MOLLUSC FAUNA AND FLORA OF THE PANNONIAN QUARTZ SANDSTONE AT MINDSZENTKÁLLA, HUNGARY

by

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Abstract

The mollusc fauna and flora collected from the Pannonian Kálla Sandstone at Mindszentkálla are preserved as internal and external moulds. The frequent *Congeria* sp., *Lymnocardium* cf. *sopronіense* and *Unio atavus* indicate the E zone of the Vienna basin. The flora (determined by L. HABLY and Zs. DEBRECZY) includes Mediterranean species, which occur also in the Sarmatian flora of the Tokaj Mts.

Introduction

The margins of the Transdanubian Midmountains and the shores of Lake Balaton display classical localities of Pannonian and Pontian flora and fauna. Description of the exposures and their rich fossil content was made by several authors from 1835 up to now, e. g. PARTSCH (1835), FUCHS (1870), HALAVÁTS (1911), LŐRENTHEY (1911), VITÁLIS (1911), STRAUSZ (1942a), BARTHA (1959), KORPÁS–HÓDI (1983), MÜLLER–SZÓNOKY (in prep.).

Besides the older, well-known localities some new ones have been established, like the quarry at Mindszentkálla. Its fossils have been mentioned by the lithostratigraphic study of JÁMBOR (1980) only. The species of this flora and fauna are discussed in the present paper.

Pannonian formations of the Kál basin (Fig. 1)

The basement of the Kál basin is made of Permian red sandstone to the southwest and Triassic carbonate rocks to the northeast. Pannonian sedimentary rocks overlie them disconformably: clay, sand and sandstone, gravel and conglomerate (Kálla Gravel – Quartz Sandstone Formation, JÁMBOR, 1980). The often similar Permian and Pannonian sandstones were first distinguished by LÓCZY (1916). He said, that the sand and sandstone margins of the Kál basin were formed by beach dunes of a former embayment of the Pannonian lake. The mouth of the bay was at Káptalantóti towards the Tapolca basin. HAJÓS (1954) indicated that the sandstone and the underlying sand have the same grain size distribution. The siliceous

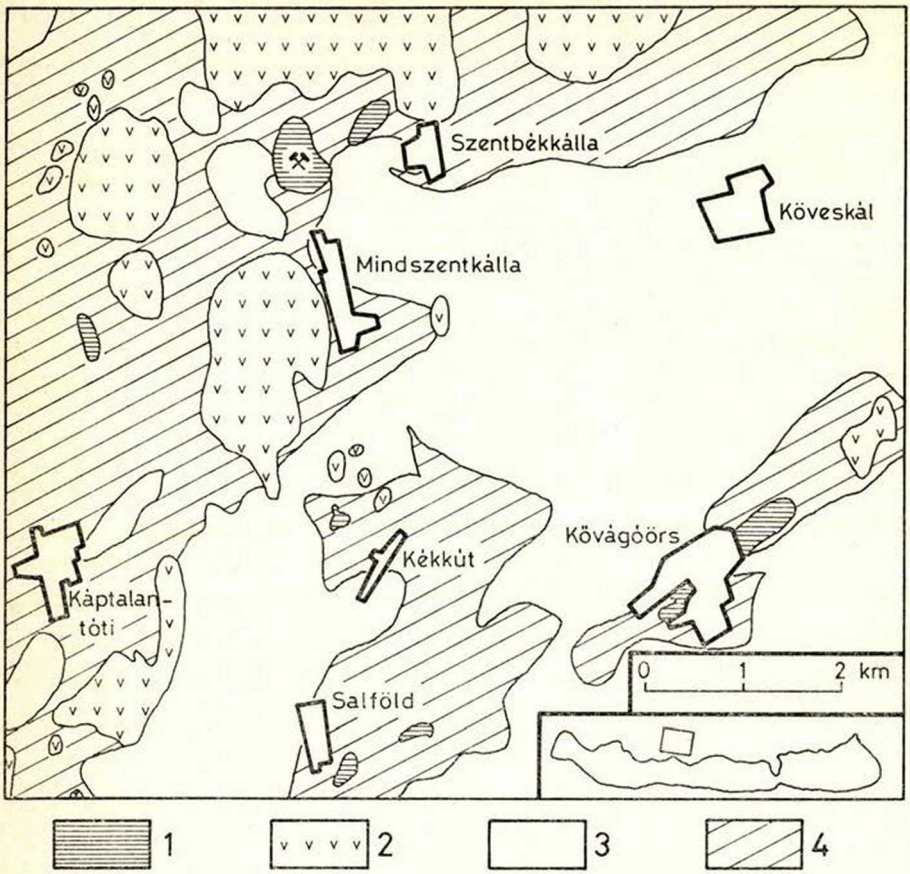

Fig. 1. The Pannonian sandstone in the Kál basin. Legend: 1: Pannonian quartz sandstone; 2: Pannonian basalt; 3: Pre-Pannonian rocks; 4: Pannonian basement (sand, clay).

matrix cemented the sand as lenses and banks; the latter preserved the underlying sand from erosion. There is a strong correlation between the cementation and gravel content of the sand (BIHARI, pers. commun.). Fragmentation and tilting of the sandstone and conglomerate beds and boulders formed the boulder fields at Kővágóörs, Salföld, Mindszentkálla and Szentbékkálla, parts of which are nature conservation areas.

The Mindszentkálla quarry

Mindszentkálla village lies at the NW margin of Kál basin, 9 km E of Tapolca. The quarry is located 1 km N of the village.

The Km – 133 borehole, drilled in the quarry yard, hit the Triassic basement at 28 m depth. The Trias is overlain by 17 m clay, 3 m silty sand

and 8 m fine sand. The latter is partly exposed by the quarry. The sand is overlain by some cm or dm thick limonite-cemented red sandstone, and by 2 – 5 m thick quartz sandstone. The latter is fine-grained at the bottom, pebbly sand at middle levels; the top is formed of some cm to 1 m thick conglomerate. The sand and gravel grains are made of quartzite, the cement is silica, therefore SiO_2-content exceeds 98,5%.

The pebbles are well rounded, 2 – 10 cm in diameter. These form some mm to dm thick graded beds in the sandstone, frequently displaying cross-bedding. Also occur in small lenses (with graded bedding) and as isolated pebbles. The orientation of small pebbles behind a larger one indicate SW to NE current transport, parallel with the supposed shoreline.

The quartz sandstone bed is cut by vertical fractures, filled by loess and soil.

Preservation of fossils

The fossils recovered from the quartz sandstone bed are external and internal moulds. During the fossilization process the calcareous shell was simultaneously being dissolved from the external and internal side as well. On specimens of the bivalve *Lymnocardium* cf. *soproniense* the outline of the ribs clearly follow the internal morphology of the shell, while muscle scars are missing (i. e. cut by the ribs). Growth lines, mostly characteristic for the external morphology, are clearly visible.

The plant fossils are mostly external moulds, but internal moulds occur, too (e. g. stems of Monocotyledonae). Plastic casts of external moulds of fir cones were prepared to facilitate determination and photography.

External and internal moulds are frequently coloured by iron and mangenese precipitates.

Fauna and flora

Fossils of the Mindszentkálla quarry were first mentioned by JÁMBOR (1980, p. 201): „M. Korpás-Hódi identified a *Congeria* sp. belonging to either *C. subglobosa* or *C. sopronensis* as well as the forms *Lymnocardium* cf. *schmidti* (M. HÖRN.) and and *Lymnocardium variocostatum* VITÁLIS. As for the biostratigraphic position of this formation, it must certainly belong, as indicated by its fauna, to the Congeria ungulacaprae Horizon."

The following forms were determined by the present author:

Congeria sp.	(7 specimens)
Lymnocardium cf. *soproniense* VITÁLIS	(21)
Lymnocardium cf. *majeri* (HÖRNES)	(2)
Lymnocardium sp. (indet.)	(4)
Unio atavus HÖRNES	(5)
Melanopsis cf. *fossilis* (MARTINI – GMELIN)	(1)
Gastropoda sp. (indet.)	(1)

I think, that this fauna is older than that of the Congeria ungulacaprae Horizon, i. e. it is not Pontian, but Pannonian. It is similar to the fauna of Sopron, Eisenstadt and the Vienna basin (E zone).

Angiosperm plants were kindly determined by L. HABLY, and pines by ZS. DEBRECZY:

Myrica sp. I.	(1)
Myrica sp. II.	(1)
Rhamnus alaternus LINNÉ	(1)
Liriodendron (?) sp.	(3)
Pinus halepensis MILLER	(2)
Pinus cf. *rostrata* (MILLER)	(2)
Pinus cf. *sylvestris* LINNÉ	(2)
Pinus sp.	(1)

Other plant fossils, which locally abundantly occur, are mostly indeterminable fragments of monocotyledonous and dicotyledonous stems and leaves. The species *Rhamnus alaternus* and *Pinus halepensis* – together with several *Myrica* species – occur in the Sarmatian flora of the Tokaj Mts. (ANDREÁNSZKY, 1959).

Congeria sp.

(Plate 1, fig, 1 – 2)

Large size, extremely variable specimens of the form group *Congeria subglobosa – Congeria pancici*. LUEGER (1980, Taf. 2, Fig. 4a – b) published similar Congerias from Eisenstadt (Fölligberg). Like those ones, the specimens from Mindszentkálla display quadrangular outlines and bear two sharp ribs *(C. pancici)*, and have a strongly concave lunule (*C. subglobosa)*.

The species *Congeria subglobosa* is known from several localities in the Pannonian basin, but is not a good index fossil due to its long range according to Hungarian authors (STRAUSZ, 1942b).

Lymnocardium cf. *soproniense* VITÁLIS, 1934

(Plate 1, fig. 4)

It is the most frequent fossil at Mindszentkálla. This species was described by VITÁLIS (1934) from the Pannonian exposures at Sopron, with special care to determine the characters distinguishing it from other large-size Lymnocardiums *(L. schmidti, L. penslii, L. variocostatum)*. STRAUSZ (1942a) indicated that *L. soproniense* is an intraspecific, local variety of *L. variocostatum*, the latter being a subspecies of *L. penslii*. The latter two fossils are index fossils of the Pontian, so-called *Congeria ungulacaprae* beds. Although the evolutionary relationships of these forms are not clear, I think, that the *L. soproniense* cannot be considered as a local variety, since it occurs in great numbers, for example in the Mály Clay in Northern Hungary.

The characters typical for *L. schmidti* and *L. variocostatum* have not been found on the internal moulds from Mindszentkálla. The keel characteristic for *L. schmidti* is missing from the edge of the area; also, the "auricle" of *L. variocostatum* is missing at the junction of the anterior and dorsal margins. Therefore, our specimens belong to the *L. soproniense* VITÁLIS species due to their outline, size and number of ribs.

Lymnocardium cf. *majeri* (HÖRNES, 1870)

(Plate 1, fig. 3)

The specimen from Mindszentkálla differs from the type *L. majeri* in the number of ribs: the species of HÖRNES bears 12–13 ribs, our specimen bears 22 ribs. Possibly, this character is not enough for determination, since HALAVÁTS (1886) and others indicated great variability in the number of ribs.

L. majeri is not known from the Vienna basin. However, in Hungary it occurs in a wide range: associated with *Congeria czjzeki* (KORPÁS–HÓDI, 1983) and with *Congeria balatonica* (STRAUSZ, 1952a).

Unio atavus (HÖRNES, 1870)

(Plate 1, fig. 5)

1870 *Unio atavus* PARTSCH–HÖRNES, Taf. 37, fig. 2
non 1870 *Unio bielzi* FUCHS–FUCHS, Taf. 17, fig. 8–10
non 1902 *Unio halavatsi* BRUSINA – BRUSINA, Taf. 24, fig. 1–4
1953 *Psilunio atavus* (PARTSCH, HÖRNES) – PAPP, Taf. 17, fig. 3
non 1959 *Unio atavus* PARTSCH–BARTHA, Taf. 7, fig. 1–2
1980 *Psilunio atavus* (HÖRNES) – LUEGER, Taf. 4, fig. 7–8

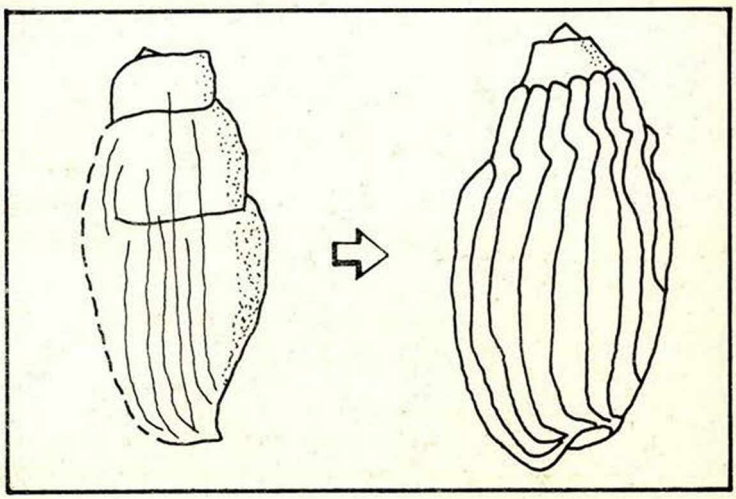

Fig. 2. Reconstruction of a *Melanopsis fossilis* internal mould.

While this species is characteristic for the E zone (PAPP, 1953) in the Vienna basin, it is considered as a poor index fossil in Hungary. Its differentiation from *Unio mihanovici* (= *Unio halavatsi*) was unclear for a long time (STRAUSZ, 1942a). MÜLLER has shown lately (MÜLLER–SZÓNOKY, in prep.) that there is a definite difference between the form *brunni* described by HÖRNES, and the Tihany specimens of *radmanesti* described by BRUSINA in the position of the umbo. The Mindszentkálla specimens belong to the species *Unio atavus* HÖRNES after their less eccentric umbo raised above the dorsal margin.

Melanopsis fossilis (MARTINI–GMELIN, 1790)
(Fig. 2; Plate 1, fig. 6)

Single, poorly preserved specimen. It is an internal mould, boundaries of the whorls are indicated by constrictions. Growth lines crossing the last two whorls indicate that the last whorl of the original shell has covered the preceding ones in great heights. This "reconstruction" suggests ranging to the. *M. fossilis* species.

Rhamnus alaternus LINNÉ
(Plate 2, fig. 5)

Typical plant of the macchia. It can withstand arid climate better than other plants of the macchia (ANDREÁNSZKY, 1959). The species and its relatives today live under Mediterranean climate, from the Canary Islands through Europe to Anatolia.

Pinus halepensis MILLER
(Plate 2, fig. 6)

The Aleppo Pine (Jerusalem Pine) is the most widespread pine in the Mediterranean realm. Its present area extends from Gibraltar to Lebanon. It is one of the few pine species native in North Africa. It prefers arid, rocky habitats, especially made of limestone; well adapted to long, dry summers. Rarely occurs in closed forests, but lives mixed with Mediterranean vegetation. Its upper limit is 200 m above sea level in Dalmatia and 1700 m in Morocco. Most frequent along the seashores, However, fossil Aleppo Pines indicate an area extending far to the north (MIROV, 1967).

Environment and climate

Litho- and biofacies of the Mindszentkálla Sandstone indicate a high energy, lakeshore environment with waves (Fig. 4).

Several authors (e. g. SZATMÁRI, 1971) studied the formation of pure quartz sand. During sand deposition the Kál basin might have been an embayment bordered by fracture-formed cliffs. The pure quartz sand was deposited in a wet climate, in the lake with insignificant salinity. Organic acids might had influence on the composition.

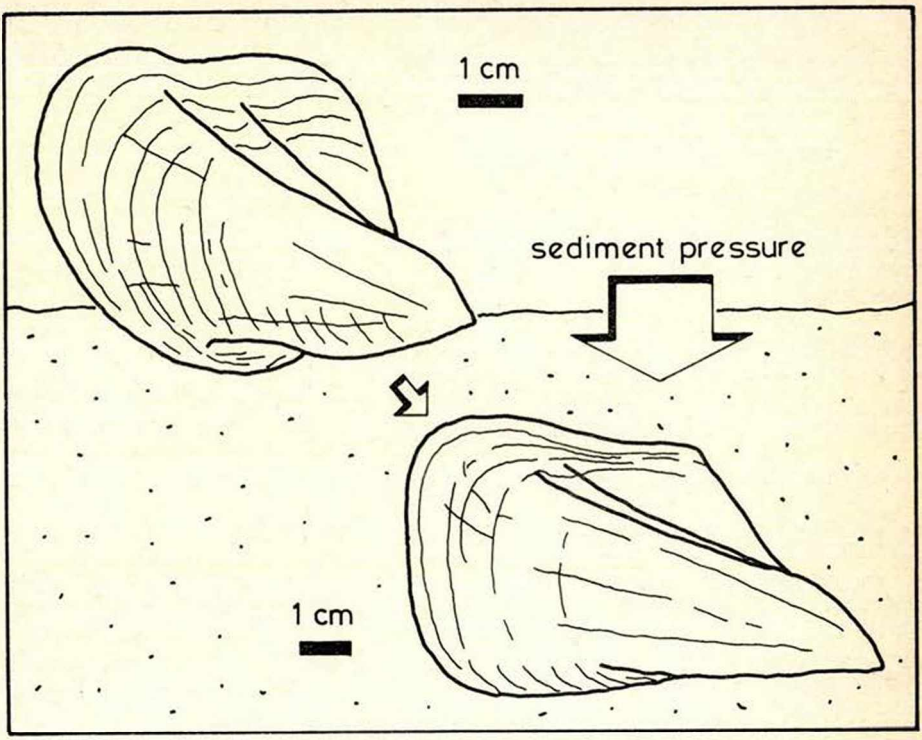

Fig. 3. Deformation of *Congeria* buried in life position.

Due to unfavourable conditions, the largest, thick-shelled fossils have remained only. Their presence indicate strongly agitated, shallow water. The thick shell is a means of even the byssate Congerias of mechanical stabilisation on a moblile substratum. *Lymnocardium* valves occur mostly impaired due to intense agiatation of water. The Unios were fossilized as open, but paired valves, while most of the Congerias as closed, double valves. These differences in preservation are due to different toughness of the ligament.

Proximity of the shore is indicated by the local abundance of plant fragments. Sand deposition might have been periodical: occasionally the molluscs were buried in life position, as observed on some *Congeria* specimens, compressed parallel with the comissure plane (Fig. 3).

It is very hard to give numerical estimates for the salinity of this bay, although there are detailed scales (BARTHA, 1971; KORPÁS–HÓDI, 1983) based on fossil assemblages. While there are living species of the genera *Congeria*, *Unio*, *Melanopsis*, but their environmental needs are hard to compare with their Pannonian ancestors. We know, that Recent species themselves are not uniform in this point of view: Congerias live both in the caves of Dalmatia and in the harbour of Antwerp (DAVITASHVILI and MERKLIN,

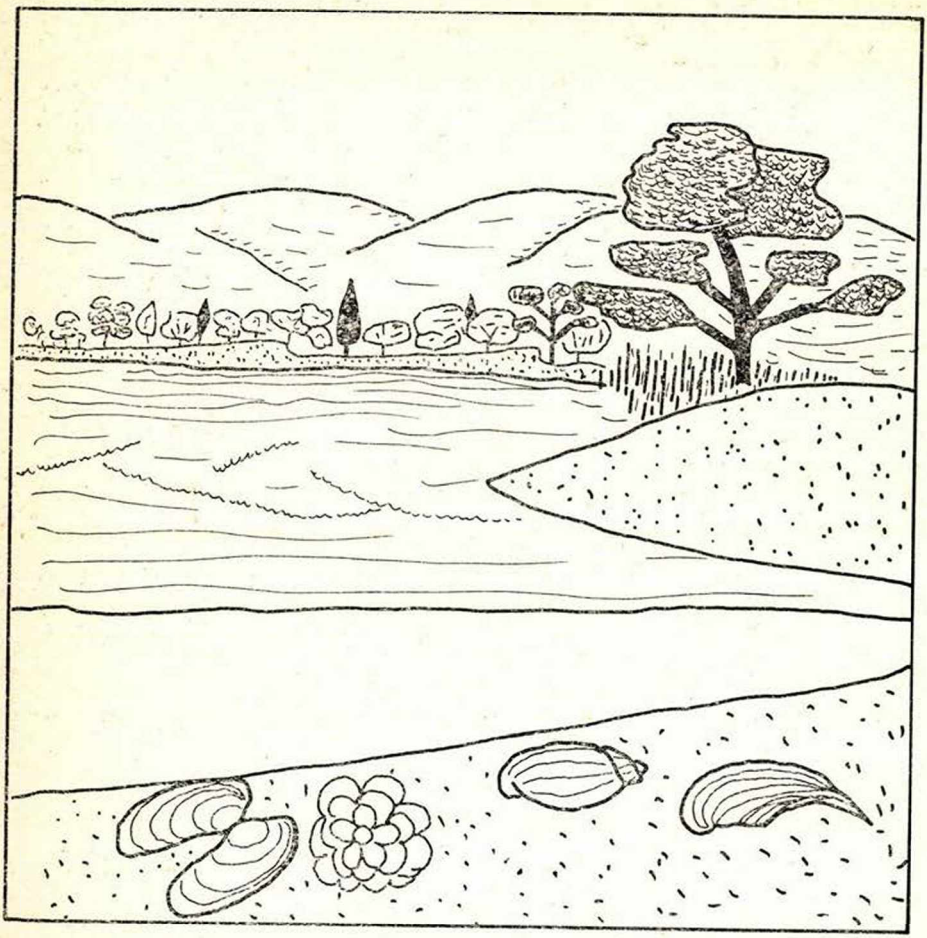

Fig. 4. The Pannonian landscape at Mindszentkálla.

1966). Also, the today exclusively freshwater *Unio* genus contains Pannonian species *(U. aiavus, U. mihanovici)*, which occur together in great numbers with the marine, probably brackish water Lymnocardiums.

The plant community unanimously indicates Maditerranean climate of the lakeshore, due to the moderating influence of the large mass of water of the Pannonian lake. Recent *Myrica* species live along sea and lake shores, mostly on brackish water marshes and on dunes. Majority of them keep their leaves or evergreen. The *Rhamnus alaternus* and the Aleppo Pine exclusively live in Mediterranean regions with winter rainfall, and 15–18 °C yearly median temprerature. The contradiction between the xerophilous flora and the high rainfall needed to form pure quartz sand can be solved. For example, the Aleppo Pine lives in southern Dalmatia, under 2000 mm

yearly rainfall, too. The distribution of precipitation, the microclimate and the rocks on the surface – Pannonian dune sand or Triassic karst here – are the major factors for the formation of the edaphic plant community.

Acknowledgements

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REFERENCES

ANDREÁNSZKY G. (1959): Die Flora der Sarmatischen Stufe in Ungarn. – Akadémiai Kiadó, Budapest

BARTHA F. (1959): Feinstratigraphische Untersuchungen am Oberpannon der Balatongegend. – Annales Inst. Geol. Publ. Hung. 48 pp. 1 – 191.

BARTHE F. (1971): A magyarországi pannon biosztratigráfiai vizsgálata. – in: A magyarországi pannonkori képződmények kutatásai pp. 9 – 172. Akadémiai Kiadó, Budapest (In Hungarian)

BRUSINA S. (1902): Iconographia molluscorum fossilium in tellure tertiaria Hungariae, Croatiae, Slavoniae, Dalmatiae, Bosniae, Herzegovinae, Serbiae et Bulgariae inventorum. – Zagreb.

DAVITASHVILI L. S. – MERKLIN R, L. (eds.) (1966): Spravochnik po ekologii morskih dvustvorok. – Moscow

FUCHS TH. (1870): Beiträge zur Kenntnis fossiler Binnenfaunen 4 und 5: Die Fauna der Congerienschichten von Tihany am Plattensee und Kup bei Pápa in Ungarn. – Jahrbuch d. k. k. Geol. Reichsanstalt 20 pp. 351 – 548.

HAJÓS M. (1954): Quarzsandstein-, Glas- und Giessand-Vorkommen aus Alsókőhát und Nyárvölgy in Kővágóörs. – Földtani Közlöny 84 pp. 356 – 361.

HALAVÁTS GY. (1886): Őslénytani adatok Délmagyarország neogén korú üledékei faunájának ismeretéhez. – A m. kir. Földt. Int. Évk. 8 pp. 117 – 135 (In Hungarian)

HALAVÁTS GY. (1911): Die Fauna der pontischen Schichten der Umgebung des Balatonsees. – in: Resultate der wissenschaftlichen Erforschung des Balatonsees 1/1/Pal. Anh. 4/2 pp. 1 – 80.

HÖRNES M. (1870): Die fossilien Mollusken der Tertiärbeckens von Wien. – Abh. d. k. k. Geol. Reichsanstalt, Wien.

JÁMBOR Á. (1980): Pannonian in the Transdanubian Central Mountains. – Annales Inst. Geol. Publ. Hung. 62

KORPÁS-HÓDI M. (1983): Paleoecology and biostratigraphy of the Pannonian Mollusca fauna in the northern foreland of the Transdanubian Central Range. – Annales Inst. Geol. Publ. Hung. 66.

LÓCZY L. (1916): Die geologischen Formationen der Balatongegend und ihre regionale Tektonik. – in: Resultate der wissenschaftlichen Erforschung des Balatonsees, Wien.

LŐRENTHEY I. (1911): Beiträge zur Fauna und stratigraphischen Lage des pannonischen Schichten in der Umgebung des Balatonsees. – in: Resultate der wissenschaftlichen Erforschung des Balatonsees 1/1/ Pal. Anh. 4/3 pp. 1 – 215.

LUEGER J. (1980): Die Molluskenfauna aus dem Pannon (Obermiozän) des Fölligberges (Eisenstädter Bucht) im Burgenland (Österreich). – Mitt. österr. geol. Ges. 73 pp. 95 – 134.

MIROV N. T. (1967): The genus Pinus. – The Ronald Press Co., New York

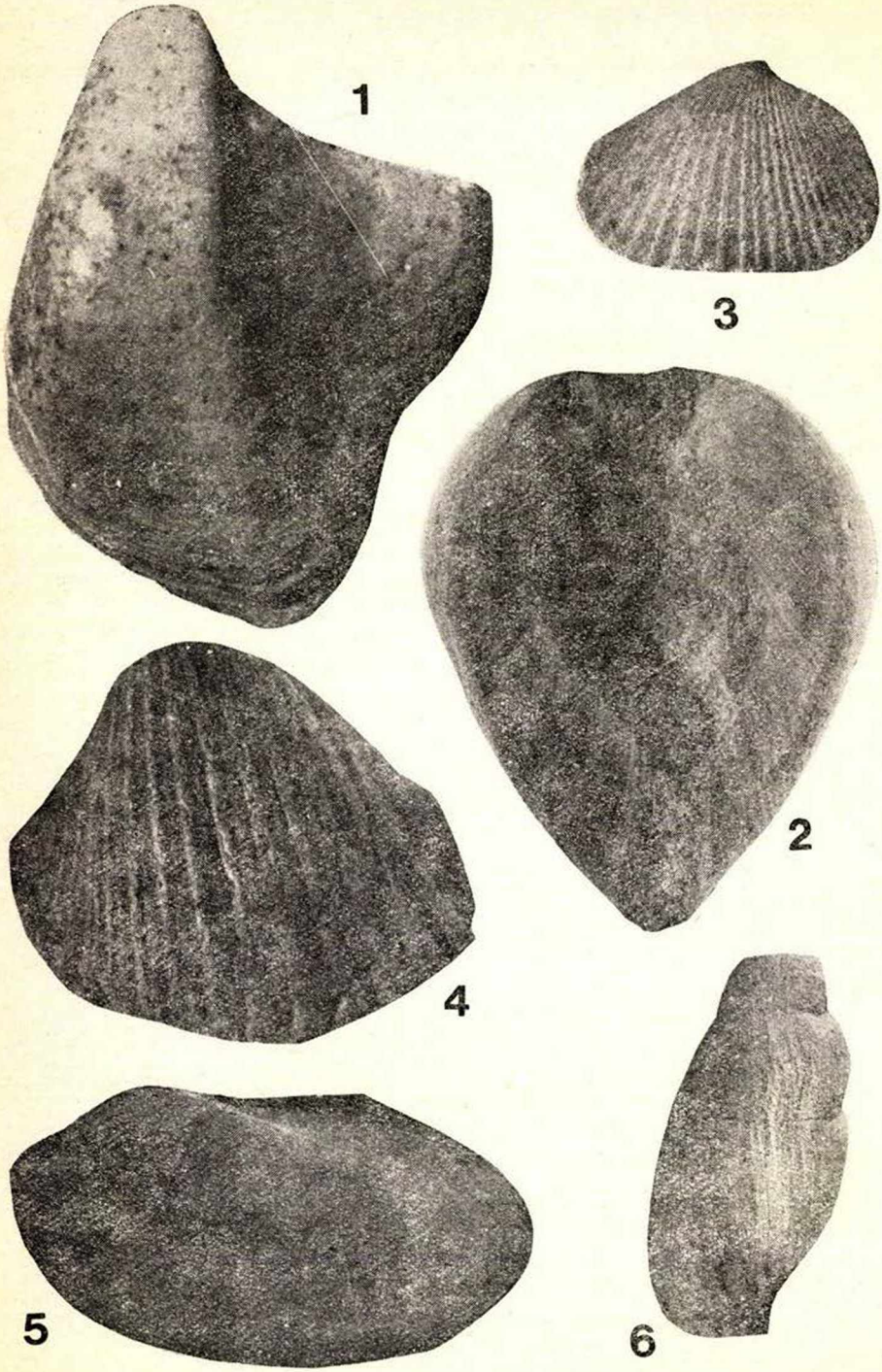
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PLATE 1.

Figs. 1 – 2. *Congeria* sp.

Fig. 3. *Lymnocardium* cf. *majeri* (HÖRNES). 1,5 x

Fig. 4. *Lymnocardium* cf. *soproniense* VITÁLIS

Fig. 5. *Unio atavus* HÖRNES

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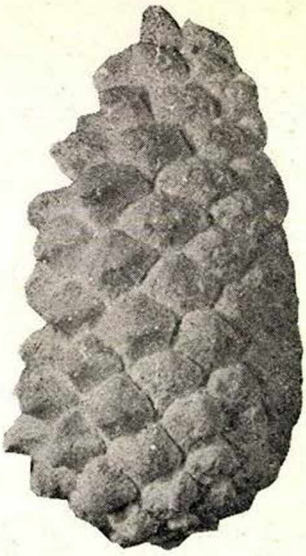

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PLATE 2.

Figs. 1–2. *Pinus* cf. *rostrata* (MILLER)

Fig. 3. *Pinus* cf. *silvestris* LINNÉ

Fig. 4. *Myrica* sp.

Fig. 5. *Rhamnus alaternus* LINNÉ

Fig. 6. *Pinus halepensis* MILLER

MÜLLER P. – SZÓNOKY M. (in prep.): Faciostratotype Tihany-Fehérpart. – in: STEVANOVIC (red.): Chronostratigraphie und Neostratotypen 8. Pontien

PAPP A. (1953): Die Molluskenfauna des Pannon im Wiener Becken. – Mitt. österr. geol. Ges. 44 85 – 222.

PARTSCH P. (1835): Über die sogenannten versteinerten Ziegenklauen aus dem Plattensee in Ungarn. – Annales d. Wiener Mus. d. Naturg. Bd. I pp. 93 – 102.

STRAUSZ L. (1942/a): Das Pannon des mittleren Westungarns. – Annales hist.-nat. Mus. Nat. Hung. 35 pp. 1 – 102.

STRAUSZ L. (1942/b): Pannóniai fauna Dernáról és Tatarosról. – A m. kir. Földt. Int. 1941 évi jelentésének függeléke pp. 191 – 199. (In Hungarian)

SZATMÁRI P. (1971): A kvarchomokképződés feltételei és a magyarországi felső pannon. – in: A magyarországi pannonkori képződmények kutatásai pp. 233 – 252 Akadémiai Kiadó, Budapest (In Hungarian)

VITÁLIS I. (1911): Die Ziegenklauen der Balatongegend und ihre Fundorte. – in: Resultate der wissenschaftlichen Erforschung des Balatonsees 1/1/Pal. Anh. 4/3 pp. 1 – 215.

VITÁLIS I. (1934): Limnocardium soproniense n. sp. – Mathematischer und Naturwissenschaftlicher Anzeiger der Ungarische Akademie der Wissenschaften 51 pp. 705 – 716.