ZITTELIANA

98 2024

PENSOFT

SNSB Bayerische Staatssammlung für Paläontologie und Geologie

Zitteliana

Zitteliana

2024. Volume 98

ISSN: 2512-5338 (print), 2747-8106 (online)

PENSOFT

Zitteliana

Content of volume **98** 2024

Zitteliana 98, 2024, 1–9 | DOI 10.3897/zitteliana.98.131387

SNSB Bayerische Staatssammlung für Paläontologie und Geologie

ZITTELIANA
An International Journal of Paleontology and Geobiology

The first recognition of the enigmatic fossil shark genus *Megalolamna* (Lamniformes, Otodontidae) from the lower Miocene of Europe and *M. serotinus* (Probst, 1879) as the newly designated type species for the genus

Jürgen Pollerspöck[1], Kenshu Shimada[2,3,4]

1 *Bavarian State Collection of Zoology, Munich, 81247, Germany*
2 *Department of Environmental Science and Studies, DePaul University, Chicago, Illinois 60614, USA*
3 *Department of Biological Sciences, DePaul University, Chicago, Illinois 60614, USA*
4 *Sternberg Museum of Natural History, Fort Hays State University, Hays, Kansas 67601, USA*

https://zoobank.org/26CE95BC-E802-4369-8B3E-D2FA6298AA3F

Corresponding author: Jürgen Pollerspöck (juergen.pollerspoeck@gmail.com)

Academic editor: Oliver Rauhut ♦ **Received** 5 July 2024 ♦ **Accepted** 18 July 2024 ♦ **Published** 14 October 2024

Abstract

Megalolamna is an elusive extinct shark genus (Lamniformes: Otodontidae) previously known from the upper Oligocene–Miocene of the USA, Colombia, Ecuador, Peru, and Japan. Here, we document the first occurrence of *Megalolamna* from Miocene marine deposits in Europe, specifically from Austria, France, Germany, and Italy. Although the taxon is regarded as a monospecific genus, this study reveals that the species name *serotinus* has the priority over any previously used names for the taxon and thus redescribes it as *Megalolamna serotinus* (Probst), **comb. nov.** This study is also significant because it demonstrates the existence of *Megalolamna* in the Mediterranean and Paratethys seas during the Miocene. *Megalolamna* inhabited the tropical–mid-latitudinal zones with spotty but wide geographic distribution.

Keywords

Austria, Elasmobranchii, France, Germany, Italy, Neogene, taxonomy

Introduction

Megalolamna is a lamniform shark genus known from the upper Oligocene–Miocene marine deposits by a single species, *M. paradoxodon* (Carrillo-Briceño et al. 2016, 2020; Shimada et al. 2017, in press). *Megalolamna* is regarded as enigmatic because of its sparse but geographically wide distributions with an uncertain phylogenetic position within the otodontid clade (Shimada et al. 2017, in press). The genus has so far been reported from the upper Oligocene Chandler Bridge Formation in South Carolina, USA, as well as the following eight Miocene localities: the Calvert Formation of Maryland, USA; Pungo River Formation of North Carolina, USA; Jewett Sand in California, USA; Uitpa Formation in Colombia; Dos Bocas Formation of Ecuador; Chilcatay Formation of Peru; Oi Formation in Mie Prefecture, Japan; and O'oshimojo Formation in Nagano Prefecture, Japan (Shimada et al. in press, and references therein).

In this study, we report the first occurrence of *Megalolamna* in Miocene marine deposits in four different countries in Europe (i.e., Austria, France, Germany, and Italy). Because the previous occurrences of the taxon are confined to the Pacific Rim and the western Atlantic Ocean (Shimada et al. in press, and references therein), the occurrences reported here significantly expand the geographic range of the genus. In addition, the recognition also includes cases of previously described specimens under two different species, one of which must be regarded as the senior synonym for the monospecific genus. Therefore, the aim of this paper is two-fold: (1) to describe

the new specimens and revise the species-level taxonomy for *Megalolamna*; and (2) to document the significantly extended known geographic range for *Megalolamna*.

Geologic setting

Upper Marine Molasse Baltringen, Walbertsweiler, Baden-Württemberg, Germany

The North Alpine Foreland Basin or "Molasse Basin" is part of the Paratethys realm and was formed during the early Oligocene to late Miocene by the Alpine Orogeny (Lemcke 1988; Hofmayer et al. 2019). The sediments of the Molasse Basin are divided into marine, brackish and freshwater Molasse units, which were formed as a result of two transgressive-regressive megacycles. The first megacycle includes the Lower Marine Molasse, the Lower Brackish Molasse and the Lower Freshwater Molasse, whereas the second megacycle comprises the Upper Marine Molasse, the Upper Brackish Molasse and the Upper Freshwater Molasse (Janssen et al. 2018; Hofmayer et al. 2019). In the Ottnangian, the marine transgression of the western Paratethys started from the Southwest. In Baden-Württemberg, the sediments of the Upper Marine Molasse consist of approximately 50 m thick glauconitic sands of the Heidenlöcher Beds (Doppler et al. 2005), which are overlain by 20 to 70 m thick sediments of the Kalkofen Formation. The Kalkofen Formation consists of glauconitic sands and marls (Heckeberg et al. 2010) and is overlain by the Baltringen Formation and the fossil-rich Baltringer Horizon (Fig. 1).

The syntype of *Otodus serotinus* described by Probst (1879) was found at the site of the now closed Kodelsberg quarry east of Baltringen (near Mietingen, district of Biberach, 48.176593, 9.895192; Baltringen Formation, middle Ottnangian, middle Burdigalian) (Pollerspöck and Unger in press).

The tooth described by Barthelt et al. (1991) comes from the Walbertsweiler sand pit (between the towns of Meßkirch and Pfullendorf, district of Sigmaringen, 47.95145, 9.1572; Kalkofen Formation, Lower Ottnangian, Middle Burdigalian: Fig. 1), which is no longer accessible and has been recultivated. Organic debris and bedding planes with ripple marks indicate a nearshore, interior neritic to shallow marine environment. The water depth is estimated to be less than 50 m based on the abundance of shallow water foraminifera (Barthelt et al. 1991; Heckeberg et al. 2010; Pippèrr et al. 2011). The former coastline was located to the north, less than 25 km away.

Upper Marine Molasse, Plesching, Upper Austria

In the former sand pits near Plesching, the deposits of the "Linzer Sande" (Egerian) and the phosphorite sands (Ottnangian) were exposed. The "Linzer Sande" of the Linz-Melk-Formation overlie the gneiss of the Bohemian Massif. The sand is whitish-grey in colour. While bivalves and gastropods are mostly distributed in the sand, a concentrated occurrence of oysters can be found at the base of the so-called oyster bank. The "Linzer Sande", which dip at about 20° to the NNE, are unconformably overlain by the phosphorite sands of the Plesching Formation. A hiatus created by a transgression in this part of the Molasse Sea comprises the complete Eggenburgian. The coarse to fine-grained phosphorite sands are green-brownish in color due to the glauconite and phosphorite content. Beach block heaps indicate a steep rocky coast (Reiter and Berning 2012). The sands were intensively collected, especially due to the relatively frequent occurrence of shark teeth (Schultz 1968). The previously undescribed tooth was found around 1985 by Dietmar Stadlhuber (Engerwitzdorf/Mittertreffling, Austria) in the phosphorite sands near Plesching (Plesching Formation, middle Ottnangian, 48.324547, 14.342461; Fig. 1).

Mazan, Mormoiron Basin (Vaucluse), Southeastern France

The Mazan site is located in Provence (Southeastern France, 44.029044, 5.157797), the southern part of the Mormoiron Basin (Vaucluse), which is part of a succession of basins that subsided between the rising Alps and the Rhodian trough. The Malemort-du-Comtat quarry, still in operation today where gypsum (Blauvac Complex Formation, Eocene) is quarried comprises sediments dating from the Miocene to the Eocene (Besson 2005; Vialle et al. 2011; Maridet et al. 2013). While the Paleogene sediments have been lithostratigraphically studied (Blauvac Complex Formation, Patis Formation, *Brotia laurae* and *Tympanotonos labyrinthus* Formation; Triat et al. 1971), the Neogene sediments lack such studies. Vialle et al. (2011) described a species-rich selachian fauna from the younger sandstone layers of the middle Miocene with predominantly deep-sea-dwelling species. The tooth found here comes from a layer that was deposited directly above the clearly recognisable Paleogene-Neogene boundary (Fig. 1). This layer can be dated to the lowest Burdigalian.

Pietra da Cantoni, Eastern Monferrato, Italy

The Monferrato succession can be considered the north-western end of the Appenninic chain. It is composed of a predominantly terrigenous sequence of Eocene and Miocene age, deposited in complex internal basins (Mancin et al. 2003) and resting unconformably on the Upper Cretaceous–Eocene Ligurian Flysch. According to recent stratigraphic and structural studies, the Monferrato area consists of two stratigraphic successions that emerge in the western and eastern parts, respectively. The western sequence of the Monferrato, that consists of coarse Oligocene to Early Miocene terrigenous sediments deposited

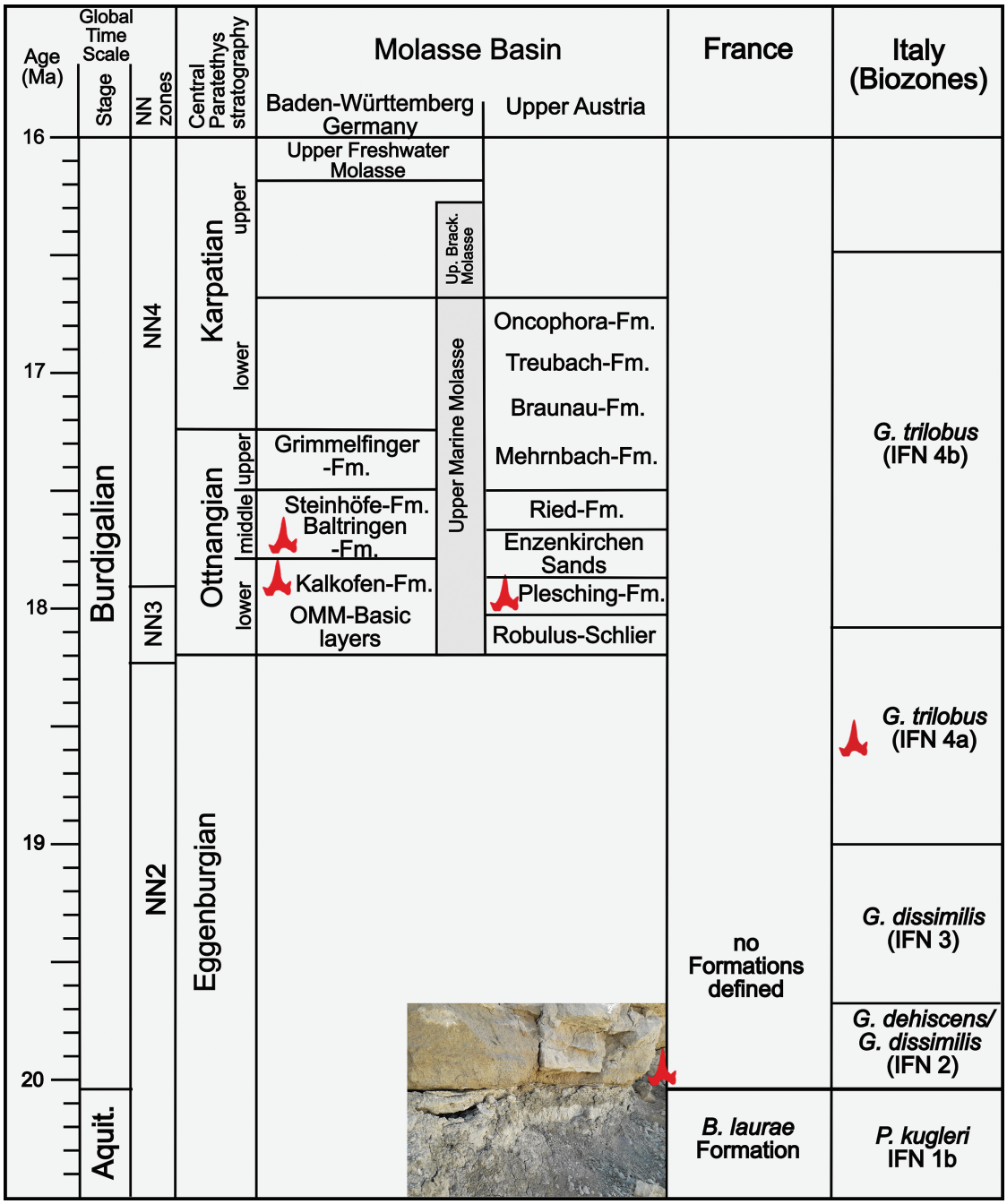

Figure 1. Stratigraphic positions of European specimens of *Megalolamna* according to their country of discovery described in this paper.

both in strongly subsiding basins and on adjacent structural uplifts, includes (from base to top): the Ranzano Sandstones, the Antognola Marls and finally the Pteropod Marls and their lateral equivalents. The eastern succession of the Monferrato, which consists of Oligocene to Early Miocene terrigenous deposits of different depths (Clari et al. 1987) and is followed by unconformable carbonates of the shelf, comprises (from bottom to top): the "Cardona Unit", the Antognola Marls and finally the "Pietra da Cantoni Group" (Mancin et al. 2003). The tooth described by Alessandri (1897) and two other specimens are housed in the Collection of the Earth Sciences Department of the University of Turin, Italy. All come from Rosignano (La Colma), which are assigned to the Pietra da Cantoni Group (*Globigerinoides trilobus* zone, INF 4a, lower Burdigalian, Fig. 1).

Results

Class Chondrichthyes Huxley, 1880
Subclass Elasmobranchii Bonaparte, 1838
Cohort Euselachii Hay, 1902
Subcohort Neoselachii Compagno, 1977
Order Lamniformes Berg, 1958
Family Otodontidae Glikman, 1964

Genus *Megalolamna* Shimada, Chandler, Lam, Tanaka & Ward, 2017

Type species. *Otodus serotinus* Probst, 1879, Kodelsberg (E Baltringen), Baden-Württemberg (Germany).

Emended diagnosis. Lamniform differing from all known species of otodontids by the following combination of characters: tooth consisting of a sharply-pointed, relatively tall, triangular main cusp, in anterior or anterio-lateral teeth one prominent pair of triangular lateral cusplets, in posterior teeth sometimes a second pair of small, secondary cusplets and strongly bilobed root; main cusp erect, in anterior teeth slightly inclined distally, or gently curved distally, in posterior teeth clearly inclined distally; lingual crown face very convex without ornamentation; labial crown face flat or subtly convex except center of base with weak depression; height and width of each lateral cusplet nearly equal with tendency to point outward; both mesial and distal cutting edges of main cusp and lateral cusplets smooth and razor-like, and continuous from apex to base; main cusp and lateral cusplets nearly erect to gently curved lingually; concave crown base and distinct, chevron-shaped tooth neck on lingual face characterized as a bourlette covered with thin enameloid layer; prominent tooth neck also on labial face in tall teeth, forming rounded ledge with thin enameloid layer that grades into enameloid of main cusp and lateral cusplets; bilobed root with rounded basal tips and moderately tight basal concavity in between; root overall robust but particularly at lingual protuberance that generally exhibits one or two prominent and a few smaller nutritive foramina; root width slightly wider than total crown width; osteodentine tooth histology (Shimada et al. in press; this study).

Megalolamna serotinus (Probst, 1879), comb. nov.

Figs 2, 3

Lamna bassanii – Alessandri 1897: 38–39, pl. 1, figs 16–16a.
Otodus sp. – Hasegawa and Uyeno 1967: 116, pl. 21, fig. 1a–c.
Odontaspis taurus obliqua – Caretto 1972: 29, pl. 4, figs 1a–c, 2a–c.
Lamna sp. – Barthelt et al. 1991: 200, pl. 2, fig. 8.
Lamna sp. – Renz 2009: 158.
Lamnidae gen. et sp. indet. – Tanaka 2013: 99, pl. 12, fig. 11a–c.
Brachycarcharias sp.? – Chandler and Young 2015: 49.
Lamniformes gen. et sp. indet. – Carrillo-Briceño et al. 2016: 86, fig. 4.16–17.
Megalolamna paradoxodon – Shimada et al. 2017: 706, fig. 2.
Megalolamna paradoxodon – Landini et al. 2019: 257, fig. 3S–U.
Megalolamna paradoxodon – Carrillo-Briceño et al. 2020: 13, fig. 5U–X.
Megalolamna paradoxodon – Shimada et al. in press: 8, fig. 2a–h.
Megalolamna paradoxodon – Pollerspöck and Unger in press.

Material. One isolated tooth (GPIT-PV-31738, as *Otodus serotinus* sp. nov. in Probst (1879): pl. 2, fig. 84) from the Baltringen-Formation (Baltringen Horizon) in Kodelsberg (east of Baltringen), Baden-Württemberg, Germany, housed in Collection of the Institute and Museum of Geology and Palaeontology of the University of Tübingen, Germany (Fig. 2A–C); one isolated tooth (SNSB-BSPG 1984 X 21, as *Lamna* sp. in Barthelt et al. (1991), pl. 2, fig. 8) from the Kalkofen Formation in Walbertsweiler, Baden-Württemberg, Germany, housed in Bavarian State Collection for Palaeontology and Geology, Munich, Germany (Fig. 3A); one isolated tooth (2022/46) from the Plesching Formation in Plesching, Austria, housed in Oberösterreichische Landes-Kultur GmbH, Geosciences collections, Leonding, Austria (Fig. 3B–E); two isolated teeth (Illustration originals, uncat.: Caretto (1972) pl. 4, figs 1a–c, 2a–c) from the lower part of the "Pietra da canton" formation, Monferrato region, Italy (lower Miocene) housed in the collections of the Museo Civico di Storia Naturale di Milano, Italy (Fig. 3F–K); three isolated teeth (syntype: Alessandri (1897) pl. 1, fig. 16b: MGPT-PU 11196; additional two specimens: MGPT uncat.) from the Pietra da Cantoni Rosignano (La Colma) housed in the collections of the Earth Sciences Department of the University of Turin, Italy (Fig. 3L–Q); one isolated tooth (UM MAZ 38)

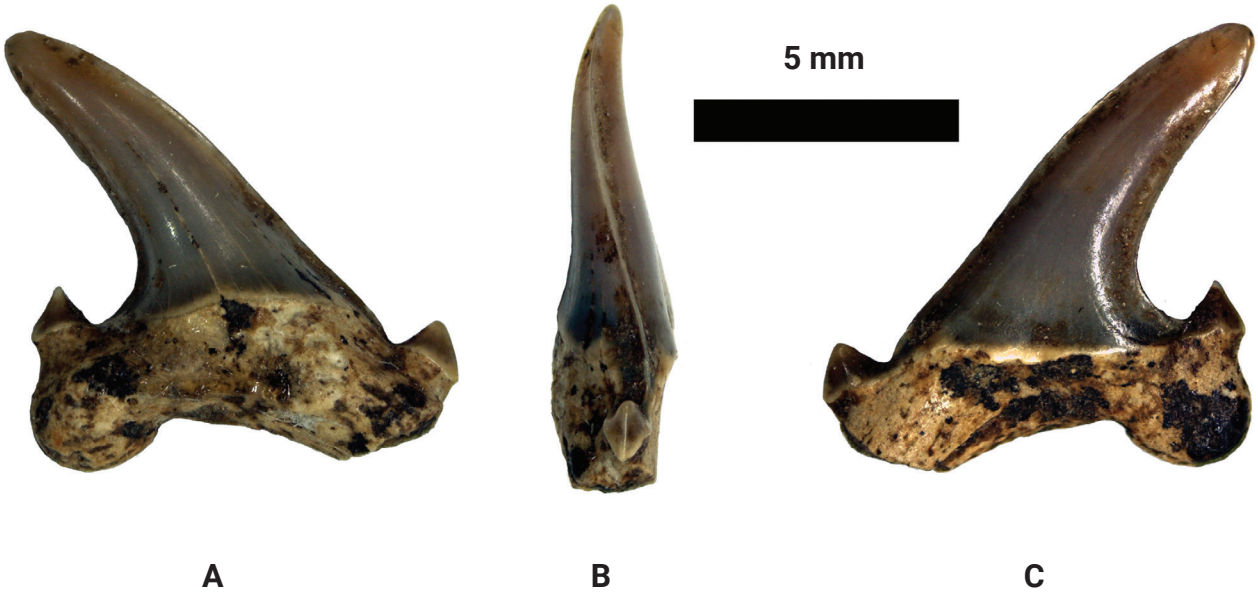

Figure 2. Tooth of *Megalolamna serotinus* comb. nov. (GPIT-PV-31738) from the Upper Marine Molasse Baltringen, Walbertsweiler, Baden-Württemberg, Germany, that was originally described as *Otodus serotinus* by Probst (1879, pl. 2, fig. 84). (**A**) lingual, (**B**) profile, and (**C**) labial views. Scale bar: 5 mm.

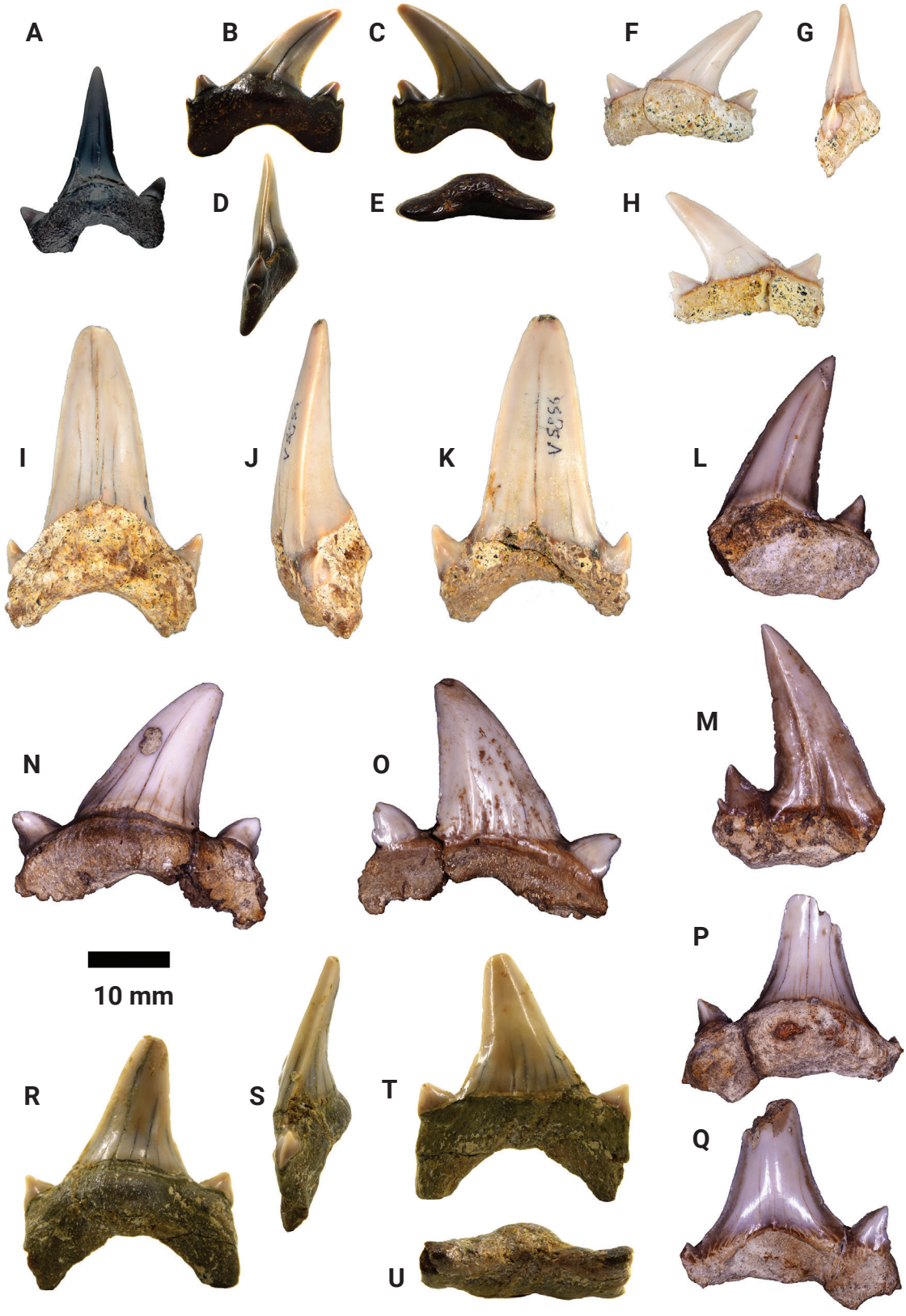

Figure 3. Additional teeth of *Megalolamna serotinus* comb. nov. from Miocene deposits of Europe described in this paper. **A:** SNSB-BSPG 1984 X 21 from the Upper Marine Molasse Baltringen, Walbertsweiler, Baden-Württemberg, Germany, in lingual view; **B–E:** Oberösterreichische Landes-Kultur GmbH Coll. no. 2022/46 from the Upper Marine Molasse, Plesching, Austria, in (**B**) lingual, (**C**) labial, (**D**) profile, and (**E**) basal views; **F–K:** Museo Civico di Storia Naturale di Milano Coll. no. V5858 and 5856 from the lower part of the "Pietra da canton" formation, Monferrato region, Italy, in (**F, I**) lingual, (**G, J**) profile, and (**H, K**) labial views; **L–Q:** Three teeth from Pietra da Cantoni, eastern Monferrato, Italy, the collection of the Earth Sciences Department of the University of Turin: MGPT uncat. in (**L**) lingual and (**M**) labial views; MGPT-PU 11196 in (**N**) lingual and (**O**) labial views; and MGPT uncat. in (**P**) lingual and (**Q**) labial views; **R–U:** UM MAZ 38 from Mazan, Mormoiron Basin, Vaucluse, France, in (**R**) lingual, (**S**) profile, (**T**) labial, and (**U**) basal views. Scale bar: 10 mm.

from the Burdigalian sediments of the Gypsum quarry "la Plâtrière" of the company Syniat, (France) housed in Institut des Sciences de l'Evolution de Montpellier, Montpellier, France (Fig. 3R–U).

Description. GPIT-PV-31738 (Fig. 2(A)–(C)) is an almost complete tooth, missing only a small portion of the mesial root lobe. It measures approximately 8.2 mm in total tooth height and 8.2 mm in total tooth width. The thickness at the crown base is about 2.3 mm, the distal lateral cusplet is slightly narrower at the base than the mesial one (1.2 mm *vs*. 1.4 mm). Its crown consists of a distally inclined main cusp with a pair of low lateral cusplets, the total crown height and width being about 5.8 mm and 8.1 mm, respectively. A small piece of the crown apex is broken off. The mesial and distal cutting edges of the main cusp are sigmoidally curved, very sharp, straight or slightly convex mesially and strongly concave distally, and their basal side continues to become the cutting edges of the lateral cusplets with practically no clear demarcation. The lingual crown base is essentially concave and slightly wavy. A thin and well-defined enameloid coating is missing due to the poor preservation of the root. However, a clear ridge is recognisable, particularly under the base of the mesial lateral cusplet, which indicates the original presence of this enameloid coating on the tooth neck. The labial base of the crown is almost straight, with some of the enameloid missing due to the state of preservation. Despite the damage to the mesial side of the root, it is recognisable that the root lobes are asymmetrical and the mesial root lobe is slightly wider than the distal root lobe. The lingual root surface is gently rounded. Large foramina or a lingual basal furrow are absent. Due to the small size and the strongly distally inclined crown, the tooth likely represents a latero-posterior tooth from a small individual.

A detailed description of the other records shown in Fig. 3 ((A)–(Q)) is not given here, as some of the material has already been published and illustrated or corresponds to the previous species diagnosis.

Discussion

Taxonomic remarks

The monospecific genus *Megalolamna* with the species *paradoxodon* was described by Shimada et al. (2017) based on Miocene teeth from the USA, Japan and Peru. However, the present study reveals that there were already two cases of historical findings of this species that have so far remained unnoticed or unrecognized in the literature. The first case is represented by the work of Probst (1879), who described the species *Otodus serotinus* from the Baltringen Formation (lower Miocene, Burdigalian, regional stage Ottnangian) on the basis of four specimens that represent the syntypes of the species (Probst 1879: pl. 2 fig. 82–85). During a recent revision of the fossil shark fauna described by Probst (1879) it was determined that the syntype under fig. 84 is conspecific and belongs to *Megalolamna paradoxodon* Shimada, Chandler, Lam, Tanaka & Ward, 2017 (Pollerspöck and Unger in press). The second case is represented by the study of Alessandri (1897), who described the species *Lamna bassanii* from Pietra da Cantoni, Eastern Monferrato (Miocene, Burdigalian, *G. trilobus* Zone (INF 4) and illustrated two teeth (pl. 1, fig. 16, 16a). Based on the description and illustration by Alessandri (1897) and the visible morphological characters, these two teeth also belong to the genus *Megalolamna*.

While both species names, '*O. serotinus*' and '*L. bassanii*', were published under the conditions of Article 10 of the International Code of Zoological Nomenclature (ICZN 1999) and are available, the taxonomic position, as described in Systematic Paleontology above, must be clarified, in particular, which species name is valid on the basis of the ICZN Article 23 (Principle of Priority).

ICZN Article 23 provides that "the valid name of a taxon is the oldest available name applied to it, unless that name has been invalidated or another name is given precedence by any provision of the Code or by any ruling of the Commission". Exceptions to this principle are only possible under the conditions of Article 23.9 (Reversal of precedence). In this case, both of the following two conditions must be cumulatively fulfilled:

1. the senior synonym or homonym has not been used as a valid name after 1899 (Article 23.9.1.1.), and
2. the junior synonym or homonym has been used for a particular taxon, as its presumed valid name, in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years (Article 23.9.1.2.)

An extensive literature search revealed that the species names *O. serotinus* and/or *L. bassanii* were used as valid names after 1899 in the following works: Joleaud (1907: *Lamna serotina* p. 172); D'Erasmo (1924: *Lamna bassanii*, p. 24); Fowler (1966: *Otodus serotina*, p.135; *Lamna bassanii*, p. 131); Cappetta (2006: ?*Cretolamna bassanii*, p. 31). It follows that the species names *bassanii* and *paradoxodon* are to be regarded here as junior synonyms of *O. serotinus*, representing the only known species within the genus *Megalolamna*.

Geographic remarks

Prior to this study, the genus *Megalolamna* was known from the upper Oligocene–Miocene deposits (but mostly Miocene) in only the following five countries: USA, Colombia, Ecuador, Peru, and Japan (Shimada et al. in press, and references therein). Therefore, the specimens reported in this paper nearly doubles the known occurrences of the genus by country, which now also include Austria, France, Germany, and Italy (a total of

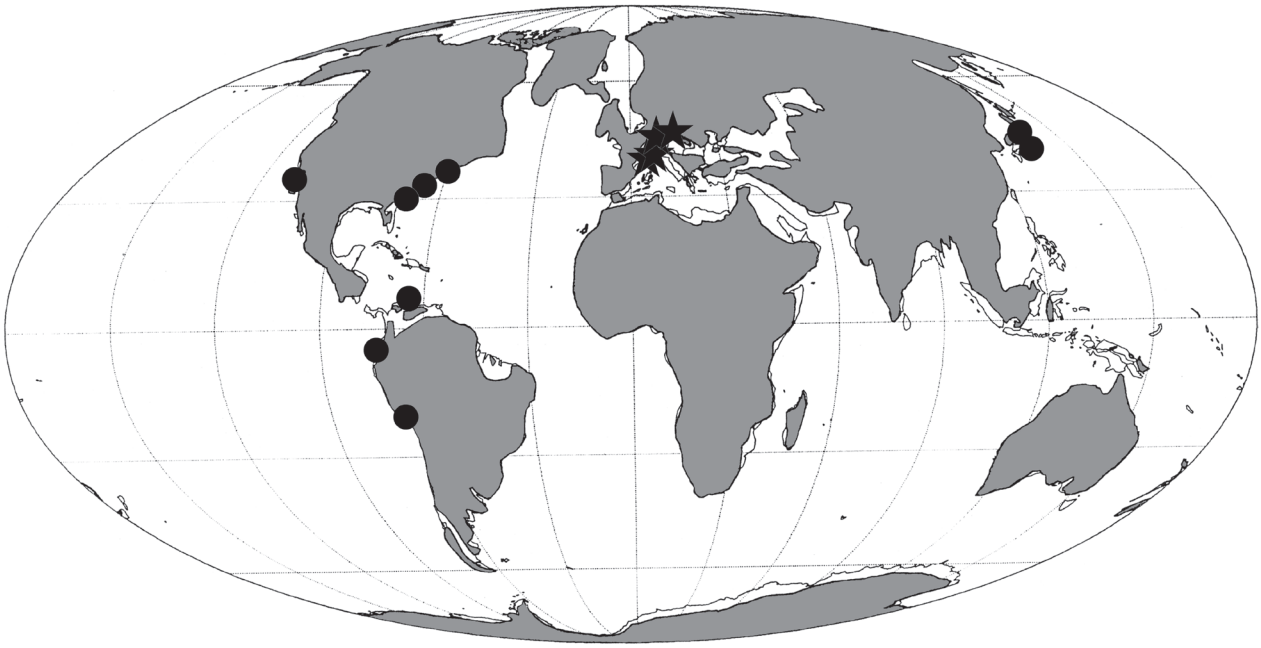

Figure 4. Geographic distribution of previous records (circle) and newly described European records (star) of *Megalolamna* (Carrillo-Briceño et al. 2016, 2020; Shimada et al. 2017, in press) using early Miocene (Aquitanian–Burdigalian) paleogeographic map (after Smith et al. 1994, p. 27).

nine countries: Fig. 4). Ocean-wise, the distribution of *Megalolamna* consists of the eastern and western margins of the Pacific Ocean, western Atlantic Ocean, and the Caribbean Ocean, and the present study adds the Mediterranean and Paratethys seas. Latitudinally, the occurrence of *Megalolamna* is distributed from the tropical to mid-latitudinal zone in both the Northern and Southern hemispheres.

Since the original description in 2017, *Megalolamna* has been characterized as an 'elusive' extinct lamniform shark due to its spotty but geographically widespread occurrences even though its existence was chronologically quite constrained, primarily to the Miocene Epoch (Shimada et al. 2017, in press). The new occurrences from Europe reported here further demonstrates its elusiveness as teeth of *Megalolamna* are never in abundance at any single locality, even though some areas have been heavily exploited palaeontologically, particularly for fossil shark teeth (e.g., Probst 1878, 1879; Schultz 1968; Caretto 1972; Barthelt et al. 1991; Brisswalter 2009; Höltke et al. 2020). In fact, its spotty but geographically widespread occurrences is reminiscent to a few present-day lamniform sharks, such as the goblin shark (*Mitsukurina owstoni*), megamouth shark (*Megachasma pelagios*), and the most elusive of all, the bigeye sandtiger shark (*Odontaspis noronhai*) (Ebert et al. 2021; Ng et al. 2022). Given that these extant taxa are sparsely but broadly distributed, it is quite possible that teeth of *Megalolamna* may be discovered or recognized in the future at other Miocene localities not presently recorded, possibly along the Atlantic coasts of Africa and South America as well as along the Indian Ocean and southwestern Pacific Ocean in the Oceania region.

Conclusions

In this paper, we document the extinct lamniform genus *Megalolamna* from the Miocene marine deposits in Europe for the first time (Figs 1–3). Whereas the genus was traditionally known by a single species *M. paradoxodon* described by Shimada et al. (2017), the new occurrence records include evidence based on specimens previously described under different names: *Otodus serotinus* by Probst (1879, pl. 2 figs 82–85), *Lamna bassanii* by Alessandri (1897, 38–39, pl. 1, figs 16–16a), *Odontaspis taurus obliqua* (Caretto 1972, p. 29, pl. 4, figs 1a–c, 2a–c), and *Lamna* sp. by Barthelt et al. (1991, p. 200, pl. 2, fig. 8.). On the basis of ICZN's Principle of Priority (Article 23), we have determined that the species name *O. serotinus* is a senior synonym to all previously described materials identified to belong to the genus *Megalolamna* – hence, *Megalolamna serotinus* (Probst, 1879), comb. nov.

Based on this study, *Megalolamna* is now known from the USA, Colombia, Ecuador, Peru, and Japan as well as from Austria, France, Germany, and Italy (Fig. 4). More significantly, the new European records demonstrate the presence of *Megalolamna* in the Mediterranean and Paratethys seas during the Miocene. The present distribution of this monospecific genus is characterized as tropical–mid-latitudinal, and its spotty but wide distribution is similar to some of the elusive extant lamniform shark, such as goblin, megamouth, and bigeye sandtiger sharks. Therefore, we contend that *Megalolamna* will possibly be recognized also from other Miocene sites along the Atlantic coasts of Africa and South America as well as along the Indian Ocean and southwestern Pacific Ocean in the future.

Acknowledgments

We sincerely thank Annalaura Pistarino (MRSN, Torino, Italy) for the support in the search for the originals of Alessandri, Marco Pavia (Museo di Geologia e Paleontologia, Torino, Italy) for the images of the originals of Alessandri and Dr. Cristiano Dal Sasso and Michele Zilioli (Sezione di Paleontologia dei Vertebrati, Museo di Storia Naturale di Milano) for the images of Caretto's figured specimens. We also thank Alberto Collareta (Università di Pisa) for sending us some useful Italian papers, the private collectors Dietmar Stadlhuber (Austria) and Sébastien Rafay (France) for the donation of the Austria and French specimen , Elmar Unger for the image of the German specimen and Ingmar Werneburg (Senckenberg Research Institute, Tübingen, Baden-Württemberg, Germany) for permission to study and photograph the originals in the Probst collection. We especially thank J. Kriwet (University of Vienna) and G. Cuny (Université Claude Bernard Lyon 1) for their valuable comments and review of the manuscript.

References

Agassiz L (1843) Recherches sur les poissons fossiles, 15th and 16th livraisons (Mars 1843). Jent and Gassmann, Soleure (text) and H. Nicolet, Neuchâtel (planches). Vol. 3: [i]–[iv], 157–390, 382*–382**, 1–32, [33]–[34], pl. 1, 18, 22, 22a, 22b, 26a, 38, 40b, 40c, 40d, 45, 47. Neuchâtel (petitpierre).

Alessandri de G (1897) La pietra da cantoni di Rosignano e di Vignale (Basso Monferrato). Studi stratigrafici e paleontologici. Museo Civico di Storia Naturale di Milano 6(1): 1–98.

Barthelt D, Fejfar O, Pfeil FH, Unger E (1991) Notizen zu einem Profil der Selachier-Fundstelle Walbertsweiler im Bereich der miozänen Oberen Meeresmolasse Süddeutschlands. Münchner Geowissenschaftliche Abhandlungen Reihe A, Geologie und Paläontologie 19: 195–208.

Berg LS (1958) System der Rezenten und Fossilen Fischartigen und Fische. Hochschulbücher für Biologie, Berlin, 310 pp.

Besson D (2005) Architecture du bassin Rhodano- provençal miocène (Alpes, SE France). Relations entre déformation, physiographie et sédimentation dans un bassin molassique d'avant-pays. MSc Thesis, Thèse de l'Ecole des Mines-Paris Tech, Paris, France.

Brisswalter G (2009) Inventaire des Élasmobranches (requins, raies, chimères) des dépôts molassiques du Sud-Luberon (Miocène supérieur), à Cabrières d'Aigues (Vaucluse) France. Courriers scientifiques du Parc Régional du Lubéron, Hors Série: 1–100.

Bonaparte CL (1838) Selachorum tabula analytica. Nuovi Annali della Science Naturali Bologna 1(2): 195–214.

Cappetta H (2006) Elasmobranchii Post-Triadici (Index specierum et generum). Backhuys Publishers, Leiden, 472 pp.

Caretto PG (1972) Osservazioni tassonomiche su alcuni Galeoidei del Miocene piemontese. Bollettino della Società Paleontologica Italiana 11(1): 14–85.

Carrillo-Briceño JD, Argyriou T, Zapata V, Kindlimann R, Jaramillo C (2016) A new early Miocene (Aquitanian) Elasmobranchii assemblage from the La Guajira Peninsula, Colombia. Ameghiniana 53(2): 77–99. https://doi.org/10.5710/AMGH.26.10.2015.2931

Carrillo-Briceño JD, Villafaña JA, De Gracia C, Flores-Alcívar FF, Kindlimann R, Abella J (2020) Diversity and paleoenvironmental implications of an elasmobranch assemblage from the Oligocene–Miocene boundary of Ecuador. PeerJ 8: e9051. https://doi.org/10.7717/peerj.9051

Chandler R, Young P (2015) The fossils of North Carolina, Volume III, Fish. Raleigh, North Carolina Fossil Club, 376 pp.

Clari P, Proto Decima F, Ricci B, Sampo M (1987) Facies di piattaforma nell'Oligocene medio del Monferrato. Bollettino della Societh Paleontologica Italiana 26(1–2): 109–118.

Compagno LJV (1977) Phyletic relationships of living sharks and rays. American Zoologist 17(2): 303–322. https://doi.org/10.1093/icb/17.2.303

d'Erasmo G (1924) Ittioliti Miocenici di Rosignano-Piemonte e di Vignale. Memorie descrittive della carta geologica d'Italia 9: 6–38.

Doppler G, Heissig K, Reichenbacher B (2005) Die Gliederung des Tertiärs im süddeutschen Molassebecken. Newsletters on Stratigraphy 41: 359–375. https://doi.org/10.1127/0078-0421/2005/0041-0359

Ebert DA, Dando M, Fowler S (2021) Sharks of the world: a complete guide. Princeton University Press, Princeton (New Jersey), 607 pp. https://doi.org/10.1515/9780691210872

Fowler HW (1966) A catalog of world fishes (4). Quarterly Journal of the Taiwan Museum 19(1–2): 77–139.

Glikman LS (1964) [Sharks of Paleogene and their stratigraphic significance]. Nauka Press, Moscow, 229 pp. [in Russian]

Hasegawa Y, Uyeno T (1967) [Fossil fishes]. In: Anancho no Kaseki (Fossils from Anancho). Anancho Educational Committee, 113–117, 180–185.

Hay OP (1902) Bibliography and catalogue of the fossil vertebrata of North America. Bulletin of the United States Geological and Geographical Survey of the Territories 179: 1–868. https://doi.org/10.5962/bhl.title.20094

Heckeberg N, Pippèrr M, Läuchli B, Heimann FUM, Reichenbacher B (2010) The Upper Marine Molasse (Burdigalian, Ottnangian) in Southwest Germany – facies interpretation and a new lithostratigraphic terminology. Zeitschrift der Deutschen Gesellschaft für Geowissenschaften 161: 285–302. https://doi.org/10.1127/1860-1804/2010/0161-0285

Hofmayer F, Kirscher U, Sant K, Krijgsman W, Fritzer T, Jung D, Weissbrodt V, Reichenbacher B (2019) Three-dimensional geological modeling supports a revised Burdigalian chronostratigraphy in the North Alpine Foreland Basin. International Journal of Earth Sciences 108: 2627–2651. https://doi.org/10.1007/s00531-019-01780-0

Höltke O, Rasser MW, Unger E, Pollerspöck J (2020) The Elasmobranch Fauna from the Upper Marine Molasse (Lower Miocene, Burdigalian) of Ursendorf (District Sigmaringen, Baden-Württemberg, SW-Germany). Palaeontos 33: 1–56.

Huxley TH (1880) On the application of the laws of evolution to the arrangement of the vertebrata, and more particularly of the Mammalia. Proceedings of the Zoological Society of London 43: 649–661.

ICZN (1999) International Code of Zoological Nomenclature. Fourth Edition [Incorporating Declaration 44, Amendment of Article 74.7.3, with Effect from 31 December 1999 and the Amendment O]. International Trust for Zoological Nomenclature, London.

Janssen R, Doppler G, Grimm K, Grimm M, Haas U, Hiss M, Köthe A, Radtke G, Reichenbacher B, Salamon M, Standke G, Teipel U, Thomas M, Uffenorde H, Wielandt-Schuster U, Subkommission, Tertiär-Stratigraphie (2018) Das Tertiär in der Stratigraphischen Tabelle von Deutschland 2016. Zeitschrift der Deutschen Gesellschaft für Geowissenschaften 169: 267–294. https://doi.org/10.1127/zdgg/2018/0152

Joleaud L (1907) Géologie et paléontologie de la Plaine du Comtat et de ses abords. Description des terrains néogènes. Mémoire de l'Académie de Vaucluse 1: 1–252.

Landini W, Collareta A, Di Celma C, Malinverno E, Urbina M, Bianucci G (2019) The early Miocene elasmobranch assemblage from Zamaca (Chilcatay Formation, Peru). Journal of South American Earth Sciences 91: 352–371. https://doi.org/10.1016/j.jsames.2018.08.004

Lemcke K (1988) Geologie von Bayern I: Das bayerische Alpenvorland vor der Eiszeit–Erdgeschichte, Bau, Bodenschätze. Schweizerbart, Stuttgart, 175 pp.

Mancin N, Pirini C, Bicchi E, Ferrero E, Valleri G (2003) Middle Eocene to Middle Miocene Planktonic Foraminiferal Biostratigraphy for Internal Basins (Monferrato and Northern Appennines, Italy). Micropaleontology 49(4): 341–358. https://doi.org/10.2113/49.4.341

Maridet O, Hugueney M, Costeur L (2013) The mammalian assemblage of Mazan (Vaucluse, France) and its position in the Early Oligocene European palaeobiogeography. Swiss Journal of Geosciences 106: 231–252. https://doi.org/10.1007/s00015-013-0145-5

Ng SL, Yu CJ, Su SH, Joung SJ (2022) A new record of the rare Bigeye Sand Tiger shark *Odontaspis noronhai* Maul, 1955 (Lamniformes: Odontaspididae) from the northwestern Pacific, with notes on dentition. Zootaxa 5094(1): 92–102. https://doi.org/10.11646/zootaxa.5094.1.3

Pippèrr M (2011) Characterisation of Ottnangian palaeoenvironments in the North Alpine Foreland Basin using benthic foraminifera – a review on the Upper Marine Molasse of Southern Germany. Marine Micropaleontology 79: 80–99. https://doi.org/10.1016/j.marmicro.2011.02.002

Pollerspöck J, Unger E (in press) „Beiträge zur Kenntniss der fossilen Fische aus der Molasse von Baltringen" – Revision zum 200. Geburtstag von Pfarrer Josef Probst. Teil Hayfische (Selachoidei A. Günther) (Schluss) (Probst 1879). Jahreshefte der Gesellschaft für Naturkunde Württemberg 180.

Probst J (1878) Beiträge zur Kenntniss der fossilen Fische aus der Molasse von Baltringen. Hayfische. Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg 34: 113–154.

Probst J (1879) Beiträge zur Kenntniss der fossilen Fische aus der Molasse von Baltringen. Hayfische. (Schluss). Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg 35: 127–191.

Reiter E, Berning B (2012) Kleiner Exkursionsführer zu ausgewählten Aufschlüssen in der Molassezone Oberösterreichs. Berichte der Geologischen Bundesanstalt 94: 25–39.

Renz M (2009) Desert sharks. PaleoPress, Lehigh Acres, 197 pp.

Schultz O (1968) Die Selachierfauna (Pisces, Elasmobranchii) aus den Phosphoritsanden (Untermiozän) von Plesching bei Linz, Oberösterreich. Naturkundliches Jahrbuch der Stadt Linz 14: 61–103.

Shimada K, Chandler RE, Lam OLT, Tanaka T, Ward DJ (2017) A new elusive otodontid shark (Lamniformes: Otodontidae) from the lower Miocene, and comments on the taxonomy of otodontid genera, including the 'megatoothed' clade. Historical Biology 29: 704–714. https://doi.org/10.1080/08912963.2016.1236795

Shimada K, Boessenecker RW, Perez VJ, Kent BW (in press) New geographic and stratigraphic occurrences of the enigmatic extinct lamniform shark, *Megalolamna* (Lamniformes: Otodontidae), from the eastern USA. Historical Biology. https://doi.org/10.1080/08912963.2023.2282664

Smith AG, Smith DG, Funnell BM (1994) Atlas of Mesozoic and Cenozoic coastlines. Cambridge Univ Press, Cambridge, 99 pp.

Tanaka T (2013) Fossil elasombranchs from the Ichishi Group of Lower Miocene in Mie Prefecture, Japan. Journal of Geoscience [Chigaku Kenkyu] 61: 93–116. [in Japanese]

Triat J-M, Truc G, Hugueney M (1971) Lithostratigraphie des couches d'âge oligocène infèrieur et moyen constituant le toit du gypse dans la carrière de Malemort (Vaucluse): données sédimentologique et paléontologiques. Annales de Université de Provence - Sciences 44: 235–246.

Vialle N, Adnet S, Cappetta H (2011) A new shark and ray fauna from the Middle Miocene of Mazan, Vaucluse (southern France) and its importance in interpreting the paleoenvironment of marine deposits in the southern Rhodanian Basin. Swiss Journal of Geosciences 130(2): 241–258. https://doi.org/10.1007/s13358-011-0025-4

Zitteliana 98, 2024, 11–18 | DOI 10.3897/zitteliana.98.129065

SNSB Bayerische Staatssammlung für Paläontologie und Geologie

ZITTELIANA
An International Journal of Paleontology and Geobiology

Description of a new species of *Aporrhais* (Gastropoda, Stromboidea) from the Upper Eocene of Western Siberia

Ulrich Wieneke[1], Pavel V. Smirnov[2], Anton Maslennikov[3], Yaroslav S. Trubin[4,5]

1 *Hagener Str. 18a, 82418 Murnau, Germany*
2 *Kazan Federal University, Kremlyovskaya 18, 420111 Kazan, Russia*
3 *Parohodskaya Str. 4, apart.70, 625002, Tyumen, Russia*
4 *University of Bonn, Nussallee 8, 53115 Bonn, Germany*
5 *Tomsk State University, Lenin Avenue 36, 634050 Tomsk, Russia*

https://zoobank.org/2206DE74-F92F-411F-A5FE-9AE915C19E75

Corresponding author: Ulrich Wieneke (stromboidea@gmail.com)

Academic editor: Alexander Nützel ♦ **Received** 5 June 2024 ♦ **Accepted** 26 November 2024 ♦ **Published** 11 December 2024

Abstract

Material from the Upper Eocene Tavda Formation of Western Siberia contains a new species, *Aporrhais siberica* **sp. nov.** It has been misidentified as *A. cornuta* Korobkov, 1949, an aporrhaid originally described from the Upper Eocene / Lower Oligocene of the Turan Sea. The main difference between *A. siberica* and *A. cornuta* is the missing spire-adnate digitation of *A. siberica*. Publications referencing both morphologies are analyzed, and revised synonymies are presented.

Keywords

Aporrhaidae, Paleogene, Siberia, Tavda Formation, Taxonomy

Introduction

The Eocene and Oligocene marine fauna of the East Peri-Tethys and adjacent regions contains several gastropod morphs of the family Aporrhaidae (Ryabinin and Korobkov 1949; Il'ina 1953; Alekseev 1963; Amitrov 2005), which are usually lumped under the name *Aporrhais cornuta* Korobkov, 1949 that was originally described from the Oligocene of the North Aral region. New fossil aporrhaid material from the Trans-Ural region of Western Siberia, collected in recent years (Popov et al. 2019), is examined in this publication, and a new species from that region is described, replacing Turbina's (1959, 1962) attribution to "*Aporrhais cornutus* Alexeiev". The similar *A. cornuta* from the Paleogene of North Aral is re-evaluated herein and compared to the new species.

Material and methods

The research material encompasses six lots and was collected in the Kyshtyrla quarry (55°55'15"N, 65°49'26"E), situated on the south-western periphery of Western Siberia, which is recognized as the Trans-Ural region (Fig. 1). The material is stored in the Museum of the Tyumen Industrial University (MTIU) and the Slovtsov Museum Complex of Tyumen (SMCT) (Tyumen, Russia).

Based on detailed studies of pollen, dinoflagellate cysts, and magnetostratigraphy, the Tavda Formation is considered as Middle and Upper Eocene in age (Akhmet'ev et al. 2004, 2010, 2012; Iakovleva 2000, 2011; Iakovleva and Heilmann-Clausen 2010; Gnibidenko et al. 2020; Kuzmina et al. 2021). Further stratigraphic and paleoenvironmental information on the formation has been provided by

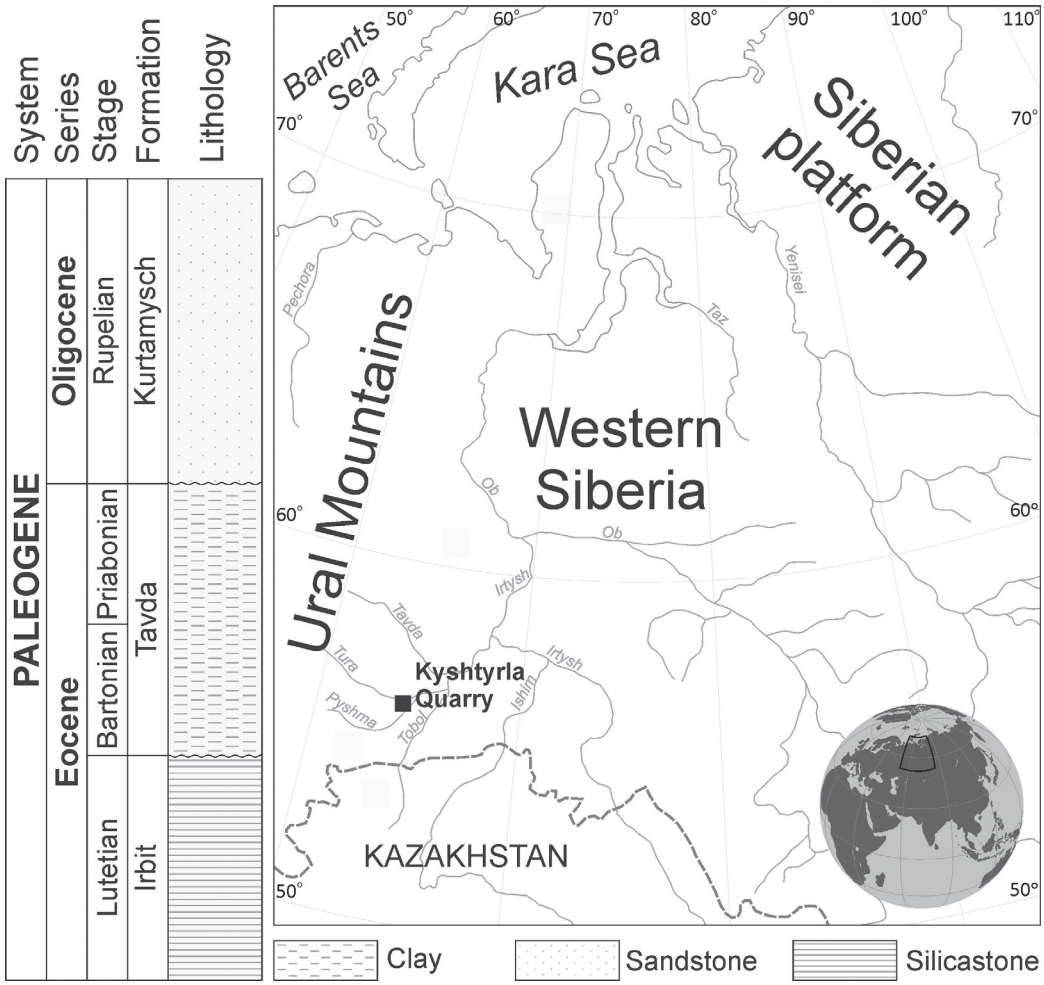

Figure 1. Location of the Kystyrla quarry and stratigraphic subdivision of the Tavda Formation after Gnibidenko et al. (2020) and Kuzmina et al. (2021).

foraminiferal assemblages (Subbotina et al. 1964; Podobina 1975, 1998, 2020). In this context, we note that the Kyshtyrla Quarry is a unique site where nearly all recent important palaeogeographical insights about the Eocene of the West Siberian Sea were made, including findings of shark teeth (Malyshkina 2006, 2012, 2021), Teleostei bone remains (Marrama et al. 2019), otoliths (Schwarzhans et al. 2021), mollusks (Trubin 2018; Popov et al. 2019), and trace fossils (Nesterov et al. 2018). Recent foraminiferal studies, accompanied by geochemical data, indicate that the quarry deposits belong to the Tavda Formation, recognized as Upper Eocene (Trubin et al. 2024) and associated with a shallow subtidal environment at the stage of increasing isolation of the West Siberian Basin from the world ocean.

The quarry is approximately 15 m deep. The deposits are polymineralic illite-smectite and montmorillonite blue-green clays with admixtures of pyrite, marcasite, siderite, quartz, and gypsum (Smirnov et al. 2019).

Sedimentary processes reflect the dynamics of a semi-isolated epicontinental sea in shallow-water environments during the Late Eocene. (Akhmet'ev et al. 2010). From the palaeogeographic point of view, the West Siberian Sea was isolated from the Arctic Ocean and connected to the Peri-Tethyan Sea via the Tyrgay Strait (Palcu and Krijgsman 2022); see Fig. 2.

To account for the numerous taxonomic and nomenclature changes a species might have undergone, we utilize chresonymies. This practice provides a comprehensive record of a species's historical names. To be exact, we use the original spelling, although this may lead to different spellings, e. g., for the author's name. While aiming to include all published occurrences, achieving complete coverage can be challenging. Despite our efforts, some entries might be missing. The names in the chresonymy are sorted into two sections. The top ones contain those that belong to the species, and the ones that bear in the reference the according name of the discussed species but do not belong to it begin with "non".

Criteria for classifying the references:

- Primary source evidence: Direct examination of the original material, high-quality figures, or detailed descriptions are prioritized for classification.
- Stratigraphy and geography: When primary source evidence is unavailable, the fossil record's stratigraphy and geographic origin are considered.
- If insufficient information exists for clear categorization, a question mark ("?") precedes the chresonymy entry.

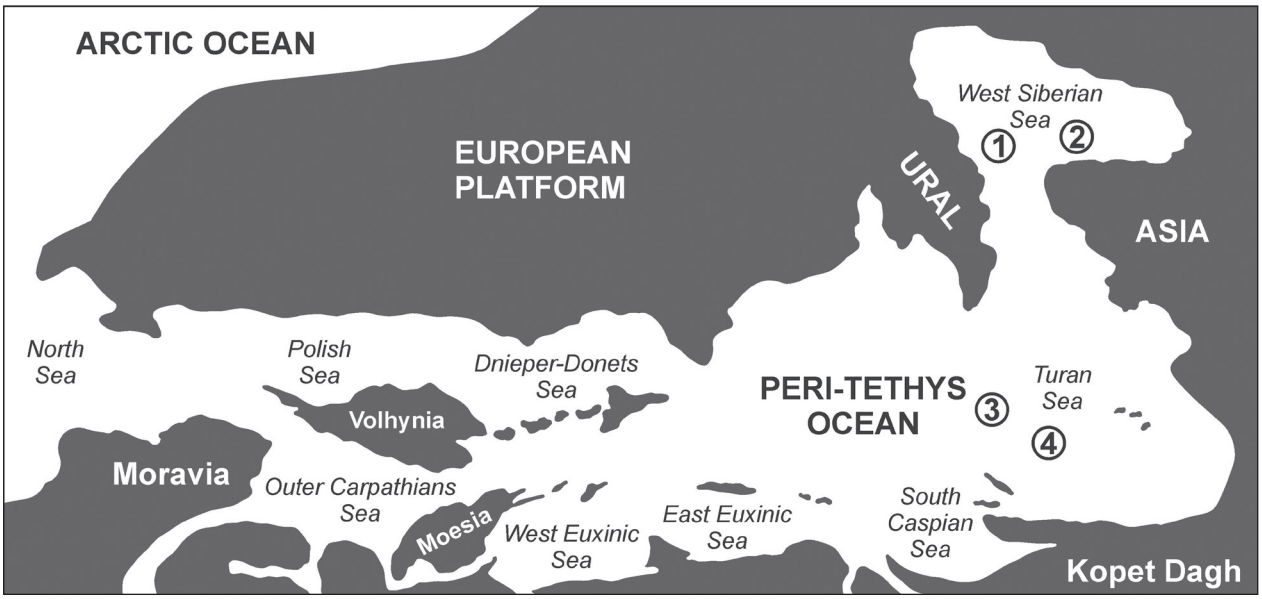

Figure 2. Paleogeography of the Peri-Tethys and subjected basins during the Late Eocene (modified after Akhmet'ev et al. 2012 and Palcu and Krijgsman 2022) and distribution of sites with *Aporrhais siberica* sp. nov.: (1) The Trans-Ural region of Western Siberia (Turbina 1959; Popov et al. 2019; this paper); (2) The central part of the Western Siberia (Turbina 1962); and *Aporrhais cornuta* Korobkov, 1949; (3) Ustyurt (Il'ina 1953, 1955, 1960; Alekseev 1963); (4) Northern Aral Sea region (Korobkov 1949; Ovechkin 1954).

The gastropod terminology is adapted from Manganelli et al. (2008).

Systematic Paleontology

Family Aporrhaidae Gray, 1850
Genus *Aporrhais* Mendes da Costa, 1778

Aporrhais siberica Wieneke & Trubin, sp. nov.

https://zoobank.org/22207F3B-5AF7-47EB-9409-A1529B948C8D
Plate 1: figs 1–12

Synonymy.

1959. *Aporrhais cornutus* Alexeiev – Turbina, pp. 30–31, pl. 2, figs. 13, 14 [non *Aporrhais cornuta* Korobkov, 1949].
1962. *Aporrhais cornutus* Alexeiev, 1945 – Turbina, p. 312, pl. 10, figs. 10, 11 [non *Aporrhais cornuta* Korobkov, 1949].
2019 *Aporrhais* sp. – Popov et al., pl. 3, fig. 5.

Types. *Holotype*: Museum of the Tyumen Industrial University MTIU K6 (Plate 1: figs 1, 2); paratypes: Museum of the Tyumen Industrial University MTIU K7, MTIU K8, MTIU K45, Slovtsov Museum Complex of Tyumen SMCT MF33788, MF33789.

Etymology. The species is named after Siberia, where Anton Maslennikov collected the holotype.

Diagnosis. A medium-sized, heavily callused *Aporrhais* with long digitations and no digitation adnate to the spire.

Description. High conical shell of medium size [~ 43 mm], conical spire with about eight whorls, aperture bears two digitations. Protoconch unknown. First three teleoconch whorls rounded, with numerous opisthocyrt growth lines. Fourth teleoconch whorl with opisthocyrt axial ribs, 11 on the abapertural part of the whorl. On the penultimate whorl, ribs strengthened, 6 on abapertural part. Last whorl with three keels, adapical keel most prominent, with about 5–6 ribs on the abapertural side, apertural side covered with callus, middle keel small with no ribs, abapical keel strongly reduced. Height of last whorl is almost half of the total height. Outer lip formed by two aperturally canaliculated digitations. Lateral adapical digitation is a spearhead-like elongation of adapical keel, long, adapically curved. Middle keel runs into the lateral abapical digitation, short, abapically directed. Abapical keel ends without building a digitation. Inner and outer lip of aperture thickly callused, columella heavily callused, callus covers the last whorl aperturally completely, adapical part of aperture also callused. Rostrum triangular, channeled.

Material. Six specimens: Four shells, MTIU K6, K7, K8, and K45. The shell MTIU K6 is fully preserved, K7 and K8 have a broken apertural extension, and K45 is a fragment. Two shells, MF33788 and MF33789, are stored in the STMC. The specimen with the number MF33788 is fully preserved. These six specimens are figured in plate 1. In the specimen with the number MF33789, the early whorls are broken off.

Measurements. fully preserved specimens: MTIU 6 (holotype), height: 43 mm; SMCT MF33788 (paratype), height: 46 mm.

Locus typicus. Northeastern wall of Kyshtyrla quarry (55°55'15"N, 65°49'26"E), Western Siberia, Trans-Ural region, Russia.

Stratum typicum. Upper part of Tavda Formation, Priabonian, Eocene, Paleogene.

Distribution. Trans-Ural region, including the type locality (Turbina 1959; this paper) and the southern part of Western Siberia near Omsk (Turbina 1962).

Discussion. *Aporrhais siberica* sp. nov. differs from *A. cornuta* by an adspiral digitation, that is absent in *A. siberica* (Plate 2: fig. 1b). The lateral adapical

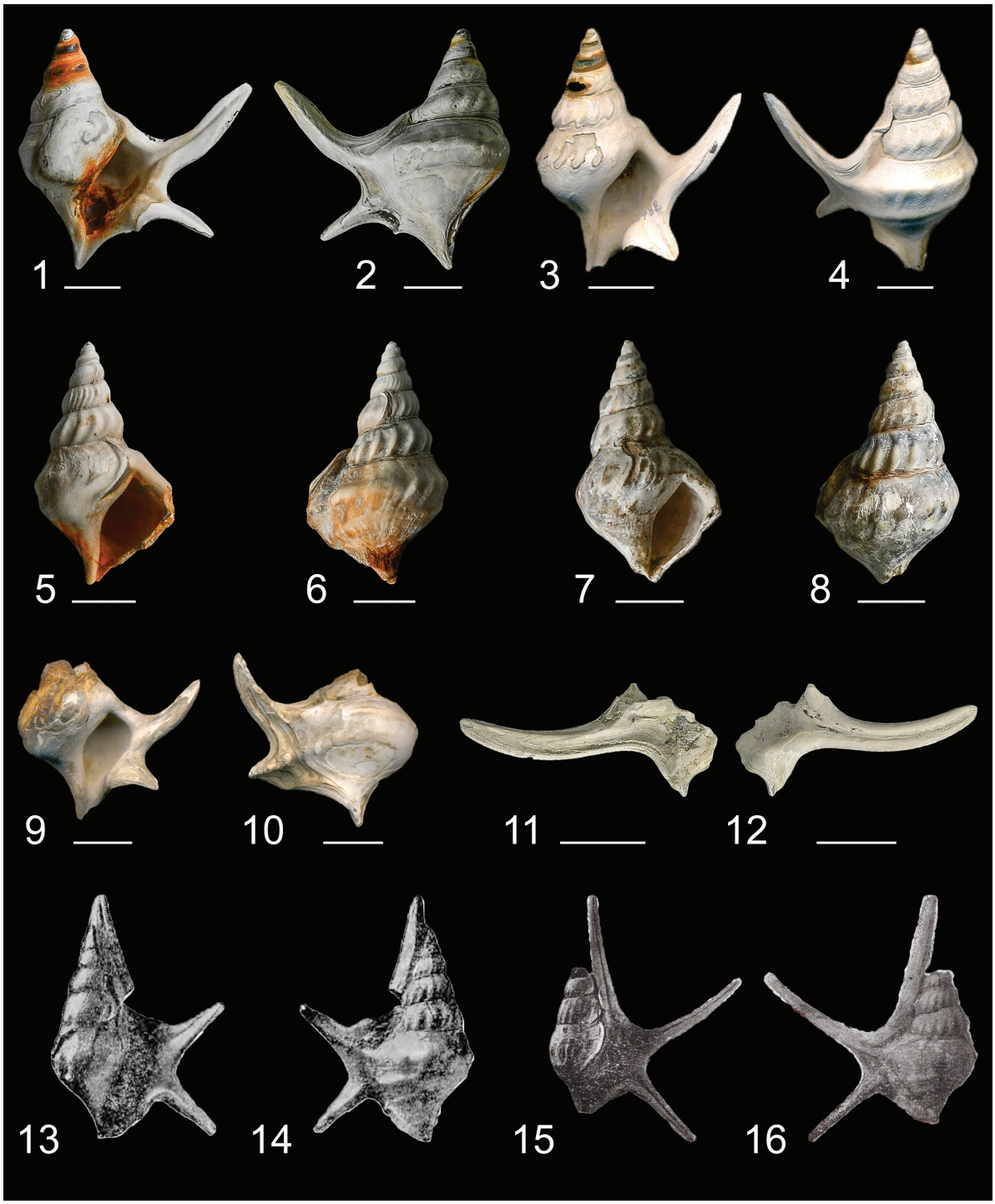

Plate 1. 1–12. *Aporrhais siberica* sp. nov. (**1, 2.** Holotype MTIU 6; **3, 4.** Paratype SMCT MF33788; **5, 6.** Paratype MTIU 7; **7, 8.** Paratype MTIU 8; **9, 10.** Paratype SMCT MF33789; **11, 12.** Paratype MTIU 45.); **13–16.** *Aporrhais cornuta* Korobkov, 1949 (**13, 14.** Korobkov 1949, pl. 65, figs 16a, b respectively, representing a syntype; **15, 16.** Alekseev 1963, pl. 16, figs 7, 11 respectively). Scale bar: 10 mm.

digitation is slightly curved in *A. cornuta* (Plate 2: fig. 2a) but more strongly curved in *A. siberica* (Plate 2: fig. 1a). A thick callus covers the apertural part of the last whorl of *Aporrhais siberica* (Plate 2: fig. 1c), while *A. cornuta* only has a thin callus restricted to the columella (Plate 2: fig. 2c) (see also Table 1). Turbina (1959, 1962) considered the Trans-Ural morph as a subadult of *Aporrhais cornuta*. The thick apertural callus, which occurs only in an adult stage, is an argument to reject this assumption.

Aporrhais cornuta Korobkov, 1949

Plate 1: figs 13–16

1949 *Aporrhais cornutus* Alexeev nov. sp. – Korobkov, p. 245, pl. 65, figs. 15, 16a, b. [basionym].

1954 *Apporhais* [sic] *cornutus* Alex. – Ovechkin, p. 76, pl. 9, fig. 22–23.

1955 *Aporrhais cornutus* Alex. – Korobkov, p. 272, pl. 57, figs. 11–13.

1955 *Chenopus* cf. *cornutus* Alex. – Ovechkin, p. 86.

1955 *Chenopus cornutus* Alex. – Ovechkin, p. 87.

1955 *Apporhais* [sic] *cornutus* Alex. – Ovechkin, p. 110.
1960 *Aporrhais cornutus* Alexeev – Orlov, pl. 21, fig. 10.
1963 *Chenopus cornutus* n. sp. – Alekseyev, pp. 78–81, pl. 15, figs. 5–16; pl. 16, figs. 5–11.
1971 *Aporrhais cornuta* Ilyina – Amitrov, pp. 68, 69, pl. 1, fig. 8.
1972 *Aporrhals* (*Chenopus*) *cornuta* Alex. – Sidorenko, p. 447.
1975 *Aporrhais cornutus* Alex. – Martynov et al., p. 227, 299, 322.
1985 *Chenopus cornutus* – Malchevskaya et al., 1985, p. 161.
1994 *Aporrhais cornutus* Korobkov, 1949 – Amitrov, pp. 104, 105, 107 [partim]
non 1858 *Rostellaria sowerbyi* Sow. – Abich, 1858, p. 21[557], pl. III [in plate caption: II], fig. 1a, b [= *Aporrhais aralensis* Eichwald, 1868]
?non 1859 *Rostellaria Sowerbyi* Sow. – Trautschold, p. 307.
?non 1868 *Aporrhais Sowerbyi* Sow. – von Koenen, pp. 158, 159
non 1953 *Aporrhais cornutus* Alexeiev – Il'ina, p. 105, pl. 6, fig. 14, pl. 7, fig. 2a, b [= *Aporrhais* sp.].
non 1955 *Aporrhais cornutus* (Alexeiev) – Il'ina, p. 61, pl. 22, figs. 1, 1a, 4, 5 [= *Aporrhais* sp.].
non 1958 *Aporrhais* (*Chenopus*) *cornutus* var. – Klyushnikov, pp. 288, 289, pl. 34, fig. 9 [= *Aporrhais* sp.].
non 1959. *Aporrhais cornutus* – Turbina, pp. 30–31, pl. 2, figs. 13, 14 [= *Aporrhais siberica* n. sp.].
?non 1960 *Aporrhais* cf. *speciosa* – Il'ina, p. 285, pl. 3, figs. 12, 13a, 14 [= *A. cornuta* fide Amitrov (1971), not seen]
non 1962 *Aporrhais cornutus* – Turbina, p. 312, pl. 10, figs. 10, 11 [= *Aporrhais siberica* n. sp.].

Original description by Korobkov, 1949 (in Russian). Крупная (высота до 57 мм), сильно расширяющаяся книзу, слегка изогнутая раковина, состоящая из 8 оборотов, разделенных глубоким узким швом. Последний оборот большой, несущий на поверхности 3 гранулированных киля, из которых нижний часто бывает совершенно гладкий. Поверхность более ранних оборотов покрыта спиральными ребрышками, количество которых колеблется в пределах от 15 до 18, пересеченными поперечными так, что образуется характерная сетчатая скульптура. На поздних оборотах сетчатая скульптура неотчетливая, вследствие сильного развития спиральных ребер. Устье узкое с 3 характерными пальцевидными отростками наружной губы. Верхний отросток, приросший по всей длине поверхности оборотов, у некоторых экземпляров значительно выступает над спиралью раковины. Второй, изогнутый отросток под углом в 50–70° к первому направлен вбок и вверх, а нижний прямолинейный отросток примерно под таким же углом к предыдущему — вбок и вниз. Верхний сильно бугорчатый киль поверхности последнего оборота в виде грубого гладкого ребра продолжается на среднем отростке, а средний киль — на нижнем. Пальцевидные отростки с внутренней стороны несут узкие каналы, открывающиеся в устье.

Original description by Korobkov (1949) (translation Trubin, Wieneke). Large (height up to 57 mm), strongly expanding downwards, slightly curved shell, consisting of 8 whorls separated by a deep narrow suture. The last whorl is large, bearing 3 granulated keels on the surface, of which the lower one is often completely smooth. The surface of the earlier whorls is covered by axial ribs, the number of which ranges from 15 to 18, crossed by transverse ones so that a characteristic reticulate sculpture is formed. On later whorls, the reticulate sculpture is indistinct due to the strong development of axial ribs. The aperture is narrow with 3 characteristic finger-like digitations of the outer lip. The adspiral digitation, grown along the entire length of the spire, in some specimens protrudes significantly above the spira. The second, curved process is directed laterally and upwards at an angle of 50–70° to the first one, and the lower rectilinear digitation is directed laterally and downwards at approximately the same angle as the previous one. The upper, strongly tuberculate keel of the surface of the last whorl, in the form of a rough, smooth rib, continues the middle digitation, and the median keel continues the lower digitation. The finger-like digitations on the inner side bear narrow canals that open at the aperture.

Types. Storage location unknown: Syntype 1 represented by Korobkov (1949), pl. 65, fig. 15, syntype 2 represented by Korobkov (1949), pl. 65, fig. 16 a, b.

Locus typicus. „Turnagly" (=Турнаглы) (in old references also cited as Turangly or Turanghul), northern Aral region, Kazakhstan.

Stratum typicum. Upper Eocene of northern Aral region (Korobkov 1949: 245), Tshegan Formation (Amitrov 1994).

Material. (additionally seen to published specimens): 2 specimens Sedgwick Museum of Earth Sciences, University of Cambridge C11743-4, ex Coll. Bateson (see Lukovitch 1921); 3 specimens Coll. Stichting Schepsel Schelp SSS54976; 5 specimens Coll. Elmar Mai, Durbusch; 10 specimens Coll. Ulrich Wieneke, Murnau.

Table 1. Comparison of *Aporrhais siberica* sp. nov. with *A. cornuta*.

Character \ Species	*Aporrhais siberica* sp. nov.	*Aporrhais cornuta*
adspiral digitation	no (Plate 2: fig. 1b)	long, protrudes the spire (Plate 2: fig. 2b)
lateral adapical digitation	shorter, stronger curved (Plate 2: fig. 1a)	long, only slightly curved (Plate 2: fig. 2a)
callus	thick, covering the apertural part of the last whorl (Plate 2: fig. 1c)	thin columellar callus (Plate 2: fig. 2c)

Discussion

The genus *Aporrhais* is treated with a feminine gender (Manganelli et al. 2008), so the correct name is *Aporrhais cornuta*, as Amitrov (1971) pointed out.

Korobkov (1949) and others attributed the name *Aporrhais cornuta* to Alexeev and referred to a manuscript by this author. This manuscript was posthumously published in 1963. Korobkoy (1949) and Alekseev (1963) included Abich's (1858) "*Rostellaria sowerbyi* Sow" (Abich 1858, pl. 3, figs 1a. b) in *Aporrhais cornuta*. Korobkov (1949) discovered that the English Eocene species *Rostellaria sowerbyi* (correct name *Aporrhais sowerbii* (Fleming, 1828))

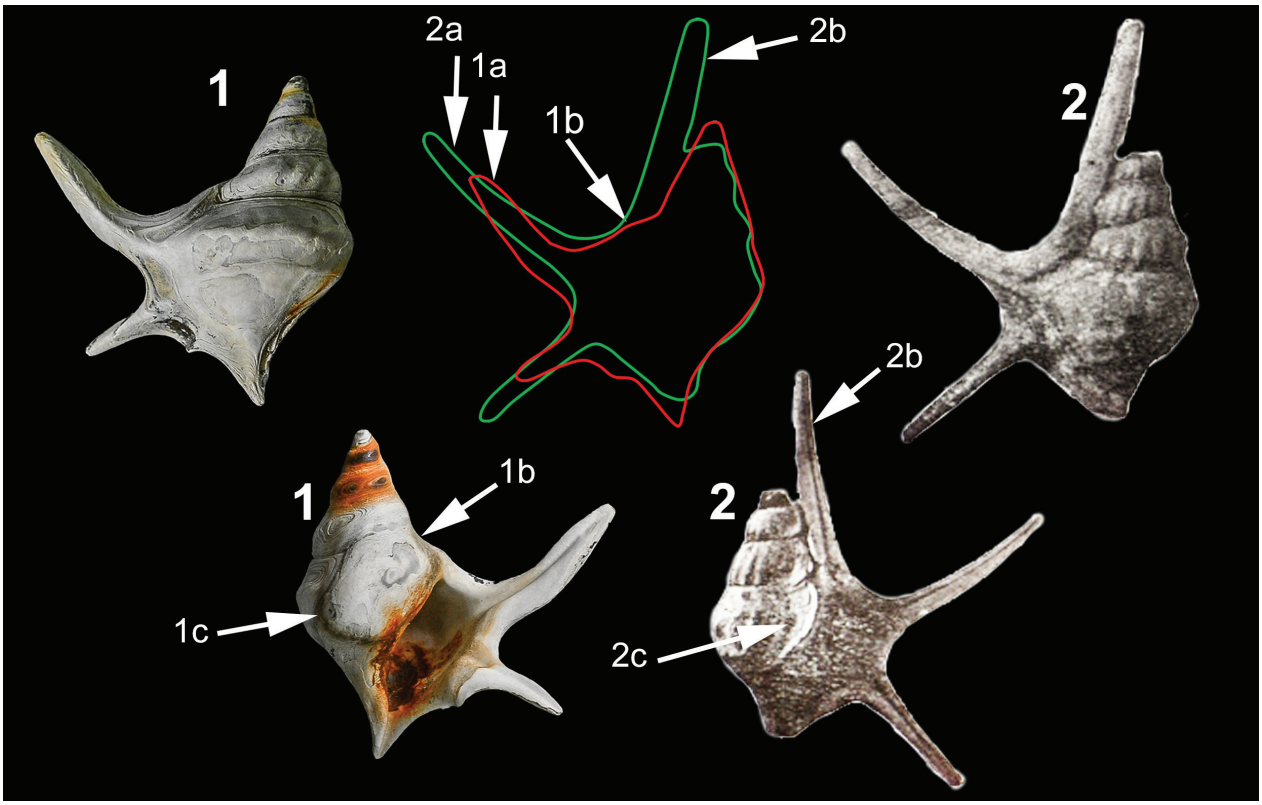

Plate 2. Differences between *Aporrhais siberica* (1) and *A. cornuta* (2), **a.** Lateral adapical digitation, **b.** Adspiral digitation, **c.** Callus.

is not conspecific with the specimens from the Crimean Eocene and described the latter as "*Aporrhais cornutus*", Amitrov (1994) revised the species *Aporrhais cornuta* and attributed it to Korobkov (1949). He also found that the specimen illustrated by Abich (1858, pl. 3, figs 1a, b) should be considered the illustration of the type of *Aporrhais aralensis* Eichwald, 1868, who cited Abich's figure (Abich 1858, pl. 3, figs 1a, b). It is a much smaller species compared to *Aporrhais cornuta*. He also claimed that only Korobkov's (1949) specimens should be regarded as syntypes. Although Alekseev (1963) lumped *A. aralensis* and *A. cornuta*, he pointed out how to distinguish them.

Before 1963, Alexeev's manuscript was cited several times:

- Korobkov (1949) cited Alexeev as the author of *Aporrhais cornuta*, but gave a different description and used different material, as can be concluded from the posthumous publication of the manuscript (Alekseev (1963). Korobkov (1949) should be considered as the describing author (see ICZN 50.1. especially 50.1.1. in combination with article 10.1.1.), as pointed out by Amitrov (1994).
- Il'ina (1953, 1955) used the name "*Aporrhais cornutus*" for a morphologically different, still undescribed species from Kazakhstan. It differs from *Aporrhais cornuta* (Korobkov, 1949) and *A. siberica* sp. nov. by the different ornamentation of the spire and by having a triangular apertural extension missing the long spines (Il'ina 1953).
- Alexeev (1963) also included a drawing from Abich (1858) of *Rostellaria sowerbyi*, p. 21[557], pl. III [in plate caption: II], fig. 1a, b for his description of *Aporrhais cornutus*. Trautschold (1859) and von Koenen (1868) also cited this drawing.
- Turbina (1959, 1962) used the name *Aporrhais cornutus* for another morphologically different species. This morph is described here as a new species: *Aporrhais siberica*.

Acknowledgments

The authors want to thank Matt Riley, Cambridge, for giving access to the Sedgwick Museum collection, Piet Hessel, Utrecht, Stichting Schepsel Schelp, for letting the first author analyze his material, and Elmar Mai, Durbusch, for presenting his material. Sven Nielsen, Valdivia, Thomas Neubauer, München, Alexander Nützel, München, and an unknown reviewer are thanked for their critical reading and commenting. It improved the publication significantly. Working through the literature was made possible by Han Stoutjesdijk, Numansdorp, the Biodiversity Heritage Library, and MolluscaBase.

References

Abich OWH von (1858) Beiträge zur Paläontologie des asiatischen Russlands. Mémoires de l'Académie des Sciences de Saint-Petersbourg. Sciences mathématiques et physiques 6(7): 537–577[, pls. 1–8]. https://doi.org/10.5962/bhl.title.61029

Akhmet'ev MA, Aleksandrova GN, Beniamovskii VN, Vitukhin DI, Glezer ZI, Gnibidenko ZN, Dergachev VD, Dolya ZHA, Zaoirizhets

NI, Kozlova GE, Kul'kova IA, Nikolaeva IA, Ovechkina MN, Radionova EP, Strel'nikova NI (2004) New Data on the Marine Paleogene of the Southwestern Siberian Plate, Paper 2. Stratigraphy and Geological Correlation 12(5): 65–86.

Akhmet'ev MA, Zaporozhets NI, Benyamovskiy VN, Aleksandrova GN, Iakovleva AI, Oreshkina TV (2012) The Paleogene history of the Western Siberian seaway – a connection of the Peri-Tethys to the Arctic Ocean. Austrian Journal of Earth Sciences 105(1): 50–67.

Akhmet'ev MA, Zaporozhets NI, Yakovleva AI, Aleksandrova GN, Beniamovsky VN, Oreshkina TV, Gnibidenko ZN, Dolya ZA (2010) Comparative Analysis of Marine Paleogene Sections and Biota from West Siberia and the Arctic Region. Stratigraphy and Geological Correlation 18(6): 635–658. https://doi.org/10.1134/S0869593810060043

Alekseev AK (1963) Paleogene Fauna of Mollusks of the Northern Aral Sea region [Paleogenovaja fauna molljuskov Severnogo Priaralja]. Publishing House of the Academy of Sciences of the Armenian SSR [Erevan, Izdatel'stvo Akademii Nauk Armjanskoj SSR], Yerevan, 230 pp. [in Russian]

Amitrov OV (1971) Oligocene complexes of gastropods of Mangyshlak and southwestern Ustyurt [Oligotsenovyye kompleksy gastropod mangyshlaka i yugo-zapadnogo Ustyurta]. In: Zhizhchenko BP, Ivanova VA (Eds) Cenozoic Stratigraphy and Paleogeography of the Oil and Gas Areas of the South of the Soviet Union [Stratigrafiya i paleogeografiya kaynozoya gazoneftenosnykh oblastey yuga Sovetskogo Soyuza], vol. 31/39–32/40, 65–81. Nedra, Moscow [Moskva: Nedra].

Amitrov OV (1994) Gastropods of the Chegan formation (Transcaspian, Eocene); 1. Previous knowledge and problems of nomenclature [Gastropody cheganskoy svity (eocen Zakaspiya). St. 1. Izuchennost' i voprosy nomenklatury]. Bulletin of Moscow Society of Naturalists, geological series [Vestnik Moskovskogo obshchestva yestestvoispytateley, Otdel geologii] 69(5): 69–110. [in Russian]

Amitrov OV (2005) Complexes of marine gastropods of the Eocene and Oligocene of western Kazakhstan [Kompleksy morskikh gastropod eotsena i oligotsena Zapadnogo Kazakhstana]. Bulletin of Moscow Society of Naturalists, geological series [Vestnik Moskovskogo obshchestva yestestvoispytateley, Otdel geologii] 80(1): 37–55. [in Russian]

Eichwald E (1865–1868) Lethaea Rossica ou Paléontologie de la Russie. Moyenne Periode. E. Schweizerbart, Stuttgart, [XXXV +] 1304 pp. https://doi.org/10.5962/bhl.title.52391

Fleming J (1828) A history of British animals, exhibiting the descriptive characters and systematical arrangement of genera and species of quadrupeds, birds, reptiles, fishes, mollusca, and Radiata of the United Kingdom. Edinburgh, [XXIII +] 565 pp. https://doi.org/10.5962/bhl.title.12859

Gnibidenko ZN, Kuzmina OB, Levicheva AV (2020) Regional Magnetostratigraphy of the Upper Cretaceous and the Cretaceous–Paleogene Boundary in Southern West Siberia as Applied to Complitation of the Cretaceous Magnetic-Polarity Scale. Russian Geology and Geophysics 61(9): 1028–1035. https://doi.org/10.15372/RGG2019170

Gray JE (1850) [text]. In: Gray ME, Figures of molluscous animals, selected from various authors. Longman, Brown, Green and Longmans, London, 4, [IV +] 219 pp.

Iakovleva AI, Heilmann-Clausen C (2010) Eocene dinoflagellate cyst biostratigraphy of research borehole 011-BP, Omsk Region, southwestern Siberia. Palynology 34(2): 195–232. https://doi.org/10.1080/01916121003629974

Iakovleva AI (2000) Biostratigraphical and paleogeographical significance of the Paleocene–Eocene dinoflagellates in Western Siberia and adjacent regions (Petchora depression and Turgay trough). GFF 122: 82–83. https://doi.org/10.1080/11035890001221082

Iakovleva AI (2011) Palynological reconstruction of the Eocene marine palaeoenvironments in south of Western Siberia. Acta Palaeobotanica 51(2): 229–248.

Il'ina AP (1953) Mollusks of the Chegan Formation from the northern chinks of Ustyurt [Mollyuski cheganskoy svity severnykh chinkov Ustyurta]. In: Paleontological Serie [Paleontologicheskiy sbornik], 93–134. State Scientific and Technical Publishing House of Oil and Mining Fuel Literature [Gosudarstvennoye nauchno-tekhnicheskoye izdatel'stvo neftyanoy i gorno-toplivnoy literatury], Leningrad and Moscow. [in Russian]

Il'ina AP (1955) Paleogene Mollusks of Northern Ustyurt [Mollyuski paleogena Severnogo Ustyurta]. State Scientific and Technical Publishing House of Oil and Mining Fuel Literature [Gosudarstvennoye nauchno-tekhnicheskoye izdatel'stvo neftyanoy i gorno-toplivnoy literatury], Leningrad, 163 pp. [in Russian]

Il'ina AP (1960) Lower Oligocene mollusks Mangyshlak, [Nizhneoligotsenovyye mollyuski Mangyshlaka]. Proceedings of VNIGRI, New Series [Tr. VNIGRI, Novaya seriya,], 154(2): 265–298. [in Russian]

Klyushkov MN (1958) Stratigraphy and Fauna of the Lower Tertiary Sediments of Ukraine; [Stratigrafiya i fauna nizhnetretichnykh otlozheniy Ukrainy]. Publishing House of the Academy of Sciences of the Ukrainian USR [Izdatel'stvo akademii nauk Ukrainskoy SSR], Kyiv, 549 pp. [in Russian]

Koenen A (1868) Über die Unter-Oligocaene Tertiaer-Fauna vom Aralsee. Bulletin Société Impériale des naturalistes de Moscou 41(1–2): 144–172.

Korobkov IA (1949) Gastropoda. In: Ryabinin AN, Korobkov IA (Eds) (1949) Atlas of Guiding Forms of Fossil Faunas of the USSR. Paleogene, 231–269, pls. 63–71.

Korobkov IA (1955) Reference book and methodological guide to tertiary mollusks. Gastropods [Spravochnik i metodicheskoe rukovdstvo po tretichnym molliuskam. Bruhonogie]. State Scientific and Technical Oil Research [Gosudarstvennii Nauchno-Teknicheskii Issledovanie Nefti], Leningrad, 795 pp. [in Russian]

Kuzmina OB, Lebedeva NK, Shchuclin NE (2021) Palynostratigraphy of the Cretaceous and Paleogene Sediments of Chelyabinsk Oblast, South Transurals. Stratigraphy and Geological Correlation 29(2): 215–240. https://doi.org/10.1134/S0869593821020040

Lukovitch MT (1921) A new contribution to the knowledge of the Lower Tertiary Mollusca of the Aral Sea. Société des Sciences Naturelle Croate 33: 157–174.

Malchevskaya TM, Kulikov MV, Vitlin AV (1985) Catalogue of Holotypes of Fauna and Flora Species stored in GNIGR Museum Issue 2, Part II - Meso-Cenozoic; [Katalog golotipov vidov fauny i flory, khranyashchikhsya v Muzeye GNIGR Vypusk 2, Chast' II - Mezokaynozoy]. Ministry of Geology of the USSR [Ministerstvo geologii SSSR], Leningrad, 254 pp. [in Russian]

Malyshkina TP (2021) *Striatolamia tchelkarnurensis* Glickman (Elasmobranchii: Lamniformes), the Youngest Valid *Striatolamia* Species. Paleontological Journal 2(2): 77–87. https://doi.org/10.1134/S0031030121020088

Malyshkina TP (2006) Late Eocene scyliorhinid sharks from the Trans–Urals, Russia. Acta Palaeontologica Polonica 51(3): 465–475.

Malyshkina TP (2012) New sharks of the genus *Abdounia* (Carcharhiniformes: Carcharhinidae) from the Upper Eocene of the Trans-Ural Region. Paleontological Journal 46(4): 60–67. https://doi.org/10.1134/S0031030112040053

Manganelli G, Spadini V, Fiorentino V (2008) The lost *Aporrhais* species from the Italian Pliocene: *A. peralata* (Sacco, 1893) (Gastropoda, Caenogastropoda). Journal of Conchology 39: 493–515.

Mantell G (1822) The Fossils of the South Downs; or Illustrations of the Geology of Sussex. Lupton Relfe, London, 1–328, pls. I–XLII. https://doi.org/10.5962/bhl.title.44924

Marrama G, Carnevale G, Smirnov PV, Trubin YS, Krivet J (2019) First report of Eocene Gadiform fishes from the Trans-Urals (Sverdlovsk and Tyumen regions, Russia). Journal of Paleontology 93(5): 1001–1009. https://doi.org/10.1017/jpa.2019.15

Martynov VA, Sigov AP, Chirva SA (1975) West Siberian Plate [Zapadno-Sibirskaya plita]. In: Nalivkin DV (Ed.) Paleogene of USSR [Paleogenovaya sistema SSSR], 315–328. Bosom [Nedra], Moskow. [in Russian]

Mendes da Costa E (1778–1779) Historia naturalis testaceorum britanniae or the British Conchology; containing the descriptions and other particulars of natural history of the shells of Great Britain and Ireland: illustrated with figures. Printed for the author, and sold by Millan, B. White, Elmsley, and Robson, London, XII, 254, VII pp., 17 pls. https://doi.org/10.5962/bhl.title.13179

Nesterov II, Smirnov PV, Konstantinov AO, Gursky H-J (2021) Types, features, and resource potential of Palaeocene–Eocene siliceous rock deposits of the West Siberian Province. International Geology Review 63(14): 504–525. https://doi.org/10.1080/00206814.2020.1719370

Orlov YA (1960) Principles of Paleontology, Mollusca - Gastropoda [Printsipy paleontologii, Mollyuski - Bryukhonogiye]. State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], Moscow, 360 pp. [in Russian]

Ovechkin NK (1954) Middle Paleogene deposits of the Turgai Depression and the Northern Aral Sea region [Otlozheniya srednego paleogena Turgayskoy vpadiny i Severnogo Priaral'ya]. State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], Moscow, 170 pp. [in Russian]

Ovechkin NK (1955) Geology of the southwestern part of the Turgai Depression [Geologiya yugo-zapadnoy chasti Turgayskogo progiba]. State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], Moscow, 156 pp. [in Russian]

Palcu DV, Krugsman W (2022) The dire straits of Paratethys: gateways to the anoxic giant of Eurasia. Geological Society, London, Special Publications: 523. https://doi.org/10.1144/SP523-2021-73

Podobina VM (1975) Foraminifers from the Upper Cretaceous and Paleogene of the West Siberian Lowland and their significant for stratigraphy [Foraminifery verkhnego mela i paleogena Zapadno-Sibirskoy nizmennosti i ikh znacheniye dlya stratigrafii]. Tomsk University Publishing House [Izdatel'stvo Tomskogo universiteta], Tomsk, 163 pp. [in Russian]

Podobina VM (1998) Paleogene foraminifera and biostratigraphy of Western Siberia [Foraminifery i biostratigrafiya paleogena Zapadnoy Sibiri]. Tomsk University Publishing House [Izdatel'stvo Tomskogo universiteta], Tomsk, 334 pp. [in Russian]

Podobina VM (2020) Paleogene foraminifera and biostratigraphy of Western Siberia [Biostratigrafiya i foraminifer paleogena Zapadnoy Sibiri]. Tomsk University Publishing House [Izdatel'stvo Tomskogo universiteta], Tomsk, 276 pp. [in Russian]

Popov SV, Trubin YS, Smirnov PV, Ordowskyi VV, Goncharova IA, Amitrov OV (2019) On the Taxonomic Composition of Mollusks from the Tavda Formation of Western Siberia. Paleontological Journal 53(1): 20–29. https://doi.org/10.1134/S0031030119010076

Ryabinin AN, Korobkov IA [Ed.] (1949) Atlas of Guiding Forms of Fossil Faunas of the USSR. Paleogene [Atlas napravlyayushchikh form iskopayemykh faun SSSR. Paleogen]. State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], Moscow, 367 pp. [in Russian]

Schwarzhans WW, Smirnov PV, Trubin YS, Ordowskyi V (2021) First record of otoliths from the Eocene of Western Siberia. Cybium 45(1): 79–80. https://doi.org/10.26028/cybium/2021-451-009

Sidorenko AV (1972) Geology of USSR, Central Kazakhstan [Geologiya SSSR, Tsentral'nyy Kazakhstan]. Bosom [Nedra], Moskow, 532 pp. [in Russian]

Smirnov PV, Deryagina OI, Novoselov AA, Trubin YS, Batalin GA, Gareev BI, Plyusnin AV (2019) Eocene Tavda Formation clays: lithogeochemical and sedimentological aspects (Kyshtyrlinskoe deposit, West Siberia). Bulletin of the Tomsk Polytechnic University. Geo Assets Engineering 330(11): 130–144. https://doi.org/10.18799/24131830/2019/11/2357

Subbotina NN, Alekseychik-Mitskevith LS, Baranovskaya OF, Bulatova ZI, Bulynnikova SP, Dubrovskaya NF, Kisel'man EN, Kozlova GE, Kuzina VI, Kiseleva OT, Krivoborskiy VV, Ushakova MV, Freyman YV (1964) Foraminifera from the Cretaceous and Paleogene deposits of Western Siberia [Foraminifery melovykh i paleogenovykh otlozheniy Zapadno-Sibirskoy nizmennosti]. Bosom [Nedra], Leningrad, 456 pp. [in Russian]

Trautschold H (1859) Ueber Petrefakten vom Aralsee. Bulletin Société Impériale des naturalistes de Moscou 32(1–2): 303–322.

Trubin YS (2018) Family Naticidae of the Tavda Formation (Eocene, Western Siberia). Ruthenica, Russian Malacological Journal 28(1): 11–17. https://doi.org/10.35885/10.35885/ruthenica.2018.28(1).2

Trubin YS, Marinov VA, Smirnov PV, Novoselov AA, Langer MR (2024) Upper Eocene benthic foraminiferal assemblages from the Western Siberia (Trans-Ural Region): a multi-proxy approach to infer environmental changes. Micropaleontology 70 (3): 287–299. https://doi.org/10.47894/mpal.70.3.07

Turbina AS (1959) Some species of bivalves and gastropods of the Paleogene of the West Siberian lowland [Nekotoryye vidy dvustvorok i bryukhonogikh paleogena Zapadno-Sibirskoy nizmennosti]. In Materials on paleontology and stratigraphy of Western Siberia [Materialy po paleontologii i stratigrafii Zapadnoy Sibiri]. Leningrad: State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], 19–36. [in Russian]

Turbina AS (1962) Gastropod mollusks of Tertiary marine sediments [Bryukhonogiye mollyuski tretichnykh morskikh otlozheniy]. In Biostratigraphy of Mesozoic and Tertiary deposits of Western Siberia [Biostratigrafiya mezozoyskikh i tretichnykh otlozheniy Zapadnoy Sibiri]. State Publishing House of Geological Literature [Gosudarstvennoye izdatel'stvo geologicheskoy literatury], Leningrad, 311–312. [in Russian]

Zitteliana 98, 2024, 19–72 | DOI 10.3897/zitteliana.98.138605

SNSB Bayerische Staatssammlung für Paläontologie und Geologie

ZITTELIANA
An International Journal of Paleontology and Geobiology

Late Jurassic (Upper Kimmeridgian) gastropods from Saal near Kelheim (Germany, Bavaria)

Joachim Gründel[1], Alexander Nützel[2,3,4]

1 *Institut für Geowissenschaften, Fachrichtung Paläontologie, Freie Universität Berlin, Malteserstraße 74–100, 12249 Berlin, Germany*
2 *SNSB-Bayerische Staatssammlung für Paläontologie und Geologie, Richard-Wagner-Str. 10, 80333 München, Germany*
3 *Department of Earth and Environmental Sciences, Paleontology and Geobiology, Ludwig-Maximilians-Universität München, Richard-Wagner-Str. 10, 80333 München, Germany*
4 *GeoBio-Center, Ludwig-Maximilians-Universität München, Richard-Wagner-Str. 10, 80333 München, Germany*

https://zoobank.org/9FB6F185-9EA1-48EB-A5C9-632BD52A8B6F

Corresponding authors: Joachim Gründel (joachim.gruendel@lingua-pura.de); Alexander Nützel (nuetzel@snsb.de)

Academic editor: Michael Krings ♦ **Received** 4 October 2024 ♦ **Accepted** 3 December 2024 ♦ **Published** 11 December 2024

Abstract

A new collection of Upper Jurassic (Kimmeridgian) gastropods from the reefal limestones of the Saal quarry near Kelheim (Lower Bavaria, Germany) is reported. It has yielded 119 species of which 80 species are nominate species, the others are treated in open nomenclature. This increases the number of known gastropod species from the Saal quarry by 54 (31 nominate species). A total of 178 gastropod species (107 nominate species) have now been reported from this locality making this occurrence the richest one from the Late Jurassic. Despite the fact that previously studied collections are from the same quarry and have the same age, these collections differ considerably from each other in species composition and relative abundances of shared species. This reflects facies differentiation in the quarry as well as colletion biases. One new genus (*Kelheimia* **gen. nov.**) and 15 new species are described: *Scurriopsis cragolis* **sp. nov.**, *Pseudorhytidopilus*? *quadratus* **sp. nov.**, *Rimulopsis danuviensis* **sp. nov.**, *Nododelphinula oblonga* **sp. nov.**, *Creniturbo gibbosus* **sp. nov.**, *Kelheimia triangulata* **sp. nov.**, *Neritopsis*? *rotundatus* **sp. nov.**, *Oonia kimmeridgiensis* **sp. nov.**, *Eustoma*? *gracilis* **sp. nov.**, *Cryptoptyxis*? *spinosus* **sp. nov.**, *Turritella lucagrita* **sp. nov.**, *Neuburgensia angulata* **sp. nov.**, *Neuburgensia rara* **sp. nov.**, *Diarthema aspera* **sp. nov.**, and *Aphanoptyxis sinerugae* **sp. nov.** *Leptomaria tuberosa* Gründel, Keupp & Lang, 2017 is seen as subjective **synonym** of *Leptomaria goldfussi* (Sieberer, 1907). *Gymnocerithium*? *convexoconcavum* Gründel, Keupp & Lang, 2019 is placed in the genus *Neuburgensia* (**comb. nov.**). *Amphitrochus*? *gerberi* Gründel, Keupp & Lang, 2017 is placed in the genus *Serrettella* (**comb. nov.**). *Neritopsis subvaricosa* Brösamlen, 1909 is placed in the genus *Hayamiella* (**comb. nov.**). *Gymnocerithium*? *convexoconcavum* Gründel, Keupp & Lang, 2019 is placed in the genus *Neuburgensia* (**comb. nov.**). *Nerinea tricincta* Münster, 1844 is placed in the genus *Aptyxiella* (**comb. nov.**). *Nerinea staszycii* (Zeuschner, 1850) is placed in the genus *Endoplocus* (**comb. nov.**). *Polyptyxisella clio* (d'Orbigny, 1852) is placed in the genus *Ptygamtis* (**comb. nov.**).

Keywords

Jurassic, Gastropoda, New Taxa, Diversity, Taxonomy

Introduction

The Saal quarry near Kelheim has yielded a highly diverse Late Jurassic gastropod fauna that was described together with material from the Late Jurassic silicified fauna from Nattheim (same age) in the past years (Gründel et al. 2015, 2017, 2019, 2022). Some years ago, a large collection of marine invertebrates including additional gastropods from the Saal quarry was obtained by the Bayerische Staatssammlung

für Paläontologie and Geologie (SNSB–BSPG, Bavarian State Collection for Palaeontology and Geology), Munich. This material was collected by the private collector Jürgen Sylla. In addition, some material from Saal became available from other collectors. Together, this new material provides considerable additional information about the gastropod fauna from the Saal quarry which is among the most diverse known Late Jurassic faunas known so far.

Geological setting

The studied gastropod fauna comes from Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria. The geological setting and depositional environment of the Upper Jurassic (Kimmeridgian) reefal limestones exposed in the Saal quarry has been treated in detail by Gründel et al. (2015, 2022).

Studied material

All specimens described in the following are from the Saal quarry (Saal near Kelheim, Bavaria) which is also the type locality for the new species described herein; all have an upper Kimmeridgian age (*stratum typicum* for new species). As mentioned, specimens were collected by Jürgen Sylla if not stated otherwise (by far most of the material studied herein comes from the Sylla collection). Jürgen Sylla collected this material over many years exclusively from the Saal quarry. In the following, this location is called ‚Saal', if the collectors has not provided further detail such as a specific location within the quarry and the beds from which the material was collected. If such information was provided by the collector Sylla, it is also given herein for the specimens in question. A few of the studied specimens derive from the collections of Fritz Lang, Helmut Keupp, and Olaf Neubauer. This material became available for us after the publication of the previous monographs on the gastropods from the Saal quarry (Gründel et al. 2015, 2017, 2019, 2022). If no collector name is mentioned, the specimens are from the Sylla collection.

Repository

Nearly all material including all type and illustrated specimens is housed in the Bayerische Staatssammlung für Paläontologie und Geologie in Munich under the general repository number SNSB–BSPG 2016 XXI. In addition, all illustrated and all type specimens have individual repository numbers. Some of the studied specimens were provided by other collectors (see above). Of those specimens, a few were returned to collectors if they are not illustrated or have type status.

Results

Systematic palaeontology

In principal, we use the suprageneric systematics as given by Bouchet et al. (2017).

Subclass Patellogastropoda Lindberg, 1986
Superfamily Patelloidea Rafinesque, 1815
Family Patellidae Rafinesque, 1815

Genus *Patella* Linné, 1758

Type species. *Patella vulgata* Linné, 1758; Recent.

Patella sp.

Plate 1: fig. 1

Material. 1 specimen, SNSB–BSPG 2016 XXI 1601 (collection O. Neubauer).

Description. Shell 7 mm long, with broadly oval outline and rounded edges in dorsal view; shell lowly limpet–shaped; apex in almost central position; central portion of shell lacks visible ornament (due to preservation?); shell otherwise with numerous strong, somewhat bulging radial ribs with 1 or 2 weaker radial ribs in between (details unclear); in addition shell ornamented with numerous weak concentric ribs.

Remarks. *Patella staceata* Gründel, Hostettler and Menkveld-Gfeller, 2020 is very similar but differs in having numerous weaker radial ribs between the strong main radial ribs. The single, probably juvenile specimen is too poorly preserved for a better identification.

Superfamily Lottioidea Gray, 1840
Family Acmaeidae Forbes, 1850

Genus *Scurriopsis* Gemmellaro, 1878

Type species. *Scurriopsis neumayri* Gemmellaro, 1878; Early Jurassic, Sinemurian; Italy.

Scurriopsis cragolis sp. nov.

https://zoobank.org/E0EC08EE-5E8A-4448-A189-6162261927BF

Plate 1: figs 2–4

Etymology. Arbitrary word formation.

Holotype. SNSB–BSPG 2016 XXI 1602 (Plate 1: figs 2–4), Sylla collection.

Paratypes. 3 specimens, SNSB–BSPG 2016 XXI 1603–1605.

Description. Limpet with almost straight to slightly convex sides in lateral view; distinctly longer than wide in

dorsal view; outline in dorsal view oval to rounded subrectangular, slightly tapering posteriorly or anteriorly; apex distinctly decentral in direction of the tapering side of the shell; shell ornamented with numerous, densely spaced fine but distinct radial ribs and much finer co-marginal concentric threads. The holotype is 26 mm long.

Differential diagnosis. *Hennocquia saalensis* Gründel et al. (2017) from the same locality and stratigraphic position is smaller, the shell is broadly elliptic in dorsal view and has distinctly convex sides in lateral view; its very weak radial ribs are confined to the anterior and posterior parts of the shell and its dominant ornament consists of strengthened growth lines. *Scurria oxyconus* Zittel sensu di Stefano (1884) is larger and the shell is broader in dorsal view and has more convex sides in lateral view; its apex is situated in an almost central position. *Fissurella kobyi* Loriol, 1890 (in Loriol and Koby) is smaller and has more convex sides in lateral view; it has fewer and stronger axial ribs, its apex has a hole as is typical for fissurellids. *Dietrichella moreana* (Buvignier, 1843) sensu Gründel et al. (2020a) has more convex sides in lateral view, is broader oval in dorsal view and lacks axial ribs.

Scurriopsis sp.

Plate 1: figs 5–8

Material. 1 specimen, SNSB–BSPG 2016 XXI 1606.

Description. Shell 8 mm long, high limpet-shaped; apex slightly decentral on anterior-posterior axis; on anterior-posterior axis, one side weakly convex in lateral view, other side almost straight; shell outline broadly oval in dorsal view; shell tapering, somewhat narrower in direction of apex; shell ornamented with numerous (ca. 50) radial ribs of equal strength, crenulated by much weaker concentric ribs; apex demarcated from rest of shell, with much weaker ornament (maybe due to preservation); shell edge wavy in dorsal view due to protruding radial ribs.

?Family Acmaeidae Forbes, 1850

Genus *Pseudorhytidopilus* Cox, 1960 (in Knight et al.)

Type species. *Pseudorhytidopilus lennieri* Cox, 1960 (in Knight et al.); Kimmeridgian; France.

Remarks. The systematic placement of this genus is unclear (Gatto and Monari 2010; Szabó in Mandl et al. 2010). Most authors place it in Acmaeidae.

Pseudorhytidopilus? *quadratus* sp. nov.

https://zoobank.org/B6959D20-CF2C-4189-A9AA-DCB15B3AAF2B

Plate 1: figs 9–11

Etymology. Latin quadratus – due to the quadratic outline of the shell.

Holotype. SNSB–BSPG 2016 XXI 1607 (Plate 1: figs 9–10).

Paratypes. 6 specimens SNSB–BSPG 2016 XXI 1608–1613.

Diagnosis. Shell thin, with trapezoidal to subquadratic outline with rounded edges in dorsal view; apex approximately in central position; shell ornamented with irregular concentric bulges.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Description. Large specimen has a diameter of 21 mm; shell very thin, shallowly cap-shaped in lateral view; trapezoidal (one side of shell slightly narrower than the other side) to subquadratic outline with rounded edges in dorsal view; apex approximately in central position; shell ornamented with irregular concentric bulges.

Remarks. Species with a similar ornament of bulges (e. g., *P.*? *ledonii* (Haber, 1932) sensu Gatto and Monari 2010, *Fabercapulus semisculptus* Monari et al. 2017) have an elliptic outline in dorsal view and a radial furrow. Other species with an oval outline in dorsal view lack a furrow and an ornament of bulges (*P. latissima* (Sowerby, 1816) sensu Munt in Martill and Etches 2020, *Berlieria maeotis* (Eichwald) sensu Gerasimov, 1992 and others).

Brunonia annulata (Yokoyama, 1890) from the Cretaceous of Japan is also cap-shaped and has a similar ornament but its type species is much larger and has a rounded, oval outline in dorsal view (Kase 1988; Dieni 1990). *Patella* (*Helcion*) *sculptilis* Zittel, 1873 has a straight shell end in lateral view, weak concentric wrinkles and numerous radial ribs.

Subclass Vetigastropoda Salvini-Plawen, 1980
Superfamily Pleurotomarioidea Swainson, 1840
Family Pleurotomariidae Swainson, 1840

Genus *Pleurotomaria* Defrance, 1826

Type species. *Trochus anglicus* Sowerby, 1818; early Jurassic; England.

Pleurotomaria agassizii Münster in Goldfuss, 1844

pl. 1: figs 13–15, pl. 2: figs 1–9 in Gründel et al. (2017)

2017 *Pleurotomaria agassizii* Münster in Goldfuss, 1844 – Gründel, Keupp and Lang: 175; pl. 1, figs 13–15; pl. 2, figs 1–9 (here more synonymy and chresonymy).

Material. 1 certain SNSB–BSPG 2016 XXI 1614 and 1 questionable specimen (SNSB–BSPG 2016 XXI 1615).

Remarks. This species was reported from the Nattheim area by Gründel et al. (2017). We report it from Saal for the first time.

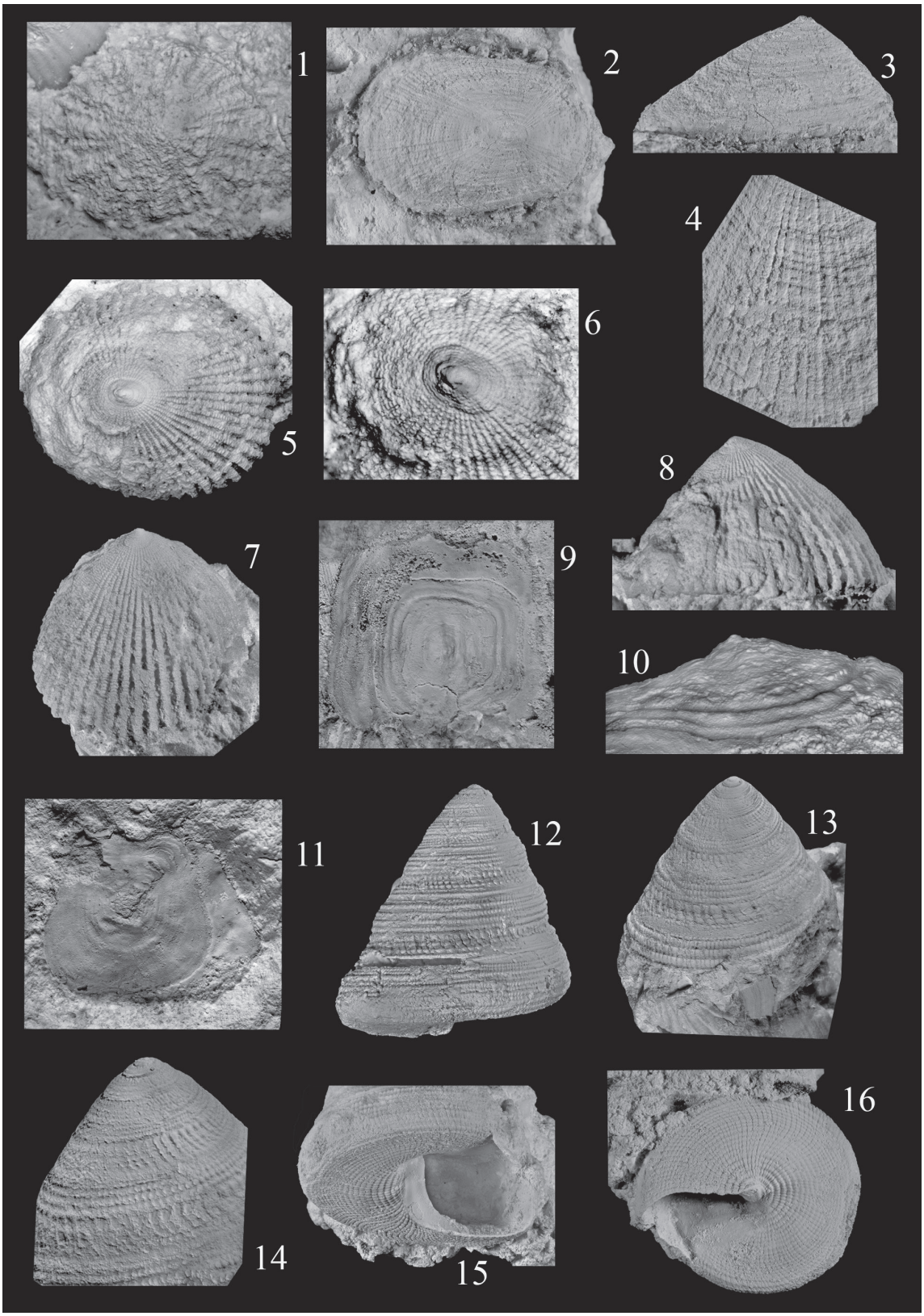

Plate 1. (1) *Patella* sp., SNSB–BSPG 2016 XXI 1601, collection O. Neubauer, dorsal view, length 7 mm. **(2–4)** *Scurriopsis cragolis* sp. nov. holotype, SNSB–BSPG 2016 XXI 1602, **(2–3)** lateral and dorsal views, length 16 mm, **(4)** detail of ornament, height ca. 5.8 mm. **(5–8)** *Scurriopsis* sp., SNSB–BSPG 2016 XXI 1606, **(5)** dorsal view, length 8 mm, **(6)** detail in dorsal view, width 3.5 mm, **(7–8)** lateral view and detail of ornament, height 6 mm. **(9–10)** *Pseudorhytidopilus*? *quadratus* sp. nov., holotype, SNSB–BSPG 2016 XXI 1607, dorsal and lateral views, largest diameter 21 mm. **(11)** *Pseudorhytidopilus*? *quadratus* sp. nov., paratype, SNSB–BSPG 2016 XXI 1608, dorsal view, largest diameter 16 mm. **(12)** *Leptomaria goldfussi* (Sieberer, 1907), SNSB–BSPG 2016 XXI 1616, lateral view, height 25 mm. **(13, 14)** *Leptomaria goldfussi* (Sieberer, 1907), SNSB–BSPG 2016 XXI 1617, early whorls and detail of ornament, **(13)** height 16.5 mm, **(14)** height 14 mm. **(15, 16)** *Leptomaria goldfussi* (Sieberer, 1907), SNSB–BSPG 2016 XXI 1618, aperture and base, width 24 mm.

Genus *Leptomaria* Eudes-Deslongchamps, 1865

Type species. *Pleurotomaria amoena* Eudes-Deslongchamps, 1849; Bajocian; France.

Leptomaria goldfussi (Sieberer, 1907)

Plate 1: figs 12–16

2017 *Leptomaria goldfussi* (Sieberer, 1907) – Gründel, Keupp and Lang: 177, pl. 2, figs 13–15; pl. 3, figs 1–2 (here more synonymy and chresonymy).
2017 *Leptomaria tuberosa* sp. nov. – Gründel, Keupp and Lang: 177, pl. 3, figs 3–5.
2017 *Leptomaria tuberosa* Gründel, Keupp and Lang – Gründel: 27, pl. 3, fig. C.

Material. 12 specimens, SNSB–BSPG 2016 XXI 1616–1627.

Description. Shell broadly trochiform, wider than high, with blunt, rounded apex; a specimen is 28 mm high; whorl face of first whorls straight, on late whorl slightly concave adapically and slightly convex abapically; selenizone separates these zones of whorl face; selenizone at about mid-whorl in early whorls, distinctly above mid-whorl in later whorls; earliest recognizable ornament consists of cancellate pattern of weak spiral threads and somewhat strengthened growth lines; spiral threads become stronger forming cords later in ontogeny; ca. 10 cords present on whorl face; growth lines may stay weak throughout ontogeny in some specimens; other specimens have strong, bulgy, prosocline axial ribs that are much broader than their interspaces on adapical portion of whorls; intersections of spiral cords and axial ribs are strongly nodular; subsutural row of nodules strongest; spiral cords strengthened below selenizone, commonly with alternation of strong and weak spiral cords; growth lines in this portion only developed as weak axial ribs; axial ribs crenulate spiral cords at intersections; base anomphalous, flat; transition from whorl face to base at rounded edge without nodes; base covered with numerous spiral cords of somewhat varying strength; strongest spiral cords towards center of base; growth lines on base sickle-shaped, straight near center opisthocyrt towards edge; aperture rounded quadratic, columellar lip somewhat broadened.

Remarks. Gründel et al. (2017) discussed the possibility that *L. tuberosa* Gründel, Keupp & Lang, 2017 is a varity of *L. goldfussi* . The new material corroborated this assumption and *L. tuberosa* is now considerd to be a synonym. Differences to *Leptomaria* sp. are explained below. *Laevitomaria*? *antoniae* (Étallon, 1861 in Thurmann and Étallon sensu Gründel et al. 2020a) has more convex whorls and deeper sutures; it lacks strengthened subsutural axial ribs. *Pleurotomaria agassizii* Münster, 1844 (in Goldfuss) has distinct subsutural axial ribs and the edge at the transition from whorl face to base bears nodes.

Leptomaria sp.

Plate 2: figs 1, 2

Material. 1 specimen, SNSB–BSPG 2016 XXI 1628.

Description. Shell broadly trochiform conical with straight sides; specimen 27 mm high; sutures indistinct; ornament of early whorls poorly preserved showing few spiral cords; selenizone visible as broad band in supra-median position on last whorls; whorl face ornamented with spiral cords, 3 above and 4–5 below selenizone; adapical spiral cords weaker than abapical cords; last whorl also ornamented with broad, bulging, prosocline, axial ribs that are poorly demarcated from their interspaces; interspaces between ribs approximately as broad as ribs; intersections of axial ribs and spiral cords usually not nodular or only weakly nodular; only one spiral cord below selenizone has distinct nodes; transition from whorl face to base at rounded edge; base flat, densely covered by spiral cords that are not nodular and broader than their interspaces; aperture not preserved.

Remarks. *Leptomaria* sp. differs from *Leptomaria goldfussi* (Sieberer, 1907) by having straighter shell sides, being more acute, having broad, bulging, poorly defined axial ribs and by largely lacking nodes at intersections of axial ribs and spiral cords.

Leptomaria phacoides Zittel, 1873

Plate 2: figs 3–5

?1844 *Trochus iurensis* Hartmann – Goldfuss: 57, pl. 180, fig. 12.
*1873 *Pleurotomaria* (*Leptomaria*) *phacoides* n. sp. – Zittel: 335, pl. 50, fig. 1.
?1907 *Leptomaria umbilicata* n. sp. – Sieberer: 61, pl. 5, fig. 9.
1997 *Leptomaria phacoides* Zittel – Hägele: 33, pl. 5, fig. 1, fig. p. 33 upper middle.
2013 *Leptomaria phacoides* Zittel – Monari and Gatto: 821, fig. 8 Q.

Material. 1 specimen SNSB–BSPG 2016 XXI 1629 and 1 cast of an impression SNSB–BSPG 2016 XXI 1630 (the impression itself is lacking).

Description. Shell low trochiform, with low whorls; specimen 41 mm wide; suture shallow;

selenizone indistinct apparently at mid-whorl on last whorl, and suprasutural on spire whorls with a bulge below it; whorls with faint remains of spiral ornamentation; base flat, demarcated from whorl face by rounded edge, widely phaneromphalous; base without visible ornamentation except for indistinct growth lines; aperture not preserved.

Remarks. *Leptomaria chryseis* Laube sensu Gründel (2012) and Monari and Gatto (2013) has an ornament of spiral and axial ribs on the early teleoconch whorls, its whorls are more convex and the sutures are more distinct. *Pleurotomaria onion* d'Orbigny sensu Loriol in Loriol and Bourgeat (1886–1888) lacks ornamentation and its umbilicus is wider. *Pleurotomaria* cfr. *philea* d'Orbigny sensu Schlosser (1882) has more convex whorls, deeper sutures, and lacks an abapical bulge and furrow. *Pleurotomaria umbilicata* Sieberer, 1907 is maybe identical with *Leptomaria phacoides* but has a weak cancellate ornament of spiral cords and axial ribs.

Leptomaria phacoides Zittel, 1873?

Plate 2: fig. 6

Material. A single shell fragment, SNSB–BSPG 2016 XXI 1631.

Remarks. The fragment of ca. four whorls shows a well preserved ornament. It possibly belongs to *Leptomaria phacoides* but it has a higher and more slender spire than the specimen described above as *L. phacoides*. Both have the selenizone below mid-whorl on the last whorl and in a suprasutural position in spire whorls. The whorl face including selenizone is covered with numerous spiral cords which are broader than the furrows separating them. The growth lines are prosocline and prosocyrt between the adapical suture and selenizone and prosocyrt between selenizone and abapical suture. The base is not preserved.

Family Trochotomidae Cox, 1960 (in Knight et al.)

Genus *Placotoma* Ferrari, Damborenea, Manceñido & Griffin, 2015

Type species. *Ditremaria amata* d'Orbigny, 1854; upper Oxfordian-lower Kimmeridgian; France.

Placotoma suevica (Quenstedt, 1884)

pl. 3: figs 10–15, pl. 4: figs 1, 2 in Gründel et al. (2017)

2017 *Placostoma suevica* (Quenstedt, 1881–1884) – Gründel, Keupp and Lang: 179, pl. 3, figs 10–15, pl. 4, figs 1–2 (here more synonymy and chresonymy).
2017 *Placostoma suevica* (Quenstedt, 1881–1884) – Gründel: 27, pl. 3, fig. D.

Material. 5 specimens, SNSB–BSPG 2016 XXI 1632–1636.

Genus *Valfinia* Cox, 1958

Type species. *Trochus quinquecinctus* Zieten, 1830–1833; upper Jurassic, South Germany.

Valfinia quinquecincta (Zieten, 1830–1833)

pl. 4: figs 3–11 in Gründel et al. (2017)

2017 *Valfinia quinquecincta* (Zieten, 1830–1833) – Gründel, Keupp and Lang: 180, pl. 4, figs 3–11 (here more synonymy and chresonymy).
2017 *Valfinia quinquecincta* (Zieten, 1830–1833) – Gründel: 27; pl. 4, fig. A.

Material. 2 specimens, SNSB–BSPG 2016 XXI 1637–1638.

Superfamily Seguenzioidea Verrill, 1884
Family Chilodontidae Wenz, 1938

Genus *Chilodonta* Étallon, 1862

Type species. *Chilodonta clathrata* Étallon, 1862; Kimmeridgian; France.

Chilodonta quadratofoveata Gründel, Keupp & Lang, 2017

pl. 6: figs 10–13 in Gründel et al. (2017)

2017 *Chilodonta quadratofoveata* n. sp. – Gründel, Keupp and Lang: 188, pl. 6, figs 10–13 (here more synonymy and chresonymy).

Material. 4 specimens, SNSB–BSPG 2016 XXI 1639–1642.

Genus *Onkospira* Zittel, 1873

Type species. *Turbo ranellatus* Quenstedt, 1852; Kimmeridgian, South Germany.

Onkospira ranellata (Quenstedt, 1852)

pl. 7: figs 3–7 in Gründel et al. (2017)

2017 *Onkospira ranellata* (Quenstedt, 1852) – Gründel, Keupp and Lang: 191, pl. 7, figs 3–7 (here more synonymy and chresonymy).
2017 *Onkospira ranellata* (Quenstedt, 1852) – Gründel: 28, pl. 5, fig. B.

Material. 2 specimens SNSB–BSPG 2016 XXI 1643–1644 and a cast of an imprint, SNSB–BSPG 2016 XXI 1645 (imprint not at hand).

Superfamily Fissurelloidea Fleming, 1822
Family Fissurellidae Fleming, 1822
Subfamily Emarginulinae Children, 1834

Genus *Rimulopsis* Haber, 1932

Type species. *Emarginula goldfussi* Roemer, 1836; higher Upper Jurassic, North Germany.

Rimulopsis perforata Gründel, Keupp & Lang, 2017

pl. 1: figs 10–12 in Gründel et al. (2017)

2017 *Rimulopsis perforata* n. sp. – Gründel, Keupp and Lang: 174, pl. 1, figs 10–12.

Material. 3 specimens, SNSB–BSPG 2016 XXI 1646–1648.

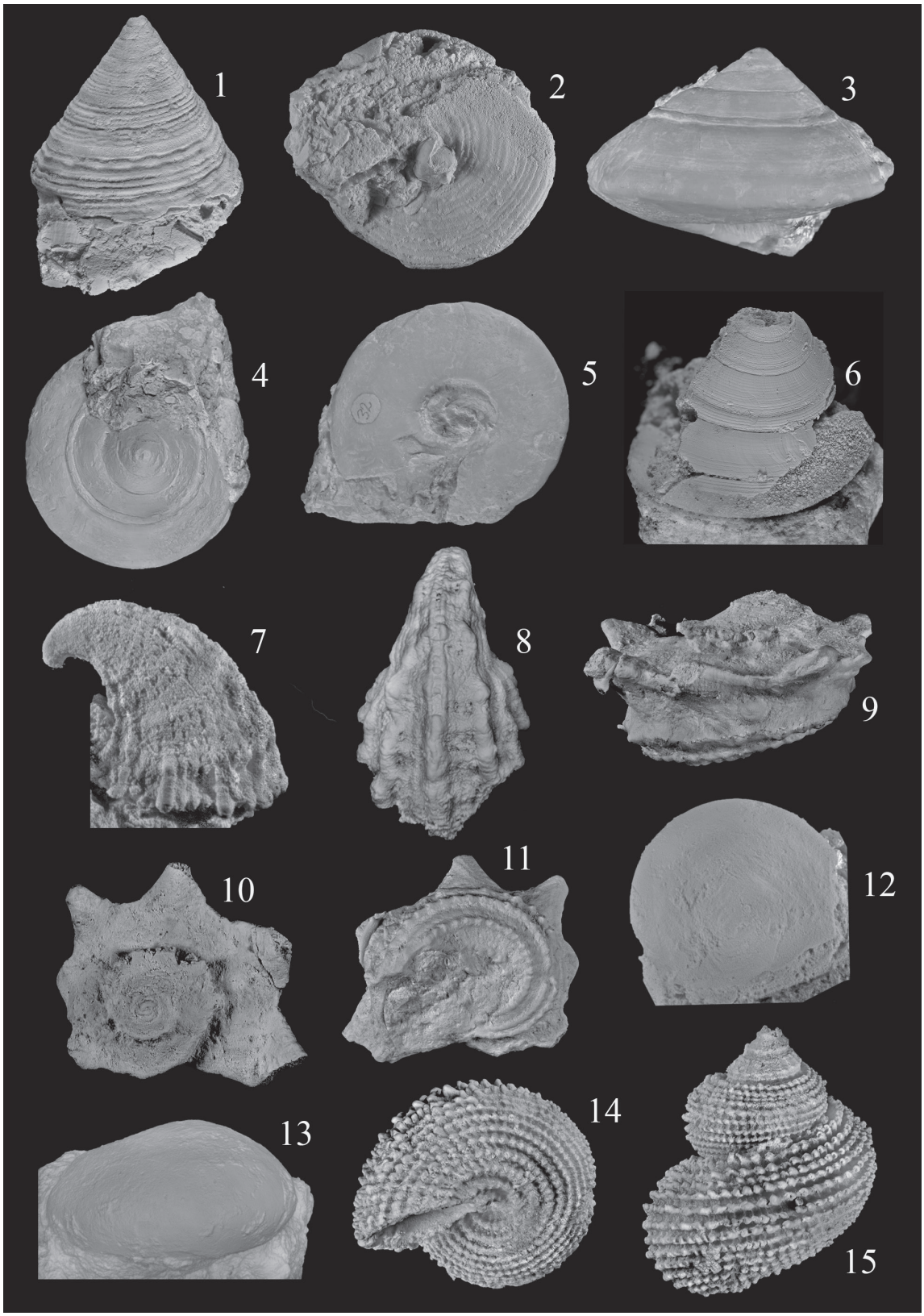

Plate 2. (1, 2) *Leptomaria* sp., SNSB–BSPG 2016 XXI 1628, lateral and basal views, width 30 mm. **(3–5)** *Leptomaria phacoides* Zittel, 1873, SNSB–BSPG 2016 XXI 1629, lateral, apical and basal views, width 41 mm. **(6)** *Leptomaria phacoides* Zittel, 1873?, SNSB–BSPG 2016 XXI 1631, lateral view, height 22 mm. **(7)** *Rimulopsis danuviensis* sp. nov., holotype, SNSB–BSPG 2016 XXI 1653, collection Neubauer, lateral view, height 9 mm. **(8)** *Rimulopsis danuviensis* sp. nov., paratype, SNSB–BSPG 2016 XXI 1654, collection Neubauer, anterior view, height 7 mm. **(9–11)** *Asperilla longispina* (Rolle, 1861), SNSB–BSPG 2016 XXI 1661, lateral, apical and basal views, width including spines 24 mm. **(12, 13)** *Falsataphrus*? *valfinense* Loriol, in Loriol and Bourgeat (1886–1888), SNSB–BSPG 2016 XXI 1696, apical and lateral views, width 12 mm. **(14, 15)** *Caryomphalus globatus* (Buvignier, 1843), SNSB–BSPG 2016 XXI 1713, basal and lateral views, width 15 mm.

Rimulopsis broesamleni Gründel, Keupp & Lang, 2017

pl. 1: figs 7–9 in Gründel et al. (2017)

2017 *Rimulopsis broesamleni* n. sp. – Gründel, Keupp and Lang: 173, pl. 1, figs 7–9 (here more synonymy and chresonymy).
2017 *Rimulopsis broesamleni* Gründel, Keupp and Lang – Gründel: 27, pl. 3, fig. B.

Material. 4 specimens, SNSB–BSPG 2016 XXI 1649–1652.

Rimulopsis danuviensis sp. nov.

https://zoobank.org/53810F30-82D3-4BBA-9F28-D87DAA577AF4
Plate 2: figs 7, 8

Etymology. After the river Donau, Latin Danubius.

Holotype. SNSB–BSPG 2016 XXI 1653 (Plate 2: fig. 7) (collection Neubauer).

Paratypes. 3 specimens Saal (2 specimens collection Sylla, SNSB–BSPG 2016 XXI 1655–1656, 1 specimen collection Neubauer, SNSB–BSPG 2016 XXI 1654).

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Limpet ornamented with a repeated alternation of one strong and 1–3 weaker radial ribs and few bulgy concentric ribs; shell angulated at two of the prominent radial ribs that are nodular at intersections with concentric ribs; several weak concentric ribs are intercalated between two strong concentric ribs.

Description. Shell limpet-shaped; a shell is 9 mm high; apex strongly bent in posterior direction protruding the posterior shell margin in lateral and dorsal view; selenizone raised, forming crest; lunulae lamellar, concave anteriorly; at each side of selenizone, 1–2 weak and then one strong radial rib; at these strong radial ribs, shell is distinctly angulated; lateral shell sides ornamented with a repeated alternation of one strong and 1–3 weaker radial ribs and few, distantly spaced bulgy concentric ribs; intersections of radial and concentric ribs nodular, nodes especially strong on the two ribs that angulate the shell; in addition, weak concentric, co-marginal ribs are present.

Remarks. *Rimulopsis broesamleni* Gründel et al., 2017 has a regularly alternation of a weaker and a stronger radial rib as well as weaker concentric ribs. This produces a cancellate ornament including deep pits demarcated by radial and concentric ribs. Instead of concentric bulgy ribs, it has more regular and defined ribs. Intersections of radial and concentric are only weakly nodular. *Rimula etalloni* Loriol in Loriol and Bourgeat (1886–1888) sensu Gründel et al. (2020a) has an alternation of each one stronger and one weaker radial rib; it lacks weaker concentric ribs between the bulgy concentric ribs. *Rimulopsis paucicostata* (Étallon, 1861 in Thurmann and Étallon) sensu Gründel et al. (2020a) has an alternation of each, one strong and one weak radial rib; bulgy concentric ribs are confined to the apical portion of the shell whereas weak concentric ribs are present in the abapical portion of the shell.

Superfamily Trochoidea Rafinesque, 1815
Family Trochidae Rafinesque, 1815

Genus *Falsotectus* Gründel, Keupp & Lang, 2017

Type species. *Falsotectus parvus* Gründel, Keupp & Lang, 2017; Kimmeridgian; South Germany.

Falsotectus parvus Gründel, Keupp & Lang, 2017

pl. 4: figs 14, 15; pl. 5: figs 1–7 in Gründel et al. (2017)

2017 *Falsotectus parvus* n. sp. – Gründel, Keupp and Lang: 182, pl. 4, figs 14–15; pl. 5, figs 1–7
2017 *Falsotectus parvus* Gründel, Keupp and Lang – Gründel: 28, pl. 4, fig. B.

Material. 4 specimens (3 specimens Saal, SNSB–BSPG 2016 XXI 1657–1659; 1 specimen Saal, "Fundort 1985, über Korallenstock, Sohle 2" (= locality 1985, above coral stock, level 2), SNSB–BSPG 2016 XXI 1660.

Family Angariidae Gray, 1857

Genus *Asperilla* Koken, 1896

Type species. *Delphinula coronoserra* Quenstedt, 1881–1884 (= *Delphinula longispina* Rolle, 1861); Kimmeridgian; South Germany.

Asperilla longispina (Rolle, 1861)

Plate 2: figs 9–11

2017 *Asperilla longispina* (Rolle, 1861) – Gründel, Keupp and Lang: 203, pl. 10, figs 11–17 (here more synonymy and chresonymy).

Material. 2 specimens, SNSB–BSPG 2016 XXI 1661–1662.

Remarks. The present specimens have fewer spines on the keel (ca. 7) than those reported by Gründel et al. (2017). In addition, the present specimens have more nodes on the spiral cord at the transition from whorl face to base. According to the literature, the base of this species is smooth or has only a single nodular spiral cord close to the spiral cord at the transition to the whorl face (Gründel et al. 2017). However, the present specimen has three distinctly nodular spiral cords on the base, besides the spiral cord at the transition to the whorl face. The meaning of these differences the present material to that reported by Gründel et al. (2017) are difficult to judge without additional well-preserved material. Therefore, we tentatively keep the present specimens under the same species name.

Family Epulotrochidae Gründel, Keupp & Lang, 2017

Genus *Discotectus* Favre, 1913

Type species. *Trochus massalongoi* Gemmellaro, 1868; Calcare a *Terebratula janitor*, Sicily, Italy.

Discotectus crassiplicatus (Étallon, 1859)

pl. 5, fig. 10–12; pl. 15: figs 3–6 in Gründel et al. (2017)

2017 *Discotectus crassiplicatus* (Étallon, 1859) – Gründel, Keupp and Lang: 183, pl. 5, fig. 10–12; pl. 15, figs 3–6 (here more synonymy and chresonymy).
2017 *Discotectus crassiplicatus* (Étallon, 1859) – Gründel: 28, pl. 4, fig. C.

Material. Saal: 8 specimens, SNSB–BSPG 2016 XXI 1663–1670; Saal, location 1985, "über Knollenkalkbank, Sohle 2" (=above nodular bed, level 2): 1 specimen, SNSB–BSPG 2016 XXI 1671.

Genus *Undatotectus* Gründel, Keupp & Lang, 2017

Type species. *Undatotectus glaber* Gründel, Keupp & Lang, 2017; Kimmeridgian; South Germany.

Undatotectus glaber Gründel, Keupp & Lang, 2017

pl. 8: figs 7–12 in Gründel et al. (2017)

2017 *Undatotectus glaber* n. sp. – Gründel, Keupp and Lang: 184, pl. 8, figs 7–12.
2017 *Undatotectus glaber* Gründel, Keupp & Lang, 2071 – Gründel: 28, pl. 4, fig. D.

Material. 12 specimens (SNSB–BSPG 2016 XXI 1672–1683); 1 specimen from Saal, locality 1985, above coral stock, Sohle 2, SNSB–BSPG 2016 XXI 1684 (all collection Sylla).

? Epulotrochidae Gründel, Keupp & Lang, 2017

Genus *Wernerocutus* Gründel, Keupp & Lang, 2017

Type species. *Trochus angulatoplicatus* Münster in Goldfuss, 1844; upper Kimmeridgian; South Germany.

Wernerocutus angulatoplicatus (Münster in Goldfuss, 1844)

pl. 8: figs 13–15; pl. 9: figs 1–5 in Gründel et al. (2017)

2017 *Wernerocutus angulatoplicatus* (Münster in Goldfuss, 1844) – Gründel, Keupp and Lang: 185, pl. 8, figs 13–15; pl. 9, figs 1–5 (here more synonymy and chresonymy).
2017 *Wernerocutus angulatoplicatus* (Münster in Goldfuss, 1844) – Gründel: 25, fig. 2.

Material. 11 specimens, SNSB–BSPG 2016 XXI 1685–1695.

Family Colloniidae Cossmann, 1917 in Cossmann and Peyrot
Subfamily Colloniinae Cossmann, 1917 in Cossmann and Peyrot

Genus *Falsataphrus* Gründel, 2000

Type species. *Falsataphrus circumcallosus* Gründel, 2000; Callovian; NE–Germany.

Falsataphrus? *valfinense* (Loriol, 1887 in Loriol and Bourgeat 1886–1888)

Plate 2: figs 12, 13

1886–1888 *Teinostoma valfinense* Loriol – Loriol in Loriol and Bourgeat: 189, pl. 21, figs 6–7.
?1997 *Buckmannia* sp. – Hägele: 52, fig. p. 52 lower left.

Material. 2 specimens, SNSB–BSPG 2016 XXI 1696–1697.

Description. Shell lens-shaped with very low spire; larger specimen 12 mm wide; last whorl embracing most of previous whorls; sutures indistinct; apex rounded; shell smooth; periphery evenly rounded; base flat; base and aperture incompletely preserved; no umbilicus and ornament visible; it is unclear whether the broad callus covering the umbilicus that would be typical of the genus *Falsataphrus* is present or not.

Remarks. *Falsataphrus corallensis* (Buvignier, 1852) sensu Gründel et al. (2020a) has at least sometimes a higher spire (Gründel et al. 2020a: pl 12: figs 13, 14); other specimens are hardly distinguishable from the present specimens (Gründel et al. 2020a: pl 12: figs 10, 11). *Falsataphrus corallensis* sensu Loriol in Loriol and Koby (1890) cannot be distinguished from *F.*? *valfinense* according to its description.

Genus *Torusataphrus* Gründel, Keupp & Lang, 2017

Type species. *Natica inornata* Quenstedt, 1858; Upper Jurassic; South Germany.

Torusataphrus inornatus (Quenstedt, 1858)?

pl. 10: figs 4–7 in Gründel et al. 2017)

?2017 *Torusataphrus inornatus* (Quenstedt, 1858) nov. comb. – Gründel et al.: 196, pl. 10, figs 4–7

Material. 1 specimen, SNSB–BSPG 2016 XXI 1698.

Remarks. The present specimen fits *T. inornatus* in general shell morphology. However, the characters typical for the genus *Torusataphrus* (callus on base and thickened outer lip) are not recognizable.

Family Metriomphalidae Gründel, Keupp & Lang, 2017

Genus *Metriomphalus* Cossmann, 1916

(sensu Gründel 2009)

Type species. *Turbo davousti* d'Orbigny, 1850; Bathonian; France.

Metriomphalus parvotuberosus Gründel, Keupp & Lang, 2017

pl. 11: figs 10–16 in Gründel et al. (2017)

2017 *Metriomphalus parvotuberosus* n. sp. – Gründel, Keupp and Lang: 197, pl. 11, figs 10–16.

2017 *Metriomphalus parvotuberosus* Gründel, Keupp & Lang, 2017 – Gründel: 29, pl. 6, fig. B.

Material. Saal: 3 specimens, SNSB–BSPG 2016 XXI 1699–1701; 1 specimen "Fundort 1985, über Korallenstock, Sohle 2" (= locality 1985, above coral stock, level 2), SNSB–BSPG 2016 XXI 1702; 3 casts of imprints that are not present, SNSB–BSPG 2016 XXI 1703–1705.

Metriomphalus sp. 1

pl. 12: figs 1–4 in Gründel et al. (2017)

2017 *Metriomphalus* sp. 1 – Gründel, Keupp and Lang: 198, pl. 12, figs 1–4.

Material. 1 specimen, SNSB–BSPG 2016 XXI 1706.

Genus *Planiturbo* Fischer, 1969

(sensu Gründel et al. 2017)

Type species. *Turbo planispira* Cossmann, 1885; Bathonian; France.

Planiturbo funatus (Goldfuss, 1844)

pl. 12: figs 5–9 in Gründel et al. (2017)

2017 *Planiturbo funatus* (Goldfuss, 1844) – Gründel, Keupp and Lang: 199, pl. 12, figs 5–9.

Material. 1 specimen "Fundort 1985, über Korallenstock, Sohle 2" (= locality 1985, above coral stock, level 2), SNSB–BSPG 2016 XXI 1707; 2 specimens Saal, SNSB–BSPG 2016 XXI 1708–1709.

Planiturbo procerus Gründel, Keupp & Lang, 2017

pl. 12: figs 10–13; pl. 15, fig. 7 in Gründel et al. (2017)

2017 *Planiturbo procerus* n. sp. – Gründel, Keupp and Lang: 200, pl. 12, figs 10–13; pl. 15, fig. 7.

2017 *Planiturbo procerus* Gründel, Keupp & Lang, 2017 – Gründel: 29, pl. 6, fig. C.

Material. 3 specimens, SNSB–BSPG 2016 XXI 1710–1712.

Genus *Caryomphalus* Gründel, Keupp & Lang, 2017

Type species. *Delphinula fumatoplicosa* Quenstedt, 1858; Kimmeridgian; South Germany.

Caryomphalus globatus (Buvignier, 1843)

Plate 2: figs 14, 15, Plate 3: fig. 1

2020 *Caryomphalus globatus* (Buvignier, 1843) n. comb. – Gründel, Hostettler and Menkveld-Gfeller: 238, pl. 9, figs 11–15, pl. 10, figs 1–13 (here more synonymy and chresonymy).

Material. 3 specimens Saal, SNSB–BSPG 2016 XXI 1713–1715; 1 specimen Saal, "Fundort 1985, über Korallenstock, Sohle 2" (= locality 1985, above coral stock, level 2), SNSB–BSPG 2016 XXI 1716.

Description. Shell broadly turbiniform; illustrated specimen 18 mm high; mature whorls evenly convex with periphery at mid-whorl; sutures impressed; earliest preserved whorls have a pronounced edge below mid-whorl; whorl face between edge and adapical suture forms oblique ramp, vertical below edge; ramp initially with three, later with four spiral cords; shell below edge initially with one spiral cord, later with two spiral cords; edge becomes increasingly less pronounced and rounded on penultimate whorl; last whorl evenly rounded, markedly convex with periphery at mid-whorl and evenly rounded transition to moderately convex base; suture considerably deflected downward in last whorl so that another 4–5 spiral cords are exposed on penultimate whorl; 17 spiral cords are present on last whorl from suture to middle of base; all spiral cords are densely covered with small pustules; axial ribs absent, or only faint axial ribs on last third of last preserved whorl; base narrowly phaneromphalous; aperture circular.

Remarks. The variability of this species could not be assessed, because only few specimens are at hand. The two best preserved specimens resemble those intermediate between variants 1 and 3 of *Caryomphalus globatus* sensu Gründel et al. (2020).

Caryomphalus sp., cf. *concavus* Gründel, Keupp & Lang, 2017

Plate 3: figs 2–3

Material. 1 specimen from Saal, SNSB–BSPG 2016 XXI 1717.

Description. Shell trochiform; illustrated specimen 14 mm high; whorls weakly convex, evenly expanding; earliest preserved whorl with two nodular spiral cords, one in suprasutural position, other spiral cord between edge

and abapical suture; a further spiral cord soon appears above edge; this spiral cord is initially weaker than the other cords but rapidly becomes as strong as other cords; suture somewhat deflected downward on the last part of last whorl, so that another spiral cord becomes exposed on penultimate whorl; edge becomes weaker, and changes to a regular spiral cord on last whorl so that whorl face becomes convex with evenly rounded transition to base; base narrowly phaneromphalous, weakly convex, covered with ca. 10 spiral cords that are somewhat weaker than those on whorl face; all spiral cords bear fine tubercles that are elongated in prosocline direction; details of round aperture not preserved.

Remarks. In *Caryomphalus concavus* Gründel, Keupp & Lang, 2017, the late whorls are more rapidly increasing (more concave flanks of shell); it has axial ribs on the early whorls, and the inner spiral cords on the base are separated by wider interspaces than the outer spiral cords.

Family Proconulidae Cox, 1960 (in Knight et al.)

Genus *Proconulus* Cossmann, 1918

Type species. *Trochus* (*Ziziphinus*) *guillieri* Cossmann, 1885; Bathonian; France.

Proconulus? sp. 1 sensu Gründel, Keupp & Lang (2017)

Plate 3: fig. 4

2017 *Proconulus*? sp. 1 – Gründel, Keupp and Lang: 193, pl. 8, figs 5–6.

Material. 3 specimens, SNSB–BSPG 2016 XXI 1718–1720.

Family Nododelphinulidae Cox in Knight et al. 1960

Genus *Nododelphinula* Cossmann, 1916

Type species. *Delphinula buckmanni* Morris & Lycett, 1851; Middle Jurassic; England.

Nododelphinula oblonga sp. nov.

https://zoobank.org/79F0D5A3-6CE6-4943-A94E-A7A63CF59AC9
Plate 3: figs 5–9

Etymology. Latin oblongum – protruding, because of the protruding keel.

Holotype. SNSB–BSPG 2016 XXI 1721 (Plate 3: figs 5–7), collection Sylla.

Paratype. 1 specimen, SNSB–BSPG 2016 XXI 1930, collection Lang.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Whorl face with strongly projecting keel and subsutural row of nodes; base entirely covered with spiral cords, one of them encircles umbilicus and is stronger with larger nodes; aperture is more or less pentagonal.

Description. Shell lowly trochiform with gradate spire, about as wide as high; larger specimen is 29 mm wide; earliest whorls are poorly preserved; first recognizable sculpture is an edge roughly in the mid-whorl, which is reinforced to form a keel; area adapical to the edge/keel forming broad, oblique ramp; whorl face below edge/keel approximately vertical, concave; during growth, keel first approaches abapical suture and then moves away again as suture sinks; keel nodular (not always clearly); nodes weaken during ontogeny; a row of nodes present below adapical suture; whorl face completely covered with spiral cords; weak, blurry, barely recognizable axial ribs run from suture to suture; spiral cord at border to base slightly weaker than keel; whorl face between these keel and border spiral cord concave, covered with slightly nodular spiral cords; base flat with angular transition to whorl face where spiral cord is situated; base distinctly phaneromphalous, covered with several spiral cords; particularly strong spiral cord surmounts umbilicus, having significantly larger nodes than those on whorl face; nodes have a pit in apertural portion and thus resemble hollow spines; aperture only incompletely preserved, having pentagonal outline.

Remarks. *Delphinula serrata* Buvignier, 1852 has a lower shell, the keel has stronger nodes, lacks the strong spiral cord surrounding the umbilicus, and has fewer but stronger spiral cords on the base. *Turbo valfinensis* Étallon sensu Loriol in Loriol and Bourgeat 1886–1888 (pl. 20, fig. 2, non fig. 3) has a more pronounced tuberculate ornament, the axial ribs are more distinct, the spiral cords are weaker and more numerous, and it lacks the strong spiral cord surrounding the umbilicus. The latter characteristic applies also to *Turbo plicatocostatus* Zittel, 1873 and to the species of the same name sensu Loriol in Loriol and Koby (1894). In both cases, the keel is weaker and the subsutural row of nodes is missing, the aperture is more rounded.

Genus *Serrettella* Fischer & Weber, 1997

Type species. *Trochus humbertinus* Buvignier, 1852; Oxfordian; France.

Serrettella gerberi (Gründel, Keupp & Lang, 2017), comb. nov.

Plate 3: figs 10–13

2017 *Amphitrochus*? *gerberi* n. sp. – Gründel, Keupp and Lang: 194, pl. 9, figs 6–9.

Material. Saal, "Fundort 1985, über Korallenstock, Sohle 2" (= locality 1985, above coral stock, level 2): 3 specimens,

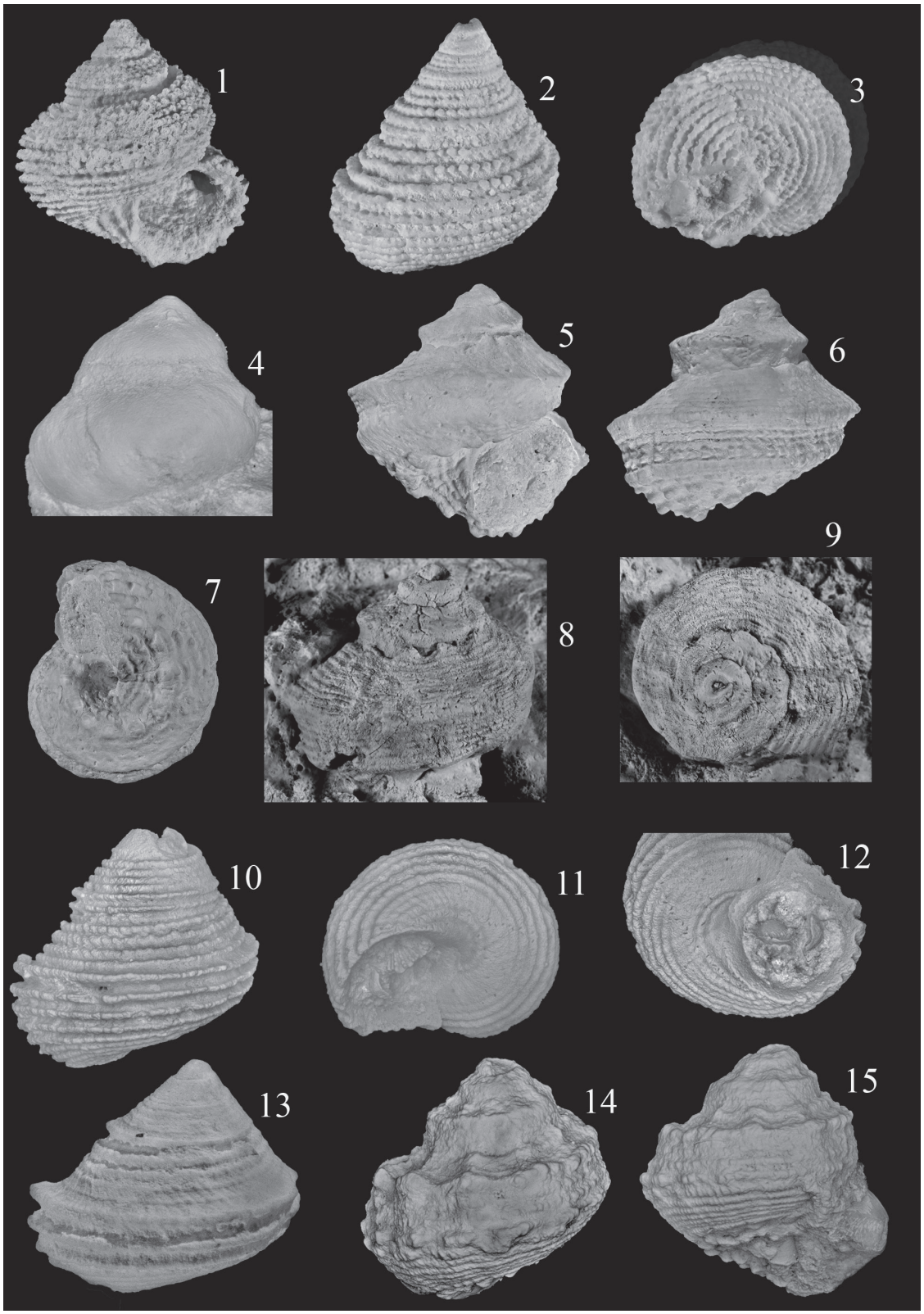

Plate 3. (1) *Caryomphalus globatus* (Buvignier, 1843), SNSB–BSPG 2016 XXI 1713, lateral view, width 15 mm. **(2, 3)** *Caryomphalus* sp., cf. *concavus* Gründel, Keupp & Lang, 2017, SNSB–BSPG 2017 XXI 1717, lateral and basal views, height 14 mm, width 12 mm. **(4)** *Proconulus*? sp. 1 sensu Gründel, Keupp and Lang (2017), SNSB–BSPG 2016 XXI 1718, lateral and basal views, height 11 mm. **(5–7)** *Nododelphinula oblonga* sp. nov., holotype, SNSB–BSPG 2016 XXI 1721, lateral views, apertural and abapertural, basal view, width 26 mm. **(8–9)** *Nododelphinula oblonga* sp. nov., paratype, SNSB–BSPG 2016 XXI 1930, collection Lang, shell in lateral and dorsal view, width 27 mm. **(10–12)** *Serrettella gerberi* (Gründel, Keupp & Lang, 2017), SNSB–BSPG 2016 XXI 1722, lateral, basal views and aperture, width 13 mm. **(13)** *Serrettella gerberi* (Gründel, Keupp & Lang, 2017), locality 1985, above coral stock, level 2, SNSB–BSPG 2016 XXI 1723, lateral view, width 9.5 mm. **(14, 15)** *Heliacanthus* sp. 1, SNSB–BSPG 2016 XXI 1726, abapertural and apertural lateral views, height 12 mm.

SNSB–BSPG 2016 XXI 1722–1724, Saal, "Fossilnest Sohle 3–4" (= fossil nest level 3–4): 1 specimen, SNSB–BSPG 2016 XXI 1725.

Description. The shell is broadly trochiform; largest specimen 14 mm wide; first approximately 2 whorls convex, without visible ornament (due to preservation?); whorl face of later whorls become straight, and sutures become inconspicuous; above abapical suture, a distinctive keel-like protruding spiral cord is formed, as well as 4 weaker ones between this cord and the adapical suture; whorl face slightly angulated by the keel-like spiral cord; as suture sinks, first one and then a second spiral cord become visible on penultimate whorl; both almost as strong as the keel-like spiral rib; transition from whorl face to the moderately convex base evenly rounded; 7–8 spiral cords on the base; all spiral cords densely covered with small pustules (not always clear due to preservation); aperture round with adapical canal; abapical edge of aperture broadly rounded.

Remarks. In contrast to the description given by Gründel et al. (2017), the present material has only four additional, relatively strong spiral cords between the adapical suture and the keel-like spiral cord. Moreover, the base of the present material is completely covered with spiral cords. Based on the limited material available, it cannot be decided with certainty whether these differences indicate genuine morphological differences (in which case there would probably be two separate species) or whether they reflect intraspecific variation or are due to preservation.

Serrettella humbertina (Buvignier) sensu Gründel et al. (2020a) has a subsutural spiral cord covered with stronger nodes, more than 4 weaker spiral cords between the adapical suture and the keel-like reinforced spiral cord, the nodes of the keel-like spiral cord increase in size during ontogeny. "*Serrettella* nov. gen. *humbertina* (Buv.)" sensu Fischer and Weber (1997) has a more concave whorl face between the keel and the adapical suture, and the keel-like spiral cord is higher on the whorl face. *Trochus humbertina* Buvignier, 1852 also has a row of reinforced subsutural nodes, the shell is higher in relation to the width and thus more slender.

Genus *Heliacanthus* Daqué, 1938 (in Wenz)

Type species. *Turbo thurmanni* Pictet & Campiche, 1863; Early Cretaceous; Switzerland.

Heliacanthus sp. 1

Plate 3: figs 14–15, Plate 4: Fig. 1

Material. 4 specimens, SNSB–BSPG 2016 XXI 1726–1729.

Description. Shell broadly turbiniform with gradate spire; largest specimen 20 mm wide; first recognizable sculpture is a distinct edge situated high on whorl face which separates an approximately horizontal ramp from a vertical abapical part; subsutural spiral cord; two spiral cords appear on either side of edge; orthocline, bulging, blurred axial ribs run from suture to suture; nodules at intersections of axial ribs with subsutural spiral cord and edge; nodes have a pit in apertural direction; base phaneromphalous, slightly convex with angular transition to whorl face; base is covered with 5–6 relatively weak spiral cords in the outer area and three strong nodular spiral ribs near center; all weaker spiral cords are finely crenulated; axial ribs very weak on base; aperture not preserved.

Remarks. ?*Nododelphinula* sp. sensu Hägele (1997) is smaller, lacks clear axial ribs, the bordering spiral cord at the transition to the base lacks nodes, on the base there is only a hump-shaped spiral cord that surrounds the umbilicus. *Heliacanthus epulus* (d'Orbigny) sensu Hägele (1997) has smaller and more numerous nodes on the edge, while it lacks a reinforced spiral cord with larger nodes at the transition to the base. *Metriomphalus* (*Metriacanthus*) *rugosus* (Buv.) sensu Fischer and Weber (1997) lacks axial ribs, the nodes on the edge at the transition to the base are larger and less numerous, and its base lacks strong and nodular spiral cords.

Heliacanthus? sp. 2

Plate 4: figs 2–7

Material. 7 specimens, SNSB–BSPG 2016 XXI 1730–1736.

Description. Shell broadly trochiform with rapidly expanding whorls and gradate spire; one of the better preserved specimens 20 mm wide; earliest whorls clearly exposed due to rapid sinking of suture; whorls ornamented with spiral cords and axial ribs, with nodular intersections; last whorl with rapidly forming wide, oblique ramp; subsutural row of small tubercles; at least 5 slightly knobby spiral cords on ramp; strong keel delimits ramp; keel with rapidly enlarging tubercles (approximately 9 on the last whorl); whorl face below keel vertical and delimited abapically by second knobby keel; at least two weak knobby spiral cords between two keels; a third, somewhat weaker keel forms border to almost flat base; two weak, knobby spiral cords present between second and third keel; base incompletely preserved, covered with several spiral cords; growth lines approximately straight, prosocline; aperture very large, round.

Remarks. *Turbo* (*Sarmaticus*) *stephanophorus* Zittel, 1873 is more slender, it has fewer nodes on the keels and on the base, there is only a single nodular spiral cord visible (= bordering spiral cord)

Nododelphinulidae? gen. et sp. indet.

Plate 4: figs 8–11

Material. 1 specimen, SNSB–BSPG 2016 XXI 1737.

Description. Shell broadly turbiniform, with gradate spire; specimen 17 mm wide; earliest visible ornament consists of two edges, one at about mid-whorl, the other

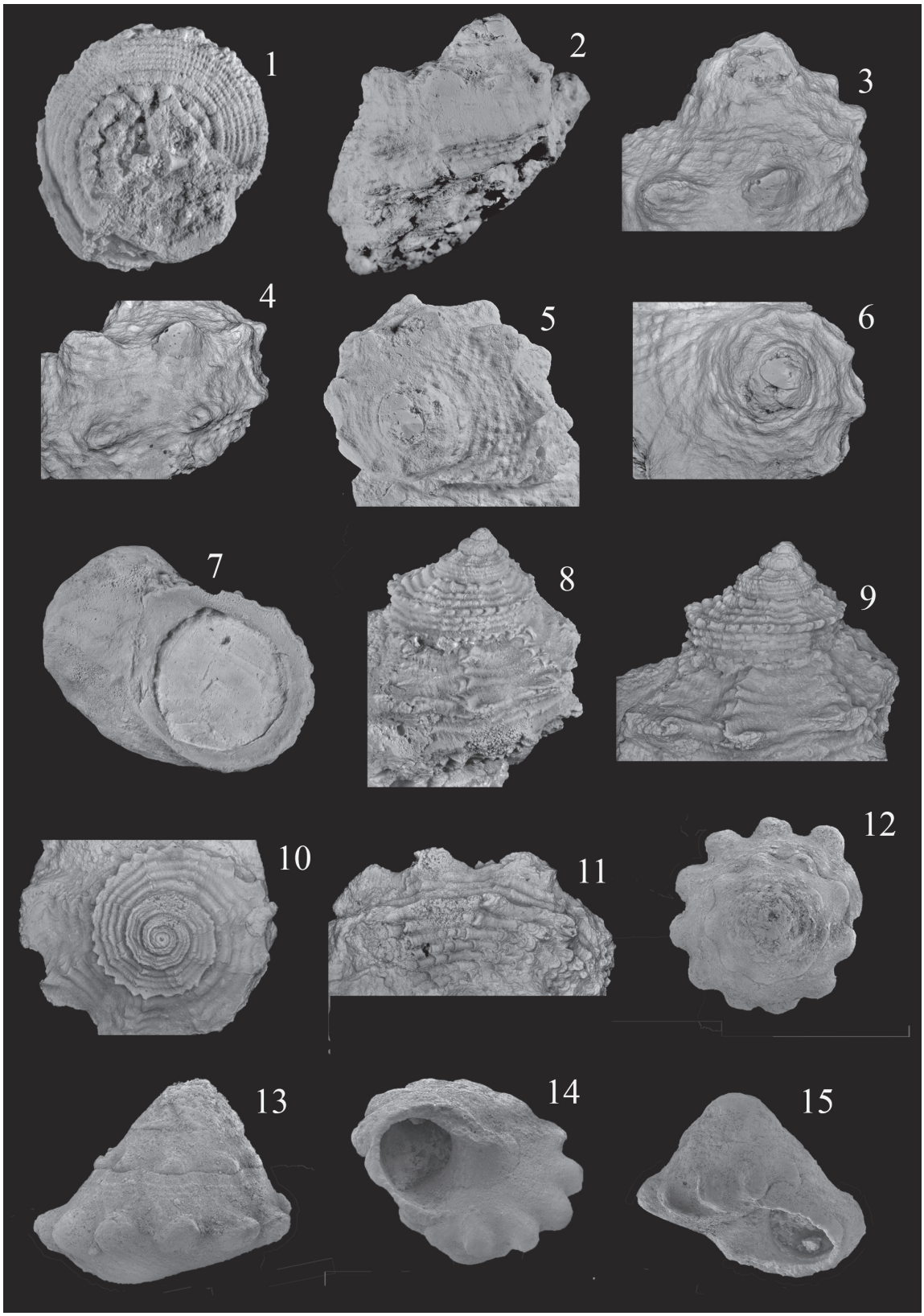

Plate 4. (1) *Heliacanthus* sp. 1, SNSB–BSPG 2016 XXI 1726, basal view, width 12 mm. **(2–6)** *Heliacanthus*? sp. 2, SNSB–BSPG 2016 XXI 1730, **(2, 5)** lateral and apical view, width 20 mm, **(3)** apex in lateral view, height 11 mm, **(4)** shell detail in lateral view, height 11 mm, **(6)** detail apical view, width 15 mm. **(7)** *Heliacanthus*? sp. 2, SNSB–BSPG 2016 XXI 1731, apertural view, height of aperture 19 mm. **(8–11)** Nododelphinulidae? gen. and sp. indet., SNSB–BSPG 2016 XXI 1731, **(8, 10)** lateral and lapical views, width of specimen 17 mm, **(9)** apex in lateral view, height 10 mm, **(11)** detail of base, width 14 mm. **(12, 13)** *Creniturbo gibbosus* sp. nov. (specimen lost), collection Lang, apical and lateral views. **(14, 15)** *Creniturbo gibbosus* sp. nov., holotype, SNSB–BSPG 2016 XXI 1738, (collection Lang), oblique basal and lateral views, width 6.5 mm.

suprasutural; whorl face above adapical edge forms oblique ramp, approximately vertical below edge; nodular spiral cord in subsutural position; between this cord and adapical edge, first one, then a second spiral cord appear on ramp and also on whorl face between edges; whorl face ornamented with widely spaced, bulging axial ribs that continue onto center of base; axial ribs approximately orthocline on whorl face and distinctly opisthocline on base; adapical edge with numerous small nodes in early whorls but fewer and larger nodes on last whorl; same trend on abapical edge, but not as distinct; nodes spirally elongated, tapering in abapertural direction with narrow beginning and trumpet-like widening in apertural direction; spoon-like pits at apertural end of nodes, which terminate abruptly, immediately followed by narrow beginning of next node; widened spoon-like ending of elongate nodes lies at intersection of axial ribs and spiral cords; base flatly convex with angular transition to whorl face; base covered with nodular spiral cords; aperture not preserved.

Remarks. The morphology of the spirally elongated nodes is to our knowledge unique; we know of no other example from the literature.

Superfamily and family unclear

Genus *Creniturbo* Cossmann, 1919

Type species. *Trochus dirce* d'Orbigny, 1853; Oxfordian; France.

Creniturbo gibbosus sp. nov.

https://zoobank.org/6586DE91-8FDD-4991-97D6-04E1A1CB8E9A
Plate 4: figs 12–15

Etymology. Latin gibbus – nodes; for the abapical row of large nodes.

Holotype. SNSB–BSPG 2016 XXI 1738 (pl. 4, figs 14–15), collection Lang.

Paratypes. 6 specimens from Saal (4 specimens collection Lang: SNSB–BSPG 2016 XXI 1739–1742, 2 specimens collection Sylla: SNSB–BSPG 2016 XXI 1743–1744)

Other material. A questionable specimen from Saal, collection Lang.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell broadly trochiform, gyroscopic; whorl face slightly concave, with several weak spiral lirae; suture shallow, inconspicuous; edge at transition from whorl face to base with 10–13 large rounded nodes, visible slightly above suture in spire whorls; aperture has circular lumen; tongue-shaped callus covers center of base.

Description. Only juvenile specimens at hand are relatively well-preserved; fully grown but poorly preserved specimens up to 16 mm wide; shell broadly trochiform, gyroscopic; whorl face slightly concave; edge at transition from whorl face to base with 10–13 large rounded nodes, visible slightly above suture in spire whorls; suture wavy due to nodes; whorl face covered with very faint spiral lirae (usually not visible due to preservation); it is not certain whether spiral lirae are also present on nodes; base slightly convex and set off from whorl face at an angle; growth lines on base opisthocyrt; spiral lirae probably also present on base, but obscured by preservation; aperture has circular lumen, slightly tapering adapically; tongue-shaped callus covers center of base.

Remarks. *Creniturbo dirce* (d'Orbigny), the type species and the only other species assigned to *Creniturbo*, has a double row of nodes at the basal edge and it has a much stronger spiral cords.

Creniturbo sp. 1

Plate 5: figs 1–4

Material. 4 specimens from Saal: SNSB–BSPG 2016 XXI 1745–1748 (2 specimens collection Sylla, 1 specimen collection Keupp, 1 specimen collection Lang).

Description. The present specimens are moderately to poorly preserved; shape, size and sculpture correspond – as far as can be seen – to those of the *Creniturbo gibbosus* n. sp.; however, the present specimens have a more or less distinct spiral cord on the base, directly below the basal edge; additional faint spiral cords obscured by poor preservation present on base; nodes on basal angulation much weaker than in *Creniturbo gibbosus*.

Remarks. *Cerithium binodum* Buvignier, 1852 is larger, its base is more convex and it has two rows of nodes on the basal edge. *Creniturbo dirce* (d'Orbigny) sensu Loriol in Loriol and Koby (1890) is also larger with a double row of nodes on the basal edge and it has strong spiral cords on the base.

Genus *Kelheimia* gen. nov.

https://zoobank.org/16E88CBF-6532-4458-9F42-9B3A190D7F44

Derivatio nominis. After the city of Kelheim that is close to the Saal quarry.

Type species. *Kelheimia triangulata* n. sp.; upper Kimmeridgian; South Germany.

Diagnosis. Shell broadly trochiform, conical, slightly coeloconoid with early whorls more slender than late whorls; early whorls with ornament of intersecting spiral cords and axial ribs; late whorls ornamented with few wide spiral cords; transition from whorl face to base at sharp, angular edge; base slightly convex, covered with spiral cords; aperture large with circular lumen and callous inner lip; growth lines straight, prosocline.

Remarks. *Pyrgotrochus* P. Fischer, 1885 and *Conotomaria* Cox, 1959 have more evenly increasing whorls, a less pronounced ontogenetic sculptural change, a flat base and a selenizone located well above the abapical suture.

Kelheimia triangulata sp. nov.

https://zoobank.org/244B074C-DFAE-4FC1-A4A3-22670DA27F5F
Plate 5: figs 5–11

Etymology. Latin triangulus – because of the triangular outline of the shell.

Holotype. SNSB–BSPG 2016 XXI 1749 (Plate 5: figs 5–7).

Paratypes. 8 specimens, SNSB–BSPG 2016 XXI 1750–1757.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. As for genus.

Description. Shell broadly trochiform, conical, slightly coeloconoid; a specimen is 48 mm wide; early whorls slender with distinct sutures; later whorls increase more rapidly producing coeloconoid shell shape; late whorls with straight whorl face, separated by inconspicuous sutures; early whorls with edge above mid-whorl separating oblique ramp and vertical abapical whorl face; several spiral cords present on both whorl portions; approximately 9 bulging, relatively wide axial ribs run from suture to suture forming nodes on edge; as width growth accelerates, edge and axial ribs disappear; straight whorl face of late whorls covered with about 8 spiral cords; cords wider than separating furrows; growth lines straight to weakly prosocyrt, prosocline on whorl face and base; transition from whorl face to base at sharp, angular edge; base anomphalous, slightly convex, covered with wide spiral cords; aperture large with circular lumen and callous inner lip.

Remarks. *Brachytrema* (*Petersia*) sp. sensu Hägele (1997) has bulgy axial ribs on the last whorls and several real folds inside the aperture (on olumella and outer lip). In *Pyrgotrochus cyproea* (d'Orbigny) sensu Fischer and Weber (1997), the whorls are has regularly increasing in width, it has a selenizone, its ornament does not show ontogenetic change, and its spiral cords are narrower. *Pleurotomaria berlieri* Loriol in Loriol and Girardot (1903) (based on a steinkern) is larger, lacks distinct ornamentation, and its aperture has an edge.

Vetigastropoda gen. et sp. indet.

Plate 5: figs 12–15

Material. 1 specimen, SNSB–BSPG 2016 XXI 1758.

Description. Shell broadly trochiform, 22 mm high; whorls low, angulated somewhat above abapical suture; edge covered with numerous nodules, possibly representing base of hollow spines; two weak subsutural spiral cords without nodes appear on last whorl; whorl face straight and without sculpture between basal edge and abapical spiral cord; nodular basal edge emerges at suture; base flat, concave in center; transition from whorl face to base angular; base without visible ornament; aperture not preserved.

Remarks. This specimen resembles the Triassic genera *Ampezzalina* Bandel, 1993 and *Bandelastraea* Nützel & Kaim, 2014 (see Karapunar and Nützel 2021, figs 78, 79) but its preservation is too poor for identification.

Subclass Neritimorpha Koken, 1896
Superfamily Neritoidea Rafinesque, 1815
Family Pileolidae Bandel, Gründel & Maxwell, 2000

Genus *Dauterria* Gründel, Keupp & Lang, 2015

Type species. *Dauterria variocostata* Gründel, Keupp & Lang, 2015; upper Kimmeridgian; South Germany.

Dauterria rotundata Gründel, Keupp & Lang, 2015

pl. 1: figs 1–4 in Gründel et al. (2015)

1997 *Pileolus* (*Pileolus*) *minutus* Zittel, 1873 – Hägele: 60, fig. p. 60, lower left.

2015 *Dauterria rotundata* n. sp. – Gründel, Keupp and Lang: 79, pl. 1, figs 1–4.

2017 *Dauterria rotundata* Gründel, Keupp & Lang, 2015 – Gründel: 30, pl. 8, fig. A.

Material. SNSB–BSPG 2016, Saal: 30 mostly juvenile specimens; „Sohle 2 über Korallenstock" (= level 2 above coral block): 5 specimens.

Dauterria variocostata Gründel, Keupp & Lang, 2015

pl. 1: figs 5–9 in Gründel et al. (2015)

2015 – *Dauterria variocostata* n. sp. – Gründel, Keupp and Lang: 80, pl. 1, figs 5–9.

Material. 3 specimens, SNSB–BSPG 2016 XXI.

Genus *Pileopsella* Gründel, 2004

Type species. *Pileolus laevis* Sowerby, 1823; Bathonian; England.

Pileopsella biconvexa Gründel, Keupp & Lang, 2015

pl. 1: figs 10–13 in Gründel et al. (2015)

2015 *Pileopsella biconvexa* n. sp. – Gründel, Keupp and Lang: 82, pl. 1, figs 10–13.

Material. 5 specimens, SNSB–BSPG 2016 XXI.

Family Parvulatopsidae Gründel, Keupp & Lang, 2015

Genus *Parvulatopsis* Gründel, Keupp & Lang, 2015

Type species. *Parvulatopsis quinquecostatus* Gründel, Keupp & Lang, 2015; upper Kimmeridgian; South Germany.

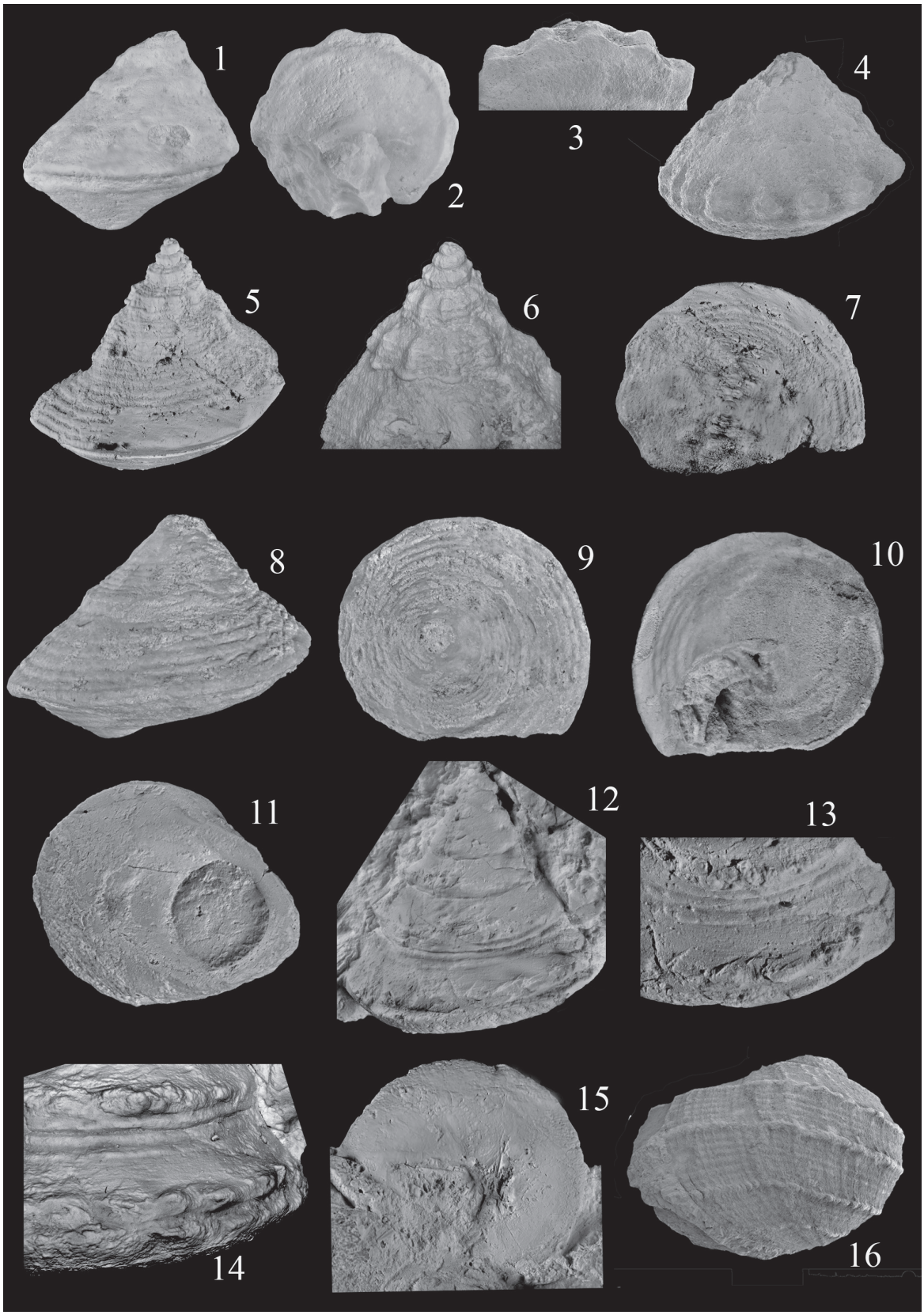

Plate 5. (1, 2) *Creniturbo* sp., SNSB–BSPG 2016 XXI 1745, lateral and basal views, width 13 mm. **(3, 4)** *Creniturbo* sp., SNSB–BSPG 2016 XXI 1746, collection Lang, **(3)** detail of base, width 3.2 mm, **(4)** lateral view, width 3.5 mm. **(5–7)** *Kelheimia triangulata* sp. nov., holotype, SNSB–BSPG 2016 XXI 1749, **(5, 7)** lateral and apical views, width 23 mm, **(6)** apex in lateral view, height 9 mm. **(8–10)** *Kelheimia triangulata* sp. nov., paratype, SNSB–BSPG 2016 XXI 1750, lateral, apical and basal views, width 47 mm. **(11)** *Kelheimia triangulata* sp. nov., paratype, SNSB–BSPG 2016 XXI 1751, oblique basal view with aperture, height of aperture 32 mm. **(12–15)** Vetigastropoda gen. and sp. indet., SNSB–BSPG 2016 XXI 1758, **(12, 15)** lateral and basal views, width 23 mm, **(13)** detail of lateral view, width 12 mm, (**14**) detail of ornament, height 10 mm. **(16)** *Parvulatopsis*? sp. 1, SNSB–BSPG 2016 XXI 1759, lateral view, width 12 mm.

Parvulatopsis quinquecostatus Gründel, Keupp & Lang, 2015

pl. 8: figs 1–7 in Gründel et al. (2015)

2015 *Parvulatopsis quinquecostatus* n. sp. – Gründel, Keupp and Lang: 85, pl. 8, figs 1–7.
2017 *Parvulatopsis quinquecostatus* Gründel, Keupp & Lang, 2015 – Gründel: 30, pl. 9, fig. A.

Material. 5 specimens, SNSB–BSPG 2016 XXI.

Parvulatopsis? sp.

Plate 5: fig. 16; Plate 6: figs 1, 2

Material. 5 juvenile specimens, SNSB–BSPG 2016 XXI 1759–1763.

Description. Shell-broadly turbiniform, egg-shaped, low-spired with rapidly increasing whorls; largest specimen 12 mm wide; smallest specimen 7 mm wide (best preserved one); whorls convex; suture sinks significantly during ontogeny; whorl face ornamented with 5 strong, knobby spiral cords; distances between adapical suture and adapical spiral cord as well as between this and the 2nd spiral cord particularly wide; this portion of whorl face distinctly oblique; whorl face vertical between 2nd and 3rd spiral cords; 4–6 weak spiral cords without nodes between strong spiral cords; growth lines straight, prosocline from adapical suture to center of the base.

Remarks. Juvenile specimens of *Bipartopsis robustus* Gründel et al., 2015 are smaller, the distances between the strong spiral cords are approximately the same but overall narrower than in *Parvulatopsis*? sp. and the adapical whorl face is not as oblique (in lateral view). *Neritopsis jurensis* Münster sensu Kuhn (1939) has 3 spiral cords at equal distances on the whorl face and strong axial ribs (according to the description, not visible in Kuhn's (1939) illustration).

Family Neridomidae Bandel, 2008

Genus *Neridomus* Morris & Lycett, 1851

Type species. *Neridomus anglica* Cox & Arkell, 1950 = *Nerita* (*Neridomus*) *hemisphaerica* Roemer sensu Morris & Lycett, 1851; middle Jurassic; England.

Neridomus hemisphaerica (Roemer, 1836)

Plate 6: figs 3–7

2019 Neridomidae oder Naticidae – Werner: 21, figs 15–16.
2019 Gastropode non det. – Werner: 21, fig. 17.

Material. 10 specimens (illustrated ones SNSB–BSPG 2016 XXI 651, 1764–1765) from Saal.

Description. Shell oblique oval in lateral view, somewhat wider than high, with convex whorls; periphery low on whorls; largest specimen 39 mm high; spire very low; very large body whorl, embracing most of previous whorls; sutures very shallow, indistinct; aside from growth lines, no sculpture visible; growth lines prosocline and weakly prosocyrt from adapical suture to center of the base; aperture teardrop-shaped with strongly and asymmetrically convex outer lip and almost straight inner lip; aperture pointed adapically and broadly rounded abapically; callus very wide with a concave-convex outer edge; color patterns of irregular patches preserved on several specimens.

Remarks. It is possible that *Neridomus hemisphaerica* is identical with *Neridomus* sp. 1 as reported by Gründel et al. (2015) that had been only known from two poorly preserved specimens which are smaller and have an approximately evenly convex outer edge of the callus (maybe due to preservation). The numerous described but feature-poor *Neridomus* species show only few characters and can hardly be reliably distinguished from each other based on the literature. The present assignment to *Neridomus hemisphaerica* Roemer is not certain. Roemer (1836) described this taxon from the Portlandian. According to his illustrations, the present material could be identical with Roemer's (1836) taxon. Hardly distinguishable forms have been repeatedly reported from the Upper Jurassic (e. g., Loriol 1881; Loriol in Loriol and Bourgeat 1886; Pčelintsev 1926; Cox 1965; Fischer and Weber 1997).

Superfamily Neritopsoidea Gray, 1847
Family Neritopsidae Gray, 1847
Subfamily Neritopsinae Gray, 1847

Genus *Neritopsis* Grateloup, 1832

Type species. *Neritopsis moniliformis* Grateloup, 1832; Tertiary; France.

Neritopsis? *rotundatus* sp. nov.

https://zoobank.org/DFA0C225-7054-4C52-ABAB-4699E4478BC8
Plate 6: figs 8–12

2017 Metriomphalidae n. gen.? sp. 1 – Gründel, Keupp and Lang: 203, pl. 15, figs 8–13.

Etymology. Latin rotundatum – rounded (because of the round shell shape).

Holotype. SNSB–BSPG 2016 XXI 1767 (Plate 6: figs 8–12).

Paratypes. 5 specimens from Saal. SNSB–BSPG 2016 XXI 1768–1772.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell neritiform, low-spired with large last whorl that is evenly convex (from adapical suture to the center of the base) and evenly covered with more than 15 spiral cords; spiral cords are about as wide as spiral furrows separating them; spiral cords entirely covered with small nodes; axial ribs absent; no callous formations visible in apertural area.

Description. Shell neritiform, holotype (largest specimen) 14 mm wide and high;

late whorls strongly and evenly convex (including base); in some specimens, a spiral cord is reinforced near adapical suture, slightly angulating whorl face and delimiting a ramp with several spiral cords; first recognizable sculpture consists of 4–6 spiral cords lacking nodes; cords almost equally strong or alternation of stronger and weaker cords; further spiral cords evenly cover whorl face and base; holotype has 18 spiral cords from adapical suture to center of base; during growth, spiral cords become equal in strength; numerous small, densely packed nodes present on spiral cords of last whorl; nodes have deep pit in apertural direction, thus resembling short hollow spines; axial ribs absent, only weakly reinforced growth lines can be seen in spiral furrows; whorl face and base evenly rounded; base anomphalous; aperture broadly oval, slightly tapering adapically and widely rounded abapically; callous formations lacking.

Remarks. *Neritopsis buchini* Guirand & Ogérien, 1865 has fewer spiral cords, the spiral cords are wider than the separating grooves, the tubercles are less numerous and not as distinct. *Neritopsis buchini* sensu Loriol in Loriol and Bourgeat (1886–1888) also has fewer spiral cords. The spiral cords of *Neritopsis buchini* are significantly narrower than the spiral grooves separating them and there are fewer nodes on the spiral cords. *Neritopsis imbricata* Étallon sensu Loriol in Loriol and Bourgeat (1886–1888) has a more inflated last whorl, the nodes on the spiral cords are smaller and more numerous. *Neritopsis imbricata* sensu Zittel (1873) has a more transversely elongated shell shape, the outer lip of the aperture is strongly asymmetrically convex with the periphery is low on the whorls. *Nerita goldfussi* Keferstein sensu Goldfuss (1844) is adapically flattened with a sunken apex and fewer spiral cords of variable thickness. The aperture of *Neritopsis*? *rotundatus* n. sp. seems to be asymmetrical and not symmetrical as would be typical for the genus *Neritopsis* (see Kaim and Sztajner 2005).

Subfamily Cassianopsinae Bandel, 2007
Genus *Wallowiella* Frýda, Blodgett & Stanley, 2003

Subgenus *Wallowiella* (*Plicaropsis*) Gründel, Keupp & Lang, 2015

Type species. *Neritites cancellatus* Stahl, 1824; upper Kimmeridgian; South Germany.

Wallowiella (*Plicaropsis*) *cancellata* (Stahl, 1824)
Plate 6: figs 13, 14 (adult), Plate 7: figs 1, 2 (juvenile)

2015 *Wallowiella* (*Plicaropsis*) *cancellata* (Stahl, 1824) – Gründel, Keupp and Lang: 88, pl. 4, figs 5–14; pl. 5, figs 1–4 (here more synonymy and chresonymy).
2016 *Wallowiella* (*Plicaropsis*) *cancellata* Stahl, 1824) – Gründel, Hostettler and Menkveld-Gfeller: 510, pl. 5, figs 5–11.
2017 *Wallowiella* (*Plicaropsis*) *cancellata* (Stahl, 1824) – Gründel: 30, pl. 9B.

Material. Total of 27 specimens; 17 specimens from Saal; 10 specimens from Saal level 4, location 1 (“Sohle 4, Fundstelle 1”); 2 specimens figured: SNSB–BSPG 2016 XXI 1773–1774.

Remarks. Many of the studied specimens from the Sylla collection differ from those reported by Gründel et al. (2015) by having an alternation of weak and strong spiral cords. These weaker spiral cords are, however, distinctly stronger than the lirae of *Hayamiella schaeferi* Gründel et al., 2015 in the same position. The nodes at the intersections of axial ribs and spiral cords are sometimes elongated like spines. The attribution of the present material to the species *Wallowiella* (*Plicaropsis*) *cancellata* is supported by the square pits formed by axial ribs and spiral cords on the shell and the formation of a knob on the outer lip.

Wallowiella (*Plicaropsis*) *compacta* Gründel, Keupp & Lang, 2015
Plate 7: figs 3–7

2015 *Wallowiella* (*Plicaropsis*) *compacta* n. sp. – Gründel, Keupp and Lang: 89, pl. 5, figs 5–9.

Material. 1 specimen from the Sylla collection and 1 from the Lang collection, SNSB–BSPG 2016 XXI 1775–1776.

Remarks. Here, we illustrate two additional well-preserved specimens for a better understanding of the species.

Genus *Cassianopsis* Bandel, 2007

Type species. *Naticella armata* Münster, 1841; upper Triassic; St. Cassian Formation (Italy).

Cassianopsis quenstedti (Brösamlen, 1909)
pl. 2: figs 10–14; pl. 3: figs 1–6 in Gründel et al. (2015)

2015 *Cassianopsis quenstedti* (Brösamlen, 1909) – Gründel, Keupp and Lang: 92, pl. 2, figs 10–14; pl. 3, figs 1–6 (here more synonymy and chresonymy).

Material. 2 specimens, SNSB–BSPG 2016 XXI.

Cassianopsis ratua Gründel, Keupp & Lang, 2015
pl. 3: figs 7–11 in Gründel et al. (2015)

2015 *Cassianopsis ratua* n. sp. – Gründel, Keupp and Lang: 94, pl. 3, figs 7–11.

Material. 1 specimen, SNSB–BSPG 2016 XXI.

Hayamiella Kase, 1984

Type species. *Neritopsis* (*Hayamiella*) *japonica* Kase, 1984; Early Cretaceous; Japan.

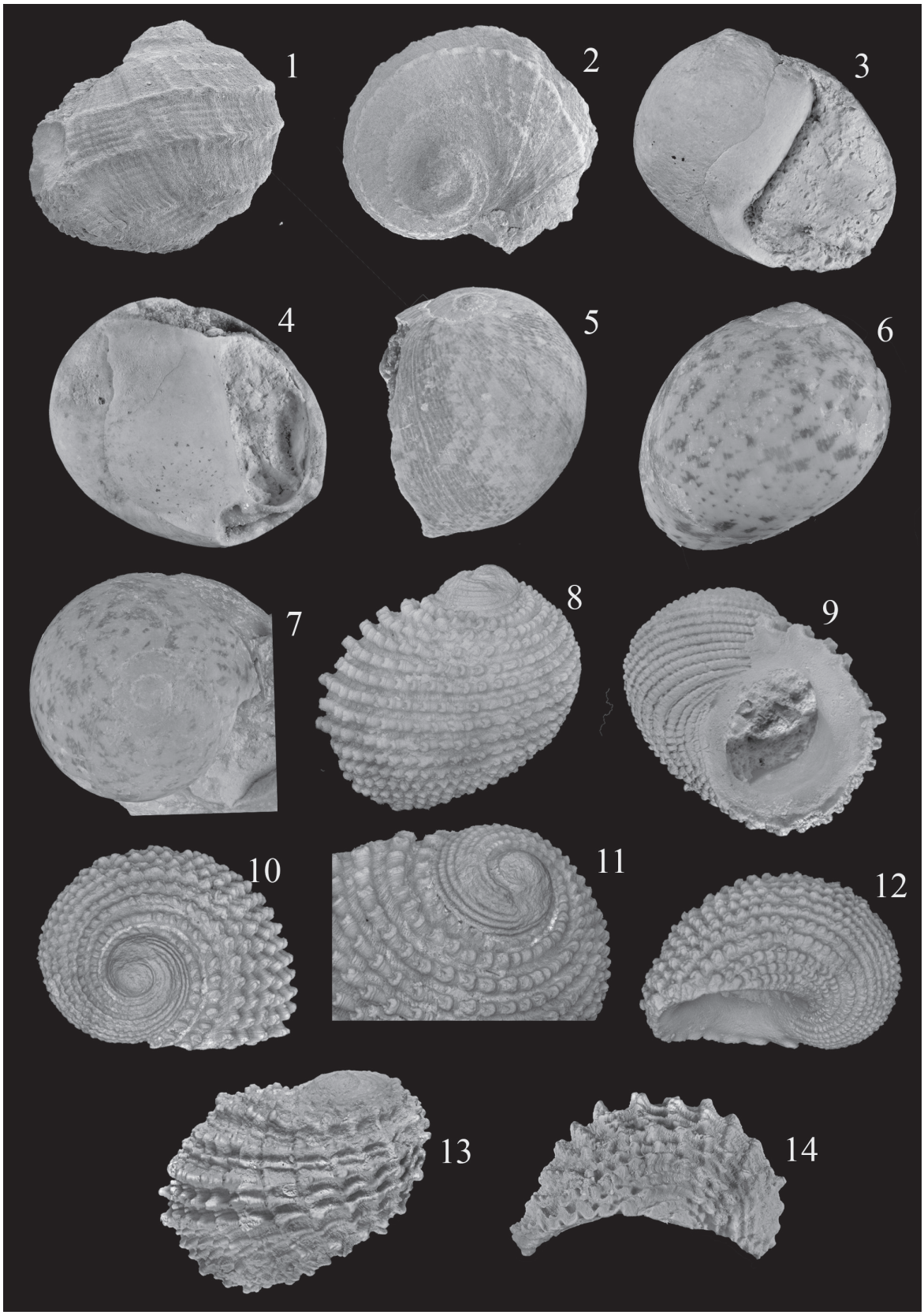

Plate 6. (1, 2) *Parvulatopsis*? sp. 1, SNSB–BSPG 2016 XXI 1759, lateral and apical views, width 12 mm. **(3)** *Neridomus hemisphaerica* (Roemer, 1836), SNSB–BSPG 2016 XXI 1764, lateral view, width 33 mm. **(4, 5)** *Neridomus hemisphaerica* (Roemer, 1836), SNSB–BSPG 2016 XXI 651, lateral views, height 35 mm. **(6, 7)** *Neridomus hemisphaerica* (Roemer, 1836) with color pattern, SNSB–BSPG 2016 XXI 1765, lateral and apical views, width 36 mm. **(8–12)** *Neritopsis*? *rotundatus* sp. nov., holotype, SNSB–BSPG 2016 XXI 1767, **(8–10)** abapertural, apertural and apical views, width 15 mm, **(11)** detail in oblique apical view, width 11 mm, **(12)** basal view, width 15 mm. **(13, 14)** *Wallowiella* (*Plicaropsis*) *cancellata* (Stahl, 1824) (adult), SNSB–BSPG 2016 XXI 1773, lateral and basal views, width 21 mm.

Hayamiella schaeferi Gründel, Keupp & Lang, 2015

pl. 5: figs 10–15; pl. 6, fig. 1 in Gründel et al. (2015)

2015 *Hayamiella schaeferi* n. sp. – Gründel, Keupp and Lang: 96, pl. 5, figs 10–15; pl. 6, fig. 1.

Material. 6 specimens and a cast of an imprint (imprint not at hand), SNSB–BSPG 2016 XXI.

Hayamiella decussata (Münster, 1844 in Goldfuss)

pl. 7: figs 1–4, pl. 8: figs 8–11 in Gründel et al. (2015)

2015 *Hayamiella decussata* (Münster in Goldfuss, 1844) – Gründel, Keupp and Lang: 98, pl. 7, figs 1–4; pl. 8, figs 8–11 (here more synonymy and chresonymy).

Material. 1 specimen, SNSB–BSPG 2016 XXI.

Hayamiella subvaricosa (Brösamlen, 1909)

Plate 7: figs 8–10

1909 *Neritopsis subvaricosa* n. sp. – Brösamlen: 243, pl. 19, fig. 29.
1997 *Neritopsis subvaricosa* Broesamlen, 1909 – Hägele: 57, fig. p. 57, upper left, pl. 7, fig. 2.

Material. 4 specimens and a cast of an imprint (imprint not at hand); illustrated specimen SNSB–BSPG 2016 XXI 1777.

Remarks. This species was not available for the study of Gründel et al. (2015). Brösamlen (1909) gave an accurate description. In the material at hand, only the illustrated specimen is almost complete. The aperture is rounded with a strongly convex outer lip. The callus is only partially preserved. At least three of the specimens are adults with a width of 16–17 mm. This species differs from the similar *Hayamiella semiplicata* (Brösamlen, 1909) by having fewer axial ribs (about 7–8 per whorl) and the axial ribs do not become weaker during late ontogeny.

Hayamiella semiplicata (Brösamlen, 1907)

pl. 6: figs 2–15 in Gründel et al. (2015)

2017 *Hayamiella semiplicata* (Brösamlen, 1907) – Gründel, Keupp and Lang: 100, pl. 6, figs 2–15 (here more synonymy and chresonymy).

Material. 1 specimen, SNSB–BSPG 2016 XXI.

Remarks. In the present specimen, the reduction of the axial ribs occurs very early. Approximately 4/5ths of the last whorl have no axial ribs.

Hayamiella? sp.

Plate 7: figs 11, 12

1997 *Neritopsis* sp. 1 – Hägele: 58, fig. p. 58, upper left, pl. 7, fig. 5.

Material. 2 specimens, illustrated specimen SNSB–BSPG 2016 XXI 1778.

Description. Shell neritiform, low-spired, apex almost flat, barely protruding last whorl in lateral view; larger shell 11 mm wide; wide ramp is inclined towards whorl axis; ornament of last whorl consists of 5 strong spiral cords approximately equally spaced; approximately 10 strong, widely spaced axial ribs run from adapical suture to center of base; intersections of strong spiral cords and axial ribs nodular; several weak spiral cords on ramp and between two strong spiral cords of rest of shell; intersections these weak spiral cords with axial ribs lack nodes; aperture unknown.

Remarks. *Neritopsis cottaldina* d'Orbigny, 1852 as illustrated by Loriol in Loriol and Bourgeat (1886–1888, figs 3–4, non figs 1–2, 5) resembles *Hayamiella*? sp. 1, but has a distinctly elevated spire and more axial ribs per whorl.

Genus *Bipartopsis* Gründel, Keupp & Lang, 2015

Type species. *Bipartopsis robustus* Gründel, Keupp & Lang, 2015; upper Kimmeridgian; South Germany.

Bipartopsis robustus Gründel, Keupp & Lang, 2015

pl. 7: figs 5–15 in Gründel et al. (2015)

2015 *Bipartopsis robustus* n. sp. – Gründel, Keupp and Lang: 55, pl. 7, figs 5–15.

Material. 1 juvenile specimen, SNSB–BSPG 2016 XXI.

Subclass Caenogastropoda Cox, 1960
Cohort Sorbeoconcha Ponder & Lindberg, 1997
Superfamily unclear
Family Brachytrematidae Cossmann, 1906
Subfamily Brachytrematinae Cossmann, 1906

Genus *Saalensia* Gründel, Keupp & Lang, 2019

Type species. *Saalensia birugata* Gründel, Keupp & Lang, 2019; upper Kimmeridgian; South Germany.

Saalensia birugata Gründel, Keupp & Lang, 2019

Plate 8: fig. 1

2019 *Saalensia birugata* n. sp. – Gründel, Keupp and Lang: 101, pl. 1, figs 10–16 (here more chresonymy and synonymy).
2020b *Saalensia birugata* Gründel, Keupp and Lang – Gründel, Hostettler and Menkveld-Gfeller: 111, pl. 1, figs 10–12.

Material. 22 specimens, illustrated specimen SNSB-BSPG 2016 XXI 1779.

Remarks. The weakening of the abapical strong spiral cord can begin in relatively early whorls. The adapical spiral cord then protrudes.

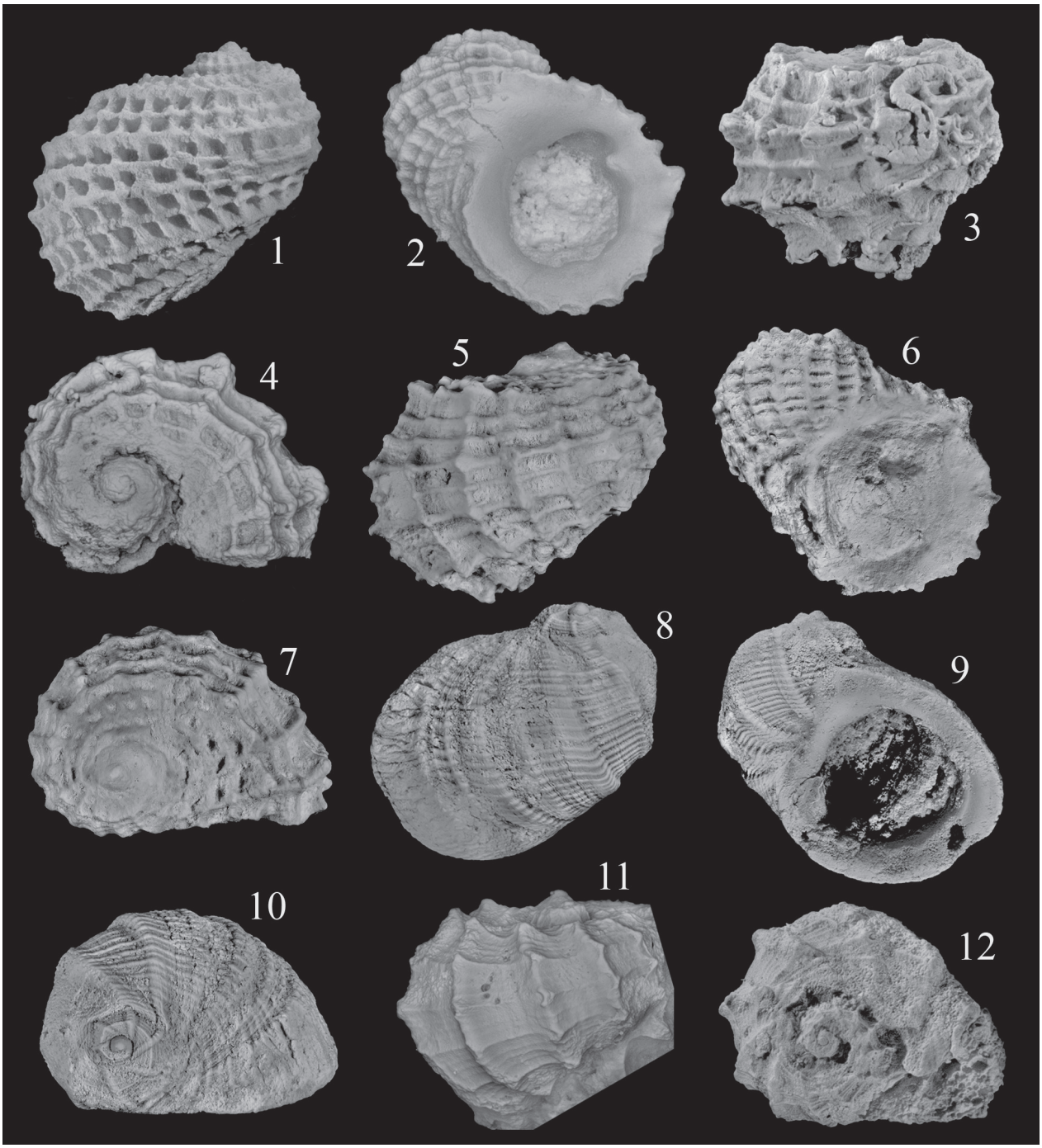

Plate 7. (1, 2) *Wallowiella* (*Plicaropsis*) *cancellata* (Stahl, 1824) (juvenile), SNSB–BSPG 2016 XXI 1774, abapertural and apertural views, width 10 mm. **(3, 4)** *Wallowiella* (*Plicaropsis*) *compacta* Gründel, Keupp & Lang, 2015, SNSB–BSPG 2016 XXI 1775 (collection Lang), lateral and axial views, width 17 mm. **(5–7)** *Wallowiella* (*Plicaropsis*) *compacta* Gründel, Keupp & Lang, 2015, c SNSB–BSPG 2016 XXI 1776, abapertural and apertural views, width 18 mm. **(8–10)** *Hayamiella subvaricosa* (Brösamlen, 1909), SNSB–BSPG 2016 XXI 1777, abapertural, apertural and apical views, width 18 mm. **(11, 12)** *Hayamiella*? sp., SNSB–BSPG 2016 XXI 1778, abapertural and apical views, width 11 mm.

Subfamily Loriolotrematinae Gründel, Hostettler & Menkveld-Gfeller, 2020

Genus *Loriolotrema* Gründel, Hostettler & Menkveld-Gfeller, 2020

Type species. *Loriolotrema liriola* Gründel, Hostettler and Menkveld-Gfeller, 2020; Oxfordian; Switzerland.

Loriolotrema sp.

Plate 8: figs 2–4

Material. 1 specimen, SNSB-BSPG 2016 XXI 1780.

Description. Shell broadly biconical, with gradate spire, 17 mm high, whorls low, rapidly increasing in width; edge at about mid-whorl of first preserved whorls, delimiting oblique ramp from approximately vertical abapi-

cal portion; weak spiral cords present on both sides of edge; orthocline axial ribs run from suture to suture, with wide interspaces; nodes at intersections of ribs and edge; edge strengthened during ontogeny and axial ribs become broadly bulging and blurred; nodes on intersections of ribs and edge become larger, rounder and also include the spiral cord located between edge and bordering spiral cord as well as bordering spiral cord; several spiral cords can be seen on wide, oblique ramp; base slightly convex with 4 (5?) spiral cords broken down into individual segments; spiral cords on base crossed by weakly strengthened growth lines; base phaneromphalous; aperture strongly damaged.

Remarks. *Loriolotrema*? *nodosa* Gründel, Hostettler and Menkveld-Gfeller is larger, the strong enlargement of the nodes begins later in ontogeny, the spiral cords on the base are not divided into partial segments. *Brachytrema kobyi* Loriol in Loriol and Koby (1889) is more slender, the whorls have a stronger keel and the base has more and unsegmented spiral cords. *Brachytrema filosum* (Buvignier) sensu Cossmann (1913) is more slender, has more spiral cords on the base, the axial ribs are not as wide and the nodes on the edge are not as large.

Brachytrematidae? gen. and sp. indet.

Plate 8: fig. 5

Material. 1 specimen, Saal, SNSB-BSPG 2016 XXI 1781.

Description. Shell turbiniform, 29 mm high, only partly preserved; whorls convex with numerous spiral cords and widely spaced axial ribs; first recognizable sculpture consists of edge directly above abapical suture; several weak spiral cords and axial ribs between edge and abapical suture; in the course of ontogeny, a spiral cord above edge and a weakly tubercular spiral cord appears between both; several spiral cords between edge and abapical suture; axial ribs become bulging and form rounded nodes at intersections with edge and several spiral cords on both sides of edge; adapical end of ribs thickened, node-like; some axial ribs thickened, varix-like; faint spiral lirae (that cannot be seen in detail due to preservation) between adapical suture and edge; spiral cord at border to base nodular; base slightly convex, with remains of spiral cords but shell largely chipped off so that only steinkern is exposed there.

Subcohort Campanilimorpha Haszprunar, 1988
Superfamily Campaniloidea Douvillé, 1904
Family Ampullinidae Cossmann, 1919 in Cossmann and Peyrot
Subfamily Ampullospirinae Cox, 1930

Genus *Pictavia* Cossmann, 1925

Type species. *Natica pictaviensis* d'Orbigny, 1852; Bathonian; France.

Pictavia lactera Gründel, Keupp & Lang, 2019

pl. 3: figs 1–4 in Gründel et al. (2019)

2019 – *Pictavia lactera* n. sp. – Gründel, Keupp and Lang: 105, pl. 3, figs 1–4.

Material. 8 specimens, SNSB-BSPG 2016 XXI 1782–1789.

Remarks. The Sylla collection contains additional poorly or fragmentarily preserved specimens that are similar in size and shape to those reported by Gründel et al. (2019). However, in the present specimens, a subsutural groove that is present in the material reported by Gründel et al. (2019) cannot be recognized. It is unclear whether this lack represents a genuine characteristic of another taxon or intraspecific variability, or is due to preservation.

Pictavia silicea (Quenstedt, 1858)

2019 *Pictavia silicea* (Quenstedt, 1858) – Gründel, Keupp and Lang: 105, pl. 2, figs 17–18 (here more chresonymy and synonymy).

Material. 1 specimen, SNSB-BSPG 2016 XXI.

Pictavia? sp.

Plate 8: figs 10, 11

Material. 1 specimen, SNSB-BSPG 2016 XXI 1790.

Description. Shell naticiform, egg-shaped, significantly higher than wide, 20 mm high; spire small; whorl face convex; sutures distinctly deepened; last whorl very large, inflated, higher than wide but distinctly elevated; transition from whorl face to strongly convex base evenly convex; shell smooth; growth lines not visible; aperture not preserved or covered with rock.

Remarks. *Natica amata* d'Orbigny sensu Loriol in Loriol and Bourgeat (1886–1888) is larger and has higher spire whorls; its last whorl is higher than wide.

Genus *Oonia* Gemmellaro, 1878

Type species. *Melania abbreviata* Terquem, 1855 (= *Pseudomelania hettangiensis* Cossmann, 1909); lower Jurassic; France.

Oonia kimmeridgiensis sp. nov.

https://zoobank.org/1F9A1750-A9FC-402D-BC37-A8A3213E38B2

Plate 8: figs 6, 7

Etymology. After the Kimmeridgian stage.

Holotype. SNSB-BSPG 2016 XXI 1791.

Paratypes. 2 specimens, SNSB-BSPG 2016 XXI 1792–1793.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell slender, oval; spire whorls low; body whorl much higher than spire, with weakly, evenly convex whorl face.

Description. Shell slender, oval, higher than wide; holotype 18 mm high; sutures distinct; body whorl nearly two times higher than spire, with weakly, evenly convex whorl face; periphery low on whorl; transition from whorl face to base evenly rounded; base stronly convex; shell smooth; growth lines weakly parasigmoidal; aperture incomplete, probably teardrop-shaped.

Remarks. Similar species (e. g., *Oonia guirandi* Loriol in Loriol and Bourgeat 1886–1888, *Pseudomelania* (*Oonia*) *cornelia* (d'Orbigny) sensu J.–C. Fischer et al. (2001) and Fischer and Weber 1997, *Ampullospira* (*Pictavia*) *calypso* (d'Orbigny) sensu Fischer and Weber 1997) usually have higher spire whorls, but above all, a wider and more convex body whorl.

Subfamily Globulariinae Wenz, 1941

Genus *Globularia* Swainson, 1840

Type species. *Globularia fluctuata* (Sowerby); recent.

Globularia? sp.

Plate 8: figs 8, 9

Material. 1 specimen, SNSB-BSPG 2016 XXI 1794.

Description. Specimen largely preserved as steinkern, 42 mm wide, egg-shaped, much wider than high, low-spired; whorls rapidly increasing, convex, without visible ornament; spire whorls low; sutures shallow but distinct; last whorl large, largely covering previous ones; transition from whorl face to base evenly convex; outer lip of aperture extends far anteriorly, curved asymmetrically, with greatest width low on whorl; outer lip of aperture shows course of growth lines: almost orthocline, opisthocyrt in adapical part of whorl, prosocyrt in abapical part; aperture not exposed.

Remarks. *Neridomus canalifera* (Buvignier) sensu Gründel et al. (2016) is significantly wider in relation to the height and the outer lip is not as asymmetrically curved. *Neritoma* (*Neridomus*) *ovula* (Buvignier) sensu Fischer and Weber (1997) is smaller and the last whorl is higher. *Nerita neumeyri* Zittel, 1873 is higher in relation to its width and the spire is less elevated. The present species could well belong to Neritimorpha, for instance the Palaeozoic/ Triassic genus *Naticopsis* is similar. Specimens with known aperture would be needed for a safer systematic placement.

Family Tylostomatidae Stoliczka, 1868

Genus *Tylostoma* Sharpe, 1849

Type species. *Tylostoma globosum* Sharpe, 1849; Turonian; Portugal.

Tylostoma sp. 1

pl. 3, fig. 19, pl. 4: figs 1–3 in Gründel et al. (2019)

2017 *Pictavia* sp. – Gründel: 32, pl. 11, fig. C.
2019 *Tylostoma* sp. 1 – Gründel, Keupp and Lang: 109, pl. 3, fig. 19, pl. 4, figs 1–3.

Material. 6 specimens, SNSB-BSPG 2016 XXI 1794–1800 (5 specimens collection Sylla, 1 specimen collection Keupp).

Subcohort Cerithimorpha Golikov & Starobogatov, 1975
Taxa of uncertain placement
Family Eustomatidae Cossmann, 1906

Genus *Eustoma* Piette, 1855

Type species. *Eustoma tuberculosa* Piette, 1855; Bathonian; France.

Eustoma sp.

Plate 8: figs 12–14

Material. 3 specimens, SNSB-BSPG 2016 XXI 1801–1803.

Description. Shell high-spired, slender, with gradate spire and narrow ramp; a specimen 31 mm high; shell sides straight; whorl face with strong axially elongated subsutural nodes (9–10 per whorl) extending over more than of whorl height; broad, sometimes slightly nodular spiral cord at rounded angular transition to base; base slightly convex; whorls face and densely covered with spiral cords of variable strength separated by narrow furrows; aperture incompletely preserved with straight siphonal canal.

Remarks. *Ditretus* sp., cf. *rostellaria* (Buvignier, 1852) has a similar ornament but differs in its stouter (less slender) shell shape, in having fewer whorls, a more delicate sculpture, and a very short abapical canal. *Eustoma tuberculosa* Piette, 1855 is larger and more slender, the aperture of adult specimens terminates adapically in a long, triangular extension. *Diatinostoma* aff. *germaini* Étallon sensu Yin (1931) has a wider, more triangular shell shape, spiral cords are largely missing, the transition from whorl face to base has a clear cord-like edge.

Eustoma? *gracilis* sp. nov.

https://zoobank.org/94401852-BBD8-4420-8368-D9D768473AFB
Plate 8: figs 15–17

Etymology. Latin gracilis – slender; because of the slender shell shape.

Holotype. SNSB-BSPG 2016 XXI 1804.

Paratypes. 4 specimens, SNSB-BSPG 2016 XXI 1805–1807.

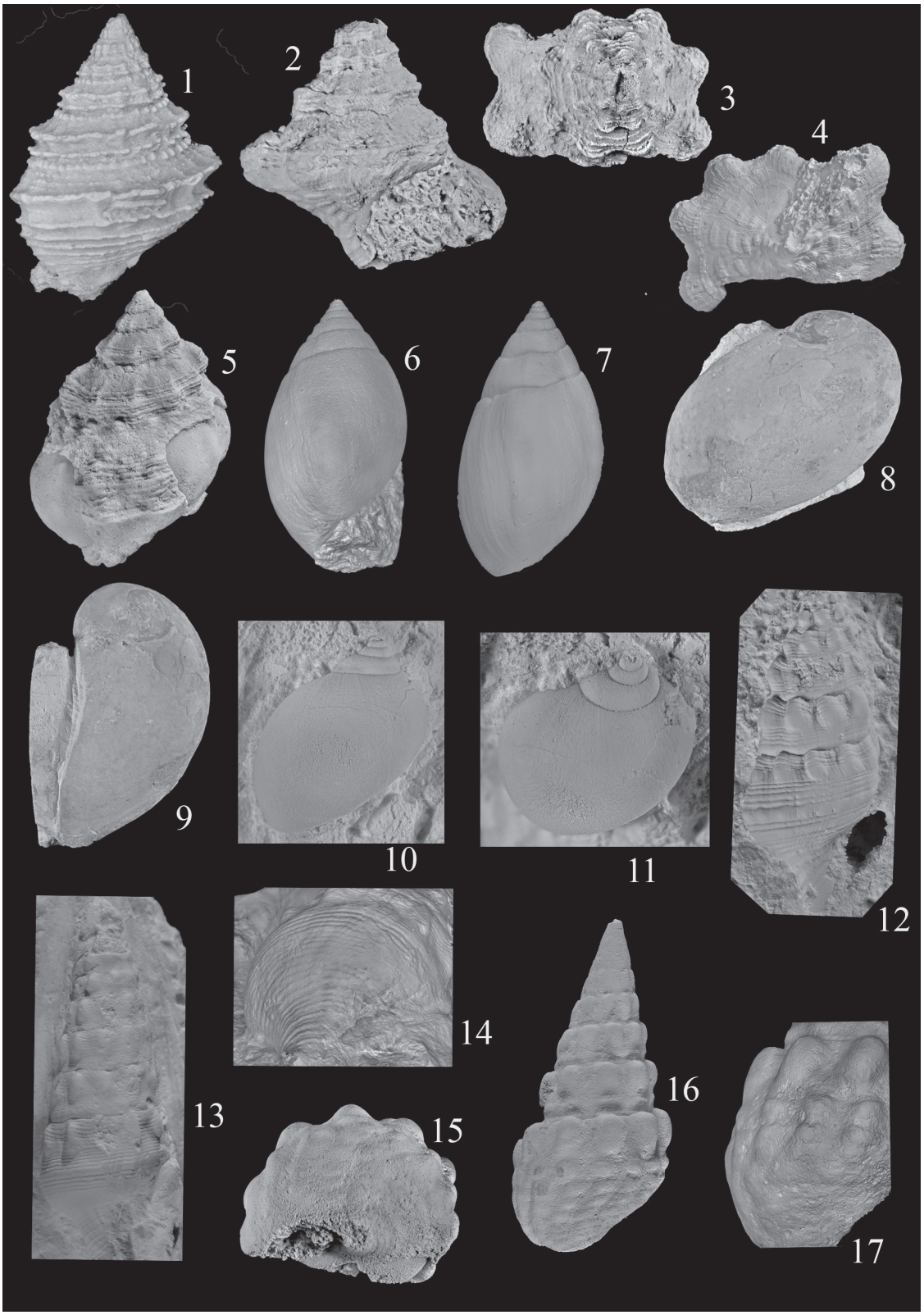

Plate 8. (1) *Saalensia birugata* Gründel, Keupp & Lang, 2019, SNSB-BSPG 2016 XXI 1779, lateral view, height 16 mm. **(2–4)** *Loriolotrema* sp., SNSB-BSPG 2016 XXI 1780, apertural, apical and basal view, width 18 mm. **(5)** Brachytrematidae? gen. and sp. indet., SNSB-BSPG 2016 XXI 1781, abapertural view, height 29 mm. **(6, 7)** *Oonia kimmeridgiensis* sp. nov., holotype, SNSB-BSPG 2016 XXI 1791, apertural and abapertural, height 18 mm. **(8, 9)** *Globularia*? sp., SNSB-BSPG 2016 XXI 1794, abapertural and oblique lateral view, width 42 mm. **(10, 11)** *Pictavia*? sp., SNSB-BSPG 2016 XXI 1790, abapertural and oblique abapertural view, height 20 mm. **(12)** *Eustoma* sp., SNSB-BSPG 2016 XXI 1801, apertural view, height 24 mm. **(13, 14)** *Eustoma* sp., SNSB-BSPG 2016 XXI 1802, **(13)** lateral view, height 31 mm, **(14)** basal view, width 10 mm. **(15–17)** *Eustoma*? *gracilis* sp. nov., holotype, SNSB-BSPG 2016 XXI 1804, **(15–16)** basal and lateral view, width 18 mm, **(17)** detail of ornament of last whorl, height 15 mm.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell moderately high-spired, relatively large and slender; whorls increase evenly in width; whorl face without distinct spiral cords; subsutural nodes become particularly large on the last whorls; transition from whorl face to base evenly rounded, with nodular spiral cord; base covered with nodose spiral cords, increasingly weaker towards center of base; nodes connected by bulbous, opisthocline axial ribs.

Description. Shell moderately high-spired, slender, with acute apex; large specimen 45 mm high; early whorls poorly preserved, with straight whorl face; late whorls with subsutural row of large rounded, axially elongated nodes (9–10 per whorl), giving spire gradate appearance by forming narrow ramp; subsutural nodes extending over more than half of whorl face height; suprasutural spiral cord with weaker and more numerous nodes; transition from whorl face to convex base evenly rounded; base with knobby spiral cords; spiral cords on base becoming weaker towards center of base while nodes on them become smaller; nodes connected by bulbous opisthocline axial ribs; whorls probably also with fine spiral lirae (obscured by poor preservation); base apparently with narrow umbilicus; aperture not preserved.

Remarks. *Ditretus* sp., cf. *rostellaria* (Buvignier) sensu Gründel et al. (2019) is smaller, the strong abapical spiral cord lies directly at the suture and has larger tubercles, on the base a third, clearer and tuberculated spiral cord is formed, the spiral cords on the base are more numerous and are not nodular, the flanks are covered with weak spiral cords. *Cerithium rostellaria* Buvignier, 1852 has smaller subsutural nodes, the whorls are angulated by the nodes, and axial ribs are missing on the base. *Cerithium schardti* Loriol in Loriol and Koby (1895) has smaller and barely abapically elongated nodes; it lacks a knobby spiral cord at the transition from whorl face to base and axial ribs on the base. *Cerithium kelheimense* Schlosser, 1882 is smaller and the shell is covered with weak spiral cords and it lacks a knobby spiral cord at the transition from whorl face to base. *Ditretus nodosostriatus* Peters sensu Yin (1931) has smaller and more numerous subsutural nodes, 1–2 spiral cords above the abapical suture; its base is unknown. *Ditretus thurmanni* Loriol sensu Yin (1931) is smaller, the nodes form only an indistinct ramp; it has 1–2 spiral ribs with small nodes between the upper row of nodes and the abapical suture. *Nerinea orbignyana* Zeuschner, 1850 has a series of small nodes above the abapical suture, the base is almost flat and lacks sculpture.

Genus *Ditretus* Piette, 1875

Type species. *Cerithium rostellaria* Buvignier, 1852; Oxfordian; France.

Ditretus sp., cf. *rostellaria* (Buvignier, 1852)

Plate 9: figs 1–4

?1931 *Ditretus valenensis* n. sp. – Yin: 46, pl. 4, figs 1–3.
2019 *Ditretus* sp., cf. *rostellaria* (Buvignier, 1852) – Gründel, Keupp and Lang: 110, pl. 4, figs 4–7.

Material. 11 specimens, SNSB-BSPG 2016 XXI 1808–1818.

Description. The description is based on specimens with relatively stout shell shape; shell acutely trochiform, stout, with few whorls; last whorl higher than spire; a specimen is 23 mm high (apex missing); whorl face of spire whorl low; shell sides straight (side view); whorl face with subsutural row of large, rounded nodes (approximately 10 nodes per whorl) with steep adapical slope producing ramp that accentuates suture; whorls including nodes covered with numerous weak spiral lirae; transition from whorl face to base rounded; nodular spiral cord at transition to base and a weaker one below it are more or less clearly developed (probably intraspecific variation); base also covered with spiral lirae; fully grown specimens with distinctly widened, large and rounded aperture; inner and outer lip strongly thickened and broadened; columellar inner lip is also thickened and somewhat detached; short abapical canal hardly visible in apertural view because canal is almost closed.

Remarks. *Ditretus rostellaria* Buvignier, 1852 differs in having whorls that are angulated at a row of nodes, its shell is more slender, the columellar inner lip is neither thickened nor detached according to the illustrations. *Diatinostoma germaini* Étallon sensu Yin (1931) largely lacks spiral cords and its aperture is unknown. *Ditretus valenensis* Yin, 1931 is similar (identical?) to the variant with a knobby spiral cord at the transition from whorl face to base. *Ditretus thurmanni* Loriol in Loriol and Koby sensu Gründel et al. (2022) is more slender and has more whorls.

Family Maoraxidae Bandel, Gründel & Maxwell, 2000

Genus *Cryptoptyxis* Cossmann, 1906

Type species. *Cerithium wrighti* Étallon, 1859; Kimmeridgian; France.

Cryptoptyxis rarenodosa Gründel, Keupp & Lang, 2019

pl. 4: figs 17–20, pl. 5: figs 1–5 in Gründel et al. (2019)

2017 *Cryptoptyxis* sp. – Werner, Nützel and Nose: 32, Abb. 3D.
2019 *Cryptoptyxis rarenodosa* n. sp. – Gründel, Keupp and Lang: 114, pl. 4, figs 17–20, pl. 5, figs 1–5 (here more chresonymy and synonymy).

Material. 5 specimens Saal, SNSB-BSPG 2016 XXI 1819–1823; 1 specimen locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2").

Cryptoptyxis? *spinosus* sp. nov.

https://zoobank.org/373A7A05-7F23-45C8-8307-10C8E6C7ACFA
Plate 9: fig. 5

Etymology. Latin spinosus – thorny; because of the thorn-like extension of the axial ribs of the last whorl.

Holotype. SNSB-BSPG 2016 XXI 1824.

Paratypes. 2 juvenile specimens, SNSB-BSPG 2016 XXI 1825–1826.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Early whorls with 5 narrow axial ribs that form rib strands running across the shell i. e., ribs are aligned over consecutive whorls; last whorl with axial ribs that terminate adapically in thorn-like extensions; a spiral sculpture could not be seen with certainty.

Description. Shell trochiform, conical, higher than wide, with last whorl higher than spire; largest specimen 22 mm high; whorls low; whorl face with straight; suture shallow but distinct; ornament consists of 5 axial ribs per whorl; axial ribs sharp, high and very narrow with a weak cusp at adapical end; axial ribs extend from adapical suture to center of base; ribs of last whorl of illustrated specimen increase significantly in height and terminate adapically in a thorn-like tip; ribs on spire whorls aligned to each other from whorl to whorl, only slightly offset from one another, forming rib strands that run weakly prosocline across shell; spiral cords or lirae absent (due to preservation?); only occasionally three faint cusps visible on crest of axial ribs that could indicate presence of spiral ornamentation; aperture not preserved.

Remarks. *Cryptoptyxis rarenodosa* Gründel et al., 2019 has a ramp, but above all, the entire shell is covered with strong spiral cords. Other similar species (e. g., *Cryptoptyxis* sp. sensu Hägele (1997) from the Upper Jurassic; *Cerithium quinquangulare* Hébert and Eudes-Deslongchamps, 1860, Callovian) lack the adapical extensions of the axial ribs on the last whorl. *Cryptoptyxis*? *fortiter* Gründel et al., 2022 has distinct spiral cords with nodes at the intersections with the axial ribs. In this species, the nodes on the subsutural spiral cord are strongly enlarged on the last whorl, but the ribs do not have an adapical extension.

Family Cassiopidae Beurlen, 1967

Genus *Coninoda* Kollmann, 1979

Type species. *Coninoda mammata* Kollmann, 1979; Albian-Cenomanian; Austria.

Coninoda strekwera Gründel, Keupp & Lang, 2019

Plate 9: figs 6, 7

2017 „*Ditretus*“ sp. – Gründel: 31, pl. 11, fig. D.

2019 *Coninoda strekwera* n. sp. – Gründel, Keupp and Lang: 112, pl. 4, figs 8–9, 12–14.

Material. 2 specimens, SNSB-BSPG 2016 XXI 1827–1828.

Remarks. A typical specimen from the Sylla collection representing *Coninoda strekwera* shows in longitudinal section that this species has no plaits or folds inside the whorls (pl. 9, fig. 7).

Coninoda? sp. 1

pl. 4: figs 10–11 in Gründel et al. (2019)

2019 *Coninoda*? sp. 1 – Gründel, Keupp and Lang: 113, pl. 4, figs 10–11.

Material. 1 specimen, SNSB-BSPG 2016 XXI 1829, locality 1985, above coral stock, level 2 (“Fundort 1985, über Korallenstock, Sohle 2”).

Superfamily Cerithioidea Fleming, 1822
Family Cryptaulacidae Gründel, 1976
Subfamily Cryptaulacinae Gründel, 1976

Genus *Tropacerithium* Gründel, Keupp & Lang, 2019

Type species. *Tropacerithium cumaritum* Gründel, Keupp & Lang, 2019; upper Kimmeridgian; South Germany.

Remarks. Deviating from the diagnosis of the genus given by Gründel et al. (2019), the few specimens presented here for *Tropacerithium* have around 5 somewhat reinforced spiral cords on the whorl face, with 2 weaker ones running in between. The intersections of the stronger spiral cords with the axial ribs are weakly knobby.

Tropacerithium cumaritum Gründel, Keupp & Lang, 2019

Plate 9: figs 8, 9

2019 *Tropacerithium cumaritum* n. sp. – Gründel, Keupp and Lang: 124, pl. 7, figs 4–7.

Material. 1 specimen, SNSB-BSPG 2016 XXI 1830.

Tropacerithium danubii Gründel, Keupp & Lang, 2019

pl. 7: figs 8–12 in Gründel et al. (2019)

2019 *Tropacerithium danubii* n. sp. – Gründel, Keupp and Lang: 124, pl. 7, figs 8–12.

Material. 2 specimens, SNSB-BSPG 2016 XXI 1831–1832.

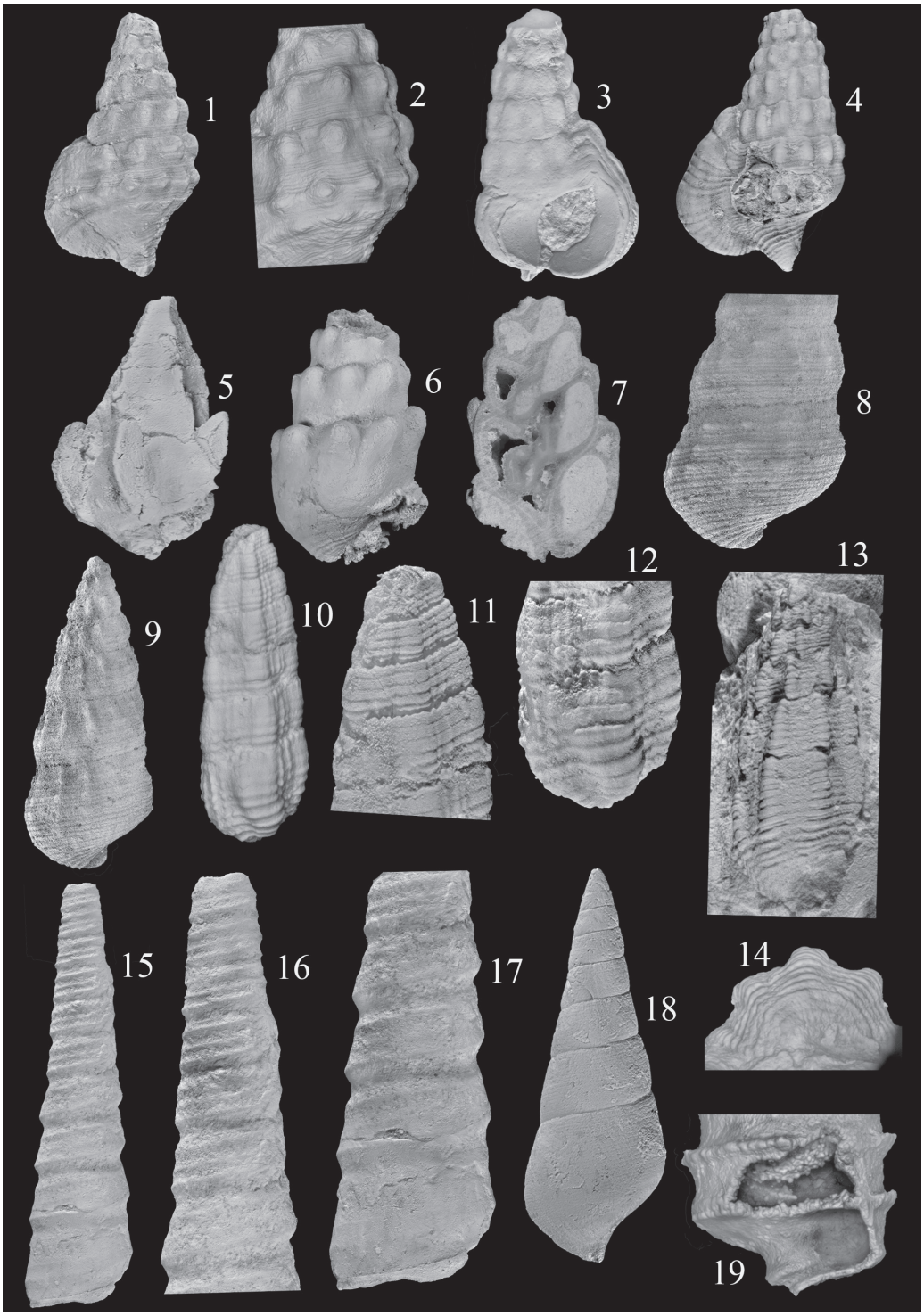

Plate 9. (1, 2) *Ditretus* sp., cf. *rostellaria* (Buvignier, 1852), SNSB SNSB-BSPG 2016 XXI 1808, **(1)** lateral view, height 25 mm, **(2)** detail of ornament, height 12 mm. **(3, 4)** *Ditretus* sp., cf. *rostellaria* (Buvignier, 1852), SNSB-BSPG 2016 XXI 1809, lateral views, height 23 mm. **(5)** *Cryptoptyxis*? *spinosus* sp. nov., holotype, SSNSB-BSPG 2016 XXI 1824, apertural and abapertural lateral views, height 22 mm. **(6, 7)** *Coninoda strekwera* Gründel, Keupp & Lang, 2019, SNSB-BSPG 2016 XXI 1827, lateral view and longitudinal section, height 33 mm. **(8, 9)** *Tropacerithium cumaritum* Gründel, Keupp & Lang, 2019, SNSB-BSPG 2016 XXI 1830, **(8)** detail of last whorl, height 4 mm, **(9)** lateral view, height 7 mm. **(10–12)** *Exelissa*? aff. *corallense* (Buvignier, 1843), SNSB-BSPG 2016 XXI 1835, locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2"), **(10)** lateral view, height 12 mm, **(11)** apex in lateral view, height 5 mm, **(12)** last two whorls in lateral view, height 7 mm. **(13, 14)** *Exelissa ursicina* (Loriol in Loriol and Koby 1889), SNSB-BSPG 2016 XXI 1836, **(13) l**ateral view, height 10 mm, **(14)** basal view, width 4.5 mm. **(15–17)** *Turritella lucagrita* sp. nov., holotype, SNSB-BSPG 2016 XXI 1840, **(15)** lateral view, height 75 mm, **(16)** earliest preserved whorls in lateral view, height 40 mm, **(17)** last whorls in lateral view, height 46 mm. **(18)** *Nudivagus*? sp. 2, SNSB-BSPG 2016 XXI 1844, lateral view, height 35 mm. **(19)** *Neuburgensia angulata* sp. nov., paratype, SNSB-BSPG 2016 XXI 1848, collection Lang, last whorl with aperture, height 6 mm.

Subfamily Exelissinae Guzhov, 2004

Genus *Exelissa* Piette, 1860

Type species. *Cerithium strangulatum* d'Archiac, 1843; Bathonian; France.

Exelissa sp. 1

pl. 6: figs 17–19 in Gründel et al. (2019)

2019 *Exelissa* sp. 1 – Gründel, Keupp and Lang: 122, pl. 6, figs 17–19.

Material. 2 specimens, SNSB-BSPG 2016 XXI 1833–1834.

Exelissa? aff. *corallense* (Buvignier, 1843)

Plate 9: figs 10–12

Material. 1 specimen from Saal, SNSB-BSPG 2016 XXI 1835: locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2") and a questionable specimen from Saal, SNSB-BSPG 2016 XXI 1931.

Description. Shell high-spired, slender with slightly convex flanks; the certain specimen has 6.5 whorls, 12 mm high; sutures distinct; 5 bulging axial ribs per whorl that are aligned from whorl to whorl; whorl face ornamented with 5 slightly nodular spiral cords; spiral cords wider than interspaces separating them; intersections of axial ribs and spiral cords not knobby; one axial rib on last whorl thickened, varix-like; base incompletely preserved, moderately convex, covered with spiral cords; axial ribs continue onto base; questionable, poorly preserved specimen larger (height 16 mm), with distinctly broader shell shape; whorls increasing more rapidly; axial ribs also continue onto base; base with at least 2 distinct spiral cords.

Remarks. *Exelissa ursicina* (Loriol, 1889 in Loriol and Koby) sensu Gründel et al. (2022) has 6–8 axial ribs per whorl and 6–7 spiral cords on whorl face. Forms are described in the literature as *Cerithium*/*Uchauxia corallense* (mostly from the Oxfordian) that are very similar to the present form (e. g., Buvignier 1852; Thurmann and Étallon 1861–1864; Quenstedt 1881–1884; Gründel et al. 2022; and herein), which differ in details (e. g., in the number of spiral cords on whorl face, in the number of axial ribs per whorl, in the convexity of the whorls). It is not always clear which of these differences are diagnostic for species or represent intraspecific variability or reflect preservation. *Cerithium mojisovici* Zittel, 1873 has a broader shell, about 7 strong spiral cords on whorl face and a weak axial rib between two strong axial ribs. *Exelissa diacritica* Cossmann, 1913 is less slender, its whorl face is more convex (more distinct sutures) and it has more axial ribs per whorl that form only indistinct rib strands stretching over the shell.

Exelissa ursicina (Loriol, 1889 in Loriol and Koby)

Plate 9: figs 13, 14

2022 – *Exelissa ursicina* (De Loriol, 1889 in De Loriol and Koby) – Gründel, Hostettler and Menkveld-Gfeller: 50, pl. 7, figs 14–20, pl. 8, figs 1–5 (here more chresonymy and synonymy).

Material. 1 specimen, SNSB-BSPG 2016 XXI 1836.

Description. Shell high-spired, slender; specimen 10 mm high; sutures shallow but distinct; whorl face with approximately 7 strong, orthocline axial ribs which weaken on base; distance between axial ribs wider than axial ribs; 6–7 strong, spiral cords on whorl face; intersections of axial ribs and spiral cords without nodes; transition from whorl face to convex base evenly rounded; base covered with spiral cords that are slightly stronger than those on whorl face; aperture unknown.

Remarks. According to Gründel et al. (2022), *Exelissa ursicina* from the Oxfordian is a variable species. The present specimen shows no clear differences to some variants of the Oxfordian species (see e. g., Loriol in Loriol and Koby 1889, Plate 8: figs 1–2, 5).

Family Cerithiidae Fleming, 1822
Subfamily Uchauxiinae Kollmann, 2005

Genus *Provolibathra* Kollmann, 2005

Type species. *Cerithium sexangulatum* Zekeli, 1852; Cretaceous Gosau Group; Austria.

Provolibathra? sp., cf. *septemplicata* (Roemer, 1836)

pl. 5: figs 17–20, pl. 6: figs 1–5 in Gründel et al. (2019)

2019 – *Provolibathra*? sp., cf. *septemplicata* (Roemer, 1836) – Gründel, Keupp and Lang: 119, pl. 5, figs 17–20, pl. 6, figs 1–5 (here more chresonymy and synonymy).

Material. 3 specimens, SNSB-BSPG 2016 XXI 1837–1839.

Family Turritellidae Lovén, 1847

Genus *Turritella* Lamarck, 1799

Type species. *Turbo terebra* Linnaeus, 1758; Indian and Pacific Ocean; recent.

Remarks. In classifying the species described below, we follow Das et al. (2018).

Turritella lucagrita sp. nov.

https://zoobank.org/5E3A2920-1B9A-4655-926E-B97774756767
Plate 9: figs 15–17

Etymology. Arbitrary.

Holotype. SNSB-BSPG 2016 XXI 1840, the only specimens at hand.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell high-spired, very slender; whorls face of early whorls barely converge, later whorls converge significantly towards the apex; early whorls with 3 spiral cords of approximately equal strength; on late whorls, abapical spiral cord (low on whorls) strengthened, prominently protruding, angulating whorl face.

Description. Shell high-spired, very slender; shell 75 mm high; shell flanks straight; sutures distinct; sculpture consists of 3 spiral cords; upper and lower spiral cord at clear distance from adapical and abapical suture respectively; on early whorls, all three spiral cords almost equally strong (middle one slightly weaker than others); whorl face of early whorls barely converge, later whorls converge significantly towards apex; no nodes visible on whorl face; on late whorls abapical spiral cord becomes stronger than others and protrudes noticeably forming an angulation low on whorl; shell ornament reduced on last preserved whorls; base and aperture not preserved; no plaits visible; narrow umbilicus present.

Remarks. *Turritella amitava* Das et al., 2018 from India (originally thought to be of Jurassic age but later found to be Miocene: Fürsich et al. 2023, and again as identified as being Upper Jurassic by Das et al. 2024) is smaller, secondary spiral cords are formed next to the 3 main spiral cords, and shows no ontogenetic reduction of the sculpture. *Turritella dhosaensis* Das et al., 2018 (also of disputed age, Jurassic vs Miocene) is smaller, the abapical and middle spiral cord is are closer to each other than the middle and adapical spiral cord; the abapical spiral cord does not protrude as much on late whorls, and the ontogenetic sculptural change is generally missing. *Promathilda* (*Teretrina*) sp. sensu Hägele (1997) is much smaller, has more numerous and weaker but equally strong spiral cords, there is no ontogenetic sculptural reduction. *Aptyxiella tricincta* (Münster) sensu Quenstedt (1881–1884) has a concave or almost straight and vertical whorl face, the subsutural spiral cord is the strongest and the abapical one is not reinforced and does not protrude.

Family uncertain

Genus *Nudivagus* Wade, 1917

Type species. *Nudivagus simplicus* Wade, 1917; Upper Cretaceous; USA (Tennessee).

Nudivagus sp. 1

pl. 5: figs 6–8 in Gründel et al. (2019)

2019 – *Nudivagus* sp. 1 – Gründel, Keupp and Lang: 116, pl. 5, figs 6–8.

Material. 3 specimens, SNSB-BSPG 2016 XXI 1841–1843.

Nudivagus? sp. 2

Plate 9: fig. 18

Material. 2 specimens from Saal, SNSB-BSPG 2016 XXI 1844–1845.

Description. Shell high-spired, slender with high whorls; a specimen is 35 mm high; shell flanks straight; whorl face slightly convex; periphery just above abapical suture; suture distinct; whorl face covered with numerous faint spiral cords that are wider than spiral furrows in between; some furrows consist of rows of minute pits; fine ornamentation only faintly visible due to preservation; transition from whorl face to moderately convex, anomphalous base evenly rounded; no sculpture visible on base; aperture damaged, oval, pointed adapically; it is unclear whether an abapical canal was present.

Remarks. *Nudivagus* sp. 1 sensu Gründel et al. (2019) has significantly lower whorls and the transition from whorl face to base has an edge. *Pseudomelania valfinensis* Loriol in Loriol and Bourgeat 1886–1888 is larger and more slender, the whorls are higher and the base is more convex. *Pseudomelania kobyi* Loriol in Loriol and Koby (1890) is taller and more slender, the whorls are higher and it lacks spiral sculpture.

Genus *Neuburgensia* Gründel, Hostettler & Menkveld-Gfeller, 2022

Type species. *Gymnocerithium concavum* Janicke, 1966; Tithonian; South Germany.

Neuburgensia convexoconcava (Gründel, Keupp & Lang, 2019), comb. nov.

pl. 2: figs 10–12; pl. 11: figs 4–5 in Gründel et al. (2019)

2019 *Gymnocerithium*? *convexoconcavum* n. sp. – Gründel, Keupp and Lang: 108; pl. 2, figs 10–12; pl. 11, figs 4–5.

Material. 2 specimens, SNSB-BSPG 2016 XXI 1846–1847.

Neuburgensia angulata sp. nov.

https://zoobank.org/AB6C376E-BB61-4299-BEA5-3C2AE8E40978
Plate 9: fig. 19, Plate 10: figs 1–6

2017 Nerineoidea Nr. 4 – Gründel: 33, pl. 14, fig. A.

Etymology. Latin angulata – angular; after the angular transition from whorl face to the flat base.

Holotype. SNSB-BSPG 2016 XXI 1849 (Plate 10: fig. 1, collection Lang).

Material. Holotype and 52 paratypes (mainly fragments of various ontogenetic stages): SNSB-BSPG 2016 XXI 1848, 1850–1855, 1932–1976; most from the collection Sylla, others from collections Keupp, Schäfer, and Neubauer, all from Saal.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell very slender; whorl face with subsutural nodular bulge, also on late whorls; shell flanks straight; whorl face straight to slightly concave; base flat, set off from whorl face by sharp clear edge at an almost right angle.

Description. Shell high-spired, slender with numerous whorls; a specimen is 24 mm high; shell flanks straight; whorls significantly wider than high; as far as the fragmentary material can be seen, the early shell has a larger spire angle than later shell; whorl face of early whorls straight with distinct sutures; then, gradual development of subsutural knobby ridge (bulge) demarcating ramp; knobs limited to outer edge of the ramp, only occasionally visible, usually not preserved; ramp usually narrow, occasionally significantly widened and concave; outer whorl face of mature whorls straight to slightly concave; spiral sculpture not recognizable; base flat, set off from whorl face by sharp clear edge at an almost right angle; base without recognizable sculpture; aperture rounded-rectangular, with very clear, backward curved abapical canal; damaged specimens show that the columella axis is hollow.

Remarks. For, the differences to *Neuburgensia rara* n. sp. see below. *Gymnocerithium*? *convexoconcavum* Gründel et al., 2019 (also from the Saal quarry) differs in having a convex whorl face in mature whorls as well as a subsutural concavity and the transitions from whorl face to base is evenly rounded. *Neuburgensia perrotunda* (Cossmann, 1913) sensu Loriol in Loriol and Koby 1889 in the sense of Gründel et al. (2022) and *Cerithium valfinense* Loriol in Loriol and Bourgeat 1886–1888 lack a subsutural bulge and the transition from whorl face to base is rounded. *Proceritella infragranulata* Janicke, 1966 has an angulated transition from whorl face to base and a slightly convex base, the suture lies on a ridge formed by two adjacent whorls, and the whorls increase in width more quickly.

Neuburgensia rara sp. nov.

https://zoobank.org/1807973A-DC43-4730-A7D0-19D9FEF8C478
Plate 10: figs 7–9

Etymology. Latin rare, because this species is rare.

Holotype. SNSB-BSPG 2016 XXI 1856, the only specimen, Saal, collection Sylla.

Diagnosis. Shell very slender, high-spired, with many whorls; early whorls have a subsutural, weakly tuberculate bulge that is reduced on later whorls; base flat; transition from whorl face to base at sharp angulation that is almost perpendicular.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Description. Shell very slender, high-spired, with many whorls; specimen is 30 mm high, with about 20 whorls, apex missing; early whorls increase more rapidly than the later ones and therefore, the early shell have a wider apical angle than later shell; early whorls with distinct subsutural bulge (sometimes nodular) emphasizing sutures; bulge reduced on later whorls; whorl face straight, sutures only slightly impressed; series of small cusps occasionally visible directly below suture; weak spiral lirae on whorl face (hardly visible due to preservation); base flat; transition from whorl face to base at sharp angulation, angle almost perpendicular with reinforced edge (visible above suture); growth lines weakly opisthocyrt on whorl face and prosocyrt on base; aperture outline rounded-rectangular, details of aperture not preserved; columella hollow.

Remarks. In other *Neuburgensia* species, the subsutural bulge is not reduced during ontogeny.

Subcohort Hypsogastropoda Ponder & Lindberg, 1997
Superfamily Littorinoidea Children, 1834
Family Purpuroideidae Guzhov, 2004

Genus *Purpuroidea* Lycett, 1848

Type species. *Purpura moreausia* Buvignier, 1843; Oxfordian; France.

Purpuroidea lapierrea (Buvignier, 1843)

Plate 10: figs 10, 11

1886–1888 *Purpuroidea gracilis* n. sp. – Loriol in Loriol and Bourgeat: 60, pl. 4, figs 2–3.
1893 *Purpuroidea lapierrea* Buvignier – Loriol in Loriol and Lambert: 15, pl. 1, fig. 7.
1913 *Purpuroidea gracilis* (De Loriol) – Cossmann: 183, pl. 11, figs 1–2; fig. 44.
2022 *Purpuroidea lapierrea* (Buvignier, 1843) – Gründel, Hostettler and Menkveld-Gfeller: 55, pl. 9, figs 11–14, pl. 10, figs 1–5 (here more chresonymy and synonymy).

Material. 2 specimens, SNSB-BSPG 2016 XXI 1857–1858.

Description. Shell globular turbiniform with gradate spire; illustrated specimen (probably juvenile) 30 mm high; spire high, slender for the genus; last preserved whorl distinctly higher than spire; earliest preserved whorls convex, without visible ornament; early whorls with subsutural concavity that rapidly widens into distinct ramp in later whorls; several weak spiral cords can be seen on one specimen; shoulder of ramp with distinct nodes on last two preserved whorls; nodes rapidly enlarging, becoming almost thorn-like; nodes terminate adapically and abapically in bulging, ill-defined axial ribs; transition from whorl face to strongly convex base evenly rounded; faint lirae are visible in places, probably originally covering entire surface of the shell; aperture unknown.

Remarks. The information about *Purpuroidea lapierrea* regarding the insertion of the nodes on the shoulder and the formation of a spiral sculpture varies in the literature.

„Rissoiform clade“
Superfamily Truncatelloidea Gray, 1840
Family Palaeorissoinidae Gründel & Kowalke, 2002

Genus *Buvignieria* Cossmann, 1921

Type species. *Rissoina unicarina* Buvignier, 1843; Oxfordian; France.

Buvignieria racitana Gründel, Keupp & Lang, 2019
pl. 8: figs 14–20 in Gründel et al. (2019)

2019 *Buvignieria racitana* n. sp. – Gründel, Keupp and Lang: 130, pl. 8, figs 14–20 (here more chresonymy and synonymy).

Material. 1 specimen SNSB-BSPG 2016 XXI 1976.

Superorder Latrogastropoda Riedel, 2000
Taxa of uncertain position
Family Colombellinidae P. Fischer, 1884

Genus *Columbellaria* Rolle, 1861

Type species. *Cassis corallina* Quenstedt, 1852; upper Jurassic; South Germany.

Columbellaria corallina (Quenstedt, 1852)
Plate 10: figs 12–15

2017 *Columbellaria* cf. *corallina* (Quenstedt, 1852) – Werner, Nützel and Nose: 32, fig. 3 A–C.
2019 *Columbellaria corallina* (Quenstedt, 1852) – Gründel, Keupp and Lang: 133, pl. 9, figs 11–17 (here more chresonymy and synonymy).
2019 *Columbellaria* sp. 1 – Gründel, Keupp and Lang: 136, pl. 9, fig. 18, pl. 10, fig. 1.

Material. 3 specimens, SNSB-BSPG 2016 XXI 1859–1861.

Description. Shell egg-shaped, higher than wide, with distinctly elevated, slender, gradate spire, consisting of more than 5 whorls; illustrated specimen (Plate 10: figs 14, 15) 21 mm high; already first preserved whorls angulated forming edge that later becomes a keel; keel separates oblique ramp and vertical abapical whorl face; ramp ornamented with several very weak spiral cords over several whorls; spiral cords no longer visible on last two spire whorls; instead, formation of subsutural spiral cord covered with small tubercles and a stronger spiral cord, also with nodes, between subsutural cord and keel; whorl face of early teleoconch with axial ribs (approximately 10 on last spire whorl); intersections of axial ribs and spiral cords nodular; all mentioned spiral cords continue onto body whorl without interruption; axial ribs disappear at transition from spire whorls to body whorl and keel is weakened into a spiral cord of equal strength as in other spiral cords; transition from convex whorl face to strongly convex base evenly rounded; body whorl covered with approximately 15 nodular spiral cords of approximately same strength; spiral cords on whorl face slightly more distant from each other than those on base; aperture with widened outer lip and spine-like protrusions where spiral cords are situated; aperture elongated with anterior and posterior siphonal canals (see Hägele 1997; Werner et al. 2017).

Remarks. The spire of the present specimens combines characteristics of *Columbellaria corallina* sensu Gründel et al. (2019) (the last whorl is approximately 10 mm wide; distinct spiral cord between adapical suture and keel) with that of *Columbellaria* sp. 1 sensu Gründel et al. (2019) (strong keel on whorls until end of spire, stronger nodes on keel). It is possible that all forms described Gründel et al. (2019) and described here are variants of a single species. Due to the lack of more extensive and better-preserved material, these forms are summarized herein under the name *Columbellaria corallina* (Quenstedt, 1852).

Columbellaria rara Gründel et al. (2022) has significantly fewer spiral cords on the body whorl and these are more bulging. *Zittelia picteti* Gemmellaro, 1870 has a wider and more convex body whorl, the spiral cords are at least as wide as the spiral furrows between them and the spire whorls are not keeled. *Columbellaria victoria* Guirand & Ogérien, 1865 and sensu Loriol in Loriol and Bourgeat (1886–1888) has spiral cords of equal strength on the body whorl, which are at least as wide as the spiral furrows between them. Its body whorl is more convex and it lacks a subsutural row of small nodes. *Columbellaria denticulata* Zittel, 1873 has more nodes on the last spire whorl and lacks subsutural row of small nodes is missing there; the outer lip of the body whorl lacks furrows.

Superfamily Stromboidea Rafinesque, 1815
Family Aporrhaidae Gray, 1850

Genus *Diarthema* Piette, 1864

Type species. *Rostellaria paradoxa* Eudes-Deslongchamps, 1843; Bathonian; France.

Diarthema aspera sp. nov.
https://zoobank.org/53B8B9AF-FA64-4FD1-87B0-DCA901E93F6B
Plate 10: fig. 16, Plate 11: figs 1–4

2019 – *Diarthema* sp. 1 – Gründel, Keupp and Lang: 137, pl. 10, figs 6–7.

Etymology. Latin aspera – rough; because of the strong ornamentation.

Holotype. SNSB-BSPG 2016 XXI 1863.

Paratypes. 7 specimens, SNSB-BSPG 2016 XXI 1862, 1864–1869 and a cast of an imprint (imprint not hand), SNSB-BSPG 2016 XXI 1870.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

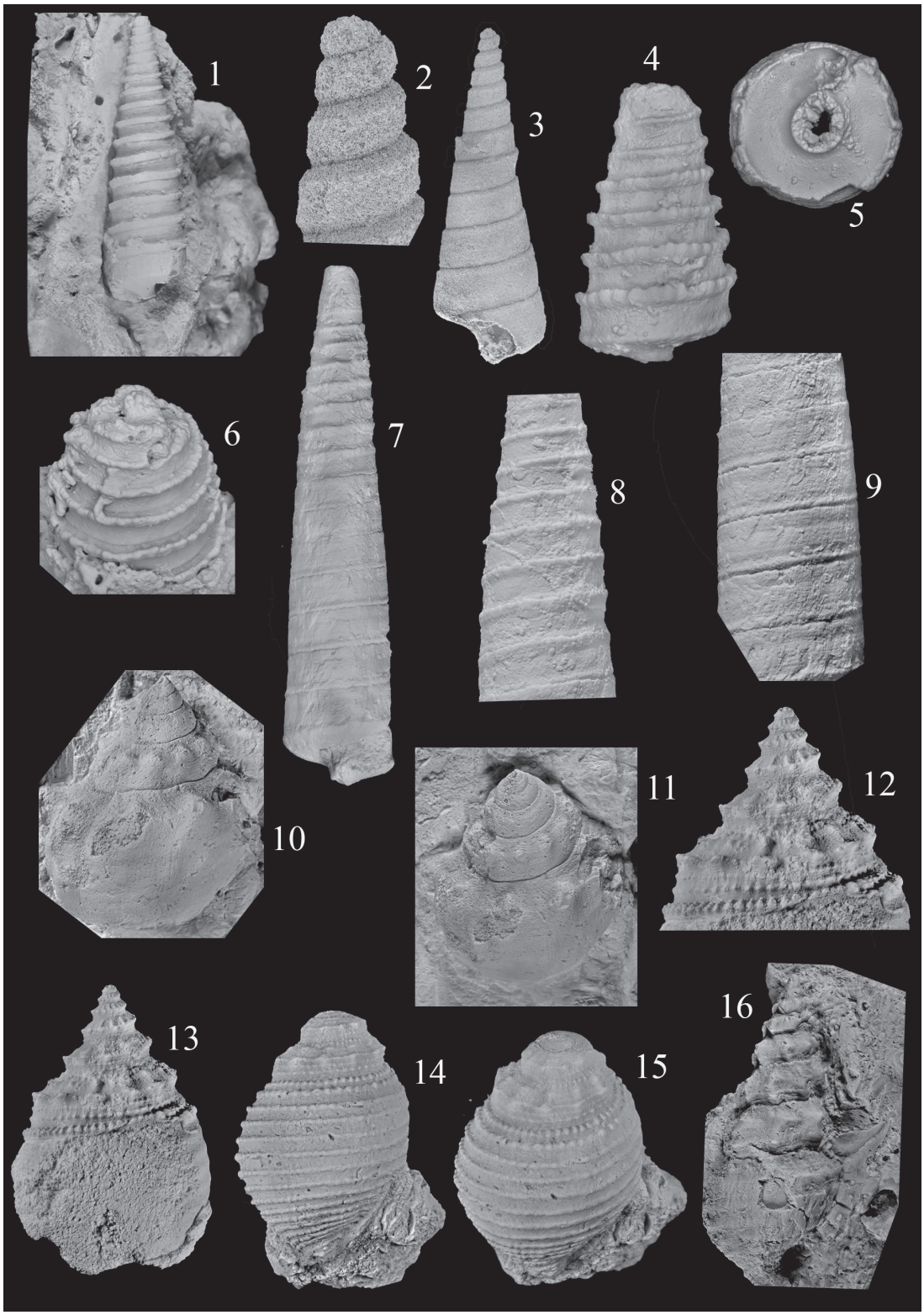

Plate 10. (1) *Neuburgensia angulata* sp. nov., holotype, SNSB-BSPG 2016 XXI 1849, collection Lang, lateral view, height 24 mm. **(2–3)** *Neuburgensia angulata* sp. nov., paratype, SNSB-BSPG 2016 XXI 1850, collection Lang, **(2)** earliest preserved whorls in lateral view, height 1 mm, **(3)** lateral view, height 6 mm. **(4)** *Neuburgensia angulata* sp. nov., paratype, SNSB-BSPG 2016 XXI 1851, collection Lang, lateral view, height 10 mm. **(5)** *Neuburgensia angulata* sp. nov., paratype, SNSB-BSPG 2016 XXI 1852, collection Schäfer¸basal view, width 6 mm. **(6)** *Neuburgensia angulata* sp. nov., paratype, SNSB-BSPG 2016 XXI 1853, collection Lang, oblique apical, width 6.5 mm. **(7–9)** *Neuburgensia rara* sp. nov., holotype, SNSB-BSPG 2016 XXI 1856, **(7)** lateral view, height 30 mm, **(8)** early whorls in lateral view, height ca. 7 mm, **(9)** middle whorls in lateral view, height 12 mm. **(10, 11)** *Purpuroidea lapierrea* (Buvignier, 1843), SNSB-BSPG 2016 XXI 1857, lateral and oblique views, height 30 mm. **(12, 13)** *Columbellaria corallina* (Quenstedt, 1852), SNSB-BSPG 2016 XXI 1859, **(12)** apex in lateral view, height 10 mm, **(13)** lateral view, height 19 mm. **(14, 15)** *Columbellaria corallina* (Quenstedt, 1852), SNSB 1860, lateral and slightly oblique lateral views, height 21 mm. **(16)** *Diarthema aspera* sp. nov., paratype, SNSB-BSPG 2016 XXI 1862, lateral view, height 44 mm.

Diagnosis. Spire whorls have a knobby angulation, axial ribs and a strong spiral cord between angulation and abapical suture; last whorl of adult specimens with two wing-like, broadened varices; wings semicircular, with 6–7 strong spiral cords forming node-like projections on outer edge wing; aperture with long vertical rostrum long.

Description. Shell with high, gradate spire and large, widened body whorl; largest specimen 45 mm high; shell slender consisting of numerous convex whorls; spire whorls angulated at mid-whorl face; suture distinct; oblique ramp demarcated by angulation; whorl face below angulation almost vertical; a weak spiral cord above angulation appears after several whorls; another spiral cord becomes visible above suture; ca. 7 strong axial ribs per whorl; axial ribs do not continue onto base in body whorl of fully grown specimens; intersections of angulation and axial ribs with strong nodes; weaker nodes at intersection abapical spiral cord; some axial ribs thickened varix-like; body-whorl of adults have strongly convex base; transition from whorl face to base evenly rounded; axial ribs disappear; former edge covered with small nodes; base with 4 strong spiral cords with fine nodes; two wing-like widened varices concave in apertural direction; outer lip of aperture widened into a semicircular wing; 6–7 strong spiral cords on the wing and several weak ones between strong cords; strong spiral cords form node-like projections on outer edge of the wing; uppermost strong spiral cord terminated in a spine pointing obliquely in apertural and adapical direction; long, vertically downward (abapical) pointing rostrum, covered with several weak spiral cords.

Remarks. Gründel et al. (2019, p. 138, as *Diarthema* sp. 1) reported a vertically upward directed shell-process attached on the penultimate for this species. This shell-process cannot be recognized in the present material. We assume that this is a silicified artifact that does not belong to the shell.

The similar *Diempterus*? *multicostatus* Gründel et al. 2022 has more numerous spiral cords of varying strength (but generally weaker than in the present species), the varices on the last whorl have 3 spine-like elongated tubercles. A wing is unknown for *Diempterus*? *multicostatus*. *Rostellaria benoisti* Guirand & Ogérien, 1865 (= *Diarthema benoisti* sensu Loriol in Loriol and Bourgeat 1886–1888) has numerous reinforced spiral cords on the wing, the wing is asymmetrical with a protruding abapical part. *Cyphosolenus tetracer* d'Orbigny sensu Loriol in Loriol and Bourgeat (1886–1888) has only 3 strong and numerous weaker spiral cords on the body whorl, the wing extends to the last spire whorl, the spire whorls lack the second strong spiral cord between angulation and abapical suture. *Pterocera thurmanni* sensu Thurmann and Étallon (1861–1864) as well as *Pterocera ponti* (Brongniart) sensu Loriol et al. (1872) and *Pterocera polypoda* Buvignier sensu Loriol in Loriol and Pellat (1874) have a similar wing, but a stouter shell with convex spire whorls, but lacks axial ribs and nodes on spire whorls.

Superfamily and family uncertain

Gen. indet. *schlosseri* (Loriol in Loriol and Bourgeat, 1886–1888)?

Plate 11: figs 5–9

?1886–1888 – *Cerithium schlosseri* P. de Loriol in Loriol and Bourgeat: 134, pl. 13, fig. 7.

Material. 4 specimens, SNSB-BSPG 2016 XXI 1871–1873, 1978.

Description. Largest specimen 36 mm high, apical whorls missing; shell slender; whorls significantly wider than high; first preserved whorl with subsutural bulge forming narrow ramp; bulge with numerous densely spaced axially elongated nodes; nodes change to larger, round, less numerous nodes on last preserved whorl; on last portion of last preserved whorl, only growth lines can be seen on bulge; there, growth lines approximately orthocline, without adapical sinus; whorl face between bulge and abapical suture with 2 somewhat stronger, nodular spiral cords and several spiral lirae; on last whorl of largest specimen, a spiral cord becomes particularly strong and knobby; transition from whorl face to weakly convex base formed by sharply projecting edge; base is entirely covered with spiral cords and lirae; base narrowly phaneromphalous; suture rises sharply shortly before the end of last preserved whorl (onset of a non-preserved wing-like apertural process?); aperture lacks folds.

Remarks. Between the bulge and the abapical suture, the two spiral cords vary from being strong to barely noticeable. In the latter case, spiral lirae are quite clear. When describing *Cerithium schlosseri*, Loriol (1886–1888, in Loriol and Bourgeat) only had the specimen at hand that was illustrated by him on pl. 13, fig. 7. It is a fragment with approximately 3 whorls, coming from the middle part of the shell. Therefore, statements about early or the final whorls of adult specimens are not possible. There are no noticeable differences to the present more completely preserved specimens. However, due to the incomplete type specimen, an identification remains tentative. *Procerithium* (*Cosmocerithium*) *dorvali* (Cossmann) sensu Reiner (1968) is more slender, the ramp is less pronounced, lacks the ontogenetic change of the sculpture (maybe comparable ontogenetic changes are not preserved). *Cerithium* (*Eustoma*) *pagoda* Zittel, 1873 has fewer subsutural nodes, the nodes are more rounded (not axially elongated), and ontogenetic changes of the ornament have not been reported.

The present specimens also resemble the Mesozoic genera *Diatrypesis* and *Cimolithium* but these genera lack the terminal extension of the outer lip. Also, some eustomatids are similar (e. g., *Silberlingiella*) which seem to have expanded outer lip (e. g., Hikuroa and Kaim 2007).

Gen. indet. *monilitesta* Zittel, 1873
Plate 11: figs 10, 11

1873 – *Cerithium monilitesta* Zit. – Zittel: 270, pl. 44, fig. 19.

Material. 1 specimen, SNSB-BSPG 2016 XXI 1874.

Description. Shell moderately slender; specimen 19 mm high; suture inconspicuous; whorl face with a directly subsutural row of nodes, lacking ramp; nodes slightly axially elongated; below, two weaker spiral cords covered with smaller, more numerous nodes; base flat; transition from base to whorl face at sharp edge that is partly exposed above abapical suture; details of base not visible; aperture damaged; approximately rectangular; no evidence for wing formation (corresponding shell area not preserved?); probably present vertical canal/rostrum is broken off.

Remarks. The sculpture is reminiscent of Gen. inc. *schlosseri* as described above. Both may represent the same, or at least to closely related, genera. *Turritella staszycii* Zeuschner, 1850 is stouter and has only 2 rows of nodes per whorl (one strong subsutural cord, one weaker above the abapical suture).

The present specimens also resemble the Mesozoic genera *Diatrypesis*, *Cimolithium* or *Metacerithium*.

Gen. indet. sp. indet
Plate 11, Figs 12–14

Material. 3 specimens, SNSB SNSB-BSPG 2016 XXI 1875–1877.

Description. Material moderately preserved, illustrated specimen 34 mm high; shell broadly trochoid with convex flanks; suture incised; whorls increase rapidly in height; ornament consists of strong, bulbous axial ribs, some of which are thickened varix-like; ribs approximately orthocline; ribs continue onto base but appear to weaken; early whorls with ca. 8 axial ribs per whorl, later whorls with ca. 5 ribs per whorl; distance between axial ribs increases during ontogeny (distance between two ribs eventually several times the width of the ribs) and ribs become stronger; ribs thickened, node-like near abapical suture; whorl face with barely visible spiral cords, approximately 5 spiral cords vaguely visible in illustrated specimen; they cross axial ribs without forming nodes; transition from whorl face to barely convex base at rounded edge; aperture rounded; in adult specimens, outer lip thickened and bulgy.

Remarks. Similar forms occur within the Brachytrematidae, but they usually have a clear abapical canal (Gründel et al. 2020b). *Turbo valfinensis* Étallon sensu Loriol in Loriol and Bourgeat (1886–1888) (pl. 20: fig. 3, non fig. 2) has a wider shell, the height of the whorls increases less rapidly and the last whorl has more nodes. *Brachytrema* sp. sensu Hägele (1997) is smaller and more slender; a spiral ornament was not reported for this species. *Purpurina costellata* sensu Piette (1856) is significantly smaller, more slender and has an abapical canal. This species also resembles species of Purpuroideidae but members of this family usually have an angulated whorl face.

Subclass Heterobranchia Burmeister, 1837
Superfamily Nerineoidea Zittel, 1873
Family unclear

Genus *Cossmannea* Pčelintsev, 1927

Type species. *Nerinea desvoidyi* d'Orbigny, 1850; Oxfordian; France.

Cossmannea desvoidyi (d'Orbigny, 1850)
pl. 1: figs 1–3 in Gründel et al. (2022)

2022 – *Cossmannea desvoidyi* (d'Orbigny, 1851) – Gründel, Keupp, Lang and Nützel: 181, pl. 1, figs 1–3 (here more chresonymy and synonymy).

Material. 2 fragments, SNSB-BSPG 2016 XXI 1878–1879, one large specimen 18 cm high, 5.5 cm wide: SNSB-BSPG 2016 XXI 1.

Remarks. This species has a very pronounced abapical siphonal canal.

Genus *Aptyxiella* P. Fischer, 1885

Type species. *Nerinea sexcostata* d'Orbigny, 1850; Oxfordian-Kimmeridgian; France.

Aptyxiella tricincta (Münster, 1844) sensu Quenstedt (1881–1884), comb. nov.
Plate 11: figs 15, 16

2022 – *Bactroptyxis*? *tricincta* (Münster) sensu Quenstedt (1881–1884) – Gründel, Keupp, Lang and Nützel: 199, pl. 13, figs 11–16 (here more chresonymy and synonymy).

Material. 5 specimens, SNSB-BSPG 2016 XXI 1880–1884 and 4 questionable specimens, SNSB-BSPG 2016 XXI 1885–1888, from Saal.

Remarks. The longitudinal section of a specimen shows that there are no plates or folds inside the aperture. The species is therefore assigned to the genus *Aptyxiella*.

Aptyxiella planata (Quenstedt, 1858)
Plate 11: figs 17, 18

? 1979 – *Pseudonerinea clytia* (d'Orbigny, 1850) – Wieczorek: 319, pl. 6, figs 1–3.

2022 – *Aptyxiella planata* (Quenstedt, 1858) – Gründel, Keupp, Lang and Nützel: 183; pl. 1, figs 4–6 (here more chresonymy and synonymy).

Material. 2 specimens, SNSB-BSPG 2016 XXI 1889–1890.

Remarks. This species has a palatal plait.

Genus *Aphanoptyxis* Cossmann, 1896

Type species. *Cerithium defrancei* Eudes-Deslongchamps, 1843; Bathonian; France.

Aphanoptyxis sinerugae sp. nov.

https://zoobank.org/72E1AFE9-9F22-47BB-B3A1-27C99EB03230
Plate 12: figs 1–3

Etymology. Latin sine rugae – without folds, because of the lack of plaits or folds within the whorls.

Holotype. SNSB-BSPG SNSB-BSPG 2016 XXI 1891.

Paratypes. Saal, 2 specimens, SNSB-BSPG 2016 XXI 1892–1893.

Type locality and stratum. Upper Jurassic (Kimmeridgian) reefal limestones from the locality Saal near Kelheim, Lower Bavaria (Gründel et al. 2015, 2022).

Diagnosis. Shell moderately slender, cyrtoconoid, apical angle decreases during ontogeny; whorl face strongly concave, without ornament; suture situated on ridge formed by two adjacent whorls; a siphonal canal appears to have formed; whorls without plaits or folds.

Description. Shell slender, cyrtoconoid, apical angle decreases during ontogeny; holotype 98 mm high; suture situated on ridge formed by two adjacent whorls; whorl face strongly concave, without ornament except of occasionally weakly reinforced growth lines; growth lines on whorl face orthocline and almost straight, bent strongly backwards below adapical suture; base slightly convex, smooth with weakly prosocyrt growth lines, phaneromphalous; transition from whorl face to base at sharp edge forming almost right angle; aperture rhomboid mouth, seemingly with siphonal canal, without plaits or folds.

Remarks. *Nerinea turbatrix* Loriol in Loriol and Bourgeat (1886–1888) has a more slender shell, its shape is not cyrtoconoid and its whorls are higher. *Cossmannea* (*Eunerinea*) *ursicina* (Thurmann) sensu Fischer and Weber (1997) has a distinct spiral sculpture. *Umbonata dilatata* (d'Orbigny) sensu Fischer and Weber (1997) is more slender, the whorls are lower and 3 plaits are formed in the aperture. *Nerinea arduennensis* Buvignier, 1852 is more slender, the whorls are lower, the shell shape is not cyrtoconoid, and several plaits are present. *Cryptoplocus engeli* Geiger, 1901 has lower and less concave whorls and a strong columellar plait. *Nerinea castor* d'Orbigny sensu Maire (1926) has no cyrtoconoid shell shape, and plaits have not been reported for it (according to d'Orbigny 1851 and Fischer and Weber 1997, several plaits are formed).

Family Pseudonerineidae Pčelintsev, 1965

Genus *Pseudonerinea* Loriol in Loriol & Koby, 1890

Type species. *Pseudonerinea blauensis* Loriol in Loriol and Koby 1890; Oxfordian (Rauracian); Switzerland.

Pseudonerinea? *pseudomelaniformis* Gründel, Keupp, Lang & Nützel, 2022

Plate 12: figs 4–6

1965 – *Pseudonerinea clio* (d'Orbigny) – Cox: 172, pl. 30, figs 5–6.
?1997 – *Ceritella* (*Fibula*) *cottaldina* (d'Orb.) – Fischer and Weber: 31, pl. 4, fig. 10
2019 – *Pseudomelania*? sp. 2 – Gründel, Keupp and Lang: 100, pl. 1, figs 7–9.
*2022 – *Pseudonerinea*? *pseudomelaniformis* n. sp. – Gründel, Keupp, Lang and Nützel 2022: 183; pl. 2, figs 1–7.

Material. 27 specimens, illustrated specimens SNSB-BSPG 2016 XXI 1894–1895.

Description. Shell very slender; a specimen is 32 mm high; whorls high; whorl face straight; suture slightly impressed; transition from whorl face to base evenly rounded; whorls smooth, at least on later whorls; aperture damaged, high oval with adapical outlet and an oblique siphonal abapical canal; inner columellar lip widened and detached.

Remarks. Many species with a similar shell shape have been described, particularly in the genus *Pseudomelania*. Without knowledge of the aperture (it is unknown or insufficiently known in most cases), a comparison of these species is only possible to a limited extent.

Nudivagus? sp. 2 sensu Gründel et al. (2019) has a wider shell with lower whorls, a spiral sculpture on the whorl face, and lacks a widened and detached columellar inner lip. *Ceritella* (*Fibula*) *cottaldina* (d'Orbigny) as depicted by Fischer and Weber (1997) is larger according to its holotype, but shows no other significant differences. The shape of the aperture is unclear: According to d'Orbigny (1851), it is broadly rounded abapically, however according to Fischer and Weber (1997), it shows the onset of a (not preserved?) channel. If *P. cottaldina* has an abapical canal, then it is probably identical to *P. pseudomelaniformis*.

Family Nerineidae Zittel, 1873

Genus *Nerinea* Deshayes, 1827

(Synonym: *Phaneroptyxis* Cossmann, 1896)

Type species. *Nerinea mosae* Deshayes, 1827; Oxfordian; France.

Remarks. Regarding the synonymy of *Nerinea* and *Phaneroptyxis*, see Kollmann (2014, p. 360).

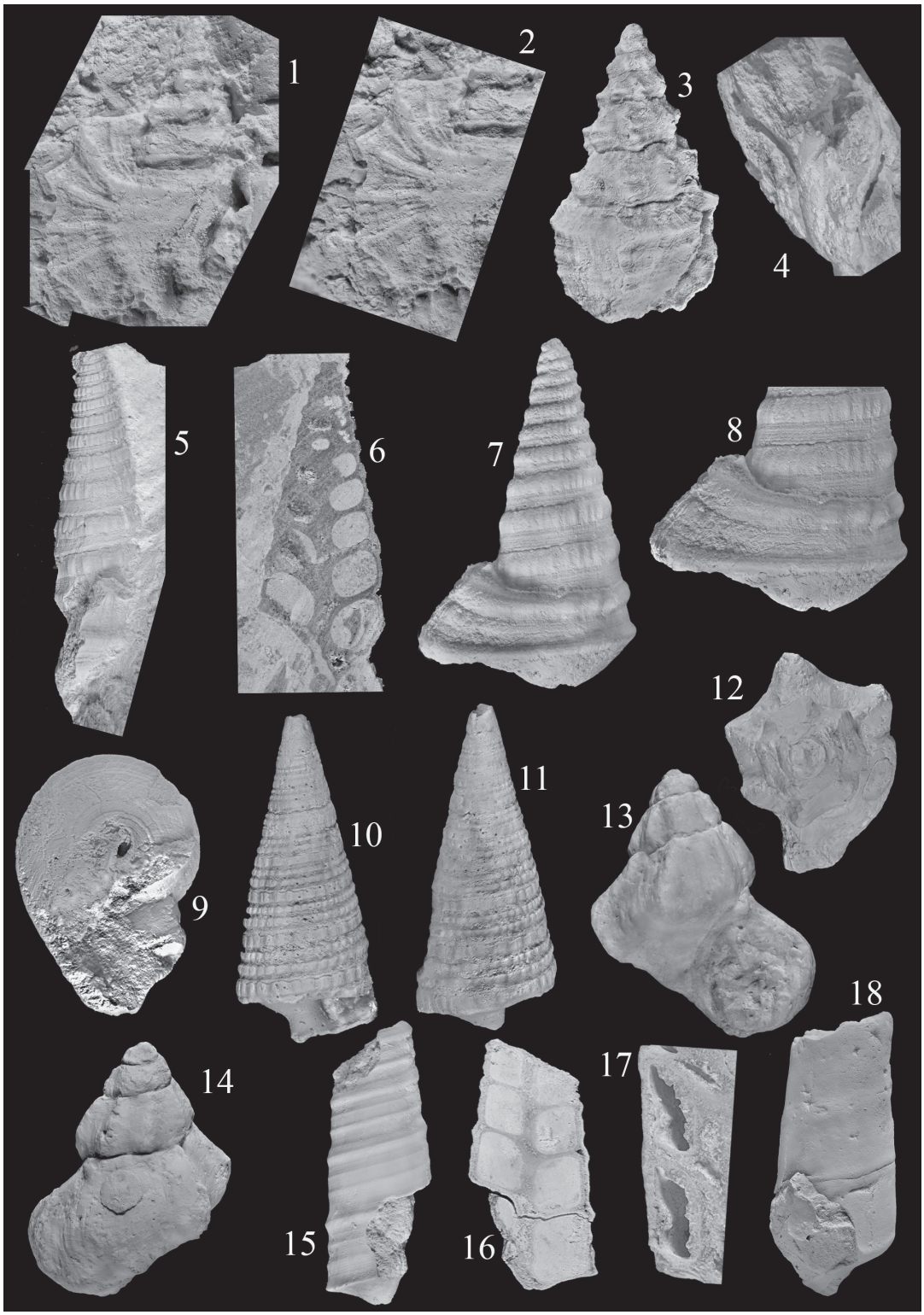

Plate 11. (1, 2) *Diarthema aspera* sp. nov., holotype, SNSB-BSPG 2016 XXI 1863, **(1)** lateral view, height 37 mm, **(2)** wing, height 16 mm. **(3)** *Diarthema aspera* sp. nov., paratype, SNSB-BSPG 2016 XXI 1864, lateral view, height 28 mm. **(4)** *Diarthema aspera* sp. nov., paratype, SNSB-BSPG 2016 XXI 1865, aperture, height 35 mm. **(5, 6)** Aporrhaidae gen. inc. *schlosseri* (Loriol in Loriol and Bourgeat 1886–1888), SNSB-BSPG 2016 XXI 1871, **(5)** lateral view, height 38 mm, **(6)** columellar section, height 32 mm. **(7–9)** Gen. indet. *schlosseri* (Loriol in Loriol and Bourgeat 1886–1888), SNSB-BSPG 2016 XXI 1872, **(7)** lateral view, height 35 mm, **(8)** last two whorls, height 19 mm, **(9)** basal view, width 16 mm (without wing), 23 mm (including wing). **(10, 11)** Gen. indet. *monilitesta* Zittel, 1873, SNSB-BSPG 2016 XXI 1874, lateral views, height 19 mm. **(12–14)** Gen. indet. sp. indet, SNSB-BSPG 2016 XXI 1875, apertural, apical and abapertural views, width of specimen 26 mm. **(15, 16)** *Aptyxiella tricincta* (Münster in Goldfuss, 1844), SNSB-BSPG 2016 XXI 1880, lateral view and columellar section, height 32 mm. **(17, 18)** *Aptyxiella planata* (Quenstedt, 1858), SNSB-BSPG 2016 XXI 1889, **(17)** longitudinal section, height 30 mm, **(18)** lateral view, height 48 mm.

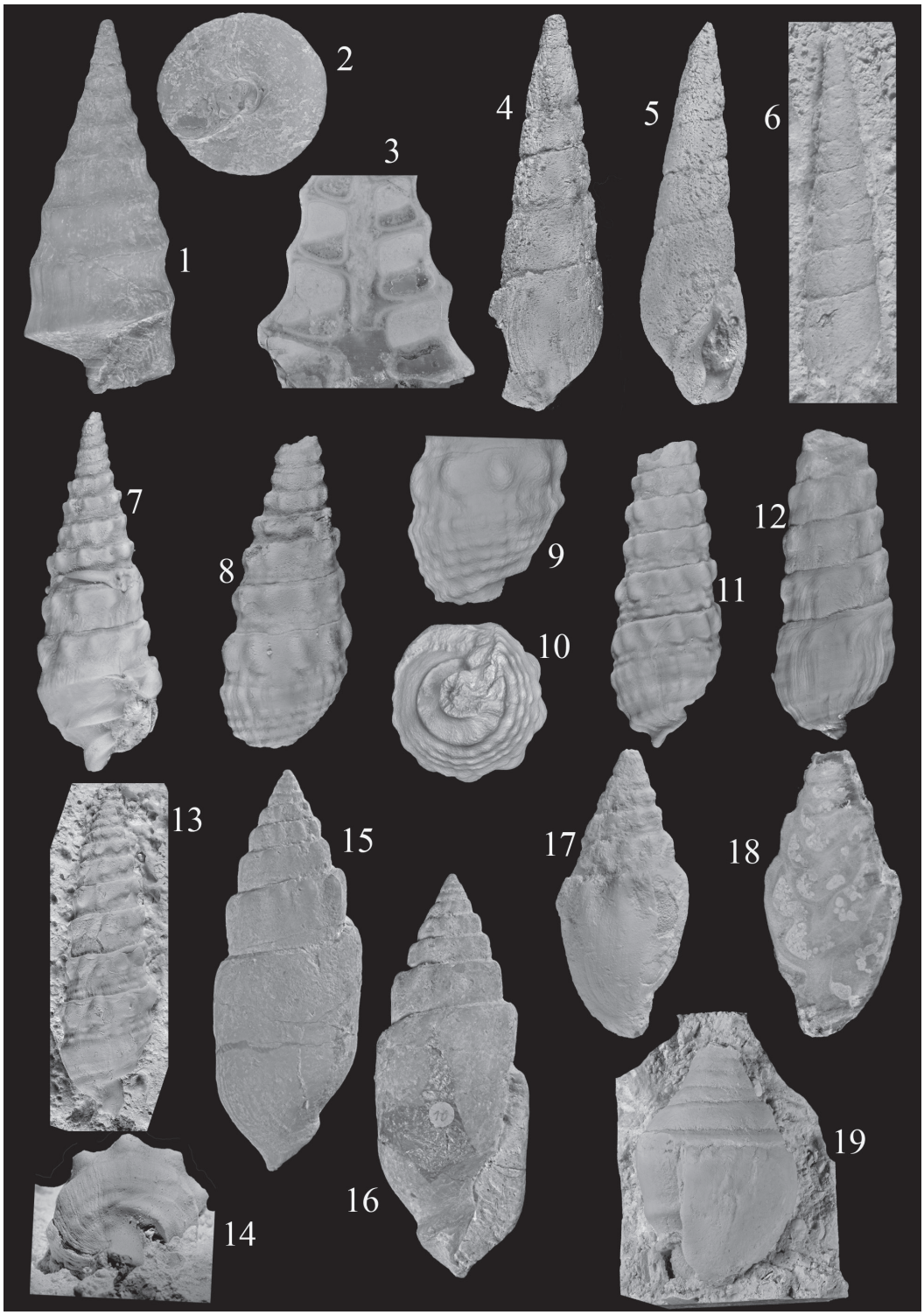

Plate 12. (1, 2) *Aphanoptyxis sinerugae* sp. nov., holotype, SNSB-BSPG 2016 XXI 1891, **(1)** lateral view, height 98 mm, **(2)** basal view, width 40 mm. **(3)** *Aphanoptyxis sinerugae* sp. nov., paratype, SNSB-BSPG 2016 XXI 1892, columellar section, height 32 mm. **(4–5)** *Pseudonerinea*? *pseudomelaniformis* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1894, abapertural and apertural lateral views, height 32 mm. **(6)** *Pseudonerinea*? *pseudomelaniformis* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1895, lateral view, height 30 mm. **(7)** *Nerinea donosa* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1896, lateral view, height 18 mm. **(8–10)** *Nerinea donosa* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1897, **(8, 10)** lateral and basal view **(9)** detail of last whorl in lateral view, height of shell 19.5 mm, width 8 mm. **(11)** *Nerinea donosa* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1898, lateral view, height 30 mm. **(12)** *Nerinea donosa* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1899, lateral view, height 26 mm. **(13, 14)** *Nerinea donosa* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1900, lateral and basal view, height 37 mm, width 11 mm. **(15, 16)** *Nerinea moreana* (d'Orbigny, 1851), SNSB-BSPG 2016 XXI 1901, abaperurtal and apertural view, height 85 mm. **(17, 18)** *Nerinea moreana* (d'Orbigny, 1851)?, SNSB-BSPG 2016 XXI 1902, lateral view and columellar section, height 27 mm. **(19)** *Endoplocus inflatus* Gründel, Keupp, Lang & Nützel, 2022, SNSB-BSPG 2016 XXI 1903, lateral view, height 34 mm.

Nerinea donosa Gründel, Keupp, Lang & Nützel, 2022

Plate 12: figs 7–13

2017 – Nerineoidea Nr. 7 – Gründel: 33, pl. 14, fig. D.
2022 – *Nerinea donosa* n. sp. – Gründel, Keupp, Lang and Nützel: 187, pl. 5, figs 1–5.

Material. 45 specimens from Saal, illustrated specimens SNSB-BSPG 2016 XXI 1896–1900.

Description. The present new material allows a more detailed description of *Nerinea donosa*: Shell slender (especially early ontogenetic part) with numerous whorls; specimen 36 mm high; whorls about twice as wide as high; subsutural bulge with nodes formed very early in ontogeny; in later whorls, bulge is largely changed to a row of large nodes (8–10 per whorl); nodes extend to about half whorl height, forming narrow ramp; ramp emphasizes suture; whorl face concave between row of nodes and abapical suture are, with 1–2 slightly nodular spiral cords; strong bordering abapical spiral cord covered by the following whorl or slightly exposed above suture, covered with small nodes (not always noticeable); growth lines weakly prosocyrt, strongly backwards below adapical suture; transition from whorl face to base slightly angular at bordering abapical spiral cord; base strongly convex, conical; base with several weakly nodular spiral cords (only visible in well-preserved specimens); aperture (see Gründel et al. 2022) narrow with siphonal canal, with two columellar plaits, 1–2 parietal plaits and in some specimens one palatal plait; if two columellar plaits are present, the adapical one is weaker than the abapical one.

Remarks. *Nerinea plassenensis* Peters, 1855 is more slender, the subsutural nodes are stronger, it has columellar and parietal plates (Peters 1855: pl. 3: fig. 12); its base has not been described in detail. *Nerinea orbignyana* Zeuschner sensu Peters (1855) has a series of distinct small cusps in suprasutural position, the bordering spiral cord is very strong, and it apparently has two further spiral cords on the base which are devoid of nodes.

Nerinea moreana (d'Orbigny, 1851)

Plate 12: figs 15–16, 17–18?

1851 – *Nerinea moreana* n. sp. – d'Orbigny: 100, pl. 257, figs 1–2.
?1851 – *Nerinea clymene* n. sp. – d'Orbigny: 102, pl. 258, figs 1–3.
1855 – *Nerinea moreana* d'Orbigny: 351, pl. 3, figs 5–7.
1881–1884 – *Nerinea moreana* d'Orbigny – Quenstedt: 546, pl. 206, fig. 47.
1882 – *Itieria moreana* d'Orbigny – Schlosser: 82, pl. 12, figs 2–3.
1893 – *Itieria moreana* d'Orbigny), Zittel – Loriol in Loriol and Lambert: 23, pl. 2, fig. 5.
1896 – *Phaneroptyxis moreana* (d'Orb.) – Cossmann: 22, pl. 2, fig. 1.
1898 – *Phaneroptyxis moreana* d'Orbigny – Cossmann: 14, pl. 2, figs 1–2.
1997 – *Phaneroptyxis moreana* (d'Orbigny, 1851) – Fischer and Weber 39, pl. 13, figs 3–4, ?fig. 5.

Material. Saal: 202 specimens; Saal, illustrated specimens SNSB-BSPG 2016 XXI 1901–1902; 3 specimens from location 1, level 4 ("Fundstelle 1, Sohle 4").

Remarks. This large, conspicuous species (the illustrated specimen is 85 mm high) is very common in the Sylla-collection, but is missing from the previously known material from Saal. According to d'Orbigny (1851: pl. 257: fig. 1), the row of nodes lies well below the adapical suture. However, the holotype of this species as reported by Fischer and Weber (1997: p. 40, pl. 13: fig. 3, lower Kimmeridgian, France) shows that the nodes are in a subsutural position, which can also be observed in the present material. Fischer and Weber (1997) gave a range from the middle Oxfordian to Portlandian for this species.

Nerinea moreana d'Orbigny sensu Buvignier (1852) (on p. 35 as *Nerinea tornatella* Buvignier, pl. 24: figs 10–12 - the specimen in fig. 13 probably does not belong to this species) is more slender and has fewer nodes per whorl. The shell shape possibly falls within the range of variation of the species *N. moreana*. *Cerithium apicatum* Eichwald, 1861 is more slender, the spire is significantly higher in relation to the height of the last whorl, the axial ribs run from suture to suture and the entire shell is covered with numerous weak spiral threads. *Nerinea moreana* d'Orbigny sensu Gemmellaro (1870) is partly broader (pl. 3: fig. 6), partly more slender (pl. 4: fig. 6) than the typical form from Central and Western Europe (a variable species or several different species).

Nerinea moreana was assigned to *Phaneroptyxis* by Cossmann (1896, 1898) and Fischer and Weber (1997) but Kollmann (2014) pointed out that *Phaneroptyxis* is a junior synonym of *Nerinea*.

Genus *Endoplocus* Cox, 1954

Type species. *Actaeon staszycii* Zeuschner, 1849; Tithonian; Poland.

Endoplocus staszycii (Zeuschner, 1849)?

Plate 13: figs 1, 2

?1850 – *Actaeon staszycii* n. sp. – Zeuschner: 130, pl. 17, figs 16–19.
1855 – *Nerinea staszycii* Zeuschner – Peters: 350, Tas. 2, figs 6–9.
1870 – *Nerinea staszycii* Zeuschner – Gemmellaro: 16, pl. 3, figs 8–10.
1998 – *Endoplocus staszycii* (Zeuschner, 1849) – Wieczorek: 319, pl. 2, figs 4–6 (here more chresonymy and synonymy).

Material. 4 specimens, SNSB-BSPG 2016 XXI 1905–1908.

Description. Shell stout with egg-shaped outline, consisting of few whorls; largest specimen 27 mm high; body whorl higher than the spire; whorl face weakly convex; whorls relatively high, smooth; sutures marked by a narrow ramp; transition from whorl face to base evenly round-

ed; base strongly convex, smooth; aperture not preserved; 2 (3?) columellar and palatal plaites as well as a parietal plait visible in longitudinal section.

Remarks. According to Peters (1855), *Nerinea staszycii* Zeuschner, 1850 is a very variable species. The specimens illustrated by Peters (1855, pl. 2: figs 6–9) correspond to the present material assigned to this species. *Actaeon staszycii* Zeuschner, 1850 is more slender, the spire is higher and it has more whorls. *Itieria austriaca* Zittel, 1873 has a subsutural row of nodes. *Nerinea staszycii* Zeuschner sensu Gemmellaro (1870) has a lower last whorl in relation to the spire height and the shell is more slender. *Phaneroptyxis simmenensis* Oost-er sensu Cossmann (1898) is more slender and its body whorl is more cylindrical.

Endoplocus acutus Gründel, Keupp, Lang & Nützel, 2022

pl. 7: figs 1–7 in Gründel et al. (2022)

2022 – *Endoplocus acutus* n. sp. – Gründel, Keupp, Lang and Nützel: 189, pl. 7, figs 1–7.

Material. All from Saal, 12 specimens (typical form), 6 specimens (variant form), 3 questionable specimens.

Endoplocus inflatus Gründel, Keupp, Lang & Nützel, 2022

Plate 12: fig. 19

2022 – *Endoplocus inflatus* n. sp. – Gründel, Keupp, Lang and Nützel: 190, pl. 8, figs 1–4.

Material. 2 specimens, SNSB-BSPG 2016 XXI 1903–1904.

Remarks. The present specimens agree with the morphology of *Endoplocus inflatus* Gründel et al., 2022. However, they are significantly larger (height 34 mm and 54 mm). At least one columellar and one parietal fold are present.

Endoplocus sp. 1

Plate 13: figs 3, 4

Material. 3 specimens, SNSB-BSPG 2016 XXI 1909–1911.

Description. Shell broadly trochospiral with strongly convex sides; illustrated specimen 41 mm high; suture somewhat impressed; last whorl large, inflated; transition from whorl face to strongly convex base evenly rounded; whorls smooth; aperture high and narrow; at least one columellar, parietal and palatal (?) plate present.

Remarks. The shell of *Endoplocus inflatus* Gründel et al. 2022 is more slender and not as rounded in lateral view. The spire is much more slender and higher. *Itieria obtusiceps* Zittel sensu Stefano (1884) has a more broadly oval outline in lateral view.

Endoplocus sp. 2

Plate 13: figs 5–8

Material. Saal: 3 specimens, SNSB-BSPG 2016 XXI 1912–1914.

Description. Shell highly trochoid; illustrated specimen 74 mm high; spire whorls significantly wider than high; sutures impressed; last whorl high; shell sides convex with evenly rounded transition to convex base; no ornament visible; aperture (always damaged) elongated, narrow, actute adapically; at least one columellar, parietal and palatal plait present.

Remarks. The available material is too sparse and poorly preserved for a sufficient description. The relationships to *Endoplocus inflatus* remain unclear. The latter may have more and lower spire whorls.

Family Ptygmatididae Pčelintsev, 1965
Subfamily Ptygmatidinae Pčelintsev, 1965

Genus *Ptygmatis* Sharpe, 1850

Type species. *Nerinea bruntrutana* Thurmann, 1832; Oxfordian; Switzerland.

Ptygmatis? *tornata* (Quenstedt, 1852)

pl. 10: figs 1–12 in Gründel et al. (2022)

2022 – *Ptygmatis tornata* (Quenstedt, 1852) – Gründel, Keupp, Lang and Nützel: 192, pl. 10, figs 1–12 (here more chresonymy and synonymy).

Material. *Ptygmatis tornata* sensu stricto (morphotype 1): Saal: 8 specimens; Saal, locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2"): 17 specimens. *Ptygmatis tornata* (morphotype 1): Saal: 8 specimens. 2 questionable specimens.

Ptygmatis nodosa (Voltz, 1836)

pl. 11: figs 1–15 in Gründel et al. (2022)

1852 – *Nerinea nodosa* Voltz – Buvignier: 34, pl. 4, fig. 6.
2022 – *Ptygmatis nodosa* (Voltz, 1836) – Gründel, Keupp, Lang and Nützel: 194, pl. 11, figs 1–15 (here more chresonymy and synonymy).

Material. 54 specimens, Saal: 51 specimens, locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2"): 3 specimens.

Ptygmatis mandelslohi (Bronn, 1836)

pl. 9: figs 1–5 in Gründel et al. (2022)

2022 – *Ptygmatis mandelslohi* (Bronn, 1836) – Gründel, Keupp, Lang and Nützel: 191; pl. 9, figs 1–5 (here more chresonymy and synonymy).

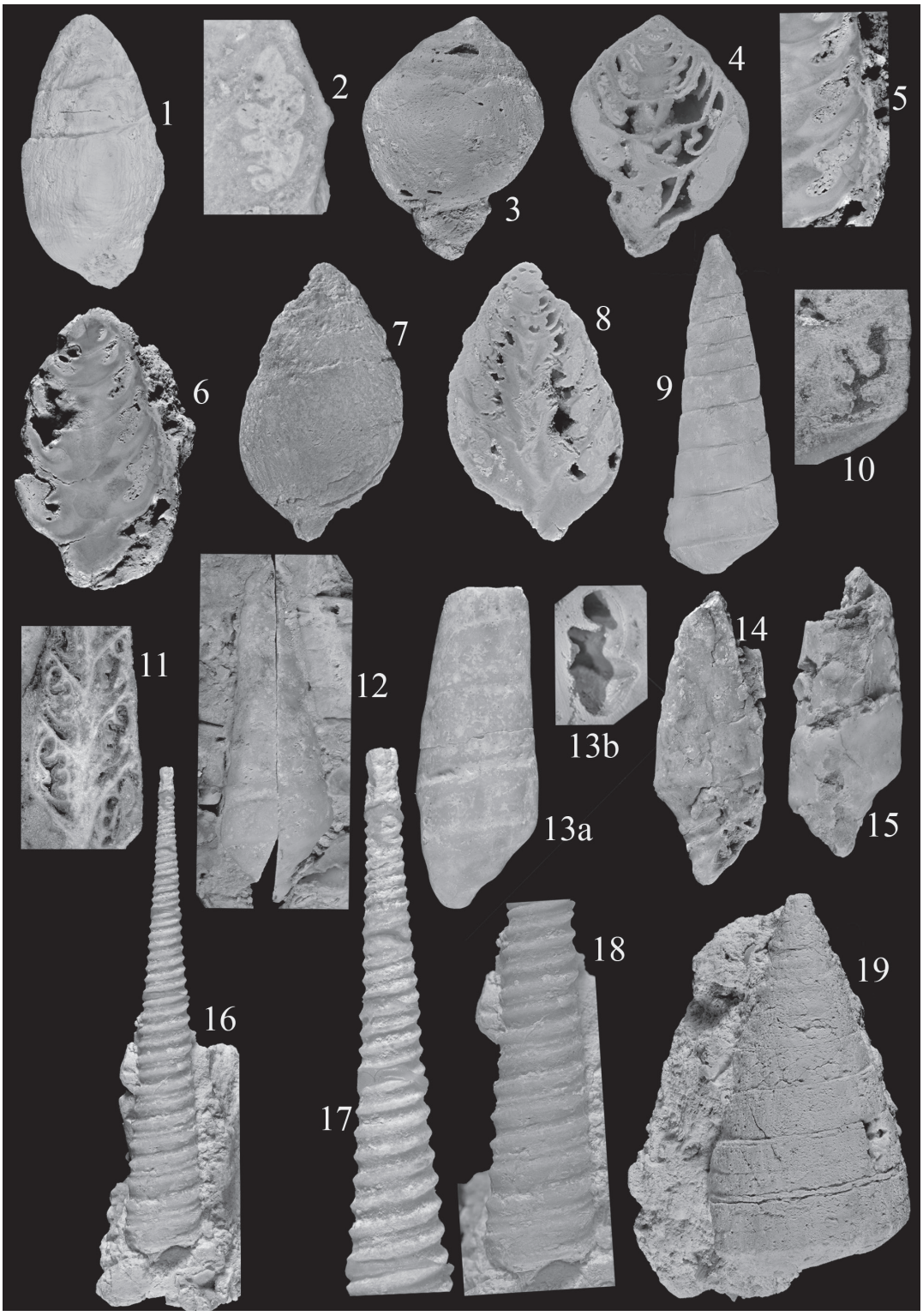

Plate 13. (1) *Endoplocus staszycii* (Zeuschner, 1849)?, SNSB-BSPG 2016 XXI 1905, lateral view, height 27 mm. **(2)** *Endoplocus staszycii* (Zeuschner, 1849)?, SNSB-BSPG 2016 XXI 1906, tranverse section of whorl showing plaits, height 9 mm. **(3, 4)** *Endoplocus* sp. 1, SNSB, SNSB-BSPG 2016 XXI 1909, lateral view and columellar section, height 41 mm. **(5, 6)** *Endoplocus* sp. 2, SNSB-BSPG 2016 XXI 1912, **(5)** whorls in transverse section, height 45 mm, **(6)** columellar section, height 74 mm. **(7, 8)** *Endoplocus* sp. 2, SNSB-BSPG 2016 XXI 1913, lateral view and columellar section, height 74 mm. **(9)** *Ptygmatis bruntrutana* (Thurmann, 1832), SNSB-BSPG 2016 XXI 1915, lateral view, height 11 mm. **(10)** *Ptygmatis bruntrutana* (Thurmann, 1832), SNSB-BSPG 2016 XXI 1916, whorl in transverse section, height 11 mm. **(11, 12)** *Ptygmatis clio* (d'Orbigny, 1852), SNSB-BSPG 2016 XXI 1917, **(11)** detail of columellar section, height 36 mm, **(12)** lateral view, height 69 mm. **(13)** *Ptygmatis clio* (d'Orbigny, 1852), SNSB XXI 1918, 13a) lateral view, height 60 mm, **(13b)** whorl in transverse section, height 11 mm. **(14, 15)** *Ptygmatis clio* (d'Orbigny, 1852), SNSB XXI 1919, lateral views, height 45 mm. **(16–18)** *Bactroptyxis*? *subcochlearis* (Münster in Goldfuss, 1844), SNSB XXI 1921, **(16)** lateral view, height 69 mm, **(17)** lateral view of early whorls, height 32 mm, **(18)** lateral view of late whorls, height 36 mm. **(19)** *Cryptoplocus subpyramidalis* (Münster in Goldfuss, 1844), SNSB-BSPG 2016 XXI 1922, lateral view, height 142 mm.

Material. 9 specimens (6 specimens from Saal, 3 specimens Saal, locality 1, level 4 ("Sohle 4, Fundstelle 1").

Remarks. The weak adapical spiral groove described by Gründel et al. (2022) is not recognizable in the present material (due to preservation?). Gründel et al. (2022) emphasized the difficulties in distinguishing *P. mandelslohi* from similar species. The distinction between the species *Ptygmatis mandelslohi* and *P. bruntrutana* is problematic. Various authors (e. g., Fischer and Weber 1997) considered both to be conspecific. In our opinion, *P. mandelslohi* is characterized by a moderately wide shell, the apical angle decreases during ontogeny (resulting in cyrtoconoid shell shape), it usually has a straight to slightly concave whorl face, relatively low whorls and a sharp edge between flank and base. *P. bruntrutana*, on the other hand, has a more slender shell (with the same plate pattern), whorls are evenly increasing in width over the entire shell (not cyrtoconoid), whorls are generally higher, the whorl face is straight to slightly convex, the transition between whorl face and base lacks a sharp edge. However, there are specimens in the present material that cannot be clearly assigned to one of the two species (real differences or due to preservation?).

Ptygmatis bruntrutana (Thurmann, 1832)

Plate 13: figs 9, 10

non 1844 – *Nerinea bruntrutana* Thurmann – Goldfuss: 40, pl. 175, fig. 5.
1858 – *Nerinea mandelslohi* Bronn – Quenstedt: 767, pl. 94,.figs 14?, 15.
1861–1864 – *Nerinea bruntrutana* Th. – Thurmann and Étallon: 94, pl. 7, fig. 39.
?1869 – *Nerinea bruntrutana* Thurmann, 1830 – Ooster and Fischer-Ooster: 7, pl. 2; Fig: 12–16.
part. 1881–1884 – *Nerinea bruntrutana* Thurmann – Quenstedt: 533ff., pl. 206, figs 1–5, 13–14; non figs 18–20, 23.
1882 – *Ptygmatis bruntrutana* Thurmann – Schlosser: 79, pl. 11, figs 11–13.
Part 1889 – *Ptygmatis bruntrutana* Thurmann – Loriol in Loriol and Koby: 27, pl. 3, figs 4–5, 7?, 9–12.
1893 – *Ptygmatis bruntrutana* (Thurmann) Zittel – Loriol in Loriol and Lambert: 25, pl. 2, figs 6–8.
1898 – *Ptygmatis bruntrutana* Thurmann – Cossmann: 74, pl. 6, figs 13–17, 20–21?
1979 – *Ptygmatis bruntrutana* (Thurmann, 1832) – Wieczorek: 324, figs 10, 14, 19–21; pl. 8, figs 2–5, 7
1997 – *Nerinea bruntrutana* Thurmann – Hägele: 34, figures on p. 34 and 35
1997 – *Nerinea bruntrutana* (Thurmann, 1832) – Hägele: 128, pl. 12, fig. 5 [as *Cossmannea* (*Eunerinea*) *subscalaris* (Münster, 1844)] and 128 upper left.
1997 – *Ptygmatis bruntrutana* (Bronn ex Thurmann, 1850) – Fischer and Weber: 42, pl. 10, fig. 6.

Material. 6 specimens from Saal, illustrated specimens SNSB-BSPG 2016 XXI 1915–1916.

Ptygmatis clio (d'Orbigny, 1852)

Plate 13: figs 11–15

2022 – *Ptygmatis clio* (d'Orbigny, 1852) – Gründel, Keupp, Lang and Nützel: 196; pl. 12, figs 1–3 (here more chresonymy and synonymy).

Material. 29 specimens from Saal, illustrated specimens SNSB-BSPG 2016 XXI 1917–1919.

Ptygmatis? *ursicina* (Thurmann in Thurmann and Étallon 1861)

pl. 12: figs 5–7 in Gründel et al. (2022)

2022 – *Ptygmatis*? *ursicina* (Thurmann in Thurmann and Étallon 1861) – Gründel, Keupp, Lang and Nützel: 196; pl. 12, figs 5–7.

Material. A fragment of 4 whorls, SNSB-BSPG 2016 XXI 1920.

Genus *Bactroptyxis* Cossmann, 1896

Type species. *Nerinea implicata* d'Orbigny, 1851; Bathonian; France.

Bactroptyxis? *subcochlearis* (Münster in Goldfuss, 1844)

Plate 13: figs 16–18

2022 – *Bactroptyxis*? *subcochlearis* (Münster in Goldfuss, 1844) – Gründel, Keupp, Lang and Nützel: 199, pl. 13, figs 6–8 (here more chresonymy and synonymy).

Material. 6 specimens and fragments, illustrated specimen SNSB-BSPG 2016 XXI 1921.

Remarks. The illustrated specimen is 69 mm high. What was suspected in 2022 can now be proven: The early whorls have only 2 strong spiral cords, one directly subsutural, the other well above the abapical suture. Only gradually a weaker spiral cord is formed between the primary spiral cords. The secondary spiral cord remains significantly weaker than the other two throughout ontogeny.

Aptyxis kehlheimensis Schlosser, 1882 (pl. 11: figs 3, 5–7; non fig. 4 in Schlosser) has weaker spiral cords and lacks a secondary third spiral cord.

Subfamily Cryptoplocinae Pčelintsev in Pčelintsev and Korobkov, 1960

Genus *Cryptoplocus* Pictet & Campiche, 1861

Type species. *Nerinea depressa* Voltz, 1836; Kimmeridgian?

Cryptoplocus subpyramidalis (Münster, 1844) in Goldfuss

Plate 13: fig. 19

1855 – *Nerinea pyramidalis* Münster – Peters: 361, pl. 4, figs 1–3.
1882 – *Cryptoplocus subpyramidalis* – Schlosser: 86, pl. 12, fig. 10.
2022 – *Cryptoplocus subpyramidalis* (Münster in Goldfuss, 1844) – Gründel, Keupp, Lang and Nützel: 200, pl. 14, fig. 6 (here more chresonymy and synonymy).

Material. 20 specimens and fragments (19 specimens from Saal; 1 specimen Saal, location 2, level 4 ("Fundstelle 2, Sohle 4"); illustrated specimen SNSB-BSPG 2016 XXI 1922.

Remarks. The present material is only moderately preserved. The illustrated specimen is 14 cm high. The subsutural bulge is often not visible. The apical angle of the shell varies; there may be transitions to *C. depressus*. *Cryptoplocus pyramidalis* (Münster, 1844) in Goldfuss, sensu Wieczorek (1979) is more slender; its shell width lies approximately between *C. subpyramidalis* and *C. depressus* (Voltz, 1836).

Cryptoplocus depressus (Voltz, 1836)

pl. 14: figs 1–5 in Gründel et al. (2022)

1931 – *Cryptoplocus depressus* Voltz – Yin: 68, pl. 7, fig. 10.
1979 – *Cryptoplocus depressus* (Voltz, 1836) – Wieczorek: 327, pl. 9, figs 1–3, 5–6, textfig. 13a–b.
2022 – *Cryptoplocus depressus* (Voltz, 1836) – Gründel, Keupp, Lang and Nützel: 200, pl. 14, figs 1–5 (here more chresonymy and synonymy).

Material. 39 specimens and fragments (37 specimens Saal; 2 specimens Saal, above coral stock, level 2 ("über Korallenstock, Sohle 2").

Family Nerinellidae Pčelintsev in Pčelintsev and Korobkov, 1960

Genus *Nerinella* Sharpe, 1850

Type species. *Nerinea dupiniana* d'Orbigny, 1842; lower Cretaceous; France.

Nerinella ornata (d'Orbigny, 1852)

pl. 15: figs 1–5 in Gründel et al. (2022)

2022 – *Nerinella ornata* (d'Orbigny, 1852) – Gründel, Keupp, Lang and Nützel: 202; pl. 15, figs 1–5 (here more chresonymy and synonymy).

Material. A fragment of 2 whorls from Saal.

Family Eunerineidae Kollmann, 2014

Genus *Eunerinea* Cox, 1947

Type species. *Nerinea castor* d'Orbigny, 1852; Oxfordian; France.

Eunerinea sp. 1

Plate 14: figs 1–6

?1861–1864 – *Nerinea speciosa* Voltz – Thurmann in Thurmann and Étallon: 104, pl. 8, fig. 51.
part 1997 – *Nerinella* cf. *laufonensis* (Thurmann, 1859) – Hägele: 131, fig. on p. 131 upper middle (not upper right).
?1997 – *Nerinella caecilia* (d'Orbigny, 1852) – Fischer and Weber: 52, pl. 8, figs 1–2.
2022 – Gen. et sp. indet. – Gründel, Keupp, Lang and Nützel: 212, pl. 19, figs 9–11.

Material. 20 specimens from Saal and 2 specimens from Saal, location 2, illustrated specimens SNSB-BSPG 2016 XXI 1923–1925.

Description. Only fragments are present; fragment shown on Plate 14: figs 2, 3 is 34 mm high; shell slender; whorl face straight to slightly concave; subsutural nodular bulge; strength of bulge and nodes vary from distinct to almost absent; a specimen from the collection Lang (Plate 14: fig. 1) has very distinct nodes that are axially elongated and opisthocline; some specimens with distinct knobby spiral cord between subsutural bulge and abapical suture as well as one (or several?) weak, knobby spiral cords on either side of it; other specimens have only two weak knobby spiral cords of approximately equal strength; transition from whorl face to slightly convex base at slightly protruding edge that forms periphery of whorls; edge has strong strong nodes, some of which visible above suture; several knobby spiral cords cover base; late whorls of large specimens have blurred axial ribs on whorl face and base; base phaneromphalous; aperture with abapical canal; at least one columellar and one (or two?) parietal plaits present in aperture.

Remarks. The few available specimens are mainly poorly preserved and show quite some variation. A comparison of Plate 14: fig. 1 with Plate 14: figs 2, 3 shows two extreme morphotypes. However, most of the fragments cannot be assigned to one of these morphotypes with certainty because of insufficient preservation. It is also not certain whether these morphologies grade into each other. The grouping of the present material under the name *Eunerinea* sp. 1 is based on similarities in the general shell shape and the basic shell ornament, the occurrence at the same locality and in the same stratigraphic level. It remains unclear whether there is one variable species or two separate species. Several species described in the literature resemble either one or the other mentioned morphotype.

The neotype of *Nerinella caecilia* (d'Orbigny) (see Fischer and Weber 1997) closely resembles the present spe-

cies, but apparently has more numerous spiral cords on the whorl face and lacks a subsutural row of nodes. The whorls are at least partially more concave. *Nerinella subimbricata* d'Orbigny, 1852 sensu Fischer and Weber (1997) is significantly more slender and the whorl face is more concave. *Ptygmatis nodosa* (Voltz, 1836) sensu Gründel et al. (2022) has, among other differences, a border spiral cord without nodes. *Nerinea sequana* Thirr sensu Bronn (1836) is more slender and the whorls are concave. *Nerinea laufonensis* Thurmann in Thurmann and Étallon 1861 lacks a subsutural row of nodes, the border spiral rib is hardly knobby and, in addition to two rows of nodes, several lirae are formed on the whorl face. *Nerinea oppeli* Gemmellaro, 1870 is similar to the specimen shown in Plate 14: fig. 1, but the subsutural row of nodes is weaker, whereas the nodes of the border spiral cord are stronger and are fully visible above the suture. *Nerinea* cf. *heightneggeri* Peters sensu Cossmann (1898) is more slender and has 7–8 spiral cords on the whorl face, two of which are tuberculate.

Eunerinea sp. 2

Plate 14: figs 7, 8

Material. 1 specimen and a fragment from Saal, SNSB-BSPG 2016 XXI 1926–1927.

Description. Shell high-spired, slender; specimen 39 mm high; sutures inconspicuous; angular edge at transition from whorl face to base exposed somewhat above suture; strong spiral cord situated at a clear distance from adapical suture; whorl face between this spiral cord and adapical suture concave, between this cord and abapical suture straight to slightly concave; edge at transition from whorl face to base very pronounced, slightly protruding, forming whorl periphery; edge probably knobby, which is not entirely certain due to preservation; base moderately convex, details are not preserved.

Remarks. The similar *Ptygmatis nogreti* Guirand and Ogérien sensu Loriol in Loriol and Bourgeat (1886–1888) has a strong spiral cord directly below the suture. *Ptygmatis carpathica* sensu Loriol in Loriol and Bourgeat (1886–1888) is larger, not as slender and the subsutural spiral cord is not broadened.

Family Itieriidae Cossmann, 1896

Genus *Itieria* Matheron, 1842

Type species. *Acteon cabanetiana* d'Orbigny, 1841; Kimmeridgian; France.

Itieria cabanetiana (d'Orbigny, 1841)

Plate 14: figs 9–11

1851 – *Itieria cabanetiana* d'Orbigny, 1847 – d'Orbigny: 99, pl. 255, fig. 3, pl. 256, figs 1–3.

1869 – *Itieria cabaneti* Matheron – Gemmellaro: 9, pl. 2, figs 1–3.

1898 – *Itieria cabanetiana* d'Orbigny – Cossmann: 12, pl. 1, figs 17–20.

1997 – *Itieria cabanetiana* (d'Orbigny, 1841) – Fischer and Weber: 39, pl. 14, figs 1–4.

2014 – *Itieria cabanetiana* (d'Orbigny, 1841) – Kollmann: 360, fig. 6 A–B.

Material. 13 specimens and fragments, illustrated specimen SNSB-BSPG 2016 XXI 1928.

Description. Shell broadly egg-shaped with last whorl much higher than spire; illustrated specimen 67 mm high; apex concave; spire whorl much wider that high; suture emphasized by very narrow ramp; whorl face feebly convex to almost straight; transition from whorl face to base evenly rounded; whorls smooth; base distinctly umbilicated; umbilicus surmounted by strong ridge; aperture elongated, very narrow, widened abapically resulting in teardrop shape; apertural folds or plaits cannot be seen clearly.

Remarks. The lectotype of this species designated by Fischer and Weber (1997, pl. 14: fig. 1) is much larger and the spire is higher with more whorls than in the present material.

Genus *Itieroptygmatis* Charvet & Termier, 1971

Type species. *Itieroptygmatis ellipticata* Charvet & Termier, 1971; Jurassic/Cretaceous transition; Bosnia and Herzegovina.

Itieroptygmatis cylindrata Gründel, Keupp, Lang & Nützel, 2022

Plate 14: figs 12, 13

2022 *Itieroptygmatis cylindrata* n. sp. – Gründel, Keupp, Lang and Nützel: 207, pl. 18, figs 1–14

Material. Morphotype 1: 53 specimens (Saal: 48 specimens; locality 1985, above coral stock, level 2 ("Fundort 1985, über Korallenstock, Sohle 2"): 5 specimens. Morphotype 2, Saal: 32 specimens, illustrated specimen SNSB-BSPG 2016 XXI 1929.

Remarks. Two morphotypes assigned to this species were described by Gründel et al. (2022). The extremes in this morphological spectrum differ greatly from each another. However, there are also specimens that are difficult to assign to one of the two morphotypes. As outlined previously, it is undecided whether a variable species or two separate species are present, mainly due the poor preservation of the material at hand. A well-preserved juvenile specimen (shell height 24 mm; Plate 14: fig. 12, 13) of morphotype 2 shows the plait structure: 2 columellar plaits (the adapical one is significantly weaker than the abapical one) and a strong parietal plait. Palatal plaits are not noticeable.

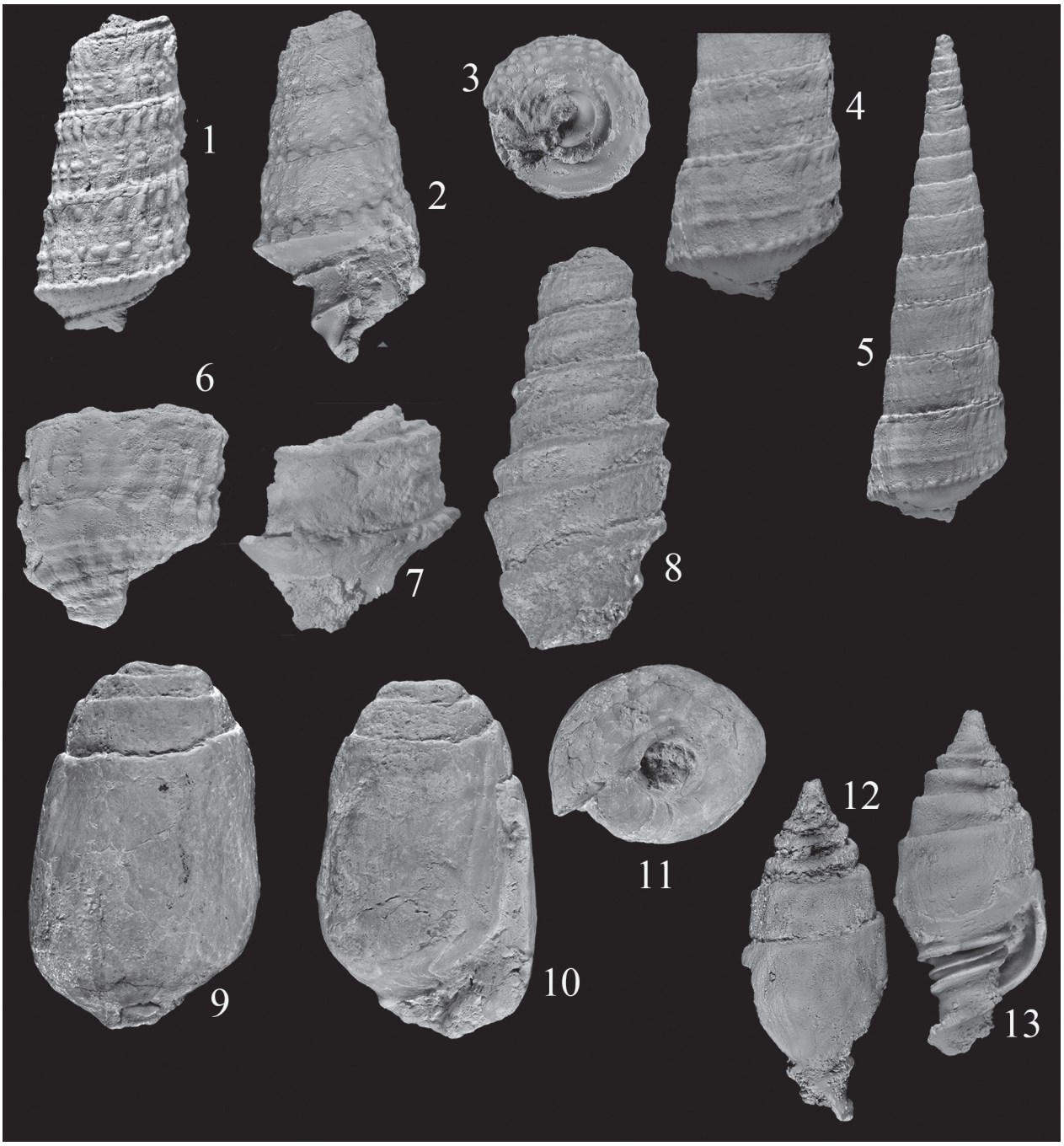

Plate 14. (1) *Eunerinea* sp. 1, SNSB BSPG 2021 XV 92, lateral view, height 19 mm. **(2, 3)** *Eunerinea* sp. 1, SNSB-BSPG 2016 XXI 1923, lateral and basal view, height 33 mm, width 16 mm. **(4, 5)** *Eunerinea* sp. 1, SNSB-BSPG 2016 XXI 1924, **(4)** lateral view, height 34 mm, **(5)** last two whorls height 21 mm. **(6)** *Eunerinea* sp. 1, SNSB-BSPG 2016 XXI 1925, fragment of a single whorl in lateral view, height 34 mm. **(7)** *Eunerinea* sp. 2, SNSB-BSPG 2016 XXI 1926, fragment of a single whorl in lateral view, width 16 mm. **(8)** *Eunerinea* sp. 2, SNSB-BSPG 2016 XXI 1927, lateral view, height 38 mm. **(9–11)** *Itieria cabanetiana* (d'Orbigny, 1841), SNSB-BSPG 2016 XXI 1928, lateral views, height 67 mm, basal view, width 41 mm. **(12, 13)** *Itieroptygmatis cylindrata* Gründel et al., 2022, morphotype 2, SNSB-BSPG 2016 XXI 1929, lateral views, height 24 mm.

Itieroptygmatis sp. 1

pl. 18: figs 15–16 in Gründel et al. (2022)

2022 – *Itieroptygmatis* sp. 1 – Gründel, Keupp, Lang and Nützel: 209, pl. 18, figs 15–16.

Material. 1 specimen from Saal, SNSB-BSPG 2016 XXI.

Genus *Rugalindrites* Gründel & Nützel, 2012

Type species. *Acteon cuspidatus* Sowerby, 1824; Bathonian; England.

***Rugalindrites cylindracea* (Cornuel, 1841)**

pl. 20: figs 1–9 in Gründel et al. (2022)

2022 – *Rugalindrites cylindracea* (Cornuel, 1841) – Gründel, Keupp, Lang and Nützel: 212, pl. 20, figs 1–9 (here more chresonymy and synonymy).

Material. 17 specimens, SNSB-BSPG 2016 XXI.

Discussion

A new collection (mostly collected by Jürgen Sylla) of Upper Jurassic (Kimmeridgian) gastropods from the reefal limestones of the Saal quarry near Kelheim (Lower Bavaria, Germany) is reported. This new material provides considerable additional information about the gastropod fauna from the Saal quarry. It has yielded 121 species of which 80 species are nominate species, the others are treated in open nomenclature. Together with the gastropod previously described from the Saal quarry (Gründel et al. 2015, 2017, 2019, 2022), this increases the number of known gastropod species from this locality by 53 species (32 nominate species). A total of 179 gastropod species (108 nominate species) have now been reported from the Saal quarry (Tables 1, 2) making this gastropod occurrence one of the richest known from the Late Jurassic. One new genus and 15 new species are described herein. Thus, Saal is now type locality of 59 gastropod species. The high diversity of gastropods and other marine invertebrates (e. g., bivalves, brachiopods, corals) reflects the highly structured reefal, shallow water habitat (see Gründel et al. 2022). The high number of taxa that had to be treated in open nomenclature reflects the poor preservation of many of the specimens. Especially the fragmentary preservation of nerineoids and other high-spired taxa as well as the corrosion of the shell ornaments commonly hinder species identification.

The Sylla collection has yielded quite a number of species that were not present in the previously studied material but also lacks taxa that are present in previously studied collections mainly gathered by Fritz Lang and additional material gathered by Helmut Keupp and Olaf Neubauer (Gründel et al. 2015, 2017, 2019, 2022). Fifty-nine species were only present in these collections studied earlier, and 54 species are only present in the Sylla collection. Sixty-five species are shared between previously studied and new collections, chiefly the Sylla collection. It is also noteworthy that species that are present in both collections commonly occur in strongly different abundances (Table 1). These differences in the faunal compositions probably reflects facies differences within the quarry at different sites. Moreover, collectors obviously used different methods (loot scheme, collection bias i. e., Sylla collected many more large specimens whereas Lang gathered preferably small specimens and species. We assume that many of the specimens treated in open nomenclature represent undescribed taxa and that the quarry yields many more species than are known to date. Currently, the quarry is not accessible due to safety reasons so that new material cannot be collected. It is possible that there are other private collections from Saal and if so, their study would be desirable.

Table 1. Gastropod species diversity from the Saal Quarry.

Total number of species	179
Total number of nominate species	109
Number of species with type locality at Saal	59
Number of species only from Sylla collection (this study)	53
Number of species only previous collections	58
Number of species present in both, in previous and Sylla collections	68

Nerineoidea form a considerable part of the gastropod fauna from Saal. With the Lang and Sylla collections, there are two independently obtained large nerineoid gastropod collections from the same location and the same age. However, both differ significantly from each other in the abundances of the species present in both collections and in the fact that many species are only represented in one of the collections. From both collections together 38 nerineoid species are reported. Both collections are almost identical in terms of the number of nerineoid species (Lang collection provided 28 species, Sylla collection 27 species). In the Lang collection, 10 of the species identified in the Sylla collection are missing; the Sylla collection 11 species that are present in the Lang collection). Therefore, both collections complement each other. Some of the nerinoid species are large (up to 20 cm) so that this group also had the highest biomass amongst gastropods in this community.

The differences of the previous collections (mainly Lang-collection) and the Sylla-collection are especially pronounced regarding Nerineoidea. Species present with more than 10 specimens/fragments (= abundant species). *Endoplocus acutus*, *Ptygmatis? tornata*, *Ptygmatis nodosa* und *Itieroptygmatis cylindrata* are abundant in both collections. *Ceritellopsis gramanni*, *Ceritella convexa* and *Ptygmatis*? *ursicina* are only abundant in the Lang collection. *Pseudonerinea*? *pseudomelaniformis*, *Nerinea donosa*, *Nerinea moreana* (with 202 specimens which are commonly very large and therefore conspicuous), *Ptygmatis clio*, *Cryptoplocus depressus*, *Cryptoplocus subpyramidalis*, *Eunerinea* sp. 1 and *Itieria cabanetiana* are only abundant in the Sylla collection.

It is remarkable that Ceritellidae are completely absent in the Sylla collection. On the other hand, the Sylla collection has yielded several large species, that are absent or rare in the Lang collection (both *Cryptoplocus*–species, *Nerinea moreana*, and *Itieria cabanetiana*). As outlined above, such differences reflect facies differentiation (reef, fore reef, lagoon) and collection biases. It is obvious that both collectors had different size preferences: H. Lang collected preferably small specimens whereas J. Sylla found on the average much larger specimens. that It is also noteworthy, that Lang and Sylla did not collect during the same period of time so that it seems possible that different facies and beds were exposed by actively progressing quarrying.

Table 2. Species and abundances of the gastropods from Saal, with differentaion of the previous collections and the Collection of J. Sylla. Attributions to subclass, Pat: Patellogastropoda, Vet: Vetigastropoda, Ner: Neritimorpha, Cae: Caenogastropoda, Het: Heterobranchia.

		Specimens previous studies	Specimens this study	Specimens combined	Species only in previous studies	Species only in this study	Species previous and this study
Pat	*Hennocquia saalensis* Gründel et al., 2017	3		3	1		
Pat	*Patella* sp.		1	1		1	
Pat	*Scurriopsis cragolis* Gründel & Nützel, 2024		4	4		1	
Pat	*Scurriopsis* sp.		1	1		1	
Pat	*Pseudorhytidopilus*? *quadratus* Gründel & Nützel, 2024		7	7		1	
Vet	*Pleurotomaria agassizii* Münster in Goldfuss, 1844		2	2		1	
Vet	*Emarginula* (*Tauschia*) sp. 1	1		1	1		
Vet	*Rimulopsis broesamleni* Gründel et al., 2017	7	4	11			1
Vet	*Rimulopsis perforata* Gründel, Keupp & Lang, 2017	3	3	6			1
Vet	*Rimulopsis danuviensis* Gründel & Nützel, 2024		4	4		1	
Vet	*Leptomaria goldfussi* (Sieberer, 1907)	5	12	17			1
Vet	*Leptomaria phacoides* Zittel, 1873		2	2		1	
Vet	*Leptomaria phacoides* Zittel, 1873?		1	1		1	
Vet	*Leptomaria* sp.		1	1		1	
Vet	*Placostoma suevica* (Quenstedt, 1881–1884)	6	5	11			1
Vet	*Valfinia qinquecincta* (Zieten, 1830–1833)	12	2	14			1
Vet	*Scissurella*? sp. 1	1		1	1		
Vet	*Falsotectus parvus* Gründel et al., 2017	76	4	80			1
Vet	*Falsotectus* sp. nov. 1	9		9	1		
Vet	*Asperilla longispina* (Rolle, 1861)		2	2		1	
Vet	*Discotectus crassiplicatus* (Étallon, 1859)	9	9	18			1
Vet	*Undatotectus glaber* Gründel et al., 2017	9	11	20			1
Vet	*Wernerocutus angulatoplicatus* (Münster in Goldfuss, 1844)	5	11	16			1
Vet	*Falsataphrus*? *valfinense* (Loriol in Loriol and Bourgeat, 1886–1888)		2	2		1	
Vet	*Eucycloscalidae*? gen. inc. sp. 1	1		1	1		
Vet	*Torusataphrus inornatus* (Quenstedt, 1858)?		1	1		1	
Vet	*Chilodonta quadratofoveata* Gründel et al., 2017	3	1	4			1
Vet	*Chilodonta haegelei* Gründel et al., 2017	1		1	1		
Vet	*Onkospira ranellata* (Quenstedt, 1852)	1	3	4			1
Vet	*Proconulus*? sp. 1	3	3	6			1
Vet	*Amphitrochus muensteri* Gründel et al., 2017	1		1	1		
Vet	*Serrettella gerberi* (Gründel, Keupp & Lang, 2017)	1	4	5			1
Vet	*Nododelphinula magnotuberosa* Gründel et al., 2017	2		2	1		
Vet	*Nododelphinula oblonga* Gründel & Nützel, 2024		2	2		1	
Vet	*Heliacanthus*? sp. 1	1	4	5			1
Vet	*Heliacanthus*? sp. 2		7	7		1	
Vet	Nododelphinulidae? gen. and sp. indet.	1	1	2			1
Vet	*Torusataphrus inornatus* (Quenstedt, 1858)	1	1	2			1
Vet	*Metriomphalus parvotuberosus* Gründel et al., 2017	8	7	15			1
Vet	*Metriomphalus* sp. 1	8	1	9			1
Vet	*Planiturbo funatus* (Goldfuss, 1844)		3	3		1	
Vet	*Planiturbo procerus* Gründel et al., 2017	6	3	9			1
Vet	*Planiturbo validotuberosus* Gründel et al., 2017	7		7	1		
Vet	*Caryomphalus concavus* Gründel et al., 2017	11		11	1		
Vet	*Caryomphalus* sp., cf. *concavus* Gründel, Keupp & Lang, 2017		1	1		1	
Vet	*Caryomphalus globatus* (Buvignier, 1843)		4	4		1	
Vet	Metriomphalidae gen. nov.? sp. 1	4	1	5			1
Vet	*Creniturbo gibbosus* Gründel & Nützel, 2024		7	7		1	
Vet	*Creniturbo* sp. 1		4	4		1	
Vet	*Kelheimia triangulata* Gründel & Nützel, 2024		9	9		1	
Vet	*Tegulacanthus tegulatus* (Münster in Goldfuss, 1844)	1		1	1		
Vet	*Sclarotrarda coronilla* (Brösamlen, 1909)	6		6	1		
Vet	gen. inc., sp. inc.	9		9	1		
Vet	Vetigastropoda gen. and sp. indet.		1	1		1	
Ner	*Dauterria rotundata* Gründel et al., 2015	110	35	145			1

		Specimens previous studies	Specimens this study	Specimens combined	Species only in previous studies	Species only in this study	Species previous and this study
Ner	*Dauterria variocostata* Gründel et al., 2015	100	3	103			1
Ner	*Pileopsella biconvexa* Gründel et al., 2015	6	5	11			1
Ner	*Neridomus laevis* (Gerasimov, 1955)?	112		112	1		
Ner	*Neridomus hemisphaerica* (Roemer, 1836)		10	10		1	
Ner	*Neridomus* sp. 1	2		2	1		
Ner	*Parvulatopsis quinquecostatus* Gründel et al., 2015	33	5	38			1
Ner	*Parvulatopsis*? sp.		5	5		1	
Ner	*Neritopsis*? *rotundatus* Gründel & Nützel, 2024		6	6		1	
Ner	*Wallowiella* (*Plicaropsis*) *cancellata* (Stahl, 1824)	28	27	55			1
Ner	*Wallowiella* (*Plicaropsis*) *compacta* Gründel et al., 2015	2	2	4			1
Ner	*Cassianopsis quenstedti* (Brösamlen, 1909)	7	2	9			1
Ner	*Cassianopsis ratua* Gründel et al., 2015	2	1	3			1
Ner	*Cassianopsis eversi* Gründel et al., 2015	5		5	1		
Ner	*Hayamiella schaeferi* Gründel et al., 2015	12	6	18			1
Ner	*Hayamiella semiplicata* (Brösamlen, 1909)	2	1	3			1
Ner	*Hayamiella decussata* (Münster, 1844 in Goldfuss)		1	1		1	
Ner	*Hayamiella subvaricosa* (Brösamlen, 1909)		4	4		1	
Ner	*Hayamiella*? sp.		2	2		1	
Ner	*Bipartopsis robustus* Gründel et al., 2015	8	1	9			1
Cae	*Pseudomelania* sp. 1	8		8	1		
Cae	*Pseudomelania*? sp. 2	7		7	1		
Cae	*Saalensia birugata* Gründel et al., 2015	42	22	64			1
Cae	*Loriolotrema* sp.		1	1		1	
Cae	Brachytrematidae? gen.and sp. indet.		1	1		1	
Cae	*Petersia* sp. 1	1		1	1		
Cae	*Costazygia* sp. 1	3		3	1		
Cae	*Erratopleura* sp. 1	1		1	1		
Cae	*Ampullina* sp. 1	7		7	1		
Cae	*Pictavia silicea* (Quenstedt, 1858)	1	1	2			1
Cae	*Pictavia lactera* Gründel et al., 2019	2	8	10			1
Cae	*Pictavia*? sp.	1	1	2			1
Cae	*Oonia kimmeridgiensis* Gründel & Nützel, 2024		3	3		1	
Cae	*Globularia*? sp.		1	1		1	
Cae	*Neuburgensia convexoconcava* (Gründel, Keupp & Lang, 2019)	10	2	12			1
Cae	*Neuburgensia angulata* Gründel & Nützel, 2024		53	53		1	
Cae	*Neuburgensia rara* Gründel & Nützel, 2024		1	1		1	
Cae	*Metacerithium* sp. 1	15		15	1		
Cae	*Tylostoma* sp. 1	6	6	12			1
Cae	*Eustoma*? *gracilis* Gründel & Nützel, 2024		5	5		1	
Cae	*Eustoma* sp.		3	3		1	
Cae	*Ditretus* sp., cf. *rostellaria* (Buvignier, 1852)	3	11	14			1
Cae	*Coninoda strekwera* Gründel et al., 2019	10	2	12			1
Cae	*Coninoda*? sp. 1	5	1	6			1
Cae	*Maoraxis* sp. 1	1		1	1		
Cae	*Cryptoptyxis rarenodosa* Gründel et al., 2019	21	5	26			1
Cae	*Cryptoptyxis? spinosus* Gründel & Nützel, 2024		3	3		1	
Cae	*Nudivagus* sp. 1	5	3	8			1
Cae	*Nudivagus* sp. 2		2	2		1	
Cae	*Uchauxia* ex gr. *limaeforme* (Roemer, 1836)	44		44	1		
Cae	*Provolibathra*? sp., cf. *septemplicata* (Roemer, 1836)	69	3	72			1
Cae	*Cryptaulax*? *parvum* Gründel et al., 2019	3		3	1		
Cae	*Cryptaulax*? *triangulare* Gründel et al., 2019	3		3	1		
Cae	*Tyrnoviella* sp. 1	1		1	1		
Cae	*Exelissa* sp. 1	2	2	4			1
Cae	*Exelissa*? Aff. *corallense* (Buvignier, 1843)		1	1		1	
Cae	*Exelissa ursicina* (Loriol in Loriol & Koby, 1889)		1	1		1	
Cae	*Shurovites robustus* Gründel et al., 2019	5		5	1		
Cae	*Shurovites* sp. 1	1		1	1		
Cae	*Tropacerithium cumaritum* Gründel et al., 2019	9	1	10			1
Cae	*Tropacerithium danubii* Gründel et al., 2019	15	2	17			1
Cae	*Turritella lucagrita* Gründel & Nützel, 2024		1	1		1	
Cae	*Bleytonella saalensis* Gründel et al., 2019	10		10	1		

		Specimens previous studies	Specimens this study	Specimens combined	Species only in previous studies	Species only in this study	Species previous and this study
Cae	Juvenile cerithioid	1		1	1		
Cae	*Palaeorissoina* sp. 1	1		1	1		
Cae	*Boreomica costaspiralis* Gründel et al., 2019	10		10	1		
Cae	*Boreomica* sp.	1		1	1		
Cae	*Boreomica* sp. 2	1		1	1		
Cae	*Purpuroidea lapierrea* (Buvignier, 1843)		2	2		1	
Cae	*Buvignieria* sp. nov. 1	2		2	1		
Cae	*Buvignieria racitana* Gründel et al., 2019	106	1	107			1
Cae	*Buvignieria convexa* Gründel et al., 2019	14		14	1		
Cae	Palaeorissoinidae? gen. inc., sp. 1	1		1	1		
Cae	*Falsobuvigna peregrina* Gründel et al., 2019	24		24	1		
Cae	*Columbellaria corallina* (Quenstedt, 1852)	7	3	10			1
Cae	*Columbellaria* sp. 1	1		1	1		
Cae	Gen. indet. *schlosseri* (Loriol in Loriol & Bourgeat, 1886–1888)		4	4		1	
Cae	Gen. indet. *Monilitesta* Zittel, 1873		1	1		1	
Cae	Strombidae gen. inc., sp. 1	1		1	1		
Cae	*Diarthema aspera* Gründel & Nützel, 2024	2	8	10			1
Cae	*Diempterus* sp. 1	4		4	1		
Cae	*Diempterus*? *fusiformis* (Münster in Goldfuss, 1844)	5		5	1		
Cae	Caenogastropoda gen. inc. 1, sp. 1		3	3		1	
Het	*Cossmannea desvoidyi* (d'Orbigny, 1851)		2	2		1	
Het	*Ceritellopsis gramanni* Huckriede, 1967	25		25	1		
Het	*Ceritellopsis plicatula* Huckriede, 1967	5		5	1		
Het	*Ceritella convexa* Gründel et al., 2022	26		26	1		
Het	*Ceritella* sp. 1	9		9	1		
Het	*Nerinea donosa* Gründel et al., 2022	10	45	55			1
Het	*Nerinea moreana* (d'Orbigny, 1851)		202	202		1	
Het	*Endoplocus acutus* Gründel et al., 2022	17	18	35			1
Het	*Endoplocus inflatus* Gründel et al., 2022	10	2	12			1
Het	*Endoplocus staszycii* (Zeuschner, 1850)?		4	4		1	
Het	*Endoplocus* sp. 1		3	3		1	
Het	*Endoplocus* sp. 2		3	3		1	
Het	*Pseudonerinea? pseudomelaniformi*s Gründel et al., 2022	37	27	64			1
Het	*Ptygmatis mandelslohi* (Bronn, 1836)	4	9	13			1
Het	*Ptygmatis*? *tornata* (Quenstedt, 1852)	37	33	70			1
Het	*Ptygmatis nodosa* (Voltz, 1836)	142	54	196			1
Het	Ptygmatis? ursicina Thurmann in Thurmann & Étallon, 1861	19	1	20			1
Het	*Ptygmatis bruntrutana* (Thurmann, 1832)		6	6		1	
Het	Ptygmatis clio (d'Orbigny, 1852)	2	29	31			1
Het	Aptyxiella tricincta (Münster, 1844)	1		1	1		
Het	*Aptyxiella tricincta* (Münster, 1844) sensu Quenstedt 1881–1884	3	5	8			1
Het	*Aptyxiella planata* (Quenstedt, 1858)		2	2		1	
Het	*Aphanoptyxis sinerugae* Gründel & Nützel, 2024		3	3		1	
Het	*Bactroptyxis* cf. *fasciata* (Voltz, 1836)	1		1	1		
Het	*Bactroptyxis*? *subcochlearis* (Münster in Goldfuss, 1844)	5	6	11			1
Het	Cryptoplocus depressus (Voltz, 1836)	3	39	42			1
Het	Cryptoplocus subpyramidalis (Münster, 1844 in Goldfuss)	3	20	23			1
Het	*Nerinella* sp. 1	4		4	1		
Het	*Nerinella ornata* (d'Orbigny, 1852)	1	2	3			1
Het	*Nerinella* sp. 2	2		2	1		
Het	Nerinella sequana (Bronn ex Thirria, 1836)	1		1	1		
Het	Nerinella biplicata (Quenstedt, 1858)	4		4	1		
Het	*Nerinella*? sp. 3	1		1	1		
Het	*Eunerinea* sp. 1	1	22	23			1
Het	*Eunerinea* sp. 2	1	2	3			1
Het	*Itieria cabanetiana* (d'Orbigny, 1841)		13	13		1	
Het	*Itieroptygmatis cylindrata* Gründel et al., 2022	57	85	142			1
Het	*Itieroptygmatis* sp. 1	2	1	3			1
Het	*Rugalindrites cylindracea* (Cornuel, 1841)	48	17	65			1
Het	*Rugalindrites* sp. 1	2		2	1		
Het	*Volvocylindrites marcousana* (Guirand & Ogérien, 1865)	39		39	1		
Het	*Sulcoactaeon* sp. 1	1		1	1		
	Total	1666	1095	2761	58	53	68

Acknowledgments

We thank Andrzej Kaim (Warsaw) for his careful review.

References

Archiac EJAD d' (1843) Description géologique du département de l'Aisne. Mémoires de la Société Géologique de France 5(2): 129–420.

Bandel K (1993) Trochomorpha (Archaeogastropoda) aus den St. Cassian-Schichten (Dolomiten, Mittlere Trias). Annalen des Naturhistorischen Museums Wien 95: 1–99.

Bandel K (2007) Description and classification of Late Triassic Neritimorpha (Gastropoda, Mollusca) from the St Cassian Formation, Italian Alps. Bulletin of Geosciences 82: 215–274. https://doi.org/10.3140/bull.geosci.2007.03.215

Bandel K (2008) Operculum shape and construction of some Neritimorpha (Gastropoda) compared to those of modern species of the subclass. Vita Malacologica 7: 19–36.

Bandel K, Gründel J, Maxwell P (2000) Gastropods from the upper Early Jurassic/early Middle Jurassic of Kaiwara Valley, North Canterbury, New Zealand. Freiberger Forschungshefte C 490: 67–132.

Beurlen K (1967) As espécies do Cassiopinae, nova subfamilia dos Turritellidae, no Cretaceo do Brasil. Arquivos de Geologia Universidadae do Recife 5: 1–44.

Bouchet P, Rocroi JP, Hausdorf B, Kaim A, Kano Y, Nützel A, Parkhaev P, Schrödl M, Strong EE (2017) Revised classification, nomenclator and typification of gastropod and monoplacophoran families. Malacologica 61: 1–526. https://doi.org/10.4002/040.061.0201

Bronn HG (1836) Übersicht und Abbildungen der bis jetzt bekannten *Nerinea*–Arten. Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde 4: 544–566.

Brösamlen R (1909) Beitrag zur Kenntnis der Gastropoden des schwäbischen Jura. Palaeontographica 56: 177–321. https://doi.org/10.1007/BF02120007

Burmeister H (1837) Handbuch der Naturgeschichte. Enslin, Berlin, , Zoologie 2: 369–858.

Buvignier A (1843) Mémoire sur quelques fossiles nouveaux des départements de la Meuse et des Ardennes. Mémoires de la Société Philomatique de Verdun (Meuse) 2: 225–252.

Buvignier A (1852) Statistique géologique, minéralogique, metallurgique et paléontologique du Département de la Meuse. JB Bailliére, Paris, 52 pp. [32 pls]

Charvet J, Termier G (1971) Les Nérinéacés de la limite Jurassique-Crétacé de Bjeliš (Nord de Sarajévo, Yougoslavie). Annales de la Société géologique du Nord 91: 187–191.

Children JG (1834) Mollusca. In: Synopsis of the contents of the British Museum, ed. 28: 88–118.

Cornuel J (1841) Mémoire sur les terrains crétacés inférieurs et supra-jurassiques de l'arrondissement de Vassy (Haute Marne). Mémoirs de la Société Geologique de France, sér. 1, 4: 229–290.

Cossmann M (1885) Contribution à l'étude de la faune de l'étage Bathonien en France (Gastropodes). Mémoirs de la Société géologique de France 3(3): 1–374.

Cossmann M (1896) Essais de paléoconchologie comparée, vol. 2. The author and Comptoir Géologique, Paris, 179 pp. [8 pls] https://doi.org/10.5962/bhl.title.52314

Cossmann M (1898) Contribution à la Paléontologie française des terrains jurassiques: Nerinées. Mémoires de la Société gélogique de France, sér. Paléontologie (2) 8: 1–179.

Cossmann M (1906) Essais de paléoconchologie comparée 7. The author and FR de Rudeval, Paris, 261 pp.

Cossmann M (1909) Essais de paléoconchologie comparée 8. The author and FR de Rudeval, Paris, 248 pp.

Cossmann M (1913) Contributions à la paléontologie française des terrains jurassiques. III. Cerithiacea et Loxonematacea. Mémoires de la Société géologique de France, série Paléontologie 46: 1–263.

Cossmann M (1916) Essais de paléontologie comparée 10. The author, Paris, 292 pp.

Cossmann M (1918) Les coquilles des calcaires d'Orgon. Bulletin de la Société géologique de France, sér. 4, 16: 336–341.

Cossmann M (1919) see Cossmann M, Peyrot A (1919).

Cossmann M (1921) Essais de paléontologie comparée 12. The author, Paris, 349 pp.

Cossmann M (1925) Essais de paléontologie comparée 13. The author, Paris, 345 pp.

Cossmann M, Peyrot A (1917–1919) Conchologie néogénique de l'Aquitaine. 3: Gastropodes, Scaphopodes et Amphineures. Actes de la Société Linnéenne de Bordeaux 69: 157–365, 70: 181–491.

Cox LR (1930) The fossil fauna of the Samana Range and some neighbouring areas. Part VIII. The Mollusca of the Hangu shales. Memoirs of the Geological Survey of India, Palaeontologia Indica, new series 15: 129–222.

Cox LR (1947) On the genotype of *Nerinea*; with a new subgeneric name *Eunerinea*. Proceedings of the Malacological Society of London 27: 248–250.

Cox LR (1954) Notes relating to the taxonomy of the gastropod superfamily Nerineacea. Proceedings of the Malacological Society of London 29: 12–16.

Cox LR (1958) Three Mesozoic gastropod generic homonyms renamed. Proceedings of the Malacological Society of London 33: 71–72.

Cox LR (1959) Diagnose of two new genera of Mesozoic Pleurotomariidae. Proceedings of the Malacological Society of London 33: 238. https://doi.org/10.1093/oxfordjournals.mollus.a064828

Cox LR (1960) see Knight et al. 1960.

Cox LR (1965) Jurassic Bivalvia and Gastropoda from Tanganyika and Kenya. Bulletin of the British Museum (National History), Geology, Supplement 1: 1–213. https://doi.org/10.5962/p.310409

Cox LR, Arkell WJ (1948–1950) A survey of the Mollusca of the British Great Oolite Series. Monographs Palaeontological Society London 102 (1948): 1–49; 103 (1950): 49–105, London.

Daqué E (1938) see Wenz 1938.

Das SS, Saha S, Bardhan S, Mallick S, Allmon WD (2018) The oldest turritelline gastropods from the Oxfordian (Upper Jurassic) of Kutch, India. Journal of Paleontology 92: 373–387. https://doi.org/10.1017/jpa.2017.89

Das SS, Saha S, Bardhan S, Mondal S, Paul S, Mallick S, Saha R, Allmon WD (2024) Comment on: Fürsich et al. 2023, Miocene instead of Jurassic: the importance of sound fieldwork for paleontological data analysis. Journal of Paleontology 2024: 1–12. https://doi.org/10.1017/jpa.2023.91

Defrance MJL (1826) Genus *Pleurotomaria*. In: Cuvier F (ed) Dictionnaire des Sciences Naturelles 41, Paris and Strasbourg, 381 pp.

Deshayes PG (1824–1837) Description des coquilles des environs de Paris. 2 volumes and atlas, Paris. https://doi.org/10.5962/bhl.title.52303

Dieni I (1990) *Brunonia annulata* (Yokoyama, 1890) (Carinariidae, Mesogastropoda)

nel Cretaceo inferiore della Sardegna. Bollettino della Società Paleontologica Italiana 29: 43–51.

Douvillé H (1904) Mollusques fossiles. In: Morgan J de (Ed.) Mission scientifique en Perse, Leroux, Paris, tome 3: 192–380.

Eichwald E von (1861) Der Grünsand in der Umgebung von Moskwa. Bulletin de la Société Impériale des Naturalistes de Moscou 34: 278–313.

Étallon A (1859–1862) Études paléontologiques sur les terrains jurassiques du Haute-Jura. Monographie de l'étage Corallien. Paris (Besançon).

Étallon A (1862) Études paléontologiques sur le Jura graylois. Mémoires de la Société d'émulation du Doubs, 3. Ser. 8: 286 pp.

Eudes-Deslongchamps JA (1843) Mémoire sur les Nérinées des terrains secondaires du Calvados. Mémoires de la Société Linnéenne de Normandie 7: 179–188.

Eudes-Deslongchamps JA (1849) Supplément au mémoire sur les Bulles et Tornatelles fossiles des terrains secondaires du Calvados. Mémoires de la Société Linnéenne de Normandie 8: 161–162.

Eudes-Deslongchamps E (1865) Note sur la délimitation des genres *Trochotoma* et *Ditremaria*. Bulletin de la Société Linnéenne de Normandie 9: 421–433.

Favre J (1913) see Joukowsky ME, Favre J (1913).

Ferrari SM, Damborenea SE, Manceñido MO, Griffin M (2015) Early Jurassic Trochotomidae (Vetigastropoda, Pleurotomarioidea) from the Neuquén Basin, Argentina. Journal of Paleontology 89: 331–345. https://doi.org/10.1017/jpa.2014.28

Fischer JC (1969) Géologie, paléontologie et paléoécologie du Bathonien au Sud–Ouest du Massif Ardennais. Mémoires du Muséum National d'Histoire Naturelle, nouv. Série, Série C, Sciences de la Terre 20: 1–319.

Fischer JC, Weber C (1997) Révision critique de la paléontologie Française d'Alcide d'Orbigny. Vol. II: Gastropodes jurassiques. Masson, Paris, 300 pp.

Fischer JC, Nindre de YV, Manivit J, Vaslet D (2001) Jurassic Gastropod Faunas of Central Saudi Arabia GeoArabia 6: 63–100. https://doi.org/10.2113/geoarabia060163

Fischer P (1880–1887) Manuel de Conchyliologie et de Paléontologie conchyliologique. Savy, Paris, 1369 pp.

Fleming J (1822) The philosophy of Zoology, a general view of the structure, functions and classification of animals 2. Constable and Co., Edinburgh, 618 pp. https://doi.org/10.5962/bhl.title.24597

Forbes E (1850) Report of the 19th meeting of the British Association for the Advancement of Science (Birmingham, 1849): 75–76.

Frýda J, Blodgett RB, Stanley GD (2003) New neritopsoidean gastropods (Neritimorpha) from the Late Triassic (Late Carnian-Early Norian) of the Wallowa Terrane, northeastern Oregon. Mitteilungen des Geologisch-Paläontologischen Instituts der Universität Hamburg 87: 55–72.

Fürsich FT, Bhosale S, Alberti M, Pandey DK (2023) Miocene instead of Jurassic: the importance of sound fieldwork for paleontological data analysis. Journal of Paleontology 97: 341–346. https://doi.org/10.1017/jpa.2022.106

Gatto R, Monari S (2010) Pliensbachian gastropods from Venetian Southern Alps (Italy) and their palaeobiogeographical significance. Palaeontology 53: 771–802. https://doi.org/10.1111/j.1475-4983.2010.00961.x

Geiger P (1901) Die Nerineen des Schwäbischen Jura. Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg 57: 275–317.

Gemmelaro GG (1868–1875) Sullas fauna del calcare a *Terebratula janitor* del nord di Sicilia. Giornale di Scienze naturali ed economichi di Palermo 4 (1868): 72–105, (1869): 130–158; 5 (1870): 90–110; 11 (1875): 257–264.

Gemmelaro GG (1878–1882) Sui fossili del calcare cristallino delle montagne del Casale e di Bellampo nella Provincia di Palermo. Giornale di Scienze naturali ed economichi di Palermo 13 (1878): 116–212, 14 (1879): 157–212, 15 (1881–1882): 98–137.

Gerasimov PA (1992) Gastropody jurskich i progranichnych nizhnemelovych otloženij Evropejskoj Rossii. Moskau (Rossiyskaja Akademija Nauk), 190 pp.

Goldfuss A (1826–1844) Petrefacta Germaniae: Tam ea quae in Museo Universitatis Regiae Borussicae Fridericiae Wilhelmiae Rhenanae servantur quam alia quaecunque in Museis Hoeninghusiano Muensteriano aliisque extant; iconibus et descriptionibus illustrata. Arnz and Comp., Düsseldorf, 1. Teil (1826–1833): 252 pp., 2. Teil (1834–1840): 312 pp., 3. Teil (1841–1844): 128 pp.

Golikov AN, Starobogatov YI (1975) Systematics of prosobranch gastropods. Malacologia, 15(1): 185–232.

Grateloup JPS de (1832) Description d'un genre nouveau de coquilles appelé Neritopsidae. Actes de la Société linnéenne de Bordeaux 5: 125–131.

Gray JE (1840) Shells of molluscous animals. Synopsis of the contents of the British Museum 42: 105–152.

Gray JE (1847) A list of genera of Recent mollusca, their synonyma and types. Proceedings of the Zoological Society of London 15: 129–219.

Gray JE (1850) Figures of molluscous animals selected from various authors. Etched for the use of students by M. E. Gray, vol. 4. Longman, Brown, Green & Longmans, London. iv + 219 pp.

Gray JE (1857) Guide to the systematic distribution of Mollusca in the Brtish Museum. Part I. Taylor and Francis, London, 230 pp.

Gründel J (1976) Bemerkungen zur Family Diastomidae Cossmann, 1895 (Cerithiacea, Gastropoda). Zoologischer Anzeiger 197: 71–89.

Gründel J (2000) Archaeogastropoda aus dem Dogger Norddeutschlands und des nordwestlichen Polens. Berliner geowissenschaftliche Abhandlungen E 34: 205–253.

Gründel J (2004) Gastropoden aus dem oberen Bathonium von Lucsur-Mer/Calvados (Normandie, France): I. Archaeogastropoda und Neritimorpha. Freiberger Forschungshefte C 502: 15–50.

Gründel J (2009) Zur Kenntnis der Genus *Metriomphalus* Cossmann, 1916 (Gastropoda, Vetigastropoda). Zitteliana A 48/49: 39–48.

Gründel J (2012) Neubearbeitung der von Laube 1867 beschriebenen Gastropodenfauna aus dem mittleren Jura von Balin/Polen. Annalen des Naturhistorischen Museums in Wien, Serie A 114: 193–288.

Gründel J (2017) Die Gastropoden-Fauna von Saal bei Kelheim. Der Steinkern, Heft 30: 20–47.

Gründel J, Kowalke T (2002) Palaeorissoinidae, a new family of marine and brackish water Rissooidea (Gastropoda, Littorinimorpha). Neues Jahrbuch für Geologie und Paläontologie Abhandlungen 226: 43–57. https://doi.org/10.1127/njgpa/226/2002/43

Gründel J, Nützel A (2012) On the early evolution (Late Triassic to Late Jurassic) of the Architectobranchia (Gastropoda: Heterobranchia), with a provisional classification. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 264/1: 31–59. https://doi.org/10.1127/0077-7749/2012/0230

Gründel J, Hostettler B, Menkveld-Gfeller U (2016) Die Gastropoden der Korallenrifffazies der St-Ursanne-Formation (mittleres Oxfordien) des Schweizer Jura. 1. Die Unterklasse Neritimorpha Koken, 1896. Revue de Paléobiologie 35: 491–516.

Gründel J, Hostettler B, Menkveld-Gfeller U (2020a) Die Gastropoden aus der Korallenrifffazies der St-Ursanne-Formation (mittleres Oxfordien) des Schweizer Jura. 2. Patellogastropoda und Vetigastropoda. Revue de Paléobiologie 39: 199–247.

Gründel J, Hostettler B, Menkveld-Gfeller U (2020b) Die Gattungen der Brachytrematidae Cossmann, 1906 (Gastropoda: Caenogastropoda) im Jura Europas. Paläontologie, Stratigraphie, Facies (25), Freiberger Forschungshefte C 558: 109–119.

Gründel J, Hostettler B, Menkveld-Gfeller U (2022) Die Gastropoden aus der Korallenrifffazies der St-Ursanne-Formation (mittleres Oxfordien) des Schweizer Jura. 3. Die Unterklasse Caenogastropoda Cox, 1960. Revue de Paléobiologie 40: 29–84.

Gründel J, Keupp H, Lang F (2015) Die Arten der Unterklasse Neritimorpha Koken, 1896 (Gastropoda) aus der Korallenfazies des oberen Kimmeridgiums (oberer Jura) von Saal bei Kelheim und dem Gebiet Nattheim (Süddeutschland). Zitteliana A 55: 77–106.

Gründel J, Keupp H, Lang F (2017) Die Arten der Patellogastropoda und Vetigastropoda (Gastropoda) aus den Korallenriffen des oberen Kimmeridgiums (oberer Jura) von Saal bei Kelheim und dem Gebiet Nattheim (Süddeutschland). Zitteliana 89: 171–228.

Gründel J, Keupp H, Lang F (2019) Arten der Unterklasse Caenogastropoda aus der Korallenfazies des oberen Kimmeridgiums (Ober-Jura) von Saal bei Kelheim und dem Gebiet Nattheim (Süddeutschland). Zitteliana 93: 97–142.

Gründel J, Keupp H, Lang F, Nützel A (2022) Late Jurassic (Upper Kimmeridgian) Heterobranchia (Gastropoda) of the coral-facies of Saal near Kelheim and the viciniy of Nattheim (Germany) Zitteliana 96: 179–221. https://doi.org/10.3897/zitteliana.96.e84187

Guirand M, Ogérien LF (1865) Quelques fossiles nouveaux du Corallien du Jura. Travaux de la Société d'Émulation du Jura, für 1865: 369–394.

Guzhov AV (2004) Jurassic Gastropods of European Russia (Orders Cerithiiformes, Buccinifomes, and Epitoniiformes). Paleontological Journal 38: 457–562.

Haber G (1932) Gastropoda, Amphineura et Scaphopoda jurassica. In: W. Quenstedt (ed.): Fossilium Catalogus. I, Animalia; pars 53. Junk, Berlin, 304 pp.

Hägele G (1997) Juraschnecken. Fossilien, Sonderband 11: 1–144.

Haszprunar G (1988) On the origin and evolution of major gastropods groups, with special reference to the Streptoneura. Journal of Molluscan Studies 54: 367–441. https://doi.org/10.1093/mollus/54.4.367

Hébert M, Eudes-Deslongchamps E (1860): Mémoire sur les fossiles de Montreuil-Bellay (Maine-et-Loire), 1re partie. Céphalopodes et Gastéropodes. Bulletin de le Société Linnéenne de Normandie 5: 153–240.

Janicke V (1966) Die Gastropoden und Scaphopoden der Neuburger Bankkalke (Mittel-Tithon). Palaeontographica A 126: 35–69.

Hikuroa DCH, Kaim, A (2007) New gastropods from the Jurassic of Orville Coast, eastern Ellsworth Land, Antarctica. Antarctic Science 19: 115–124. https://doi.org/10.1017/S0954102007000168

Joukowsky ME, Favre J (1913) Monographie géologique et paléontologique du Salève (Hte-Savoie, France) Mémoires de la Société de Physique et d'Histoire naturelle de Gèneve 37: 295–523.

Kaim A, Sztajner (2005) The opercula of neritopsid gastropods and their phylogenetic importance. Journal of Molluscan Studies 71: 211–219. https://doi.org/10.1093/mollus/eyi029

Karapunar B, Nützel A (2021) Slit-band gastropods (Pleurotomariida) from the Upper Triassic St. Cassian Formation and their diversity dynamics in the Triassic. Zootaxa 5042(1): 1–165. https://doi.org/10.11646/zootaxa.5042.1.1

Kase T (1984) Early Cretaceous marine and brackish-water Gastropoda from Japan. National Science Museum, Tokyo, 199 pp.

Kase T (1988) Reinterpretation of *Brunonia annulata* (Yokoyama) as an Early Cretaceous carinariid mesogastropod (Mollusca). Journal of Paleontology 62: 766–771.

Knight JB, Cox LR, Keen AM, Smith AG, Batten RL, Yochelson EL, Ludbrook NH, Robertson R, Yonge CM, Moore RC (1960) Treatise on Invertebrate Paleontology, Part I, Mollusca 1. University of Kansas Press, Lawrence, KS, 351 pp.

Koken E (1896) Die Gastropoden der Trias um Hallstatt. Jahrbuch der königlich-kaiserlichen geologischen Reichsanstalt 46: 37–126.

Kollmann HA (1979) Gastropoden aus den Losensteiner Schichten der Umgebung von Losenstein (Oberösterreich). 3. Teil: Cerithiacea (Mesogastropoda). Annalen des Naturhistorischen Museums Wien 82: 11–51.

Kollmann HA (2005) Révision critique de la Paléontologie Française d'Alcide d'Orbigny, vol. 3. Gastropodes crétacés. Backhuys Publishers, Leiden, 239 pp.

Kollmann HA (2014) The extinct Nerineoidea and Acteonelloidea (Heterobranchia, Gastropoda): a palaeobiological approach. Geodiversitas 36: 349–383. https://doi.org/10.5252/g2014n3a2

Kuhn O (1939) Beiträge zur Fauna des Oxford und Kimmeridge in Nordbayern. Neues Jahrbuch für Geologie und Paläontologie Abteilung B, Beilagen-Band 80: 464–497.

Lamarck JBPA de, Monet de (1799) Prodrome d'une nouvelle classification des coquilles.Mémoires de la Société Histoire Naturelle des Paris 1: 63–91.

Lindberg DR (1986) Radular evolution in the Patellogastropoda. American Malacological Bulletin 4 (1): 115.

Linné C (1758) Systema naturae, ed. 10 reformata 1. Holmiae.

Loriol P de (1881) Monographie paléontologique des Couches de la zone à *Ammonites tenuilobatus* (Badener Schichten) d'Oberbuchsitten et de Wangen (Soleure). – Mémoires de la Société Paléontologique Suisse 7: 1–60 and 8: 61–120.

Loriol P de, Bourgeat AE (1886–1888) Études sur les mollusques des couches coralligènes de Valfin (Jura). Mémoires de la Société Paléontologique Suisse 13–15: 1–369.

Loriol P de, Koby E (1889–1892) Études sur les mollusques des couches coralligènes inférieures du Jura Bernois. Mémoires Société paléontologiques de Suisse 16–19: 1–419.

Loriol P de, Koby E (1894) Étude sur les mollusques du Rauracien inférieur du Jura Bernois. Mémoires Societé paléontologiques de Suisse 21: 1–129.

Loriol P de, Koby E (1895) Étude sur les mollusques du Rauracien superieur du Jura Bernois. 1e supplément. Mémoires Société paléontologiques de Suisse 22: 1–51.

Loriol P de, Lambert J (1893) Description des Mollusques et Brachiopodes des couches séquaniennes de Tonnerre (Yonne). Mémoires Société paléontologiques de Suisse 20: 1–213.

Loriol P de, Pellat E (1874) Monographie paléontologique et géologique des étages de la formation Jurassique des environs de Boulogne-sur-Mer (Pt. 1). Mémoires de la Société de Physique et d'Histoire Naturelle de Genève 1823: 261–407.

Loriol P de, Royer E, Tombeck H (1872) Monographie paléontologique et géologique des étages supérieurs de la formation jurassique du département de la Haute-Marne. Mémoires de la Société Linnéenne de Normandie 15 and 16: 1–542.

Lovén SL (1847) Malacozoology. Konglia Vetenskaps-Akademiens Förhandlingar: 175–199.

Lycett J (1848) Notes on the distribution of the fossil conchology of the Oolite formations in thevicinity of Minchinhampton, Gloucestershire. The Annals and Magazine of Natural History (2) 2: 248–259. https://doi.org/10.1080/03745485809494703

Maire V (1926) Les Gastropodes du Jurassique supérieur graylois (fin). Bulletin de la Société, grayloise d'émulation, Gray 19: 85–173.

Mandl GW, Dulai A, Schlögl J, Siblik M, Szabó J, Szente I, Vörös A (2010) First results on stratigraphy and faunal content of the Jurassic between Bad Mitterndorf and Toplitzsee (Salzkammergut, Austria). Abhandlungen der Geologischen Bundesanstalt 65: 77–34.

Martill DM, Etches S (2020) Fossils of the Kimmeridge Clay Formation (Volume 1). Palaeontological Association Field Guide to Fossils 16, 436 pp.

Matheron P (1842) Sur le genre *Itieria*. Bulletin de la Société Géologique de France 13: 493–495.

Monari S, Gatto R (2013) *Pleurotomaria* Defrance, 1826 (Gastropoda, Mollusca) from the Lower Bajocian (Middle Jurassic) sediments of Luxembourg, with considerations on its systematic, evolution and palaeobiogeographical history. Palaeontology 56: 751–781. https://doi.org/10.1111/pala.12014

Monari S, Gatto R, Valentini M (2017) Vetigastropoda and Neritimorpha from the Lower Bajocian of Luxembourg and palaeobiogeography of Aalenian-Bajocian (Middle Jurassic) Gastropoda of western Europe. Journal of Systematic Palaeontology 16(6): 449–492. https://doi.org/10.1080/14772019.2017.1312578

Morris J, Lycett J (1851–1855) A monograph of the Mollusca from the Great Oolite, chiefly from Minchinhampton and the coast of Yorkshire. Palaeontographical Society London 1851: 1–130; 1853: 1–80; 1855: 81–147. https://doi.org/10.1080/02693445.1853.12088369

Münster G von (1841) Beschreibung und Abbildung der in den Kalkmergelschichten von St. Cassian gefundenen Versteinerungen. In: Wissmann HL, Münster G zu, Braun KF (Eds) Beiträge zur Geologie und Petrefacten-Kunde des südöstlichen Tirol's vorzüglich der Schichten von St. Cassian. Buchner, Bayreuth, 25–152.

Münster G von (1844) See Goldfuss A (1826–1844).

Munt MC (2020) see Martill DM, Etches S (2020).

Nützel A, Kaim A (2014) Diversity, palaeoecology and systematics of a marine fossil assemblage from the Late Triassic Cassian Formation at Settsass Scharte, N Italy. Paläontologische Zeitschrift 88: 405–431. https://doi.org/10.1007/s12542-013-0205-1

Ooster WA, Fischer-Ooster C de (1869) Pétrifications remarcables des Alpines suisses: le Corallien de Wimmis. 1. Band. H. Georg, Genf and Basel, 16 pp.

Orbigny A d' (1841) Description de quelques espèces de Mollusques fossiles de France. Revue zoologique par la Société Cuvierienne 4: 318–319.

Orbigny A d' (1842–1843). Paléontologie française. Description zoologique et géologique de tous les animaux Mollusques et Rayonnés fossiles de France. Terrains crétacés. Tome 2. Paris, 456 pp.

Orbigny A d' (1850) Prodrome de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés, volume 1. Masson, Paris, IX + 394 pp.

Orbigny A d' (1851–1860) Paléontologie française, terrains jurassiques. Tom II, Gastéropodes. Masson, Paris, 621 pp.

Pčelintsev VF (1926) Jurskaja fauna doliny Kubani bliz stanicy Krasnogorskoj. Trudy Geologičeskogo Muzeja Akademii Nauk SSSR 1: 77–114.

Pčelintsev VF (1927) Fauna jury i nižnego mela Kryma i Kavkasa. Mémoires du Comité géologique, nouvelle série 17xc: 1–320.

Pčelintsev VF (1960) see Pčelintsev VF, Korobkov IA (1960).

Pčelintsev VF (1965) Murčisoniata Mezozoja gornogo Kryma. Akademia Nauk SSSR, Izdatelstvo Nauka, Moskva-Leningrad, 215 pp.

Pčelintsev VF, Korobkov IA (1960) Osnovy paleontologii. Molljuski-Brjuchonogie, Moskva, 360 pp.

Peters KF (1855) Die Nerineen des oberen Jura in Österreich. Sitzungsberichte der mathematisch-naturwissenschftlichen Classe der kaiserlichen Akademie der Wissenschaften 16: 336–366.

Pictet JF, Campiche G (1861–1864) Descripion des fossiles du terrain Crétacé des environs de Sainte Croix. In: Pictet JF (1858–1872) Matériaux pour la Paléontologie Suisse sér. 3, 2: 1–752.

Piette E (1855) Observations sur les étages inférieurs du terrain jurassique dans les départements des Ardennes et de l'Aisne. Bulletin de la Société géologique de France (2) 12: 1083–1122.

Piette E (1860) Sur un nouveau genre de gastéropodes. Bulletin de la Société géologique de France (2) 18: 14–16.

Piette E (1864–1891) Paléontologie française, terrains jurassiques. Tome III. Gastéropodes. Masson, Paris, 535 pp. (1864): 1–48, 1866: 49–96, 1867: 97–144, 1869: 145–192, 1876: 193–336, 1882: 337–400, 1891: 401–535.

Piette E (1875) Sur plusieurs genres nouveaux on peu connus de gastéropodes. Association française pour l'avancemement des sciences - Compte rendu de la 3e session - Lille 1874. Association française pour l'avancemement des sciences, Paris, 360–366.

Ponder WF, Lindberg DR (1997) Towards a phylogeny of gastropod molluscs: an analysis using morphological characters. Zoological Journal of the Linnean Society 119: 83–265. https://doi.org/10.1111/j.1096-3642.1997.tb00137.x

Quenstedt FA (1852) Handbuch der Petrefaktenkunde. 1. Auflage, 792 pp., Tübingen (Laupp).

Quenstedt FA (1856–1858) Der Jura. 1. Lfg. (1856): 1–208, pl. 1–24; 2. Lfg. (1856): 209–368, pl. 24–48, 1 Profiltafel (Lias); 3. Lfg. (1857): 369–576, pl. 49–72, 1 Profiltafel (Brauner Jura); 4. Lfg. (1857): I–IV + 577–842, pl. 73–100, 1 Profiltafel (Weißer Jura). Laupp and Siebeck, Tübingen. https://doi.org/10.1002/prac.18570720161

Quenstedt FA (1881–1884) Petrefaktenkunde Deutschlands. Erste Abteilung, Band 7: Gasteropoden. Fues´s, Leipzig, 867 pp.

Rafinesque CS (1815) Analyse de la nature, ou tableau de l'univers et des corps organises. The author, Palermo, 224 pp. https://doi.org/10.5962/bhl.title.106607

Reiner W (1968) Callovian gastropods from Hamakhtesh Hagadol (southern Israel). Israel Journal of Earth Sciences 17: 171–198.

Riedel F (2000) Ursprung und Evolution der „höheren" Caenogastropoda. Berliner geowissenschaftliche Abhandlungen E 32: 1–240.

Roemer FA (1835–1836) Die Versteinerungen des norddeutschen Oolithen-Gebirges. Hahn'sche Hofbuchhandlung, Hannover, 218 pp. https://doi.org/10.5962/bhl.title.118663

Rolle F (1861) Über einige neue oder wenig bekannte Mollusken-Arten aus Sekundär-Ablagerungen. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Classe 42: 261–279.

Salvini-Plawen L von (1980) A reconsideration of systematics in the Mollusca (phylogeny and higher classification). Malacologia 19: 249–278.

Schlosser M (1882) Die Fauna des Kelheimer *Diceras*-Kalkes. I. Vertebrata, Crustacea, Cephalopoda und Gastropoda. Palaeontographica 28: 41–110.

Sharpe D (1849) On *Tylostoma*, a proposed genus of gastropods mollusks. Quarterly Journal of the Geological Society of London 5: 376–380. https://doi.org/10.1144/GSL.JGS.1849.005.01-02.42

Sharpe D (1850) Remarks on the genus *Nerinea* with an account of the species found in Portugal. Quarternal Journal of the Geological Society London 6: 101–114. https://doi.org/10.1144/GSL.JGS.1850.006.01-02.14

Sieberer K (1907) Die Pleurotomarien des schwäbischen Jura. Palaeontographica 54: 1–68.

Sowerby J (1812–1822) The mineral conchology of Great Britain. 1 (1812), 234 S., pl. 1–9, (1813): pl. 10–44, (1814): pl. 45–78, (1815): pl. 79–102; 2 (1815): 251 S., pl. 103–114, (1816): pl. 115–150, (1817): pl. 151–186, (1818): pl. 187–203; 3 (1818): 194 S., pl. 204–221, (1819): pl. 222–253, (1820): pl. 254–271, (1821): pl. 272–306; 4 (1821): 114 S., pl. 307–318, (1822): pl. 319–383. Meridith, London.

Sowerby J de C (1823–1846) The mineral conchology of Great Britain. 4 (1823): S. 115–160, pl. 384–407; 5 (1823): 168 S., pl. 408–443; (1824): pl. 444–485; (1825): pl. 486–503; 6 (1826): 250 S, pl. 504–545; (1827): pl. 546–580; (1828): pl. 581–597; (1829): pl. 598–609; 7 (1840): 80 S., pl. 610–618; (1841): pl. 619–623; (1843): pl. 624–628; (1844): pl. 629–643; (1846): pl. 644–648. Meridith, London.

Stahl CF (1824) Uebersicht über die Versteinerungen Württembergs und dem gegenwärtigen Standpunkt der Petrefaktenkunde. Correspondenzblatt des Königlich-Württembergischen Landwirtschaftlichen Vereins 6: 1–91.

Stefano G di (1884) Sopra altri fossili del Titonio inferiore di Sicilia. Giornale di Scienze Naturali ed Economichi 16: 8–37.

Stoliczka F (1867–1868) Cretaceous fauna of Southern India. 2. The Gastropoda. Memoirs of the geological Survey of India Palaeontologica Indica 5: 1–498.

Swainson W (1840) A treatise on malacology; or the natural classification of shells and shell-fish. Longman, London, viii + 419 pp. https://doi.org/10.5962/bhl.title.8027

Szabó J (2010) see Mandl GW et al. (2010).

Terquem O (1855) Paléontologie de l'étage inferieur de la formation liassique de la province de Luxembourg, Grand-Duché (Hollande) et de Hettange du département de la Moselle. Mémoires de la Société géologique de France (2) 5: 219–343.

Thurman J (1832) Essai sur le soulèvements jurassiques du Porrentruy: déscription géognostique de la série jurassique et théorie orographique du soulèvement. Mémoires de la Société du muséum d'histoire naturelle de Strasbourg 1: 1–84.

Thurmann J, Étallon A (1861–1864) Lethea bruntrutana ou études paléontologiques et stratigraphiques sur le Jura bernois et en particulier les environs de Porrentruy. Neue Denkschrift der allgemeinen Switzerlanderischen Gesellschaft für die Naturwissenschaften 18–20: 1–500.

Verrill AE (1884) Second catalogue of Mollusca recently added to the fauna of the New England coast and the adjacent part of the Atlantic, consisting mostly of deep-sea species, with notes on others previously recorded. Transactions of the Connecticut Academy of Arts and Sciences 6: 139–194. https://doi.org/10.5962/bhl.part.7412

Voltz PL (1836) Über das fossile genus *Nerinea*. Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde 4: 359–543.

Wade B (1917) New and little known Gastropoda from the Upper Cretaceous of Tennessee. Proceedings of the Academy of Natural Sciences of Philadelphia 69: 280–304.

Wenz W (1938–1944) Gastropoda. Teil I: Allgemeiner Teil und Prosobranchia. In: Schindewolf OH „Handbuch der Paläozoologie" Band 6. Bornträger, Berlin, 1639 pp. 1938: 1–480, 1939: 481–720, 1940: 721–960, 1941: 961–1200, 1943: 1201–1506, 1944: 1507–1639.

Werner W, Nützel A, Nose M (2017) Fossilien aus dem Oberjura von Saal – Die Sammlung Jürgen Sylla. Freunde der Bayerischen Staatssammlung für Paläontologie und Historische Geologie München e.V., Jahresbericht 2016 und Mitteilungen, 28–37.

Werner S (2019) Oberjura-Schnecken mit Farbmustererhaltung. Der Steinkern 37: 12–25.

Wieczorek J (1979) Upper Jurassic nerineacean gastropods from the Holy Cross Mts. (Poland). Acta Palaeontologica Polonica 24: 299–350.

Wieczorek J (1998) Nerineaceans from the Ernstbrunn Limestone (Tithonian, Austria). Annalen des Naturhistorischen Museums Wien 99A: 311–329.

Yin TH (1931) Étude de la Faune du Tithonique Coralligène du Gard et de l'Hérault. Travaux du laboratoire de Géologie de la faculté des sciences de Lyon 17, Mémoire 14: 1–191.

Zekeli F (1852) Die Gastropoden der Gosaugebilde. Abhandlungen der kaiserlich-königlichen Geologischen Reichsanstalt 1: 1–124. https://doi.org/10.5962/bhl.title.49120

Zeuschner L (1849, 1850) Geognostische Beschreibungen des Nerineenkalkes von Inwald und Roczyny. Naturwissenschaftliche Abhandlungen Wien, 3 (1850): 133–146.

Zieten CH von (1830–1833) Die Versteinerungen Württembergs. Verlag & Lithographie der Expedition des Werkes unserer Zeit, Stuttgart, 102 pp. [72 pls]

Zittel K (1873) Die Gastropoden der Stramberger Schichten. Palaeontographica, Supplement 2/1: 194–373.