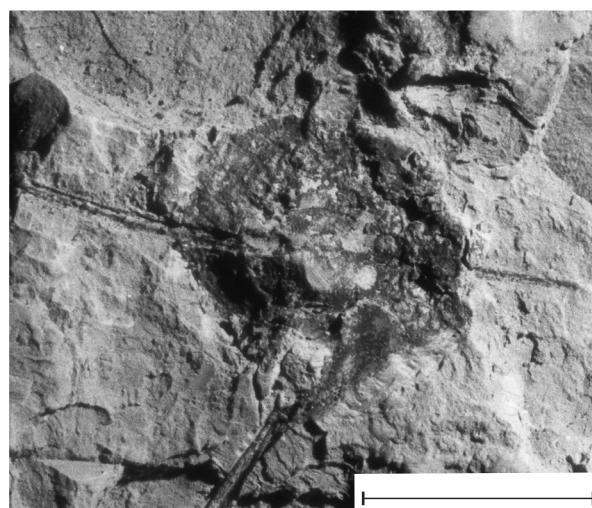


Fig. 1. Compression/impression of cf. *Hemitrapa* from the former open-cast mine Ležáky, Most (coll. S. Hurník, Regional Museum, Most, No. 9/pa 351). Scale bar 1 cm

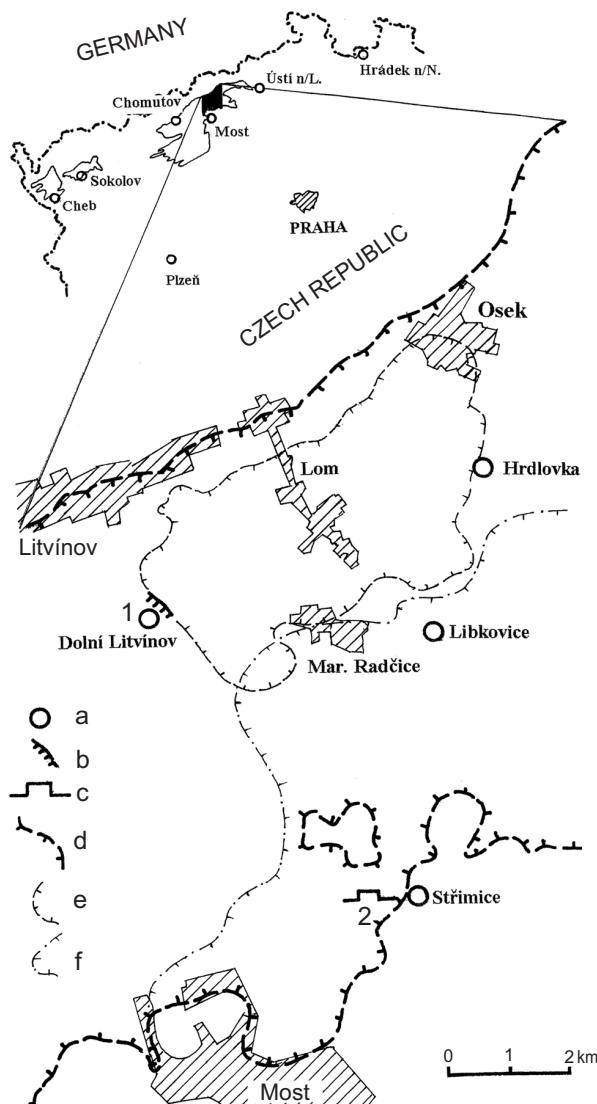


Fig. 2. Geographic position of the site of *Hemitrapa heissigii* Gregor at the former village Dolní Litvínov in the Most Basin, N Bohemia, Czech Republic. **a** – villages removed by mining activity, **b** – the site of *Hemitrapa heissigii* at Dolní Litvínov (1), **c** – the site of cf. *Hemitrapa* in the former open-cast mine Ležáky, Most (2), **d** – outcrop line of the main coal seam, **e** – outcrop line of the Lom seam, **f** – extent of the Bílina delta

were referred to *Trapa credneri* Schenk (Búžek et al. 1992), come also from the coaly-sandy deposits above the main coal seam. They do not belong to the Trapaceae and represent a new genus *Schenkiella* Wójcicki & Z. Kvaček of unknown affinities (Wójcicki & Kvaček 2002). The single leaf from the Pětipsy area of the Most Formation, determined as *Trapa* sp. (Búžek 1971), does not belong to this genus. The marginal teeth lack characteristic terminal double mucros, which are diagnostic of *Trapa* foliage (cf. McIver & Basinger 1993: 45, Stockey & Rothwell 1997, Kovar-Eder et al. 2002). Similar leaf fossils occur also in the al-

luvial facies of sandy-clay lenses in the Bílina Mine (second author personal observation, coll. Dvořák, Bílina Mine).

MATERIAL AND METHODS

All the material collected by Hurník in 1958, comprising about 15 impressions of fruits, has been available for the present study including the two specimens figured by Hurník (1961). The fruit impressions are devoid of coal matter and their features are mostly poorly preserved, of low contrast. They all occurred in a single layer of weathered thinly bedded light brown clayish coal of the Lom Seam near the former village of Dolní Litvínov at longitude 13°37'00"E and latitude 50°37'00"N (Fig. 2), now covered by the Růžodoly refuse dump. According to Hurník (pers. comm.) in 1958 the lower part of the Lom Seam was accessible in an artificial outcrop exposed by digging of an earth cut behind the former stables of the agricultural co-operative. The outcrop was composed of interchanging thin sandy clay inter-beds and weathered coal seamlets, one containing the fruits. The fruits occurred associated only with fragments of monocotyledonous strap-shaped foliage and rhizomes.

The Lom Seam complex consists of up to 11 seamlets and is developed only in a limited area in the central, deepest part of the Most Basin in broader environs of Lom (Elznic 1966). Coal of the Lom Seam is of poor quality and the seam complex attains usually not more than 3 m in thickness. It is situated high above the Main Seam of the Most Basin. According to the floristic correlation (Búžek et al. in Klomínský 1994) its age was estimated as late Early Miocene (late Egenburgian to Ottangian of the Paratethys regional stratigraphy). The palaeomagnetostratigraphy (Bucha et al. 1987) assumed still younger age (Badenian), which was not corroborated by other means of independent dating. Because the earliest known record of *Hemitrapa heissigii* from Bavaria is dated to Karpatian/early Badenian (MN 5, Rauscheröd – see discussion below), the latter dating seems now more acceptable from the point of view of the palaeofloristic correlation.

The photographic documentation was done by the first author using Kodak Academy (200 ASA) film, a Minolta X700 camera with 1:1 Kenko converter and Minolta Rokkor-X 50 mm lens. The contrast was enhanced by a very low angle of light. The specimens studied are housed in the Regional Museum, Most and National Museum, Prague (material partly figured by Hurník 1961). Besides, experience from the study of several fossil records of the Trapaceae including the material from Austria (Naturhistorisches Museum, Wien), France (Muséum National d'Histoire Naturelle, Service de Paléobotanique, Paris; Musée d'Histoire Naturelle Henri Lecoq, Clermont-Ferrand), Germany (Museum für Naturkunde, Berlin; Paläontologisches Museum, München; Institut für Paläontologie, Universität Würzburg) and the topotypic material of *Hemitrapa* from Japan (Natural Science Museum, Tokyo) has been employed for comparison and determination.

SYSTEMATIC PART

Trapaceae Doum. nom. cons.

Hemitrapa Miki

Hemitrapa heissigii Gregor

Figs 3–4

- 1961 *Trapa silesiaca* Goepp.; Hurník, p. 200, Pl. 37, figs 1–3.
- 1980 *Trapa silesiaca* Goepp.; Gregor, p. 36, Pl. 11, figs 9, 10.
- 1982a *Hemitrapa heissigii* Gregor sp. nov.; Gregor, p. 353, Fig. 3K–V, a–e, Pl. 13–15.
- 1982b *Hemitrapa heissigii* Gregor; Gregor, p. 117, Fig. 8, Pl. 9, figs 1–9.
- 1983 *Hemitrapa heissigii* Gregor; Schmid & Gregor, p. 51, Pl. 2, fig. 2, Pl. 3, figs 6–8.
- 1983 *Hemitrapa heissigii* Gregor; Gregor & Schmid, p. 63, Pl. 1–3.
- 1986 *Hemitrapa heissigii* Gregor; Gregor, p. 57, Pl. 3, fig. 5.
- 1997 *Hemitrapa heissigii* Gregor; Riederle & Gregor, p. 13, Pl. 3, fig. 5–7.
- 1997 *Hemitrapa heissigii* Gregor; Schmitt & Butzmann, p. 62, Fig. 2, Pl. 4, figs 1a–b, 14, 15b.
- 1997 *Hemitrapa heissigii* Gregor; Riederle, p. 108.

Material. Regional Museum, Most, Czech Republic, coll. file Nos 9/pa 351, 351a–l (13 specimens; 9/pa 351i = Hurník 1961: Pl. 37, fig. 1); National Museum, Prague, coll. file Nos G 7916 (= Hurník 1961: Pl. 38, figs 2, 3), G 7917.

Description. Impressions of fruits somehow obtrullate in outline, from 20 to more than 30 mm high including conically-pointing apical bristles closing apical aperture approximately as long as the neck; fruit base mostly acute in outline, with adhering stalk fragments at least up to 8 mm length; fruit with well-defined head, up to 10 mm high (some-

time about 25 mm), usually slightly narrowed into up to 8 mm long, conical to subconical neck; surface of fruit head and neck finely ribbed; frame of the fruit usually well pronounced, with two pairs of ascending (50° – 75°) relatively slender arms, more than 15 mm long, gradually broadening towards the base, inserted approximately in 2/3 from the fruit base, armed apically with retrorsely barbed harpoons; one pair of arms probably somewhat shorter and inserted slightly below the line joining the bases of longer arms; presence of at least small tubercles on the fruit frame between arms very probable; the fruits are broadest (approximately 16 mm or more) in the line of their frame; surface of the lower part of the fruit body covered with a few slightly protruding longitudinal ribs.

DISCUSSION

The specimens from Dolní Litvínov collected by Hurník (1961) and originally determined as *Trapa silesiaca* Goepp. evidently differ from that species erected for Late Miocene material from Sośnica in SW Poland (Goeppert 1855, Wójcicki & Zastawniak 2002). They are characteristic of the extinct genus *Hemitrapa* described by Miki (1941) from Neogene of Japan distributed in Eurasia (e.g. Boulay 1899, Miki 1952, 1959, Vassilev 1954, Kornilova 1960, Tanai 1961, Tanai & Suzuki 1963, Gregor 1982a, b, Mai 1985, Mai & Walther 1991, Wójcicki et al. 1999, Uemura et al. 2001, Kovar-Eder et al. 2002) and Alaska in North America (Heer 1869). This is the first evidence of *Hemitrapa* representative from the Neogene of the Czech Republic.

The fruit impressions from Dolní Litvínov are poorly preserved but they bear most of characteristics that permit their more precise determination. Characteristic combination of characters as: somehow obtrullate fruits in outline with conically-pointing apical bristles, acute to somewhat rounded in outline fruit base with adhering stalk, well-defined relatively short head, usually narrowed into conical to subconical neck, well pronounced frame of fruit, with two pairs of ascending arms gradually broadening towards the base, inserted in ca. 3/4 from the fruit base, and probable presence of at least small tubercles on the fruit frame between arms, place them in

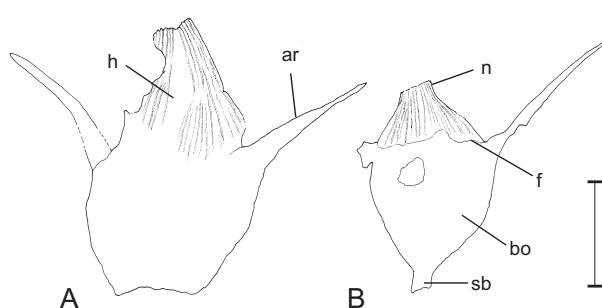


Fig. 3. *Hemitrapa heissigii* Gregor from the Most Basin. **A** – coll. Nos 9/pa 351a (= Fig. 4a), **B** – coll. Nos 9/pa 351b (= Fig. 4b); **ar** – arm, **bo** – body, **f** – frame, **h** – head, **n** – neck, **sb** – stalked base. Scale bar 1 cm

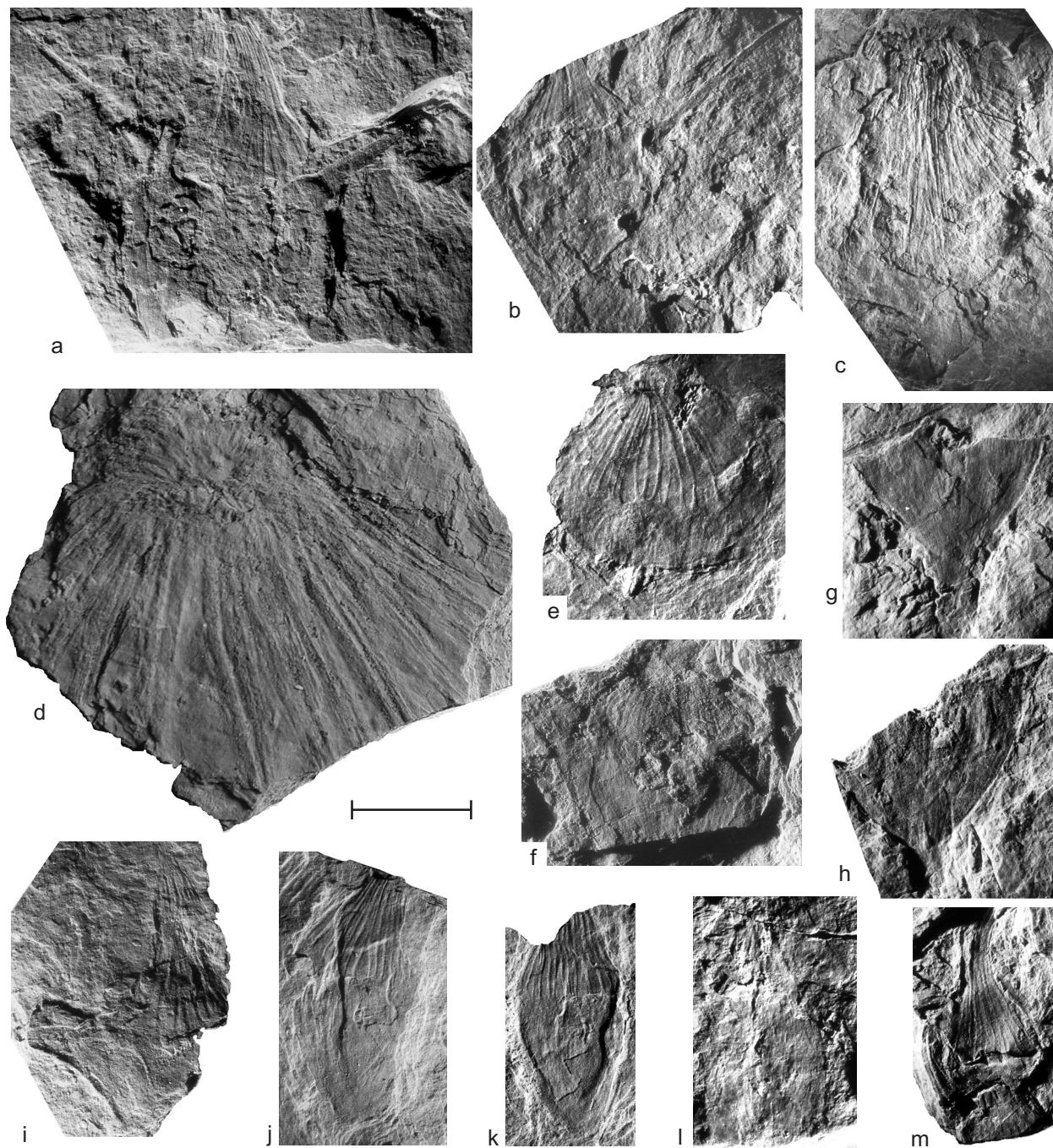


Fig. 4. *Hemitrapa heissigii* Gregor from the Most Basin (all coll. S. Hurník; **a-c, e-m** – Regional Museum, Most; **d** – National Museum, Prague). **a** – impression of a more complete fruit, No. 9/pa 351a (= Fig. 3a); **b** – impression of almost complete fruit, No. 9/pa 351b (= Fig. 3b); **c** – impression of almost complete fruit head with well pronounced neck, No. 9/pa 351c; **d** – impression of fruit fragment obliquely from the apex showing finely ribbed head and apical aperture, No. G 7917; **e** – specimen slightly obliquely from the apex showing the fruit head framed, No. 9/pa 351h; **f** – No. 9/pa 351i (= Hurník 1961: Pl. 37, fig. 1); **g-h** – fragments of stalked fruit bases (Nos 9/pa 351k and 351l, respectively); **i** – No. 9/pa 351d; **j** – No. 9/pa 351e; **k** – No. 9/pa 351f; **l** – No. 9/pa 351j; **m** – No. 9/pa 351g. Scale bar 1 cm

Hemitrapa heissigii Gregor. This species was originally described from Eberstetten near Pfaffenhofen in Bavaria (Gregor 1982a) and includes assemblages from another localities of southern Germany as e.g. Gallenbach (Schmid & Gregor 1983, Gregor & Schmid 1983), Kirrberg (Riederle & Gregor 1997), En-

trischenbrunn (Schmitt & Butzmann 1997), Ursberg (Riederle 1997), Rauscheröd (Gregor 1982a, 1986), correlated to the late Early Miocene / Middle Miocene – MN5 & 6 (Böhme et al. 2002, Kovar-Eder et al. 2002). The fossil fruits from the Czech locality are variable in size (Fig. 4a–m) and are especially similar in

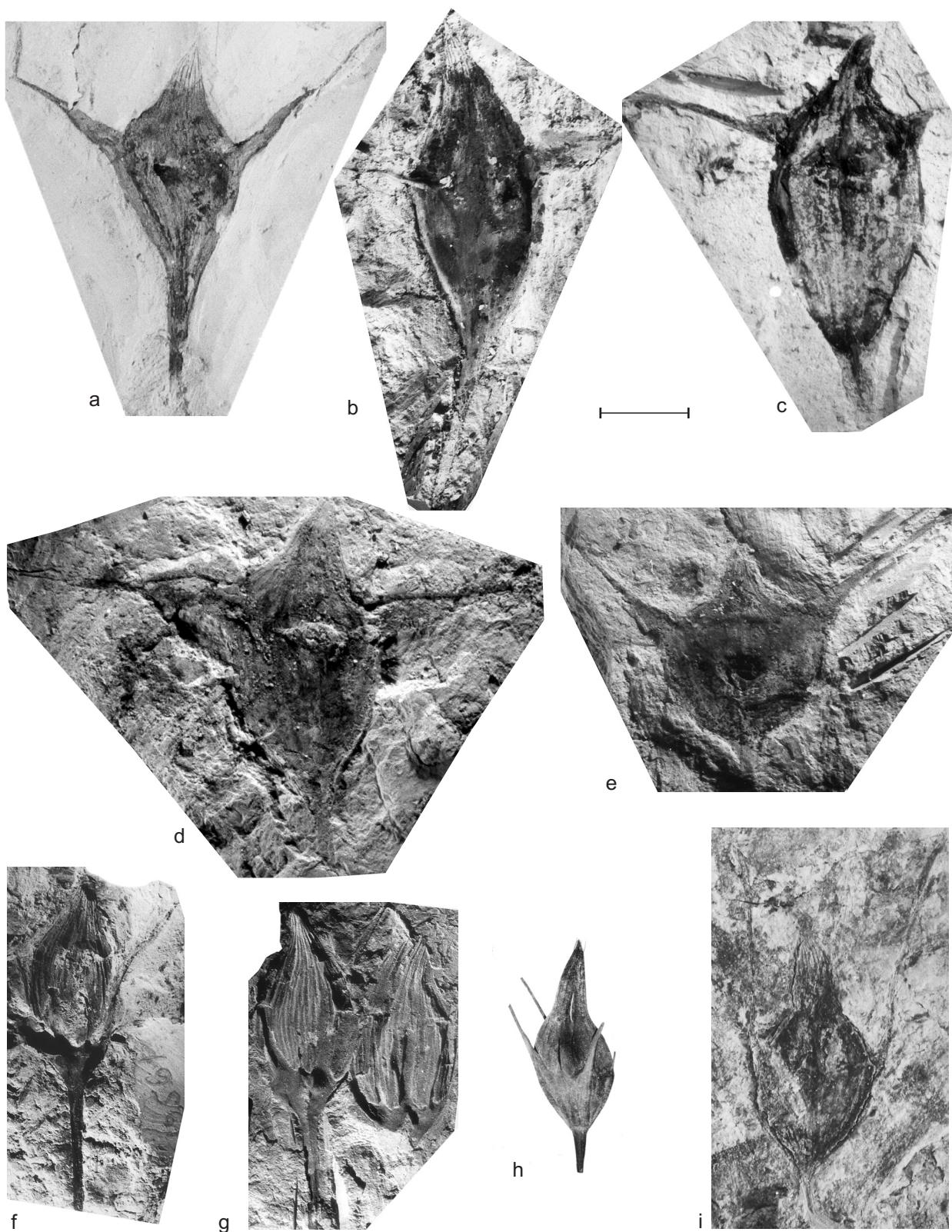


Fig. 5. **a–e** – *Hemitrapa heissigii* Gregor. Palaeobotanical collection of the Paläontologisches Museum, München, coll. W. Jung: **a** – holotype, Eberstetten, coll. No. 1972 XII 11, **b** – paratype, Haag, coll. No. 1979 XV 2), **c** – paratype, Rauscheröd, coll. No. 1979 XV 16, **d** – paratype, Eberstetten, coll. No. 1972 XII 13, **e** – paratype, Eberstetten, coll. No. 1972 XII 16; **f–g** – *Hemitrapa pomelii* (Saporta) Mai from Gergovie, Puy-de-Dome (Collection Saporta, Muséum National d'Histoire Naturelle, Paris): **f** – syntype of *Trapa pomelii* Saporta ex Boulay (= *Carpolithes pomelii* Saporta, nom. nud.), No. 12561, **g** – s.n., s.coll.; **h–i** – *Hemitrapa trapelloidea* Miki: **h** – topotype from the Seto Porcelain Clay Formation of Akazu mine, Seto City, Aichi Prefecture, Central Honshu, Japan, coll. K. Uemura 1980, s.n., Natural Science Museum, Tokyo, Japan, **i** – imprints from Pellendorf, Austria, the palaeobotanical collection of the Naturhistorisches Museum Wien, coll. J.Kovar-Eder, No. 2000B0008/1, 2. Scale bar 1 cm

the shape to these of Rauscheröd (Fig. 5c), the oldest known so far *H. heissigii* of the Karpatian / Early Badenian (the mammal Neogene zone MN5 – Böhme et al. 2002, Kovar-Eder et al. 2002). It should be stressed, however, that great morphological variability of fruits included into *H. heissigii* (Fig. 5a–e; see also Gregor 1982a, Huckriede & Urban 1998, Mai 2001, Wójcicki & Wilde 2001, Czaja 2002, Wójcicki & Zastawniak 2002) suggests that the species is probably composed of more than one taxon and should be treated as an aggregate. Some of the fruits included into *H. heissigii* share e.g. some morphological characters with *Trapa* (Fig. 5g, e). This problem is the subject of ongoing detailed studies by the first author to be presented separately.

The fruits from Dolní Litvínov evidently differ from other two *Hemitrapa* species known from the European Paleogene / Neogene, i.e. *Hemitrapa pomelii* (Saporta) Mai reported from the Upper Oligocene of France (Saporta 1878, Boulay 1899), and Germany (Mai & Walther 1991), and Lower Miocene of Germany (Mai & Walther 1991), and from *H. trapelloidea* described by Miki (1941) from the Seto Porcelain Clay Formation of Japan (late Miocene in age; see Tsukagoshi et al. 1995, Momohara 1997). The first is recognized mainly by the relatively narrowly oblong-elliptical outline of its fruits with head constituting approximately 4/5 of the fruit, slender arms located closely to the fruit base and by relatively long additional reduced arms inserted between long arms (Fig. 5f, g). The second species, *H. trapelloidea*, recently discovered in Europe in the Pannonian sediments of Pellendorf, Austria (Kovar-Eder et al. 2002), is characteristic by its characteristic ovate fruit shape, long and very slender upward pointing arms inserted slightly above the centre of the fruit and additional reduced arms between longer ones (Fig. 5h, i).

This new discovery from Dolní Litvínov is one of the oldest known occurrences of *Hemitrapa heissigii*. It fits rather well to the region and contributes remarkably to the knowledge of distribution and diversification of the extinct genus *Hemitrapa*.

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