

ORIGINAL RESEARCH
PAPER



New Cancellariidae (Neogastropoda) assemblages from the Middle Miocene of Hungary with description of a new species

ZOLTÁN KOVÁCS^{1*}  and ZOLTÁN VICIÁN²

¹ Department of Palaeontology, Eötvös University, Pázmány sétány 1/C, 1117 Budapest, Hungary

² Neptun utca 86., 10/42, H-1158 Budapest, Hungary

Received: March 20, 2020 • Accepted: September 23, 2020

Published online: March 4, 2021

ABSTRACT

In this paper we review five cancellariid assemblages from the Hungarian part of the Pannonian Basin (Börzsöny, Bakony, and Mecsek Mts regions) which yielded 26 species. Ten species are recorded for the first time in Hungary. One species, *Scalptia nemethi* n. sp. is described as new. A revision of the Hungarian museum collections and historical Hungarian literature is also provided. *Sveltia salbriacensis* Peyrot 1928 is considered a junior subjective synonym of *Petitina inermis* (Pusch 1837).

KEYWORDS

Miocene, Badenian, Cancellariidae, Central Paratethys, Pannonian Basin

INTRODUCTION

The aim of this paper is to review the early Badenian (early Middle Miocene) distribution of the family Cancellariidae in the Hungarian part of the Pannonian Basin (Central Paratethys) by investigation of five recently collected mollusk assemblages (Börzsöny Mts: Letkés, Bakony Mts: Bánd, and Devecser, Mecsek Mts: Mecsekpölöske and Tekeres, Fig. 1). In the previous literature the cancellariids were underrepresented; only three species were documented from Letkés (Csepregy-Meznerics 1956; Strausz 1966), three from Bánd (Kókay 1966), and two from Devecser (Csepregy-Meznerics 1958; Strausz 1966). For this study gastropod collections of the Hungarian Natural History Museum, Budapest (HNHM), and the Mining and Geological Survey of Hungary, Budapest (MGSH) were also revisited. Photos of the cancellariid assemblage from Letkés in the Senckenberg Forschungsinstitut, Frankfurt am Main (SFI) were studied; these specimens were collected by Helmut Krock, late German fossil collector.

As a result of the research 26 species are described and illustrated in this paper; 21 species are recorded from Letkés, seven from Bánd, five from Devecser and Tekeres, and two from Mecsekpölöske. Ten taxa, *Bonellitia austriaca* (Hoernes and Auinger), *Contortia callosa* (Hörnes), *Contortia tortoniana* (Sacco), *Merica obsoleta* (Hörnes), *Ovilia excassidea* (Sacco), *Perplicaria mioquadrata* (Sacco), *Scalptia dertoparva* (Sacco), *Scalptia polonica* (Pusch), *Trigonostoma exampullaceum* (Sacco) and *Tritonoharpa mariechristinae* Lesport, Cluzaud and Verhecken are recorded for the first time in Hungary; a new species, *Scalptia nemethi* n. sp., is also designated.

MATERIALS AND METHODS

The specimens investigated in this paper are stored in museum collections of the HNHM, the MGSH, and the SFI, as well as in private collections of Anton Breitenberger

*Corresponding author.
E-mail: kzkovacsoltan@gmail.com



Fig. 1. Early Badenian fossiliferous localities in Hungary discussed in the text, and their locations in the Central Paratethys. (B – Börzsöny Mts, F – Făget Basin, H – Herend Basin, KB – Korytnica Basin, LB – Lom Basin, M – Mecsek Mts, NB – Nógrád Basin, TCR – Transdanubian Central Range, SCF – South Carpathian Foredeep, VB – Vienna Basin) (modified from Haas 2012 and Sant et al. 2019)

(Austria), Tamás Hirmetzi (Fót), Zsolt Kovács (Gödöllő), László Nádai (Budapest), Tamás Németh (Balatonkenese), László Sövény (Bonyhád), Márton Zsoldos (Bakonyáná) (Hungary), Gerhard Stein (Germany), and of the authors. The Cancellariidae taxonomy and morphological terminology follow Harzhauser and Landau (2012) and Landau et al. (2006, 2013). Comprehensive works of Batuk (1997, 2006) and Cahuzac et al. (2004) were also used for taxonomical revision. Only Miocene geographical distribution of the Cancellariidae is cited; for Pliocene ranges see Landau et al. (2006) and Harzhauser and Landau (2012).

Abbreviation: shell length (SL) and shell width (SW) in mm.

Geologic settings and the gastropod fauna

Letkés (W Börzsöny Mts, N Hungary). Letkés is a Middle Miocene site in the northern part of the Pannonian

Basin. A comprehensive work of Badenian mollusks of Szob and Letkés was published by Csepregy-Meznerics (1956), describing 280 gastropod and 86 bivalve taxa. The locality studied herein is a new excavation situated about 400 m eastward of the village of Letkés (47.888319° N, 18.784647° E). The deposits are characterized by resedimented beds consisting of limonitic marly sand with andesite rock fragments, andesitic tuff and eroded colonial coral blocks – the sediments represent the Lower Badenian Pécsszabolcs Member of the Lajta Formation (referred to as Sámsonháza Fm. in former literature, see Kercksmár 2015) that was deposited in littoral–sublittoral zones. The extremely rich macrofauna shows a mixture of taxa deriving from different biotopes. Five superfamilies or families have been revised within the gastropod assemblage: Conoidea (Kovács and Vicián 2014; Harzhauser and Landau 2016), Siphonarioidea (Harzhauser et al. 2017), Tonnoidea and Ficoidea (Kovács and Vicián 2018), and Muricidae (Kovács 2018; Kovács et al. 2018), as well as several uncommon species of special interest were described by Vicián et al. (2017).

Three cancellariid species were recorded at Letkés by Csepregy-Meznerics (1956) and Strausz (1966). In the newly collected mollusk material, more than 400 cancellariid specimens were determined at species level, representing 21 species (Table 1).

Table 1. Cancellariidae species of the investigated early Badenian assemblages

	Letkés	Bánd	Devecser	Tekerkes
<i>Bonellitia austriaca</i>	3	–	–	–
<i>Pseudobabylonella nysti</i>	–	–	3	–
<i>Cancellicula dregeri</i>	1	–	–	–
<i>Bivetiella dertonensis</i>	25	–	1	–
<i>Calcarata vindobonensis</i>	3	–	–	7
<i>Contortia callosa</i>	51	–	–	–
<i>Contortia fenestrata</i>	6	–	–	1
<i>Contortia saccoi</i>	1	–	–	–
<i>Contortia tortoniana</i>	–	1	4	–
<i>Merica obsoleta</i>	7	–	–	–
<i>Ovilina excassidea</i>	7	–	–	–
<i>Perplicaria mioquadrata</i>	–	–	–	1
<i>Petitina inermis</i>	4	–	–	–
<i>Scalptia dertoparva</i>	1	–	–	–
<i>Scalptia gradata</i>	93	6	–	–
<i>Scalptia nemethi</i> n. sp.	1	58	–	–
<i>Scalptia neugeboreni</i>	6	1	–	–
<i>Scalptia polonica</i>	140	–	–	–
<i>Scalptia spinosa</i>	7	–	–	3
<i>Sveltia dertovaricosa</i>	8	1	5	100
<i>Sveltia lyrata</i>	–	–	150	–
<i>Trigonostoma</i>	10	–	–	–
<i>exampullaceum</i>				
<i>Trigonostoma exgeslini</i>	6	67	–	–
<i>Venturia imbricata</i>	22	55	–	–
<i>Tritonoharpa</i>	5	–	–	–
<i>mariechristinae</i>				

Mollusks of Letkés represent shallow to deeper-water biotopes (Kovács and Vicián 2014), so the gastropod alpha diversity is generally high. The Cancellariidae material is among the most highly diverse assemblages in the Central Paratethys. Three species, *Contortia callosa*, *Scalptia gradata*, and *S. polonica* are dominant in the cancellariid assemblage, representing altogether 70% of the specimens. The abundance of *C. callosa* is remarkable, as the species is very rare at other Middle Miocene localities of the Paratethys. Both the Letkés and the Bánd materials are of special interest for the occurrence of a new species: *S. nemethi* n. sp. Other uncommon species such as *B. austriaca*, *Cancellicula dregeri*, *Contortia saccoi*, *M. obsoleta*, *Ovilia excassidea* or *Trigonostoma exampullaceum* are also documented. The appearance of the genus *Tritonoharpa* in Hungary is recorded for the first time.

Bánd (Herend Basin, Bakony Mts, W Hungary). Each gastropod material studied herein was collected from artificial trenches of Locality 28. The locality was described first as “Excavation 28” by Kókay (1966); it is located 250 m southeast of the village church of Bánd (47.121087° N, 17.786770° E). The deposits are characterized by mollusk and coral-bearing grey clay and yellowish clayey sand of approx. 2 m thickness; these shallow marine sediments belong to the Pécsszabolcs Member. The colonial coral, brachiopod, polyplacophoran, gastropod, and bivalve material indicate intertidal to infralittoral zones, and a patch reef paleoenvironment (Dulai 2007).

Three species were recorded from the locality by Kókay (1966). Based on revisions of museum collections and the newly collected private material, more than 190 specimens are recorded, representing seven species (Table 1).

Gastropods from this locality were recently reviewed by Vicián et al. (2017) and Kovács (2020). In the shallow-water patch reef environment, species of the nearshore are over-represented; e.g., within the turritellid material *Archimediella carpathica* Harzhauser and Landau 2019 [= *Turritella* (*Archimediella*) *dertonensis* in Kókay 1966 (non Mayer)] and *Oligodia bicarinata* (Eichwald 1830) are the most abundant. In the family Conidae *Lautoconus kovacsi* Harzhauser and Landau 2016 is the dominant species, while the muricid *Janssenia echinulata* (Pusch 1837) accounts for about 50% of the gastropods found.

Cancellariids are less diverse than at Letkés. Species of the deeper circalittoral zone, which are frequent at Letkés (e.g., *Contortia callosa*, *S. polonica*), are absent at Locality 28. The fauna is of special interest for its abundance of *S. nemethi* n. sp., the appearance of *S. neugeboreni*, and a new record in the Pannonian Basin: *Contortia tortoniana*. Three taxa: *S. nemethi* n. sp., *Trigonostoma exgeslini*, and *Venturia imbricata* predominate among the cancellariid material.

Devecser (Devecser–Nyírád Basin, Bakony Mts, W Hungary). The geology of the area was treated by Csepregy-Meznerics (1958) and Selmeczi (2003). Fauna lists of

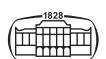
Badenian mollusks from the vicinity were published by the first author without illustrations; later two cancellariid specimens were illustrated by Strausz (1966). The locality studied herein is located on Tik Hill east of Devecser (46.10221° N, 17.46773° E), and was first recorded by Németh (2005) and Dulai (2005). Yellow marly sand of 190 cm thickness was excavated by artificial trenches; the deposit represents the Pécsszabolcs Member. The deposits are very rich in excellently preserved gastropods. One hundred and sixty-three cancellariid specimens were determined at species level, and five species are documented. We highlight the presence of *Contortia tortoniana* and the abundance of *Sveltia lyrata* (Table 1).

Tekeres (NW Mecsek Mts, SW Hungary). The geology and stratigraphy of the Orfű–Tekeres region were dealt with by Báldi et al. (2002); gastropods were recorded from borehole Tekeres-1 by Bohn-Havas (1973). The Lower Badenian deposits belong to the Pécsszabolcs Member and the Tekeres Schlier Formation (the latter represents offshore marine environments). The locality studied herein is located 100 m east of Lake Herman Ottó in a forested area (46.17449° N, 18.13063° E); it was first recorded by Bosnakoff, 2013. Clayey sand of 180 cm thickness was excavated by artificial trenches; the deposit represents the Pécsszabolcs Fm. The macrofauna is very rich in Badenian invertebrate and vertebrate fossils. The analysis of the gastropod assemblage is in progress; the family Muricidae was investigated by Kovács (2020).

The gastropod material was collected by the staff of the HNHM (M. Szabó, A. Dulai) and T. Németh. Eighty-two specimens were determined at species level, representing five species (Table 1).

The deposit indicates nearshore to offshore paleoenvironment. The gastropod fauna is dominated by the turritellid *Ptychidia vindobonensis* (Handmann 1882) and the aporhaid *Aporrhais dactylifera* (Boettger 1902); from the Conidae only one species, *Conilithes exaltatus* (Eichwald 1830) appears frequently. The cancellariid diversity is low. Of special interest are the presence of the rare genus *Perplicaria*, and the extended geographical range of the other species. The dominant cancellariid is *Sveltia dertovaricosa*, that otherwise occurs only sporadically in other Badenian localities of the Pannonian Basin; it forms 89% of the family. Bathymetric ranges of two abundant species, *Calcarata vindobonensis* and *S. dertovaricosa* can be inferred from the habitats of their Late Miocene–Pliocene descendants. *Calcarata calcarata* (Brocchi 1814) is abundant in the deep circalittoral zone, while *Sveltia varicosa* (Brocchi 1814) is typical of the sublittoral inner neritic settings (Brunetti et al. 2011). The faunal composition of the assemblage is unique in the Pannonian Basin, as a few gastropod species [e.g., *P. mioquadrata* or the muricid *Pteropurpura friedbergi* (Cossmann and Peyrot 1924)] appear only at Tekeres in Hungary (Kovács 2020).

Mecsekpölöske (N Mecsek Mts, SW Hungary). The geology and stratigraphy of the Mecsekpölöske region were treated



by Strausz (1928) and Chikán (1991). The Lower Badenian deposits of the area represent the Pécsszabolcs Member. The newly discovered locality is located 1 km east of the village in a ravine on the western side of the Nagy Hill (46.22311° N, 18.22904° E). Three collections were examined: the mollusk assemblage collected by the staff of the HNHN (M. Szabó, A. Dulai) and the private collections of T. Németh and L. Sövény.

Alternating layers of mollusk-bearing limestone and dark yellow sandy clay of approx. 3 m thickness were excavated in the locality. The analysis of the gastropod fauna is in progress (Kovács 2020). Two species, *Bivetiella dertonensis* (Bellardi 1841) (2 specimens) and *Scalptia hidasensis* (Hoernes and Auinger 1890) (20 specimens) represent the Cancellariidae; the latter is relatively common in the assemblage. *S. hidasensis* has been known only from Hidas in the Pannonian Basin.

Systematic paleontology

Class Gastropoda Cuvier, 1795.

Order Neogastropoda Wenz 1938.

Superfamily Cancellarioidea Forbes and Hanley 1851.

Family Cancellariidae Forbes and Hanley 1851.

Admetula-clade (sensu Harzhauser and Landau 2012).

Genus *Bonellitia* Jousseume 1887.

Type species: *Cancellaria bonellii* Bellardi 1841

Bonellitia austriaca (Hoernes and Auinger 1890) (Fig. 2/A)

1890 *Cancellaria Austriaca* nov. form. – Hoernes and Auinger, p. 275, Pl. 33, Figs 15/A–C.

2012 *Bonellitia austriaca* (Hoernes and Auinger) – Harzhauser and Landau, p. 10, Figs 3/B, 4/B, C (cum syn.).

Studied material: 3 specimens (max. SL 10 mm, SW 6 mm). HNHN: INV 2020.45. SFI: Krock Coll.: 444322, 444577.

Remarks: *B. austriaca* differs from the congeners by characteristic sculpture. The strong axial ribs are crossed by raised spiral cords producing a cancellate pattern of deep, subquadrate interspaces (Harzhauser and Landau 2012). The genus is known in the Badenian Pannonian Basin, *Bonellitia bonellii* (Bellardi) was recorded by Strausz (1966) and Csepregy-Meznerics (1969). *B. austriaca* is newly recorded in the Pannonian Basin; it occurs in the gastropod assemblage of Letkés.

Distribution: Central Paratethys. ?Ottangian: North Alpine Foreland Basin (S Germany), Badenian: Vienna Basin (Austria), Southern Moravia (Czechia), Pannonian Basin (Hungary: Börzsöny Mts: Letkés).

Subfamily Admetinae Troschel 1865.

Genus *Pseudobabylonella* Brunetti, Della Bella, Forli and Vecchi 2009

Type species: *Cancellaria minima* Reeve 1856.

Pseudobabylonella nysti (Hörnes 1854).

1854 *Cancellaria nysti* – Hörnes, p. 305, Pl. 34, Fig. 1.

1956 *Admete (Babylonella) fusiformis nysti* Hörnes – Csepregy-Meznerics, p. 418, Pl. 9, Figs 11–12, 18–19, 28–29.

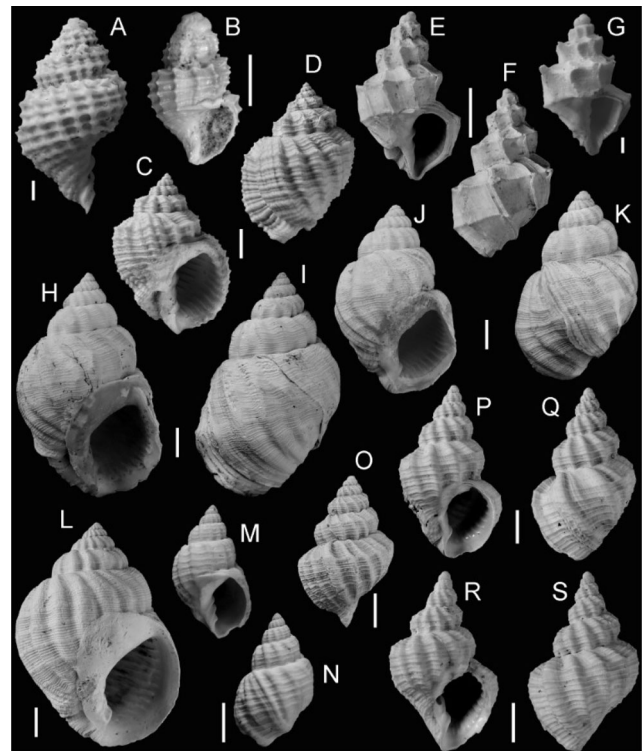


Fig. 2. (A) *Bonellitia austriaca* (Hoernes and Auinger), SL 10, Letkés (HNHN: INV 2020.45). (B) *Cancellicula dregeri* (Hoernes and Auinger), SL 3, Letkés (444441, Coll. Krock, SFI). (C–D) *Bivetiella dertonensis* (Bellardi), SL 27, Letkés (Coll. Németh). (E–G) *Calcarata vindobonensis* (Hilber): (E–F) SL 17.5, Tekeres, (G) SL 9, Letkés (Coll. Németh). (H–L) *Contortia callosa* (Hörnes), Letkés: (H–I) SL 38 (Coll. Nádai), (J–K) SL 32.2 (Coll. Hirmetzl), (L) SL 38 (Coll. Németh). (M–N) *Contortia fenestrata* (Eichwald), SL 17, Letkés (Coll. Hirmetzl). (O) *Contortia saccoi* (Hoernes and Auinger), SL 22, Letkés (Coll. Hirmetzl). (P–S) *Contortia tortoniana* (Sacco), Devecser: (P–Q) SL 26.2, (R–S) SL 23.3 (Coll. Németh). Scale bars: 1 mm for A–B, G; 5 mm for C–D, H–S

1966 *Cancellaria (Admete) fusiformis nysti* Hörnes – Strausz, p. 384, Pl. 12, Figs 13–14.

2012 *Pseudobabylonella nysti* (Hörnes) nov. comb. – Harzhauser and Landau, p. 13, Figs 3/C, 4/E (cum syn.).

Studied material: 3 specimens in private collections (max. SL 8.8 mm, SW 3 mm).

Remarks: The taxonomic arrangement of *C. nysti* was discussed by Harzhauser and Landau (2012), and it was assigned to the genus *Pseudobabylonella*. The species was the most frequent cancellariid in the locality of Szob (Csepregy-Meznerics 1956), but it is uncommon at other sites of the Pannonian Basin. *P. nysti* is a new occurrence at Devecser.

Distribution: Central Paratethys. Badenian: Vienna Basin (Austria, Czechia), Pannonian Basin (Hungary: Börzsöny Mts: Szob, Cserhát Mts: Mátraverebély, Bakony Mts: Devecser, Mecsek Mts: Pécsvárad), Făget Basin (Romania).

Genus *Cancellicula* Tabanelli 2008.

Type species: *Cancellaria (Narona) Dregeri* Hoernes and Auinger 1890.

Cancellicula dregeri (Hoernes and Auinger 1890) (Fig. 2/B)

1890 *Cancellaria* (e. *Narona*?) *Dregeri* nov. form. – Hoernes and Auinger, p. 280, Pl. 33, Figs 18–19.

1969 *Cancellaria dregeri* Hoernes et Auinger – Csepregy-Meznerics, p. 94, Pl. 5, Figs 20, 32.

2012 *Cancellicula dregeri* (Hoernes and Auinger) – Harzhauser and Landau, p. 16, Figs 3/F, 4/F–G (*cum syn.*).

Studied material: 1 specimen (SL 3 mm, SW 1.8 mm). SFI: Krock Coll.: 444441.

Remarks: The specimen figured here with flattened protoconch and teleoconch sculpture corresponds to the holotype and the syntype of *Cancellicula dregeri* reillustrated by Harzhauser and Landau (2012). The species is typical of deeper water environments of the Neogene Paratethys and the Proto-Mediterranean Sea. Although it is widely distributed in the Central Paratethys, *C. dregeri* is rare in Pannonian Basin localities. Only one fragmentary specimen appears in the gastropod assemblage of Letkés; it was collected by H. Krock. We were able to study photos by courtesy of Ronald Janssen and Sigrid Hof.

Distribution: Middle Miocene–Pleistocene. Central Paratethys. Badenian: Vienna Basin (Austria, Czechia), Eisenstadt–Sopron Basin (Austria), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Bükk Mts: Borsodbóta), Făget Basin (Romania). Proto-Mediterranean Sea. Tortonian–Messinian: Torino Hills (Italy).

Subfamily Cancellariinae Forbes and Hanley 1851.

Genus *Bivetiella* Wenz 1943.

Type species: *Cancellaria similis* Sowerby 1833.

Bivetiella dertonensis (Bellardi 1841) (Fig. 2/C–D)

1841 *Cancellaria bonellii* var. *Dertonensis* Bell. – Bellardi, p. 248, Pl. 3, Figs 11–12.

1890 *Cancellaria subcancellata* – Hoernes and Auinger, p. 273 (non d'Orbigny).

1954 *Cancellaria subcancellata perscalarata* – Csepregy-Meznerics, p. 49, Pl. 6, Figs 19–21 (reillustrated by Strausz 1966, Pl. 44, Figs 2–3) (non Sacco).

1956 *Cancellaria* (*Cancellaria*) *subcancellata* – Csepregy-Meznerics, p. 415, Pl. 9, Figs 32–35 (non d'Orbigny).

1966 *Cancellaria cancellata dertonensis* Bellardi – Strausz, p. 376, Pl. 45, Figs 5–6.

non 1966 *Cancellaria cancellata dertonensis* – Strausz, Pl. 45, Figs 2–4 [= *Contortia fenestrata* (Eichwald 1830)].

1971–1972 *Cancellaria cancellata perscalarata* – Csepregy-Meznerics, Pl. 14, Fig. 26 (non Sacco).

1973 *Cancellaria cancellata* – Borza, Pl. 3, Fig. 4 (non Linnaeus).

2011 *Bivetiella praecedens* – Brunetti et al., Fig. 2/D, E (non Beyrich).

2012 *Bivetiella dertonensis* (Bellardi) – Harzhauser and Landau, p. 18, Figs 3/H, 5/B–D (*cum syn.*).

2013 *Bivetiella dertonensis* (Bellardi) – Landau et al., p. 224, Pl. 35, Fig. 3, Pl. 80, Fig. 11.

Studied material: 28 specimens (max. SL 27 mm, SW 19.7 mm). HNHM: M.62.885. Private collections: 27 specimens.

Remarks: The taxonomical revision of the species was arranged by Harzhauser and Landau (2012). *B. dertonensis* is widespread in the Paratethys, and appears in numerous Badenian localities in Hungary; however, it is usually a rare element of the gastropod assemblages. Based on morphology the specimen figured by Brunetti et al. (2011, Fig. 2/D, E) as *B. praecedens* from the Badenian of Szob is here considered as a representative of *B. dertonensis*.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Eisenstadt–Sopron Basin, Styrian Basin (Austria), Vienna Basin (Austria, Czechia), Korytnica Basin (Poland), Pannonian Basin (Hungary: Börzsöny Mts: Szob, Letkés, Hont, Cserhát Mts: Sámsonháza, Bükk Mts: Borsodbóta, Bakony Mts: Devecser, Mecsek Mts: Hidas, Mecsekpölöske), Făget Basin (Romania). NE Atlantic. Serravallian: Aquitanian Basin (France), Montjuic Basin (Spain), Tortonian: Cacela Basin (Portugal). Proto-Mediterranean Sea. Serravallian–Tortonian: Karaman Basin (Turkey), Tortonian–Messinian: Po Basin (Italy).

Genus *Calcarata* Jousseaume 1887.

Type species: *Voluta calcarata* Brocchi 1814.

Calcarata vindobonensis (Hilber 1892) (Fig. 2/E–G)

1892 *Cancellaria* (*Trigonostoma*) *calcarata* Broc. var. *Vindobonensis* Hilb. – Hilber, p. 1020.

1956 *Cancellaria* (*Calcarata*) *calcarata* – Csepregy-Meznerics, p. 417, Pl. 9, Figs 36–39 (non Brocchi).

1966 *Cancellaria* (*Calcarata*) *calcarata* – Strausz, p. 381, Text-fig. 166, Pl. 43, Figs 16–18 (non Brocchi).

2012 *Calcarata vindobonensis* (Hilber) nov. comb. – Harzhauser and Landau, p. 19, Figs 3/I, 5/A (*cum syn.*).

Studied material: 10 specimens (max. SL 17.5 mm, SW 10.5 mm). HNHM: INV 2020.54 (4 spec.). SFI: Krock Coll.: 444107A–B. Private collections: 4 specimens.

Remarks: Based on taxonomical revision the *Cancellaria calcarata* recorded in the Badenian Central Paratethys were assigned to *vindobonensis* by Harzhauser and Landau (2012). The latter species differs from the Late Miocene–Pliocene *Calcarata calcarata* (Brocchi) in morphology by presence of weakly developed spiral cords on the last whorl between the shoulder and the basal carina, and on the base, by shorter base and less developed basal spiral carina. Based on new collecting work the occurrence of the species is documented in the Letkés, Tekeres and Hidas gastropod assemblages; these records extend the geographical range of *C. vindobonensis* in the Pannonian Basin.

Distribution: Central Paratethys. Badenian: Vienna Basin (Austria, Czechia, Slovakia), Korytnica Basin (Poland), Pannonian Basin (Bosnia; Hungary: Börzsöny Mts: Szob, Letkés, Mecsek Mts: Bodolyabér, Hidas, Pécsvárad, Tekeres), Făget Basin, Caransebeș Basin, Transylvanian Basin (Romania), Krka Basin (Slovenia), South Carpathian Foredeep (Bulgaria).

Genus *Contortia* Sacco 1894.

Type species: *Cancellaria contorta* Basterot 1825.

Contortia callosa (Hörnes 1854) (Fig. 2/H–L)

1854 *Cancellaria callosa* Partsch – Hörnes, p. 314, Pl. 34, Figs 14–16.



2012 *Contortia callosa* (Hörnes) nov. comb. – Harzhauser and Landau, p. 21, Figs 3/J, 5/E, F, G (*cum syn.*).

2013 *Contortia callosa* (Hörnes) – Landau et al., p. 226, Pl. 35, Figs 5–6, Pl. 69, Fig. 6, Pl. 80, Fig. 12.

Studied material: 51 specimens in private collections (max. SL 38.2 mm, SW 27.8 mm).

Remarks: *Contortia callosa* differs from its congeners by a larger and more robust shell with fine spiral threads and broad, weakly developed axial ribs. The species displays moderate morphological variability in height of the spire. *C. callosa* is widely distributed in the Paratethys and the Proto-Mediterranean Sea but generally rare. It is a new occurrence in the Pannonian Basin, occurring in the recently discovered early Badenian fossiliferous locality near Kisbattyán (for detailed description of the site see Kovács 2020), and in the Letkés assemblage, where its relative abundance is notable.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Vienna Basin, Eisenstadt–Sopron Basin (Austria), Korytnica Basin (Poland), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Mecsek Mts: Kisbattyán), Făget Basin (Romania). Proto-Mediterranean Sea. Langhian: Torino Hills (Italy), Serravallian–Tortonian: Karaman Basin (Turkey).

Contortia fenestrata (Eichwald 1830) (Fig. 2/M–N)

1830 *Cancellaria fenestrata* – Eichwald, p. 222.

1956 *Cancellaria* (*Merica*) *fenestrata* Eichwald – Csepregy-Meznerics, p. 417, Pl. 9, Figs 24–27.

1966 *Cancellaria cancellata dertonensis* – Strausz, Pl. 45, Figs. 2–4 (non Bellardi).

2008 *Contortia contorta* – Brunetti et al., Fig. 7/E–F (non Basterot).

2012 *Contortia fenestrata* (Eichwald) nov. comb. – Harzhauser and Landau, p. 23, Fig. 5/H, I (*cum syn.*).

Studied material: 7 specimens in private collections (max. SL 17 mm, SW 10.2 mm).

Remarks: *Contortia fenestrata* differs from *C. callosa* by its small size, slender shell, higher spire and presence of an umbilicus. The species is newly recorded at Letkés and Tekeres in the Pannonian Basin. The specimen illustrated by Brunetti et al. (2008, Fig. 7/E–F) as *Contortia contorta* from the Badenian deposits of Szob (Börzsöny Mts) in fact represents *C. fenestrata*.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Vienna Basin (Austria), Polish–Carpathian Foredeep (Poland, Ukraine), Pannonian Basin (Bosnia; Hungary: Börzsöny Mts: Szob, Letkés, Mecsek Mts: Hidas, Tekeres), Făget Basin (Romania), South Carpathian Foredeep (Bulgaria).

Contortia sacoi (Hoernes and Auinger 1890) (Fig. 2/O)

1854 *Cancellaria Bellardii* – Hörnes, p. 314, Pl. 34, Fig. 17 (non Michelotti).

1890 *Cancellaria Sacoi* – Hoernes and Auinger, p. 274 pars. 1969 *Cancellaria* (*Bonellitia*) *evulsa taurina* – Csepregy-Meznerics, p. 93, Pl. 5, Figs 35, 36 (non Sacco).

1971–1972 *Cancellaria fenestrata* – Csepregy-Meznerics, Pl. 14, Figs 17, 19 (non Eichwald).

2012 *Contortia sacoi* (Hoernes and Auinger) nov. comb. – Harzhauser and Landau, p. 25, Fig. 6/A, B (*cum syn.*).

Studied material: 1 specimen in private collection (SL 22 mm, SW 13.9 mm).

Remarks: The species differs from the similar *C. tortoniana* in having a somewhat broader shell, lower spire, strong varices on the last whorl, two columellar folds (as opposed to three in *C. tortoniana*) and lack of an umbilicus.

Distribution: Central Paratethys. Badenian: Vienna Basin, Eisenstadt–Sopron Basin, Styrian Basin (Austria), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Bükk Mts: Borsodbóta, Balaton, Csermely), Făget Basin (Romania).

Contortia tortoniana (Sacco 1894) (Fig. 2/P–S, Fig. 3/A–B)

1854 *Cancellaria Bellardii* – Hörnes, p. 314, Pl. 34, Fig. 18 (non Michelotti).

1894 *Cancellaria* (*Bonellitia*) *evulsa* var. *tortoniana* – Sacco, p. 46.

1966 *Cancellaria* (*Merica*) *fenestrata* – Strausz, Pl. 45, Fig. 7 (non Eichwald).

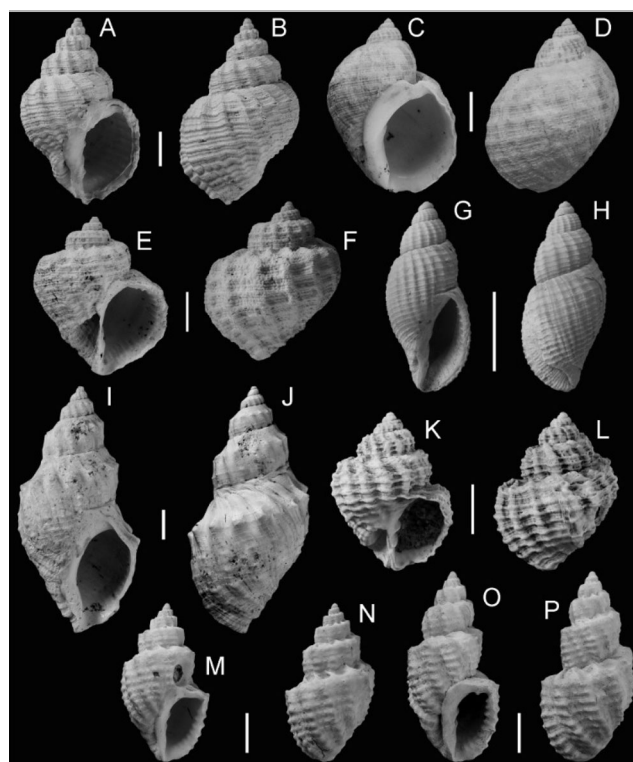


Fig. 3. (A–B) *Contortia tortoniana* (Sacco), SL 27, Bánd (Coll. Németh).

(C–D) *Merica obsoleta* (Hörnes), SL 22, Letkés

(Coll. Hirmetzl). (E–F) *Ovilia excassidea* (Sacco), SL 20, Letkés

(Coll. Náda). (G–H) *Perplicaria mioquadrata* (Sacco), SL 12,

Tekeres (Coll. Németh). (I–J) *Petitina inermis* (Pusch), SL 41,

Letkés (HNHM: INV 2020.46). (K–L) *Scalptia dertoparva* (Sacco),

SL 16, Letkés (Coll. Hirmetzl). (M–P) *Scalptia gradata* (Hörnes),

Letkés: (M–N) SL 20 (HNHM: INV 2020.47), (O–P) SL 24

(Coll. Hirmetzl). Scale bar: 5 mm

2012 *Contortia tortoniana* (Sacco) nov. comb. – Harzhauser and Landau, p. 25, Fig. 6/C, D (*cum syn.*).

Studied material: 5 specimens in private collections (max. SL 27 mm, SW 17.3 mm).

Remarks: The taxonomical revision of the species was provided by Harzhauser and Landau (2012). *Contortia tortoniana* is characterized by moderate morphological variability in height of the spire and the strength of the sculpture. It differs from the similar *C. sacoi* by a somewhat higher spire, lack of varices on the last whorl and three columellar folds. *C. tortoniana* is newly recorded in the Pannonian Basin.

Distribution: Central Paratethys. Badenian: Vienna Basin, Eisenstadt–Sopron Basin (Austria), Korytnica Basin (Poland), Pannonian Basin (Hungary: Bakony Mts: Bánd, Devecser), Făget Basin (Romania), South Carpathian Foredeep (Bulgaria).

Genus *Merica* H. and A. Adams 1854.

Type species: *Cancellaria melanostoma* G. B. Sowerby II 1849.

Merica obsoleta (Hörnes 1856) (Fig. 3/C–D)

1856 *Cancellaria obsoleta* – Hörnes, 678, Pl. 52, Fig. 3.

2012 *Merica obsoleta* (Hörnes) – Harzhauser and Landau, p. 29, Fig. 6/I, J (*cum syn.*).

Studied material: 7 specimens (max. SL 22.6 mm, SW 16.8 mm). SFI: Krock Coll.: 444468, 444483. Private collections: 5 specimens.

Remarks: Three species of the genus: *Merica crenata* (Hörnes 1856), *M. obsoleta* (Hörnes 1856) and *Merica succineiformis* (Boettger 1906) were recognized by Harzhauser and Landau (2012); all three are very uncommon. *M. crenata* and *succineiformis* are locally endemic species; the first is known from Grund (Austria), the second from Coșteiu de Sus (Romania). *M. obsoleta* has been recorded from both sites; however, in the Badenian it is known only at Grund. The species is a new occurrence in the Pannonian Basin.

Distribution: Central Paratethys. Karpatian: Waschberg Unit (Austria), Badenian: North Alpine Foreland Basin (Austria), Pannonian Basin (Hungary: Börzsöny Mts: Letkés).

Genus *Ovilia* Jousseume 1887.

Type species: *Cancellaria doliolaris* Basterot 1825.

Ovilia excassidea (Sacco 1894) (Fig. 3/E–F)

1856 *Cancellaria cassidea* – Hörnes, p. 682, Pl. 52, Fig. 8 (non Brocchi).

1894 *Cancellaria* (*Trigonostoma*) *cassideum* forma *excassidea* – Sacco, p. 8.

2012 *Ovilia excassidea* (Sacco) nov. comb. – Harzhauser and Landau, p. 32, Fig. 7/C (*cum syn.*).

2013 *Ovilia excassidea* (Sacco) – Landau et al., p. 232, Pl. 36, Fig. 9.

Studied material: 7 specimens in private collections (max. SL 20 mm, SW 17 mm).

Remarks: This uncommon species has been known only from the Vienna and the Karaman basins; it is recorded for the first time in the Pannonian Basin.

Distribution: Central Paratethys. Badenian: Vienna Basin (Austria), Pannonian Basin (Hungary: Börzsöny Mts: Letkés). Proto-Mediterranean Sea. Serravallian: Karaman Basin (Turkey).

Genus *Perplicaria* Dall 1890.

Type species: *Perplicaria perplexa* Dall 1890.

Perplicaria mioquadrata (Sacco 1894) (Fig. 3/G–H)

1890 *Cancellaria* (d. *Merica*) *Laurensii* – Hoernes and Auinger, p. 281, Pl. 33, Fig. 1–3 (non Grateloup).

1894 *Merica mioquadrata* – Sacco, p. 66.

2012 *Perplicaria mioquadrata* (Sacco) nov. comb. – Harzhauser and Landau, p. 34, Figs 3/K, 7/F, G (*cum syn.*).

Studied material: 1 specimen in private collection (SL 12 mm, SW 5.4 mm).

Remarks: The species is widespread in the Central Paratethys but recorded for the first time in the Pannonian Basin. Only a single *P. mioquadrata* specimen is known from the mollusk assemblage of Tekeres.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin (Austria), Vienna Basin (Czechia), Korytnica Basin (Poland), Pannonian Basin (Hungary: Mecsek Mts: Tekeres), Făget Basin (Romania), South Carpathian Foredeep (Bulgaria).

Genus *Petitina* Harzhauser and Landau 2012.

Type species: *Cancellaria inermis* Pusch 1837.

Petitina inermis (Pusch 1837) (Fig. 3/I–J)

1837 *Cancellaria inermis* – Pusch, p. 129, Pl. 11, Fig. 22.

1928 *Sveltia salbriacensis* nov. sp. – Peyrot, p. 220, Pl. 13, Figs 25–26 only [27–28 = *S. lyrata* (Brocchi 1814)] (refigured by Cahuzac et al. 2004, p. 249, Fig. 9/H–K).

1956 *Cancellaria* (*Sveltia*) *inermis* Pusch – Csepregy-Meznerics, p. 416, Pl. 9, Figs 20–21.

1966 *Cancellaria* (*Sveltia*) *inermis* Pusch – Strausz, p. 380, Pl. 43, Figs 6–9.

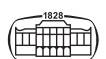
2012 *Petitina inermis* (Pusch) – Harzhauser and Landau, p. 35, Figs 3/L, 7/H, I, J (*cum syn.*).

2013 *Petitina inermis* (Pusch) – Landau et al., p. 230, Pl. 35, Figs 12–13.

2017 *Petitina inermis* (Pusch) – Biskupič, Fig. 6/E.

Studied material: 4 specimens (max. SL 52.5 mm, SW 25 mm). HNHM: INV 2020.46. SFI: Krock Coll.: 444438. Private collections: 2 specimens.

Remarks: The species is widespread in the Middle Miocene of Europe, and is characterized by significant shell variability, mainly in the height of the spire and the development of the sculpture (Harzhauser and Landau 2012). The specimen illustrated herein with high, gradate spire is closely allied in morphology to the specimen that was described as *S. salbriacensis* by Peyrot (1928) from the Late Burdigalian (or Langhian) Aquitanian Basin. According to Cahuzac et al. (2004: 249) only one specimen, the holotype of *salbriacensis*



is known. Based on size and morphology Peyrot's taxon is considered as a junior synonym of *P. inermis*.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Eisenstadt–Sopron Basin (Austria), Vienna Basin (Austria, Czechia, Slovakia), Korytnica Basin (Poland), Pannonian Basin (Hungary: Börzsöny Mts: Szob, Letkés, Bükk Mts: ?Borsodbóta), Făget Basin (Romania), Krka Basin (Slovenia). NE Atlantic and Proto-Mediterranean Sea. Seravallian–Tortonian: Aquitanian Basin (France), Adiça (Portugal), Montjuic Basin (Spain), Karaman Basin (Turkey).

Genus *Scalptia* Jousseume 1887b.

Type species: *Cancellaria obliquata* Lamarck 1822.

Scalptia dertoparva (Sacco 1894) (Fig. 3/K–L)

1856 *Cancellaria scabra* – Hörnes, p. 681, Pl. 52, Fig. 7 (non Deshayes).

1894 *Cancellaria* (*Trigonostoma*) *scabrum* var. *dertoparva* – Sacco, p. 7.

2012 *Scalptia dertoparva* (Sacco) nov. comb. – Harzhauser and Landau, p. 38, Figs 3/N, 8/C (*cum syn.*).

Studied material: 1 specimen in private collection (SL 16 mm, SW 13 mm).

Remarks: *S. dertoparva* differs in morphology from the more abundant *S. polonica* by its shorter and broader shell, wider aperture, as well as by the presence of a parietal denticle and a small umbilicus. The species is newly recorded in the Pannonian Basin.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Vienna Basin (Austria), Pannonian Basin (Hungary: Börzsöny Mts: Letkés).

Scalptia gradata (Hörnes 1854) (Fig. 3/M–P)

1854 *Cancellaria gradata* – Hörnes, p. 319, Pl. 35, Fig. 2.

1956 *Cancellaria* (*Trigonostoma*) *gradata* Hörnes – Csepregy-Meznerics, p. 416, Pl. 9, Figs 30–31.

1962 *Cancellaria* sp. – Kecskeméti-Körmendi, p. 91, Pl. 11, Fig. 16.

1966 *Cancellaria* (*Trigonostoma*) *gradata* Hörnes – Strausz, p. 378, Pl. 45, Figs 8–11.

?1966 *Cancellaria* (*Trigonostoma*) *gradata* Hörnes – Strausz, Text-fig. 165, Pl. 45, Figs 12–13.

1973 *Cancellaria* (*Trigonostoma*) *gradata* Hörnes – Bohn-Havas, p. 1061, Pl. 6, Figs 14–15 only (Figs 12–13: *Scalptia nemethi* n. sp.).

2012 *Scalptia gradata* (Hörnes) – Harzhauser and Landau, p. 42, Fig. 8/I (*cum syn.*).

Studied material: 99 specimens (max. SL 24 mm, SW 12 mm). HNHN: INV 2020.47. Private collections: 98 specimens.

Remarks: *S. gradata* is widespread in the Central Paratethys. It is a new occurrence at Letkés, where it is the second most abundant cancellariid (23%) in the cancellariid material. The *S. gradata* specimens in this assemblage are characterized by a moderate morphological variability in strength of the parietal denticle. On adult specimens the

spire may attain more than 50% of the total shell length (Fig. 3/O–P). The specimen illustrated by Strausz (1966, Pl. 45, Figs 12–13) differs from the type of *S. gradata*, and needs to be revised.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Vienna Basin, Eisenstadt–Sopron Basin (Austria), Polish–Carpathian Foredeep (Poland), Pannonian Basin (Bosnia; Hungary: Börzsöny Mts: Szob, Letkés, Cserhát Mts: Sámsonháza, Bakony Mts: Várpalota, Márkó, Bárd, Mecsek Mts: Hidas, Hosszúhetény, Pécsvárad), Făget Basin (Romania).

Scalptia hidasensis (Hoernes and Auinger 1890) (Fig. 5/A–D)

1890 *Cancellaria* (d. *Trigonostoma*) *hidasensis* nov. form. – Hoernes and Auinger, p. 276, Pl. 33, Figs 13–14.

non 1950 (*Trigonostoma*) *hidasensis* – Csepregy-Meznerics, Pl. 3, Fig. 15 [= *Trigonostoma exgeslini* (Sacco 1894)].

1966 *Cancellaria* (*Trigonostoma*) *hidasensis* Hoernes and Auinger – Strausz, p. 378, Pl. 45, Fig. 16 only.

2012 *Scalptia hidasensis* (Hoernes and Auinger) nov. comb. – Harzhauser and Landau, p. 43, Figs 3/P, 9/A, B (*cum syn.*).

Studied material: 20 specimens in private collections (max. SL 19 mm, SW 14 mm).

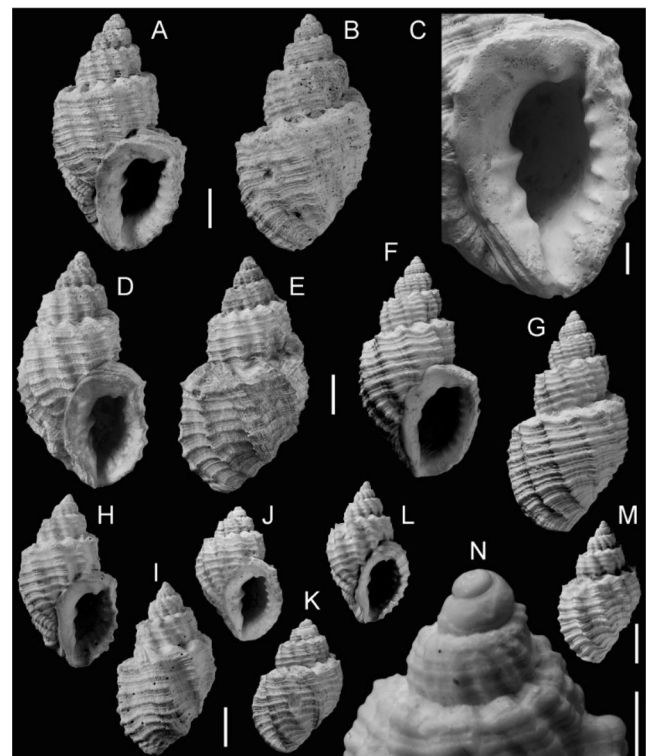


Fig. 4. (A–N) *Scalptia nemethi* n. sp.: (A–B–C) Holotype, SL 30, Bárd (HNHN PAL 2020.25.1.), (D–E) Paratype 4, SL 30, Bárd (Coll. Németh), (F–G) Paratype 5, SL 28, Bárd (Coll. Vicián), (H–I) Paratype 1, SL 22, Bárd (HNHN PAL 2020.26.1.), (J–K) Paratype 3, SL 17, Letkés (HNHN PAL 2020.28.1.), (L–M–N) Paratype 2, SL 18, Bárd (HNHN PAL 2020.27.1.). Scale bars: 5 mm for A–B, D–M; 2 mm for C; 1 mm for N

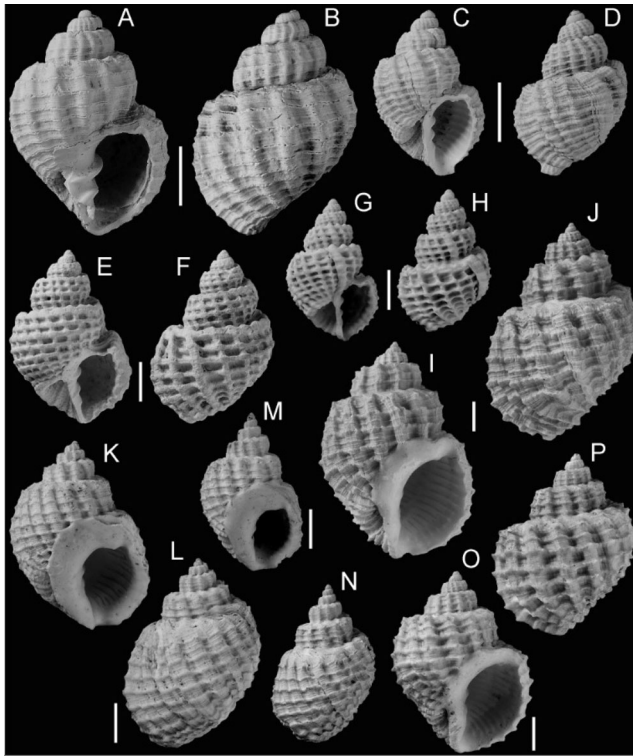


Fig. 5. (A–D) *Scalptia hidasensis* (Hoernes and Auinger), Mecsekpölöske: (A–B) SL 19, (C–D) SL 14 (Coll. Németh). (E–H) *Scalptia neugeboreni* (Hörnes): (E–F) SL 22, Báánd (Coll. Németh), (G–H) SL 18, Letkés (HNHM: INV 2020.48). (I–P) *Scalptia polonica* (Pusch): (I–J) SL 37.4 (Coll. Németh), (K–L) SL 24 (HNHM: INV 2020.49), (M–N) SL 20 (HNHM: INV 2020.50), (O–P) SL 26 (Coll. Németh). Scale bar: 5 mm

Remarks: The occurrence of *S. hidasensis* in the early Badenian deposits of Mecsekpölöske, and the neighboring Kisbattyán, extends the paleogeographic range of the species that has been known only at Hidas (Mecsek Mts) and Buitur (Transylvanian Basin).

Distribution: Central Paratethys. Badenian: Pannonian Basin (Hungary: Mecsek Mts: Hidas, Mecsekpölöske, Kisbattyán), Transylvanian Basin (Romania).

Scalptia nemethi n. sp. (Fig. 4/A–N)

?1966 *Cancellaria* (*Trigonostoma*) *gradata* Hörnes – Strausz, Text-fig. 165, Pl. 45, Figs 12–13 (only).

1973 *Cancellaria* (*Trigonostoma*) *gradata* – Bohn-Havas, Pl. 6, Figs 12–13 (only) (non Hörnes).

Holotype: PAL 2020.25.1., HNHM, Dep. Palaeontology and Geology, SL 30 mm, SW 17.4 mm, Báánd (Fig. 4/A–C).

Paratype 1: PAL 2020.26.1., HNHM, Dep. Pal. and Geol., SL 22 mm, SW 12.6 mm, Báánd (Fig. 4/H–I).

Paratype 2: PAL 2020.27.1., HNHM, Dep. Pal. and Geol., SL 18 mm, SW 10.5 mm, Báánd (Fig. 4/L–N).

Paratype 3: PAL 2020.28.1., HNHM, Dep. Pal. and Geol., SL 17 mm, SW 11 mm, Letkés (Fig. 4/J–K).

Paratype 4: 2020.01, Coll. Németh, SL 30 mm, SW 16.6 mm, Báánd (Fig. 4/D–E).

Paratype 5: 2019.Báánd.10, Coll. Vicián, SL 28 mm, SW 15.5 mm, Báánd (Fig. 4/F–G).

Type strata: Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Formation).

Type locality: Locality 28, Báánd, Bakony Mts, Hungary.

Derivation of name: In honor of Tamás Németh, Hungarian fossil shell collector.

Material: 59 specimens at Báánd, 1 specimen at Letkés, 1 specimen at Pécsszabolcs.

Diagnosis: *Scalptia* with medium sized fusiform shell, paucispiral protoconch, five teleoconch whorls, gradate spire, last whorl with angulated shoulder, ovate aperture with lirate outer lip and well-developed parietal denticle, three columellar folds, sculpture of marked axial ribs and spiral cords.

Description: Shell medium-sized (max. SL 30, SW 18), fusiform with a high, gradate spire. Small nucleus, eroded, low, paucispiral protoconch of approx. 1 3/4 smooth, convex whorls, junction with teleoconch delimited by weak prosocline scar. First teleoconch whorl rounded, cancellate sculpture with dense axial ribs and fine spiral cords. The second to fifth teleoconch whorls slightly convex, scalate and angulated, suture undulating, sutural ramp horizontal, narrow. Last whorl 73–76% of the total length, slightly convex with sloping subsutural ramp, sharply angled at shoulder. Aperture moderately narrow and ovate, outer lip thickened by labral varix, strongly lirate within. Strong parietal denticle, well-developed, thickened parietal callus. Columella weakly excavated, bearing three oblique columellar folds, columella callus thickened, tuberculate. Short and open siphonal canal, narrow umbilical chink. Axial sculpture of regularly spaced, rounded, orthocline to prosocline ribs on spire whorls, and 9–10 raised, prosocline ribs on the last whorl. Spiral sculpture of narrow and sharp primary cords (10 on the last whorl) and fine secondary and tertiary threads in the interspaces. The spiral cords and threads override the axial ribs.

Remarks: Based on morphology the new species is assigned to the genus *Scalptia*. *S. gradata* (Hörnes) resembles *S. nemethi* n. sp. in gradate and angulated spire but differs by its smaller size, more slender shell, higher protoconch, more strongly angulated first teleoconch whorl, rounded primary spiral cords, triangular aperture, thinner outer lip and weaker parietal denticle. Two morphotypes of *S. gradata* were described from N Italy, the Tortonian *Trigonostoma gradatum* var. *dertumbilicata* and the Langhian *Trigonostoma gradatum*? var. *tauroconnectens* (Sacco 1894: 10–11, Pl. 1, Figs 21–22); both are small forms with weakly developed spiral sculpture, thin lips, and lack of parietal denticle. *S. dertocosticillata* (Sacco 1894) – known in Poland in the Badenian Paratethys – is also a similar form but is distinguishable by its shorter last whorl, weaker axial sculpture and lack of parietal denticle. The Middle Miocene *S. crassicosta* (Bellardi 1841) (Sacco 1894, Pl. 1, Figs 33–35; Ferrero Mortara et al. 1984, Pl. 29, Fig. 7) is also similar in size and overall morphology but differs by its rounded axial ribs, weaker spiral cords, a broader parietal callus, and presence of a small umbilicus. The specimen illustrated by

Bohn-Havas (1973, Pl. 6, Figs 12–13) as *C. gradata* from the Mecsek Mts differs from the type of *S. gradata* in shell proportion and aperture with parietal denticle; it is considered as a juvenile representative of *S. nemethi* n. sp. The *S. gradata* illustrated by Strausz (1966, Pl. 45, Figs 12–13) may also represent the new species. However, this specimen is not available in the museum collections; it is presumed to be lost.

S. nemethi n. sp. is known only in the Pannonian Basin at the moment, but as juvenile specimens are similar to *S. gradata* it is possible that more occurrences will be recorded in the Central Paratethys.

Distribution: Central Paratethys. Badenian: Pannonian Basin (Hungary: Bakony Mts: Bánd, Börzsöny Mts: Letkés, Mecsek Mts: Pécszabolcs).

Scalptia neugeboreni (Hörnes 1856) (Fig. 5/E–H)

1856 *Cancellaria Neugeboreni* – Hörnes, p. 680, Pl. 52, Fig. 6. 2012 *Scalptia neugeboreni* (Hörnes) – Harzhauser and Landau, p. 46, Fig. 9/C (*cum syn.*).

2017 *Scalptia neugeboreni* (Hörnes) – Vicián et al., p. 271, Pl. 3, Fig. 10.

Studied material: 7 specimens (max. SL 22 mm, SW 15.8 mm). HNHN: INV 2020.48. SFI: Krock Coll.: 444611A–B, 444638. Private collections: 3 specimens.

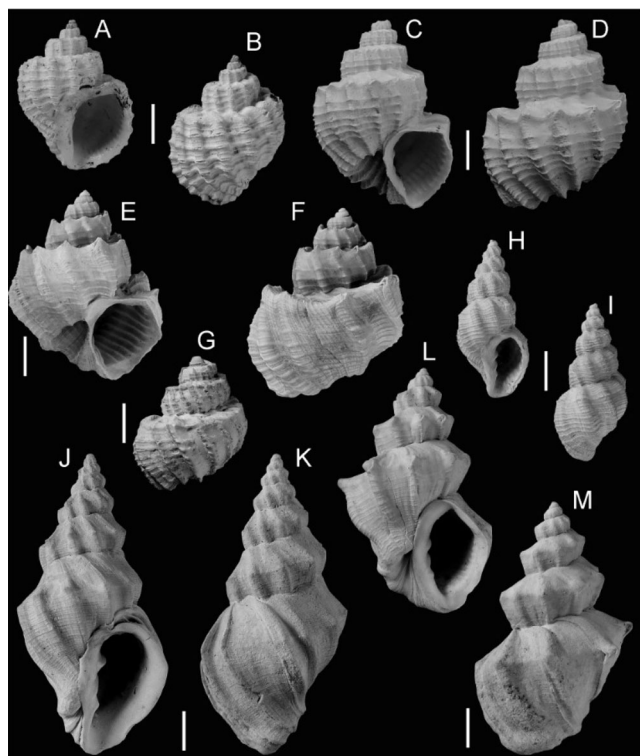


Fig. 6. (A–B) *Scalptia polonica* (Pusch, SL 19 (HNHN: INV 2020.51)). (C–G) *Scalptia spinosa* (Grateloup), (C–D) SL 24, Letkés (Coll. Hirmetzl), (E–F) SL 24, Tekeres (Coll. Németh), (G) SL 17, Letkés (HNHN: M.62.883). (H–I) *Sveltia dertovaricos* (Sacco), SL 20, Tekeres (HNHN: INV 2020.52). (J–M) *Sveltia lyrata* (Brocchi), Devcsér: (J–K) SL 38, (L–M) SL 32 (Coll. Németh). Scale bar: 5 mm

Remarks: *S. neugeboreni* is distinguished from the similar *S. hidasensis* in morphology by stronger sculpture with broad primary cords without any secondaries.

Distribution: Central Paratethys. Badenian Vienna Basin (Austria, Czechia), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Bakony Mts: Bánd), Făget Basin (Romania).

Scalptia polonica (Pusch 1837) (Fig. 5/I–P, Fig. 6/A–B)

1837 *Cancellaria acutangula* Fauj. var. *polonica* – Pusch, p. 128, Pl. 11, Fig. 17.

2012 *Scalptia polonica* (Pusch) – Harzhauser and Landau, p. 39, Figs 3/M, 8/D, E (*cum syn.*).

2013 *Scalptia polonica* (Pusch) – Landau et al., p. 233, Pl. 36, Fig. 5.

Studied material: 140 specimens (max. SL 37.4 mm, SW 27 mm). HNHN: INV 2020.49–51. SFI: Krock Coll.: 444422 (13 spec.). Private collections: 125 specimens.

Remarks: *S. polonica* is a very common species in the Badenian Paratethys; however, its presence is recorded for the first time in the Pannonian Basin at Letkés, where it is the most abundant cancellariid (35%). The species shows moderate intraspecific morphological variability, and the large material makes it possible to distinguish two morphotypes. The dominant morphotype A agrees well with the typical form with elongated shell, ovate last whorl, narrow subsutural ramp and ovate aperture (see Harzhauser and Landau 2012, Fig. 8/D, E; Fig. 5/G–J). Morphotype B (13 specimens) is characterized by identical protoconch and sculpture but possesses a broader shell, a more deeply canalliculate infrasutural area, a more angulated shoulder on the last whorl, and wider aperture (Fig. 5/O–P, Fig. 6/A–B) Fig. 5/K–N. This morphology somehow resembles that of *S. dertoparva* but differs in the protoconch, in the strongly gradate spire and the sculpture. The worn fragmentary specimen illustrated by Kókay (1966, Pl. 9, Fig. 11) as *Cancellaria (Trigonostoma) puschi* at Bánd represents *Venturia imbricata* (Hörnes).

Distribution: Proto-Mediterranean Sea. Burdigalian: Torino Hills (Italy), Rhône Basin (France), Serravallian–Tortonian: Karaman Basin (Turkey). Central Paratethys. Ottnangian: North Alpine Foreland Basin (S Germany), Karpatian: Pannonian Basin (Hungary). Badenian: Korytnica Basin (Poland), North Alpine Foreland Basin, Eisenstadt–Sopron Basin, Styrian Basin (Austria), Vienna Basin (Austria, Czechia), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Bakony Mts: Bánd), Făget Basin (Romania), Krka Basin (Slovenia), South Carpathian Foredeep (Bulgaria).

Scalptia spinosa (Grateloup 1827) (Fig. 6/C–G)

1827 *Cancellaria Spinosa* – Grateloup, p. 21.

1832 *Cancellaria spinifera* – Grateloup, p. 342.

non 1950 *Cancellaria (Trigonostoma) spinifera* Grat. – Csepregy-Meznerics, p. 58, Pl. 3, Fig. 13 (refigured by Strausz 1966, Pl. 45, Fig. 14) [= *Scalptia exgeslini* (Sacco 1894)].

?1966 *Cancellaria* (*Trigonostoma*) *spinifera* Grateloup – Strausz, p. 377, Text-fig. 164.
 1966 *Cancellaria* (*Trigonostoma*) *ampullacea* – Strausz, p. 377, Pl. 45, Figs 17–18 (non Brocchi).
 1971–1972 *Cancellaria* (*Trigonostoma*) *spinifera* Grat. – Csepregy-Meznerics, Pl. 14, Fig. 28.
 2012 *Scalptia spinosa* (Grateloup) – Harzhauser and Landau, p. 41, Figs 3/O, 8/F, G, H (*cum syn.*).
 2013 *Scalptia spinosa* (Grateloup) – Landau et al., p. 233, Pl. 36, Fig. 8.
 2019 *Scalptia spinosa* (Grateloup) – Cárdenas et al., Fig. 7/B.

Studied material: 10 specimens (max. SL 24 mm, SW 17.6 mm). HNHM: M.62.883, M.62. 884 (2 spec.), INV 2020.55. Private collections: 6 specimens.

Remarks: A taxonomical revision of the species was provided by Cahuzac et al. (2004) and Harzhauser and Landau (2012), in which *C. spinifera* Grateloup was considered as a junior synonym of *S. spinosa*. The species is distinguished from *Trigonostoma exampullaceum* (Sacco) by a higher spire, rounded teleoconch whorls and widely spaced axial ribs. The specimen shown by Strausz (1966, Pl. 45, Figs 17–18) as *C. (T.) ampullacea* from Letkés represents *S. spinosa*. The species is uncommon but widespread in the Badenian Pannonian Basin; the appearance in the Tekeres assemblage extends its geographical range.

Miocene distribution: NE Atlantic and Proto-Mediterranean Sea. Burdigalian–Tortonian: Aquitanian Basin (France), Cacula Basin (Portugal), Torino Hills, Po Basin (Italy), Serravallian–Tortonian: Karaman Basin (Turkey), Tortonian: Guadalquivir Basin (Spain). Central Paratethys. Badenian: Korytnica Basin (Poland), North Alpine Foreland Basin, Eisenstadt–Sopron Basin, Styrian Basin (Austria), Vienna Basin (Austria, Czechia), Pannonian Basin (Hungary: Börzsöny Mts: Szob, Letkés, Bükk Mts: Balaton, Mecsek Mts: Tekeres), Făget Basin (Romania).

Genus *Sveltia* Jousseaume 1887.

Type species: *Voluta varricosa* Brocchi 1814.

Sveltia dertovaricosa (Sacco 1894) (Fig. 6/H–I)

1894 *Cancellaria* (*Sveltia*) *dertovaricosa* Sacco – Sacco, p. 57, Pl. 3, Fig. 49.

1950 *Cancellaria* (*Sveltia*) *dertovaricosa* Sacco – Csepregy-Meznerics, p. 59, Pl. 3, Fig. 17.

1966 *Cancellaria* (*Sveltia*) *varicosa dertovaricosa* Sacco – Strausz, p. 380, Pl. 43, Figs 10–12.

1966 *Cancellaria* (*Sveltia*) *ex aff. dertovaricosa* Sacco – Kókay, Pl. 9, Fig. 12.

2012 *Sveltia dertovaricosa* (Sacco) – Harzhauser and Landau, p. 49, Figs 3/S, 9/H (*cum syn.*).

2013 *Sveltia dertovaricosa* (Sacco) – Landau et al., p. 228, Pl. 35, Fig. 9.

2019 *Sveltia dertovaricosa* (Sacco) – Cárdenas et al., Fig. 7/C.

Studied material: 114 specimens (max. SL 22 mm, SW 10 mm). HNHM: M.62.886; INV 2020.52, 2020.56 (39 spec.). SFI: Krock Coll.: 444516, 444591. Private collections: 71 specimens.

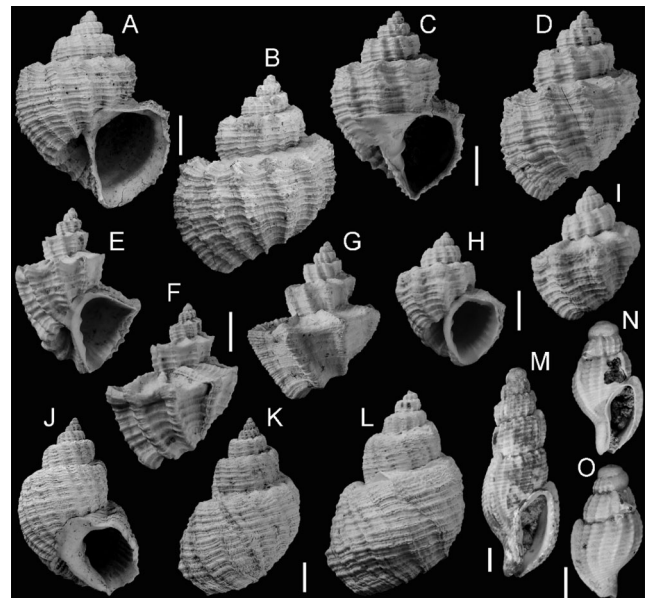


Fig. 7. (A–D) *Trigonostoma exampullaceum* (Sacco), Letkés: (A–B) SL 25, (Coll. Hirmetzl), (C–D) SL 24 (Coll. Németh). (E–I) *Trigonostoma exgeslini* (Sacco): (E–F) SL 21, Bárd (Coll. Németh), (G) SL 20, Letkés, (H–I) SL 17, Letkés (Coll. Hirmetzl). (J–L) *Ventrilia imbricata* (Hörnes): (J–K) SL 30, Bárd (HNHM: INV 2020.53), (L) SL 35, Letkés (Coll. Hirmetzl), (M–O) *Tritonoharpa mariechristinae* Lesport, Cluzaud and Verhecken, Letkés: (M) SL 8.8 (444202, Coll. Krock, SFI, Photo: Sigrid Hof), (N–O) SL 4 (444349, Coll. Krock, SFI, Photo: Sigrid Hof). Scale bars: 5 mm for A–L; 1 mm for M–O

Remarks: A taxonomical revision of the species was carried out by Harzhauser and Landau (2012). The widespread Middle Miocene *S. dertovaricosa* was frequently synonymized in the literature with the very similar but two-folded Late Miocene–Pliocene *S. varicosa* (Brocchi 1814); however, *dertovaricosa* is distinguishable by having three columellar folds (Sacco 1894, Landau et al. 2006). The species is newly recorded at Tekeres, where it is unusually abundant.

Distribution: Proto-Mediterranean Sea. Burdigalian: Torino Hills (Italy), Serravallian–Tortonian: Karaman Basin (Turkey), Gavdos (Greece), Tortonian: Po Basin (Italy), Guadalquivir Basin (Spain). NE Atlantic. Langhian–Serravallian: Aquitanian Basin (France). Central Paratethys. Badenian: North Alpine Foreland Basin, Vienna Basin, Styrian Basin (Austria), Korytnica Basin (Poland), Pannonian Basin (Bosnia, Serbia; Hungary: Börzsöny Mts: Szob, Letkés, Bakony Mts: Bárd, Devecser, Mecsek Mts: Hidas, Tekeres), Făget Basin (Romania), Krka Basin (Slovenia), South Carpathian Foredeep (Bulgaria).

Sveltia lyrata (Brocchi 1814) (Fig. 6/J–M)

1814 *Voluta lyrata* – Brocchi, p. 311, Pl. 3, Fig. 6.

1956 *Cancellaria* (*Sveltia*) *lyrata* Brocchi – Csepregy-Meznerics, p. 416, Pl. 9, Figs 22–23.

1966 *Cancellaria* (*Calcarata*) *lyrata* Brocchi – Strausz, p. 382, Pl. 43, Figs 19–24.

1966 *Cancellaria* (*Calcarata*) *lyrata spinulosa* Brocchi – Strausz, p. 382, Pl. 45, Fig. 1.

1971–1972 *Cancellaria (Narona) lyrata* Brocchi – Csepregy-Meznerics, Pl. 14, Figs 21, 24.
 1971–1972 *Cancellaria (Narona) lyrata spinulosa* (Brocchi) – Csepregy-Meznerics, Pl. 14, Figs 25, 27, 29.
 2012 *Sveltia lyrata* (Brocchi) – Harzhauser and Landau, p. 51, Figs 3/T–U, 10/A–B (*cum syn.*).

Studied material: 150 specimens in private collections (max. SL 38 mm, SW 18.6 mm).

Remarks: *S. lyrata* is characterized by moderate morphological variability in width of the shell, and development of small spines. The species is common in the Miocene of Europe, and also widespread in the Pannonian Basin.

Distribution: Proto-Mediterranean Sea. Miocene: Torino Hills, Montegibbio (Italy), Late Miocene: Spain. NE Atlantic. Langhian–Serravallian: Aquitanian Basin (France). North Sea Basin: Early–Middle Miocene (Belgium, the Netherlands, Germany, Denmark). Central Paratethys. ?Ottomanian: North Alpine Foreland Basin (Bavaria), Badenian: North Alpine Foreland Basin (Austria), Vienna Basin (Austria, Czechia), Eisenstadt–Sopron Basin (Austria, Hungary: Sopron), Pannonian Basin: Börzsöny Mts: Szob, Bükk Mts: Balaton, Borsodbóta, Csermely, Bakony Mts: Devecser), Făget Basin (Romania), South Carpathian Foredeep (Bulgaria).

Genus *Trigonostoma* Blainville 1827.

Type species: *Delphinula trigonostoma* Lamarck 1822.

Trigonostoma exampullaceum (Sacco 1894) (Fig. 7/A–D)

1854 *Cancellaria ampullacea* var. – Hörnes, p. 321, Pl. 35, Fig. 4.

1894 *Cancellaria (Trigonostoma) gradatum* forma *exampullacea* – Sacco, p. 10.

non 1966 *Cancellaria (Trigonostoma) ampullacea* Brocchi – Strausz, p. 377, Pl. 45, Figs 17–18 [= *Scalptia spinosa* (Gratoloup 1827)].

2012 *Trigonostoma exampullaceum* (Sacco) nov. comb. – Harzhauser and Landau, p. 56, Fig. 10/G (*cum syn.*).

Studied material: 10 specimens in private collections (max. SL 25.2 mm, SW 20.8 mm).

Remarks: This uncommon species is recorded for the first time in the Pannonian Basin at Letkés. The *C. (T.) ampullacea* specimen illustrated by Strausz (1966, Pl. 45, Figs 17–18) in fact represents *S. spinosa* (see above).

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin (Austria), Vienna Basin (Austria, Czechia), Pannonian Basin (Hungary: Letkés).

Trigonostoma exgeslini (Sacco 1894) (Fig. 7/E–I)

1854 *Cancellaria Geslini* – Hörnes, p. 320, Pl. 35, Fig. 3 (non Basterot).

1894 *Cancellaria (Gulia) Geslini* forma *exgeslini* – Sacco, p. 22.

1950 *Cancellaria (Trigonostoma) spinifera* – Csepregy-Meznerics, p. 58, Pl. 3, Fig. 13 (refigured by Strausz 1966, Pl. 45, Fig. 14) (non Gratoloup).

1966 *Cancellaria (Trigonostoma) exgeslini* (Sacco) – Kókay, p. 63, Pl. 9, Fig. 10 [non *Scalptia gradata* Hörnes 1854)].

2012 *Trigonostoma exgeslini* (Sacco) – Harzhauser and Landau, p. 58, Figs 3/W, 11/A, B (*cum syn.*).

2013 *Trigonostoma exgeslini* (Sacco) – Landau et al., p. 231, Pl. 36, Figs 1–2.

Studied material: 73 specimens (max. SL 29 mm, SW 26 mm). SFI: Krock Coll.: 444266, 444666. Private collections: 71 specimens.

Remarks: *Trigonostoma exgeslini* was recorded by Kókay (1966) in the gastropod assemblage of Bánd; however, Plate 9, Fig. 10 was erroneously marked as *C. (T.) gradata* Hörnes on the explanation. *T. exgeslini* forms 37% in the cancellariid fauna of Locality 28. The species is a new occurrence at Letkés. In this material the shells are somewhat variable; the specimens are characterized by strongly angulated to slightly rounded spire whorls.

Distribution: Central Paratethys. Badenian: North Alpine Foreland Basin, Eisenstadt–Sopron Basin, Vienna Basin (Austria), Korytnica Basin (Poland), Pannonian Basin (Hungary: Mecsek Mts: Hidas, Bakony Mts: Bánd, Börzsöny Mts: Letkés), Făget Basin (Romania). Proto-Mediterranean Sea. Serravallian–Tortonian: Karaman Basin (Turkey).

Genus *Ventrilia* Jousseume 1887.

Type species: *Cancellaria tenera* Philippi 1848.

Ventrilia imbricata (Hörnes 1854) (Fig. 7/J–L)

1854 *Cancellaria imbricata* – Hörnes, p. 327, Pl. 35, Fig. 16.

1950 *Cancellaria (Trigonostoma) exgeslini* – Csepregy-Meznerics, p. 58, Pl. 3, Fig. 16 (non Sacco).

v 1966 *Cancellaria (Trigonostoma) puschi* Hoernes et Auinger – Kókay, p. 63, Pl. 9, Fig. 11.

2012 *Ventrilia imbricata* (Hörnes) – Harzhauser and Landau, p. 61, Fig. 10/I (*cum syn.*).

2013 *Ventrilia imbricata* (Hörnes) – Landau et al., p. 231, Pl. 36, Figs 3–4.

Studied material: 77 specimens (max. SL 35 mm, SW 23.7 mm). HNHM: INV 2020.53. MGS: 1 specimen without inv. number. SFI: Krock Coll.: 444503. Private collections: 74 specimens.

Remarks: The presence of the species in the Pannonian Basin was recorded by Harzhauser and Landau (2012). *V. imbricata* was common in the Badenian Central Paratethys; the new records presented herein verify its wide distribution in Hungary as well. The species is one of the most abundant cancellariids in the gastropod assemblage of Bánd, but uncommon at Letkés. The fragmentary specimen illustrated by Kókay (1966, Pl. 9, Fig. 11) as *C. (T.) puschi* represents *V. imbricata*.

Miocene distribution: Central Paratethys. Karpatian–Badenian: Korneuburg Basin, North Alpine Foreland Basin, Eisenstadt–Sopron Basin, Styrian Basin (Austria), Vienna Basin (Austria, Czechia), Korytnica Basin (Poland), Pannonian Basin (Hungary: Börzsöny Mts: Letkés, Bakony Mts: Bánd, Mecsek Mts: Hidas), Făget Basin (Romania). Proto-Mediterranean Sea. Serravallian–Tortonian: Karaman Basin



(Turkey), Po Basin (Italy). NE Atlantic. Tortonian: Cacela Basin (Portugal).

Subfamily Plesiotritoninae Beu and Maxwell 1987.

Genus *Tritonoharpa* Dall 1908.

Type species: *Tritonoharpa vexillata* Dall 1908.

Tritonoharpa mariechristinae Lesport, Cluzaud and Verhecken 2015 (Fig. 7/M–O)

?1997 *Tritonoharpa* sp. – Bałuk, p. 52, Pl. 17, Figs 1–2.

2015 *Tritonoharpa mariechristinae* nov. sp. – Lesport et al., p. 31, Fig. 10, Pl. 8, Figs 10–12, Pl. 9, Figs 1–5, 7–10.

Studied material: 5 specimens (max. SL 8.8 mm, SW 3.3 mm). SFI: Krock Collection: 444202, 444203, 444323, 444349, 444450.

Remarks: Miocene records of the genus *Tritonoharpa* are very rare in Europe, and only four species have been designated. The material presented herein was collected by H. Krock at Letkés, and stored in the collection of the Senckenberg Forschungsinstitut. We studied photos of the specimens, courtesy of Ronald Janssen and Sigrid Hof.

The fragmentary Badenian specimens from Poland (Bałuk 1997) probably represent the same taxon. The Chattian–Burdigalian *T. aquitaniensis* Lesport, Cluzaud and Verhecken (2015) from France is distinguishable by its broader shell, more convex teleoconch whorls and stronger axial and spiral sculpture. The Burdigalian *T. speciosum* Bellardi 1873 from northern Italy is characterized by its very fine sculpture, while the Serravallian *T. alanbeui* Landau et al. 2013 from Turkey differs mainly in sculpture. The presence of the NE Atlantic *T. mariechristinae* in the Central Paratethys remarkably extends the paleogeographic range of the species.

Distribution: NE Atlantic. Langhian: Aquitanian Basin (France). Central Paratethys. Badenian: ?Korytnica Basin (Poland), Pannonian Basin (Hungary: Börzsöny Mts: Letkés).

CONCLUSION

Twenty-six cancellariid species are recorded from five early Badenian (Middle Miocene) mollusk assemblages in the Hungarian part of the Pannonian Basin. The cancellariid material of Letkés (Börzsöny Mts, N Pannonian Basin) is the most diverse with 21 species, of which eight (*Bonellitia austriaca*, *Contortia callosa*, *Merica obsoleta*, *Ovilia excassidea*, *Scalptia dertoparva*, *S. polonica*, *Trigonostoma exampullaceum*, *Tritonoharpa mariechristinae*) are new occurrences for Hungary. Beside Letkés three other Central Paratethyan regions are characterized by similar high diversity of the family. Based on the comprehensive revision of Harzhauser and Landau (2012) and the gastropod collection of the HNHM, the highest diversity can be documented in the Făget Basin (SW Romania) at Coșteiu de Sus with 22 species, while 21 species are known from the mollusk assemblages of Grund (North Alpine Foreland Basin), and in the Vienna Basin (Austria) at Gainfarn and Steinebrunn. Distant parts of the Central Paratethys are characterized by almost identical cancellariid diversity.

In the Herend Basin (Bakony Mts) the cancellariid fauna of Locality 28 at Báánd consists of seven species; the material is of special interest because of the frequent occurrence of *Scalptia nemethi* n. sp. The material of Devecser (Bakony Mts) is characterized by low diversity (five species); it extends the paleogeographic range of *Contortia tortoniana* and *Pseudobabylonella nysti*. The fauna of Tekeres (Mecsek Mts) shows similar low diversity, but *Perplicaria mioquadrata* is recorded for the first time in the Pannonian Basin. The occurrence of *Scalptia hidasensis* at Mecsekpölöske extends the geographic range of the species in the Pannonian Basin.

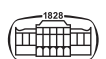
Beside the species described or mentioned in the present paper, two other taxa are known from the early Badenian of Hungary: *Solatia exwestiana* (Sacco 1894) (= *Cancellaria subcancellata infracosticillata* in Csepregy-Meznerics 1969, Pl. 5, Figs 20, 32), and *Trigonostoma subsuturale* (d'Orbigny 1852) (= *C. subcancellata* in Csepregy-Meznerics 1971–1972, Pl. 14, Fig. 23). In the early Middle Miocene 43 Cancellariidae species were recorded from the Central Paratethys by Harzhauser and Landau (2012). Based on new field work, as well as on revisions of museum collections and the previous Hungarian literature, occurrences of 29 species are documented herein from the Hungarian part of the Pannonian Basin.

ACKNOWLEDGEMENTS

We thank Attila Ősi (Eötvös University, Budapest), Ronald Janssen and Sigrid Hof (Senckenberg Forschungsinstitut, Frankfurt am Main) for their professional help. Private fossil collectors mentioned above kindly offered their gastropod materials for study. Special thanks are due to Tamás Németh (Hungary); this paper would not have been possible without his selfless help. We are grateful to Alfréd Dulai (Hungarian Natural History Museum, Budapest) and Bernard M. Landau (Naturalis Biodiversity Center, Leiden), whose critical comments helped to improve the manuscript. Domonkos Verestői-Kovács (Budapest) contributed to the illustration work.

REFERENCES

- Báldi, K., Benkovics, L., and Sztanó, Ó. (2002). Badenian (Middle Miocene) basin development in SW Hungary: subsidence history based on quantitative paleobathymetry of foraminifera. *International Journal of Earth Sciences (Geologische Rundschau)*, 91: pp. 490–504. <https://doi.org/10.1007/s005310100226>.
- Bałuk, W. (1997). Middle Miocene (Badenian) gastropods from Korytnica, Poland; Part III. *Acta Geologica Polonica*, 47(1–2): pp. 1–75.
- Bałuk, W. (2006). Middle Miocene (Badenian) gastropods from Korytnica, Poland; Part V: Addenda et Corrigenda ad Prosobranchia. *Acta Geologica Polonica*, 56(2): pp. 177–220.



- Bellardi, L. (1841). Description des Cancellaires fossiles des terrains tertiaires du Piémont. *Memorie della Reale Accademia delle Scienze di Torino, Ser.*, 2(3): pp. 225–264.
- Biskupič, R. (2017). *Lithology and faunal assemblages of the Late Badenian (Serravallian) deposits of the clay pit Konopiská at Rohožník (Vienna Basin, Slovakia)*. Poster, 16th Geological Seminar: New knowledge about geological setting and evolution of the Western Carpathians, ESI, SAS, Bratislava.
- Bohn-Havas, M. (1973). Tortonische Molluskenfauna des Östlichen Mecsek-Gebirges. *Jahrbuch der Ungarischen Geologischen Anstalt*, 53(4): pp. 945–1161.
- Borza, T. (1973). Rétegtani és őslénytani vizsgálatok Hont (E-Börzsöny) környékén [Stratigraphical and paleontological investigations in the vicinity of Hont (northern Börzsöny Mountains)]. *Földtani Közöny*, 103(1): pp. 27–40 (in Hungarian).
- Bosnakoff, M. (2013). Badeni otolithok egy tekeresi feltárásból (Badenian otoliths from an excavation of Tekeres). Field Guide Abstracts, 16. Hungarian Palaeontological Meeting, 12, Orfű (in Hungarian).
- Brocchi, G. (1814). *Conchiologia fossile subapennina, con osservazioni geologiche sugli Apennini e sul suolo adiacente*, Vol. 1–2. Stamperia Reale, Milano, p. 712.
- Brunetti, M., Della Bella, G., Forli, M., and Vecchi, G. (2008). La famiglia Cancellariidae Gray J.E., 1853 nel Pliocene italiano: note sui generi *Scalptia* Jousseume, 1887, *Tribia* Jousseume, 1887, *Contortia* Sacco, 1894, *Trigonostoma* Blainville, 1827 e *Aneurystoma* Cossmann, 1899 (Gastropoda), con descrizione di una nuova specie. *Bollettino Malacologico*, 44(5–8): pp. 51–69.
- Brunetti, M., Della Bella, G., Forli, M., and Vecchi, G. (2011). La famiglia Cancellariidae Gray J.E., 1853 nel Pliocene italiano: note sui generi *Bivetiella*, *Sveltia*, *Calcarata*, *Solatia*, *Trigonostoma* e *Brocchinia* (Gastropoda). *Bollettino Malacologico*, 47(2): pp. 85–130.
- Cahuzac, B., Lesport, J.-F., and Lagarde, L. (2004). Révision des Cancellariidae (Mollusca, Gastropoda) décrites par Grateloup (1827–1847) dans le Miocène des Landes (SW France). *Geo-diversitas*, 26(2): pp. 207–261.
- Cárdenas, J., Bajo, I., and Maestre, M.V. (2019). Estudio paleontológico de los gasterópodos y escafópodos (Mollusca) del Tortonense superior de Arroyo Trujillo, Cantillana (Sevilla). *Spanish Journal of Palaeontology*, 34(2): pp. 205–227. <https://doi.org/10.7203/sjp.34.2.16095>.
- Chikán, G. (1991). Die Käinozoischen Ablagerungen des westlichen Mecsekgebirges. *Jahrbuch der Ungarischen Geologischen Anstalt*, 72: pp. 5–281.
- Csepregy-Meznerics, I. (1950). Die Tortonische fauna von Hidas (kom. Baranya, Ungarn). *Jahrbuch der Ungarischen Geologischen Anstalt*, 39(2): pp. 3–115.
- Csepregy-Meznerics, I. (1954). Helvetische und Tortonische fauna aus dem Östlichen Cserhátgebirge. *Jahrbuch der Ungarischen Geologischen Anstalt*, 41(4): pp. 3–185.
- Csepregy-Meznerics, I. (1956). Die Molluskenfauna von Szob und Letkés. *Jahrbuch der Ungarischen Geologischen Anstalt*, 45(2): pp. 363–477.
- Csepregy-Meznerics, I. (1958). Die Fauna von Devecser und ihr Alter. *Annales historico-naturales Musei nationalis hungarici*, 50: pp. 49–53.
- Csepregy-Meznerics, I. (1969). Nouvelles Gastropodes et Lamelibranches pour la faune hongroise des gisements tortonien-inférieurs de la Montagne de Bükk. *Annales historico-naturales Musei nationalis hungarici, Pars Mineralogica et Palaeontologica*, 61: pp. 63–127.
- Csepregy-Meznerics, I. (1971–1972). La faune Tortonienne-Inférieure des gisements tufiques de la Montagne de Bükk: Gastéropodes II. *Annales Musei Agriensis*, 8: pp. 26–46.
- Dulai, A. (2005). Badenian (Middle Miocene) Polyplacophora from the Central Paratethys (Bánd and Devecser, Bakony Mountains, Hungary). *Fragmenta Palaeontologica Hungarica*, 23: pp. 29–49.
- Dulai, A. (2007). Badenian (Middle Miocene) micromorphic brachiopods from Bánd and Devecser (Bakony Mountains, Hungary). *Fragmenta Palaeontologica Hungarica*, 24–25: pp. 1–13.
- Eichwald, E. (1830). *Naturhistorische Skizze von Lithauen, Volhynien und Podolien in Geognostisch-Mineralogischer, Botanischer und Zoologischer Hinsicht*. Zawadzki, Wilna, Leipzig, p. 256.
- Ferrero Mortara, E., Montefameglio, L., Novelli, M., Opresso, G., Pavia, G., and Tampieri, R. (1984). *Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco*. Parte II. Museo Regionale di Scienze Naturali, Torino, p. 484.
- Grateloup, J. P. S. de (1827). Description de plusieurs espèces de coquilles fossiles des environs de Dax (Landes). *Bulletin d'Histoire naturelle de la Société Linnéenne de Bordeaux*, 2: pp. 3–27.
- Grateloup, J. P. S. de (1832). Tableau des coquilles fossiles qu'on rencontre dans les terrains calcaire tertiaires (faluns) des environs de Dax, département des Landes. *Actes de la Société Linnéenne de Bordeaux*, 5: pp. 314–344.
- Haas, J. (Ed.) (2012). *Geology of Hungary*. Springer-Verlag, Berlin Heidelberg, p. 244.
- Harzhauser, M. and Landau, B. (2012). A revision of the Neogene Cancellariid Gastropods of the Paratethys Sea. *Zootaxa*, 3472: pp. 1–71.
- Harzhauser, M. and Landau, B. (2016). A revision of the Neogene Conidae and Conorbidae (Gastropoda) of the Paratethys Sea. *Zootaxa*, 4210(1): pp. 1–178.
- Harzhauser, M., Landau, B., and Breitenberger, A. (2017). The false limpet *Siphonaria* in the circum-Tethyan Miocene with emphasis on its occurrence in the Paratethys Sea. *Annalen des Naturhistorischen Museums in Wien, Serie A*, 119: pp. 115–130.
- Hilber, V. (1892). Fauna der *Pereiraia*-Schichten von Bartelmae in Unter-Krain. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe, Abt. 1, Mineralogie, Botanik, Zoologie, Anatomie, Geologie und Paläontologie*, 101: pp. 1005–1032.
- Hoernes, R. and Auinger, M. (1890). Die Gasteropoden der Meeres-Ablagerungen der ersten und zweiten Miocänen Mediterran-Stufe in der Österreichisch-Ungarischen Monarchie. *Abhandlungen der k.k. Geologischen Reichsanstalt*, 12: pp. 233–282.
- Hörnes, M. (1851–1870). Die fossilen Mollusken des Tertiär-Beckens von Wien. *Abhandlungen der k.k. Geologischen Reichsanstalt*, 3: pp. 1–42 (1851), pp. 43–208 (1852), pp. 209–296 (1853), pp. 297–382 (1854), pp. 383–460 (1855), pp. 461–736 (1856).

- Kecskeméti-Körmendi, A. (1962). Új molluszkafajok a várpalotai középsőmiocénből. I. Gastropoda (Neue Molluskenarten aus dem Mittelmiozän von Várpalota. I. Gastropoden). *Földtani Közlemények*, 92(1): pp. 81–99 (in Hungarian).
- Kercsmár Zs. (Ed.) (2015). *Surface geology of Hungary*. Geological and Geophysical Institute of Hungary, Budapest, p. 66.
- Kóka, J. (1966). Geologische und paläontologische Untersuchung des Braunkohlengebietes von Herend-Márkó (Bakony-Gebirge, Ungarn). *Geologica Hungarica, Series Palaeontologica*, 36: pp. 3–147.
- Kovács, Z. (2018). Description of three new species of Muricidae (Neogastropoda) from the Miocene Paratethys. *Novapex*, 19(1): pp. 29–35.
- Kovács, Z. (2020). New Muricidae (Neogastropoda) faunas from the Middle Miocene of Hungary. *Földtani Közlemények*, 150(3): pp. 449–468.
- Kovács, Z. and Vicián, Z. (2014). Badenian (Middle Miocene) Conoidean (Neogastropoda) fauna from Letkés (N Hungary). *Fragmenta Palaeontologica Hungarica*, 30: pp. 53–100.
- Kovács, Z. and Vicián, Z. (2018). Middle Miocene Tonnoidea and Ficoidea (Caenogastropoda) assemblages from Letkés (Hungary). *Fragmenta Palaeontologica Hungarica*, 34: pp. 75–104. <https://doi.org/10.17111/FragmPalHung.2017.34.75>.
- Kovács, Z., Hirmetzl, T., and Vicián, Z. (2018). Miocene Muricidae (Neogastropoda) assemblage from Letkés (Hungary). *Bollettino Malacologico*, 54(2): pp. 110–133.
- Landau, B., Petit, R., and Marquet, R. (2006). The Early Pliocene Gastropoda (Mollusca) of Estepona, Southern Spain. Part 12: Cancellarioidea. *Palaeontos*, 9: pp. 61–101.
- Landau, B., Harzhauser, M., İslamoğlu, Y., and Silva, C. (2013). Systematics and palaeobiogeography of the gastropods of the middle Miocene (Serravallian) Karaman Basin, Turkey. *Cainozoic Research*, 11–13: pp. 1–584.
- Lesport, J.-F., Cluzaud, A., and Verhecken, A. (2015). The Cenozoic Plesiotritoninae (Mollusca: Neogastropoda: Cancellarioidea: Cancellariidae) of the Aquitaine Basin, southwestern France. *Palaeontos*, 27: pp. 1–64.
- Németh, T. (2005). *Devecser (Tik-hegy) miocén üledékeinek faunakutatása (Fauna research of the Miocene deposits of Devecser, Tik Hill)*. Bakony-kutatói jelentés, Bakonyi Természettudományi Múzeum, Zirc, pp. 1–20 (in Hungarian).
- Peyrot, A. (1928). Conchologie néogénique de l'Aquitaine. *Actes de la Société Linnéenne de Bordeaux*, 79(Supplément): pp. 1–263.
- Pusch, G.G. (1836–1837). *Polens Paläontologie oder Abbildung und Beschreibung der vorzüglichsten und der noch unbeschriebenen Petrefakten aus den Gebirgsformationen in Polen, Volhynien und den Karpathen*. Schweizerbart, Stuttgart, pp. 1–80 (1836), pp. 81–218 (1837).
- Sacco, F. (1894). *I molluschi dei terreni terziarii del Piemonte e della Liguria*. Parte 16. (Cancellariidae). Clausen, Torino, p. 78.
- Sant, K., Palcu, D., Turco, E., Di Stefano, A., Baldassini, N., Kouwenhoven, T., Kuiper, K., and Krijgsman, W. (2019). The mid-Langhian flooding in the eastern Central Paratethys: integrated stratigraphic data from the Transylvanian Basin and SE Carpathian Foredeep. *International Journal of Earth Sciences*, 108(7): pp. 2209–2232. <https://doi.org/10.1007/s00531-019-01757-z>.
- Selmeczi, I. (2003). *Prepannóniai miocén képződmények a Dunántúli-középhegység DNY-i részén (Devecser-nyirádi-medence, Tapolcai-medence, Keszthelyi-hegység E-i előtere)* (Pre-Pannonian Miocene formations in the SW Transdanubian Central Range. Devecser-Nyirád Basin, Tapolca Basin, N Keszthely Hills). PhD Thesis, University of Pécs, Pécs, p. 130 (in Hungarian).
- Strausz, L. (1928). Das Mediterran des Mecsekgebirges in Südungarn. *Geologische und Palaeontologische Abhandlungen, N. F.*, 15(5): pp. 361–418.
- Strausz, L. (1966). *Die miozän-mediterranen Gastropoden Ungarns*. Akadémiai Kiadó, Budapest, p. 692.
- Vicián, Z., Krock, H., and Kovács, Z. (2017). New gastropod records from the Cenozoic of Hungary. *Földtani Közlemények*, 147(3): pp. 265–282. <https://doi.org/10.23928/foldt.kozl.2017.147.3.265>.

