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"RHAMNUS" WARTHAE HEER, AN IMPORTANT ELEMENT OF THE CENTRAL PARATETHYAN REGION DURING THE EGERIAN

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"Rhamnus" warthae HEER is an important, characteristic element in the Central Paratethyan region during the Egerian. It was published under several different names, which are revised and summarised here. Cuticle of the leaves have never been preserved, but based on its quite characteristic, and clearly observable venation, it is well identifiable. Its occurrence is limited to the Hungarian, as well as to the Transylvanian (Romanian) Egerian basin. It was one of the most important hygrophilous elements of the Egerian flora and vegetation in the Hungarian and Transylvanian Palaeogene basins.

Key words: *"Rhamnus" warthae*, Egerian, Central Paratethys, Hungary, Transylvania, swamp vegetation

INTRODUCTION

During the systematic revision of the flora of the Egerian holostratotype, namely the Eger-Wind brickyard (KVAČEK and HABLY 1991), several leaf specimens published already by ANDREÁNSZKY (1966) under numerous names turned out to be a taxonomically consistent group predominating the flora. Since he assigned specimens belonging to the same taxon into different systematic groups, the mass occurrence, and importance of the species became apparent.

The leaves of this plant were published first time by HEER (1872), from the Zsil Valley from Transylvania (Romania) under several names. Later STAUB (1887) also mentioned it from the same locality, using even more different names (see in the Systematic part).

During the study of the other Egerian localities of Hungary by HABLY (1988, 1989, 1993*a*, 1994) the leaves were found belonging to the same species and identical with the leaves from the Eger-Wind brickyard (HABLY 1988) for the first time.

The systematic revision of the flora of the Eger-Wind brickyard (KVAČEK and HABLY 1991) has clarified, that the leaves from the Zsil Valley described by STAUB (1887), as well as the leaves from the Eger-Wind brickyard described by ANDREÁNSZKY (1966) belong to this species. In the list presented below all synonyms are given that were found during or before this recent study. Almost two hundred undetermined and unpublished specimens of this species were studied re-

cently in the collection of the Hungarian Natural History Museum, and this has thoroughly confirmed and broadened our knowledge about the variability and character of this species. Its remains came to light mostly from the "upper strata" and some of them from the "middle strata". In the "lower strata" these leaves are absent.

In this work we summarise all the data we have concerning this species, and attempt the interpretation of its taphonomic and palaeoecological background.

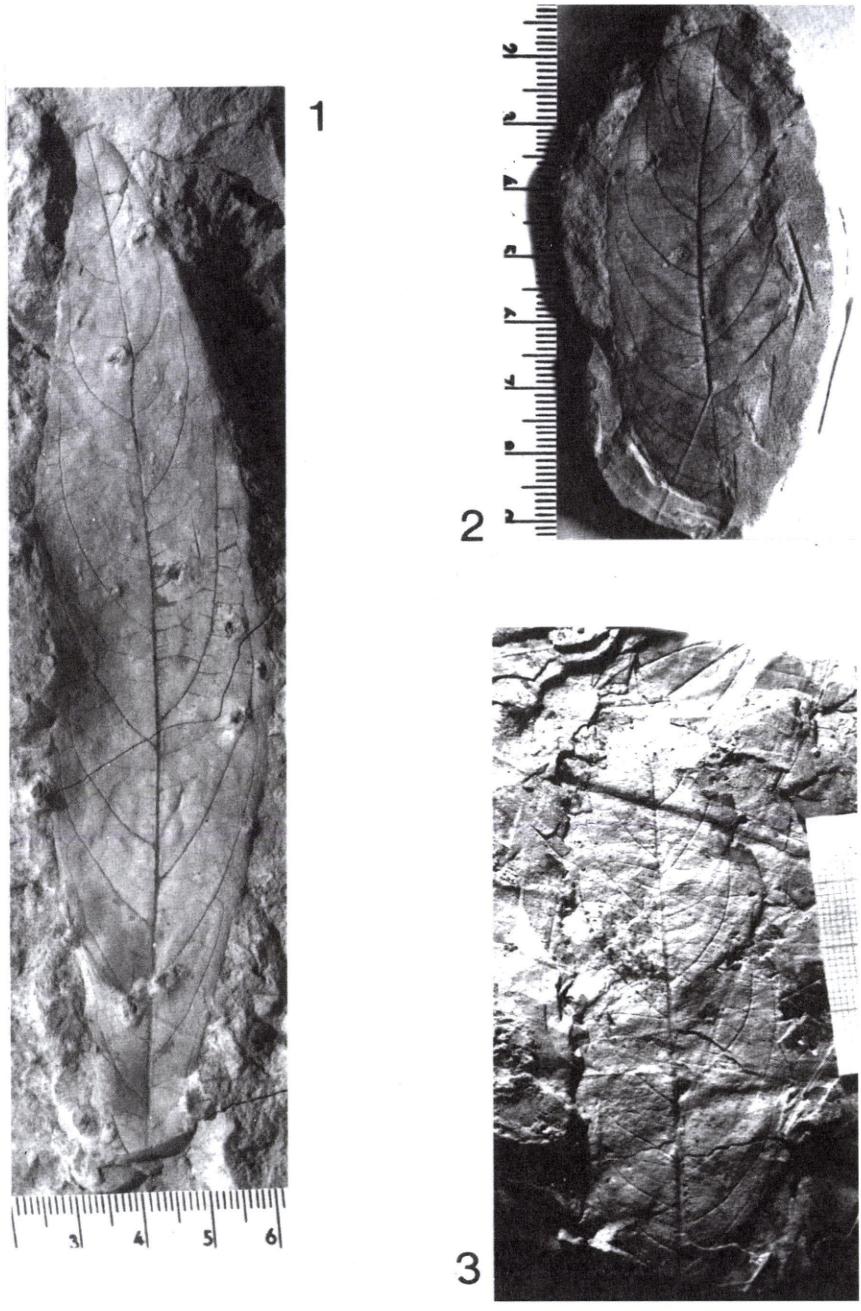
SYSTEMATIC PART

1872 *Rhamnus warthae* Heer; HEER, p. 23, Pl. 5, Figs 2, 3, 4a; Pl. 6, Figs 3–5.
1872 *Juglans heerii* Ett.; HEER, p. 24, Pl. 5, Fig. 4a.
1887 *Rhamnus warthae* Heer; STAUB, p. 360, Pl. 38, Figs 1–2.
1887 *Juglans heerii* Ett.; STAUB, p. 281, Pl. 27, Fig. 1.
1887 *Laurus primigenia* Unger; STAUB, p. 303, Pl. 28, Fig. 6; Pl. 29, Fig. 1; Pl. 34–35, Fig. 1d.
1966 *Styrax* cf. *japonica* Sieb. et Zucc.; ANDREÁNSZKY, p. 85, Text. fig. 76.
1966 *Elaeocarpus palaeolanceolatus* Kolak.; ANDREÁNSZKY, p. 94, Text. fig. 87.
1973 *Lauraceophyllum* (*Litsea*) *primigenia* (Unger) Givulescu; GIVULESCU, p. 18, Pl. 4, Fig. 1; Pl. 6, Fig. 20; Pl. 7, Figs 1–13.
1988 *Symplocos* sp.; HABLY, p. 44, Pl. 9, Fig. 6; Text. fig. 80.
1989 *Symplocos* sp.; HABLY, p. 89, Pl. 3, Fig. 1; Text. figs 55–56, 58.
1991 *"Rhamnus" warthae* Heer; KVAČEK and HABLY, p. 64, Pl. 12, Figs 1, 4.
1993*a* *"Rhamnus" warthae* Heer; HABLY, p. 12, Pl. 2, Fig. 2.
1997 *Rhamnus warthae* Heer; PETRESCU *et al.*, p. 81, Pl. 11, Figs 2–3; Pl. 32, Fig. 4.

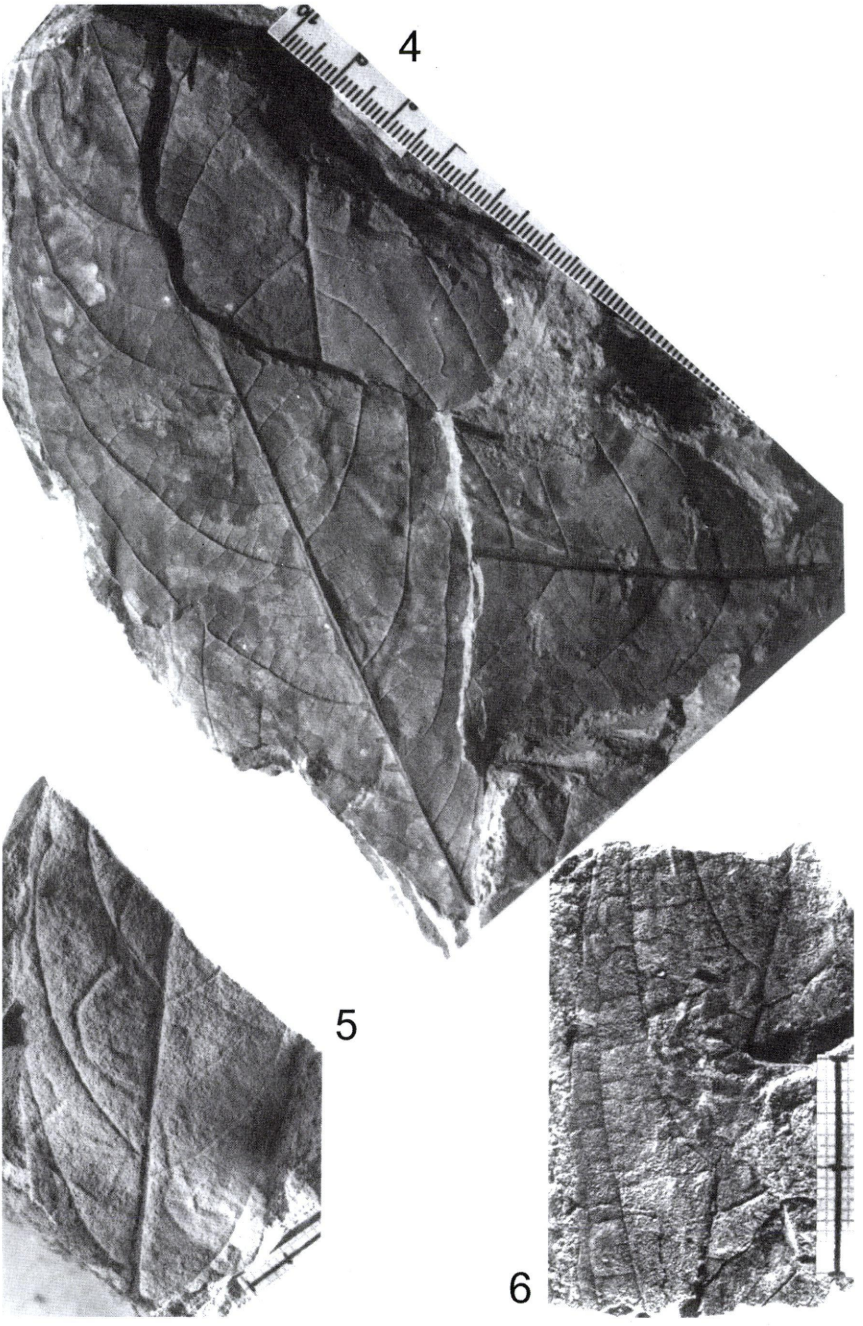
Material: Andornaktálya: BP 89.557.2, cf. BP 89.564.1; Eger-Wind brickyard: BP 67.115.1, BP 70.28.1, BP 70.34.1, BP 70.40.1, BP 71.728.1, BP 90.9.1–BP 90.56.1, BP 92.4.1–BP 92.5.1; Kesztölc: BK–1133; Nagysáp: BK–1155, BK–1327; Petrozsény (Petrusany): BP 58.51.1, BP 58.53.1; Pomáz: BP 97.161.2, BP 97.176.1; Pusztaberki: cf. BP 99.364.1.

Description. Leaves simple. Lamina 3.5–14 cm long and 2.1–5.5 cm wide. Shape of lamina obovate, ovate to lanceolate. Apex acute, base cuneate. Margin toothed. Teeth irregular, very thin, sharp, and very small. Venation camptodromous-brochidodromous. Midvein, secondaries and also the tertiaries are strong, well observable. Secondaries, as well as the tertiaries form compound loops are very characteristic of the species.

Taxonomic remarks. The valid systematic position of *"Rhamnus" warthae* Heer is doubtful. KVAČEK and HABLY (1991) suggested an affinity to the genus *Rubus*, based on its mass occurrence in the riparian vegetation of the Eger-Wind brickyard and also in the Zsil Valley since it recalls a similar association of the Lower Miocene of North Bohemia. In the latter area riparian forest was dominant,



Figs 1–3. Variable leaf forms of *"Rhamnus" warthae* Heer: 1 = BP 70.40.1, long, narrow form, Eger-Wind brickyard; 2 = BP 70.28.1, small, narrow form, Eger-Wind brickyard; 3 = BP 89.557.2, Andornaktálya.



Figs 4–6. Variable leaf forms of *"Rhamnus" warthae* Heer: 4 = BP 70.34.1, large, broad form, Eger-Wind brickyard; 5 = BK-1133, fragment from Kesztölc; 6 = BK-1155, fragment from Nagysáp.

and it included large masses of leaves of *Rubus meriani* (Heer) Kolakovszkij. Therefore we tried to match *"Rhamnus" warthae* to some *Rubus* species and mentioned recent simple-leaved *Rubus* species belonging to the sect. Sozostyli Focke from southern China and others from subtropical SE Asia that recall our fossils (*e.g. R. mairei* Leveille), but are not identical with those.

Our study of recent material in the herbarium, *Brassiopsis speciosa* Dence et Pl. shows great similarity to our *"Rhamnus" warthae.* It is native to Yunnan province and occurs in elevations up to 1150 m in the mountains. Unfortunately, the fossil material does not have cuticle, so we cannot identify the fossil with the above-mentioned recent material.

Thus we use the name, justified by priority, given by Heer.

TAPHONOMY, PALAEOECOLOGY

The identification and even the recognition of *"Rhamnus" warthae* depend considerably on the sediments embedding its leaves. The very fine, and rarely exposed teeth are preserved only in fine-grained sediments. In coarse-grained sediments the teeth are usually destroyed. Thus, the leaves seem to be entire margined to which it can be attributed that these leaves were often assigned to the family of Lauraceae (*Laurus primigenia* (STAUB 1887), *Lauraceophyllum* (*Litsea*) *primigenia* (GIVULESCU 1973)).

The venation, even the dense tertiary venation is very strong and well preserved not only in mudstone, but also in coarse-grained sediments. This characteristic venation recalls that of the leaves of *Rhamnus*. According to the sedimentological analysis of the localities (HABLY 2001), the proportion of the mudstone that contained the leaves of *"Rhamnus" warthae* still identifiable was more than 50% in the plant bearing sediments, (*e.g.* Pomáz 70%, Andornaktálya 56%, Kesztölc 55%, Eger-Wind brickyard 52%).

Large amounts of its leaves are only known from two localities, Zsil Valley (Transylvania, Romania) and the Eger-Wind brickyard (Hungary) and there are several specimens at Csolnok (Hungary) (ERDEI and WILDE, in progress). These localities represent a swamp vegetation. In Eger-Wind *"Rhamnus" warthae* is associated with *Osmunda lignitum*, *Blechnum dentatum*, *Pronephrium stiriacum*, *Myrica longifolia*, *Comptonia dryandra*, *Ulmus pseudopyramidalis*, *Alnus oligocaenica* and *Acer tricuspidatum* f. *hungaricum*, which are typical members of a swamp vegetation. The mass occurrence of large, well preserved leaves of several species suggest that they were not exposed to a long transport. The leaves occur densely through several layers which means that the leaves must have fallen down

more or less continuously close to the sedimentary basin. Their presence is more or less autochthonous, and refers to a swampy, partly riparian vegetation. The leaves of *"Rhamnus" warthae* are variable, but the large and wide leaves are dominant and typical.

Most of the leaves of various species collected here, are usually large, like those of *Alnus oligocaenica* Andr., *Ulmus pseudopyramidalis* Z. Kvaček et Hably, *"Talauma" egerensis* Andr., *Tetracentron agriense* (Andr.) Z. Kvaček et Hably, *Acer tricuspidatum* Bronn f. *hungaricum* (Andr.) Z. Kvaček et Hably.

At the other important locality of *"Rhamnus" warthae*, namely in the Zsil Valley, we find similar conditions (STAUB 1887, GIVULESCU 1973, KVAČEK and HABLY 1991) as in the Eger-Wind brickyard.

At all other localities, where *"Rhamnus" warthae* have been occurred: Kesztölc (HABLY 1988), Nagysáp (HABLY 1989), Andornaktálya (HABLY 1993*a*), Pomáz (HABLY 1994), swamp vegetation is very subordinate. In these localities only a few leaves of this species were recorded, even from the rich, well preserved floras (*e.g.* Pomáz).

The above data and observations provide sufficient support for our conclusion, that depending on the edaphic factors *"Rhamnus" warthae* was part of a swamp vegetation.

DISTRIBUTION OF *"RHAMNUS" WARTHAE* HEER

The palaeogeographical distribution of this species is limited to the Central Paratethyan area, more closely to the Intra-Carpathian region, *e.g.* Hungary and Transylvania. No data of this species is known out of this region. All the floras, containing the species, are dated from the Egerian (Upper Oligocene) age. All above facts suggest, that it was an endemic species.

The appearance of *"Rhamnus" warthae* Heer correlates with the abrupt floral change at the boundary of the early and the late Oligocene (HABLY 1993*b*). At that time a great number of species became extinct, however, several of them have successfully passed this time frame, although their abundance might have decreased – or unchanged. After this boundary some of them showed increased abundance, and have become more important than before. There is a group of species, which appeared firstly in the Egerian, and included the first representatives of the "Arctotertiary" elements as well as several thermophilous elements like *"Rhamnus" warthae* Heer. The large-scale turnover of the vegetation was much more complex than it could be explained solely by cooling of the climate. Geological events affecting terrestrial vegetation by changing significantly the environment and cli-

mate of its habitat should be taken also into consideration. One of such possible events was the major sea level drop at 30 Ma (HAQ 1991). Orogenic phase at the boundary of early and late Oligocene also caused a change of the land surface, which must have had an effect on the ecology and environment of the flora.

Connected to this floral change several new species appeared in this region, and were limited to the Egerian or Egerian-Eggenburgian ages, among them *Alnus oligocaenica* Andr., *Ulmus pseudopyramidalis* Z. Kvaček et Hably, *"Talauma" egerensis* Andr., *Tetracentron agriense* (Andr.) Z. Kvaček et Hably, *Acer tricuspidatum* Bronn f. *hungaricum* (Andr.) Z. Kvaček et Hably, *Dryophyllum callicomifolium* (Andr.) Z. Kvaček et Hably, *"Arbutus" preunedo* Andr., *Ilex? andreanszkyi* Z. Kvaček et Hably and *Tuzsonia hungarica* Andr.

These species are know only from Hungary, and partly from Romania (Transylvania, Zsil Valley) from Egerian layers. It confirms, that the above-mentioned floras must have developed in close connection with each other, but isolated from other regions. We have to consider the presence of Magura ocean (CSONTOS *et al.* 1992) to the north, which might have formed a large barrier between the Hungarian and other floras located to the north. To explain the isolation of the Egerian floras in the Intra-Carpathian region, we also have to consider the palaeogeographical conditions according to the model of terrains (CSONTOS *et al.* 1992, HABLY and KÁZMÉR 1996).

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