

## Preliminary radiocarbon dated paleontological and geological data for the Quaternary malacofauna at Püspökfürdő

(Baile 1 Mai, Oradea region, Romania)

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**Abstract:** Tóth Mihály magyar természettudományi szakember volt az első, aki Magyar Orvosok és Természetvizsgálók 1890. augusztus 16–20-ig Nagyváradon tartott XXV. Vándorgyűlésen átfogóan beszámolt a püspökfürdői terület negyedidőszaki malakofaunájáról, köztük a *Melanopsis* fajok változásairól. Munkája nyomán előbb Spiridon Brusina, majd Kormos Tivadar végzett malakológiai vizsgálatokat a püspökfürdői negyedidőszaki Mollusca-fajokon, köztük a *Melanopsis* és *Theodoxus* taxonokon. Munkájuk nyomán 1999 tavaszán a nagyváradai Körös múzeum vezetésének engedélyével több szelvényt és fűrást alakítottunk ki a püspökfürdői védett területen, és ezen szelvényekből 4, illetve 10 cm-es mintavétellel Mollusca-héjat, köztük több ezer *Melanopsis* és *Theodoxus* taxonokhoz sorolt héjakat nyertünk ki. A malakológiai vizsgálatokat üledékföldtani, geokémiai, radiokarbon, anthrakológiai és pollenanalitikai elemzésekkel egészítettük ki. Jelenleg a Mollusca-héjak összehasonlító biogeokémiai, morfológiai és genetikai elemzéseit végezzük, de az eddigi adatok alapján a kutatócsoport egy előzetes adatközlés mellett döntött. Az eddigi vizsgálatok eredményei nyomán a terület refúgiumként (mérsékeltövi, és nem szubtrópusi oázisként) működött a jégkor utolsó lehúlése során, de a vizsgált területen élő *Melanopsis parreyssii* (Phillippi, 1847) faj taxonómiai besorolása kérdéses, és az őslénytani adatok nyomán ez a taxon inkább a *Fagotia acicularis* egy magasabb víz-hőmérséklethez alkalmazkodó holocén korban kialakult változatának, mintsem önálló fajnak tekinthető.

**Keywords:** palaeontology, molluscs, Püspökfürdő, thermal lake, shell evolution.

### Introduction

The very first report about the *Melanopsis* species in the Püspökfürdő area was bounded to the Austrian geologist, von Bregrath Franz Ritter Hauer (Hauer, F. 1852). On the other hand, conforming to Phillippi, who was the finder of *Melanopsis parreyssii* (Phillippi, R. A. 1847), the found specimen was ensued from Hungary, and the collector was the Austrian naturalist, von Mühlfeld. Unfortunately Phillippi neither mentioned the specimen's exact locality nor when and where von Mühlfeld visited Hungary. Currently it can't be proved but not impossible that the very first found of this taxa was come from Püspökfürdő, because the specimens of the taxa can be easily found on the ground, and then this area was part of Hungary.

The first geological series of the Püspökfürdő area, with the *Melanopsis* taxa in the layers, was publicised by an Austrian geologist, von Heinrich Wolf (Wolf, H. 1863). The publicised series contained a slightly formed humic horizon in the immediate vicinity of the thermal lake (Wolf, H. 1863; 290 pp, Fig. 7.). Unfortunately, von Heinrich Wolf used neither a compass dial nor a scale nor a map, and because of the significant environmental changes of the past 150 years his description can be hardly used. But some parts of his publicised series-description could be found in the elaborated sections and boreholes. Thereafter these mollusc species were mentioned during the comprehensive geological analysis of the Oradea region (Szontágh, T. 1890) and also in the borehole for water layer-series of Béla Zsigmondy.

Regardless of these investigations the Hungarian natural scientist Mihály Tóth was the very first who reported the quaternary malacofauna of the Püspökfürdő area in the 25<sup>th</sup> Hungarian Itinerary Congress of Doctors and Naturalists in Oradea, in 1890. He gave a detailed account of the quaternary malacofauna, among other things the change of the *Melanopsis* species. In his work he reported the mollusc fauna what he got by layer-rarefying from an approx. 2 m high section. According to the change of the *Melanopsis* taxa he described a various development-process with many *Melanopsis* species during the Quaternary. He considered that the thermal lake formed earlier than the Holocene, and derived the *Melanopsis* taxa from a Tertiary collective ancestor which survived the glacial.

Set out from Mihály Tóth's work, Spiridon Brusina then Tivadar Kormos examined the quaternary malacofauna of the Püspökfürdő area, among others the *Melanopsis* and the *Theodoxus* taxa (Brusina, S. 1902; Kormos, T. 1903a,b; 1905a,b). Brusina did not elaborated sections or boreholes, he made taxonomic investigations only from ground shells and from Tóth's shell-collection (Brusina, S. 1902). In his work he determined 8 taxa, including the *Melanopsis parreyssii* as well as 23 varietals of them. Unfortunately, he notified neither figures nor detailed description for the taxa and varietals only a short word in Latin for each other (Brusina, S. 1902). Brusina – based on an earlier work of paleobotanic Móric Staub (Staub, M. 1892) – considered that the *Melanopsis* taxa are remains of a Tertiary subtropical oasis which survived the glacial because of the thermal lake in Püspökfürdő.

Tivadar Kormos – based on Zsigmondy's and Mihály Tóth's results – mapped the area's geological and morphological attributes and elaborated an 11 meter high, combined section-borehole layer series. Over and above the detailed geological and stratigraphic investigations Kormos made a detailed examination on the *Theodoxus* and *Melanopsis* specimens described by Brusina (Kormos, T. 1903a,b, 1905a,b). Kormos also examined other ground sections, published maps and geological layer-series and marked his and Mihály Tóth's section as well.

This was the base work for us when we began the examinations on the development of the *Theodoxus* and *Melanopsis* taxa as well as the geological and chronologic development of the Püspökfürdő area. The main conclusions of Kormos were the *Melanopsis* and *Theodoxus* taxa can be traced back to a Tertiary collective ancestor. The recent malacofauna of the thermal lake of Püspökfürdő is a relict fauna, a subtropical survivor one, which has both evolutionary and genealogical relation of the late Tertiary Slavonian malacofauna.

Simultaneously, Kormos noticed that the *Melanopsis* specimens of Püspökfürdő can be genealogically related to the taxa of *Fagotia* genus: *Fagotia acicularis* and *F. esperi* (Kormos, T. 1905a). Some researchers consider the latter species, *Esperiana (Microcolpia) daudebartii acicularis* (Fèrussac, 1823) and *Esperiana (Fagotia) esperi* (Fèrussac, 1823), are Pontic ranged (Fehér, Z. et al., 2004), but the cyclic appearance of these species in the Carpathian Basin clearly estimated during the Quaternary interglacial periods, not the Tertiary (Krolopp, E. 1973, 1983).

The base of the malacological investigations of Kormos was a botanical occurrence in the thermal lake, the presence of the Egyptian white water-lily (*Nymphaea lotus termalis*). This plant, the fauna and the thermal lake was considered as a subtropical oasis, a relict of an older geologic age (Kerner, A. 1887, Simonkai, L. 1890, Staub, M. 1903). The Egyptian white water-lily was considered as a Quaternary taxa by the majority of botanists, this is why Kormos also considered this age for the other relicts, notwithstanding that several botanists gave voice about the origin of the water-lily of the thermal lake (Borbás, V. 1894, Richter, A. 1897). Kormos considered Egyptian origin both of the *Melanopsis* and Egyptian white water-lily, and noticed

that two lived together there, this is why he considered the *M. parreyssii* a Quaternary taxa, and based on the presence of the water-lily at Püspökfürdő, he thought the thermal lake is a subtropical relict area.

### Recent investigations

After the World War 1 the malacological examinations regressed in the area of Püspökfürdő, the only prominent work was Pauca's (1937), besides the governmental protection of the area in 1933. By doubtful examinations and descriptions he kept only two species (*Melanopsis parreyssii* and *M. sikorai*) of Tóth's and Brusina's works, but he did not mention why he classified these species to the *Melanopsis* genus as Tertiary relicts. In fact this conception was adapted into the comprehensive work of Romanian molluscs (Grossu, A. 1986) and later other works (Fehér, Z. et al., 2004, Wanek, F. 2005), notwithstanding was proved that the Egyptian white water-lily established this area only in the early Holocene (Diaconeasa, B. 1962, Diaconeasa, B. & Popa, D. 1964). This is why cannot be demonstrated any continuity between the recent and the Tertiary flora, based on the pollen analyses, the relicts of the area could have been established during the interglacial periods or the Holocene.

Likewise, the Tertiary relict thought *Theodoxus prevostianus* species (Kormos, T. 1903, 1905a,b, Soós, L. 1906, 1932) only evolved during the middle Pleistocene, and settled during the Mindel interglacial (Krolopp, E. 1973). So set out from its presence it can't be concluded to a Tertiary refuge, only to an interglacial period of the late or middle Pleistocene (Sümegei, P. 1999). Properly, the presence of the *Theodoxus prevostianus* shows that the area is not a subtropical oasis, but a temperate refuge which formed during the cold glacial periods because of the plus heat of the thermal water. In this refuge thermophilous mollusc species could survive during the cold glacial periods like *Theodoxus prevostianus*, *Fagotia acicularis*, *Fagotia esperi*, *Helicigona (Chilostoma) banatica* (Sümegei, P. 1999).

This paleontological fact is proved by the malacological analyses on the elaborated section and boreholes in 1999 and the comparison with the malacofauna of the examined section of Kormos (Sümegei, P. 1999). Because of the pebbly sediment in the bedrock and the freshwater lake sediments above the limestone layer had a radiocarbon age of 15,000–13,000 cal BP years (Sümegei, P. 1999), which is the very late Pleistocene and the Pleistocene-Holocene border period. Thus the "*Melanopsis*" shell-container layers are extraordinary young (Sümegei, P. 1999), so these layers are cannot be parallel with any early Pleistocene or Pliocene layers as Tóth said in 1891.

In 1999 a researcher team (Tamás Deli, Gusztáv Jakab, Enikő Magyari, Csaba Tóth former PhD students) with the leadership of Pál Sümegei elaborated some boreholes and a section in the Püspökfürdő area with the permission of the local Körösvidéki Museum. The section's lower part, above the pebbly horizon a greenish-grey late glacial lake sediment layer deposited with high carbonate and Ca-Mg ion content. In this sediment several smooth and long-shaped shells came to light which were identified as *Melanopsis hazay* species (Tóth, M. 1891, Brusina, S. 1902, Kormos, T. 1903a,b, 1905a,b). On the other hand, based on comparative biometric examinations this shape belongs to the *Fagotia acicularis* species. The outstanding significance of this layer is it contains the shells of *Theodoxus prevostianus* taxa in black and purple colours, moreover several *Planorbis planorbis* and *Planorbarius corneus* shells and an in-washed *Helicigona (Chilostoma) banatica* shell came to light. From identification of

the tiny charcoals, parts of deciduous and coniferous trees and shrub charcoals came to light (identification by Edina Rudner), and the layer's pollen content also signed the deciduous and coniferous trees' presence (identification by Imola Juhász).

The appearance of the ordinary "*Melanopsis*", namely the *Fagotia* shape, in the warming lake system in the Pleistocene-Holocene border period is quite similar to the formation of freshwater limestone layers during the Riss glacial and Riss-Würm interglacial border period in the vicinity of Eger (Krolopp, E. 1985). Because in the lime-sediment deposited in end of Riss glacial also appeared the *Fagotia acicularis*, the *Theodoxus prevostianus* and the interglacial marker species *Helicigona banatica*.

On the top of the late glacial lake sediment layer a more carbonated snow-white coloured lake sediment layer deposited, by the radiocarbon dating results this layer younger than 11,600 cal BP years, which signs the early Holocene, and also has high Ca-Mg ion content. In this horizon many *Fagotia acicularis* shells came to light, but other stepped forms of *Fagotia* genus appeared which named "*Melanopsis sikorai*" in the original descriptions (Brusina, S. 1902, Kormos, T. 1903a,b, 1905a). Moreover besides the stepped and smooth shelled *M. sikorai* shape other shapes appeared which also had stepped and smooth shell, but with crest in the middle line of their whorls, this kind of shape could identified as *Melanopsis mucornifera* and *M. staubi* (Brusina, S. 1902, Kormos, T. 1903a,b, 1905a). The standard shapes of *Fagotia acicularis* and the *Melanopsis sikorai*, *M. mucornifera*, *M. staubi* shapes are connected by transitional series, and by the reason of the investigated hundreds of them it can be said that an entire transition happened between these shapes. These forms and shapes are the warm-water varieties of *Fagotia acicularis*, not independent species. The appearance and the development of the different shapes and forms are quite similar to the *Melanopsis doboi*, described by Zoltán Schréter (Schréter, Z. 1975, 1978), which evolved in the last glacial carbonated warm water systems in the vicinity of Eger. This form also has crest or edge in the middle line of its whorl, but after thorough examinations of the shells it is certain that this is a warm-water variety of the *Fagotia acicularis* (Krolopp, E. 1985).

From about 8,400-8,500 cal BP years, the type of the sediment changed, a greyish layer deposited with high carbonate and Ca-Mg ion content, with many freshwater and terrestrial mollusc-shells. From this layer a lot of deciduous charcoals came to light. The organic content of the lake sediment-series gradually rose, besides the significant appearance of *Fagotia acicularis* and its "*Melanopsis*" forms the abundance of *Theodoxus prevostianus* specimens raised. From this layer besides the known varieties of *Fagotia acicularis*, some new varieties appeared with ribbed but not stepped shells, the *Melanopsis hungarica* and the *M. sublanceolata* (Brusina, S. 1902, Kormos, T. 1903a,b, 1905a). This layer contained thousands of unbroken shells and after the analyses it can be said that they connect the standard shape of *Fagotia acicularis* and the varieties with the use of series. Probably the evolution of the shapes depended on the raised organic matter content and the warming water. It is worth mentioning that the *Nymphae lotus termalis* species had a certain appearance in this horizon, but the *Melanopsis parreyssii* form did not appear. It is proved that the two taxa did not settle and appear in the same time into the thermal lake of Püspökfürdő (Baile 1 Mai).

The *Melanopsis parreyssii* form appeared in a high carbonated and organic matter contented peaty thermal lake within floating mat spots between 3,000 and 4,000 cal BP years, but the lower samples of the peaty layer-series also contained all of the smooth, stepped, non-stepped and ribbed shell-varieties of "*Melanopsis*" form. In the concomitant fauna lake,

swamp, marsh, shore and terrestrial species appeared, and indicated a mosaic-like swampy lake environment during the deposition of this layer.

In progress to the surface the abundance of the varieties with smooth and ornamental whorled shells decreased, in the vicinity of the surface only the varieties with ribbed shells (*M. parreyssii*, *M. hungarica*, *M. sublanceolata*) remained. The reasons of the increased dominance of these varieties were the changed environmental parameters: the thermal lake transformed into swamp, increased organic matter content (eutrophication), increasing water temperature. Thus the evolution-series of these varieties can be traced back to the standard shape of *Fagotia acicularis*: the changed environmental parameters of the thermal lake indicated the evolution of the “*Melanopsis*-like” forms. In our opinion the unidentified “*Melanopsis*” taxa of the thermal lake at Püspökfürdő are just different forms of *Fagotia acicularis*, because of the changed thermal lake environment, in this way the dissociation of the *Melanopsis parreyssii* as an independent species is quite doubtful.

### Summary

Mihály Tóth was the first Hungarian natural scientist who reported the quaternary malacofauna of the Püspökfürdő area, among others the changes of the *Melanopsis* taxa in the 25<sup>th</sup> Hungarian Itinerary Congress of Doctors and Naturalists in Oradea, in 1890. Set out from his work Spiridon Brusina then Tivadar Kormos examined the quaternary malacofauna of the Püspökfürdő area, among others the *Melanopsis* and the *Theodoxus* taxa. Due to their works in 1999 we elaborated several sections and boreholes on the protected Püspökfürdő area with the permission of the local Körös Museum of Oradea. From these sites samples were taken from every 4 or 10 cm thus we recovered several thousand shells of *Melanopsis* and *Theodoxus* species. Malacological examinations were made up with sedimentological, geochemical, radiocarbon, anthracological and palynological examinations. Currently the comparative biogeochemical, morphological and genetic analyses were fulfilled on the mollusc shells, this is why our results are only preliminary now. According to the latest analyses it can be told that this area was a refuge (temperate not subtropical) during the last glacial period. But the taxonomical ranging of the *Melanopsis parreyssii* is uncertain, based on paleontological data this taxa is rather a kind of *Fagotia acicularis*, which adapted the higher water temperatures and evolved during the Holocene, not an independent taxa.

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