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Mesozoic gastropods from Siberia and Timan (Russia). Part 2: Neogastropoda and Heterobranchia

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Abstract: This is a second paper dealing with juvenile and little known Mesozoic gastropods from Siberia and the Timan region. This part contains description of gastropods belonging to Neogastropoda and Heterobranchia. Described are 16 species, five of them are new. They are: *Sulcoactaeon uralicus*, *S. timanicus*, *S. bojarkensis* (Bullinidae), *Vasjugania vasjuganensis* (Acteonidae), and *Biplica siberica* (Ringiculidae). The new genus *Vasjugania* (Acteonidae) is proposed. Eight species are left in the open nomenclature. The protoconch of Siberian *Khetella*, illustrated here for the first time, suggests that this genus belongs to Purpurinidae and the whole family is a possible stem group for the Neogastropoda. Apart from *Khetella* the Siberian fauna seems to be of cosmopolitan character having common elements both with Europe and North America.

Key words: Siberia, Timan, Jurassic–Cretaceous, paleontology (gastropods), taxonomy.

Introduction

This paper continues studies on taxonomy of juvenile and little known Mesozoic gastropods from Siberia and the Timan region (see Kaim *et al.* 2004). Although some pioneering work was done already in 19th century (*e.g.* Tullberg 1881), the Mesozoic gastropods from northern Russia remain rather poorly known. More systematic treatment of the gastropods started in 1970s (Beisel 1977, 1983, 1991). As published in Russian those papers received only limited attention outside Russia. The material described herein widens our knowledge about the gastropod fauna from Siberia, the region usually treated as a blank spot in considerations on gastropod paleobiogeography (*e.g.* Kiel 2002).

The material illustrated herein comes mainly from boreholes drilled in the Western Siberia (Fig. 1). Additional material was obtained by the hand collecting during expeditions of the United Institute of Geology, Geophysics and Mineralogy

to northernmost Siberia. Apart from collection of the junior author, gastropod material was provided also by B.N. Shurygin, A.S. Turbina, and V.A. Zakharov. Their contribution is gratefully acknowledged.

The material is housed at the Institute of Paleobiology, Polish Academy of Sciences in Warszawa (abbreviated ZPAL). The collection of Beisel (1977, 1983, 1991) is housed at the Paleontological Museum of United Institute of Geology, Geophysics and Mineralogy, Russian Academy of Sciences in Novosibirsk (abbreviated MIGiG).

Geological setting

The gastropod shells described in this paper have been extracted from Upper Jurassic to Upper Cretaceous rocks from various sites of Western Siberia (Fig. 1). Some additional material came also from Eastern Siberia and Timan (= Pechora Basin). Mesozoic strata in Siberia lie usually almost horizontally, and the fossils are not significantly affected by diagenesis. The specimens were collected both from boreholes and outcrops.

Fig. 1. Sketch map of the Western Siberia showing localities mentioned in the text.

The Jurassic gastropods described in this paper come from marine shallow-water, Upper Jurassic strata cropping out in the northern part of Central Siberian Plateau along the Levaja Bojarka River and on Taymyr Peninsula along the Kamiennaja River. The stratigraphy and facies development of these sections have been studied in detail by Saks (1969) and Zakharov (1970) respectively. A monograph of gastropods from those regions was published by Beisel (1983).

The Valanginian gastropod described herein comes from the Saranpaulskaja borehole that is located close to the eastern rim of the Ural Mountains (Fig. 1). The specimen was collected from silty clays of the Khorasoim Fm (Golbert *et al.* 1972).

Abundant gastropod material came from the Maastrichtian part of the Gankin Fm in Western Siberia. This formation is represented by greenish-grey calcareous silts and clays containing numerous shelly fossils. The shells are usually well preserved with the aragonitic layer still present. There are no outcrops of this formation, and it is known exclusively from the boreholes drilled mainly in the 1950s and 1960s. The faunistic content is characterised by a relatively high contribution of gastropod shells (Beisel 1991). This might be explained by a relatively low-energy, shallow-water environment with a low sedimentation rate. The biostratigraphy of Gankin Fm has been described by Podobina (2000) based on foraminifer assemblages.

For more detailed information on Siberian Mesozoic, the reader is referred to general paper on stratigraphy of oil-bearing basins in Siberia (Shurygin 2000). The ammonoid biostratigraphy of the most important Mesozoic sections of Siberia has been published by Zakharov *et al.* (1997).

Systematic palaeontology

Class Gastropoda Cuvier, 1797
Subclass Prosobranchia Milne Edwards, 1848
Suborder Neogastropoda Thiele, 1929
Superfamily uncertain
Family Purpurinidae Zittel, 1895
Genus *Khetella* Beisel, 1977

Type species: *Khetella bojarkae* Beisel, 1977 by original designation; Late Kimmeridgian, Levaja Bojarka River, northern part of Central Siberian Plateau, Russia.

Emended diagnosis. — Shell conical with weakly convex whorls. Protoconch smooth and low-spired. Demarcation between protoconch and teleoconch well developed. Axial ribs absent at base. Peristome D-shaped with short, anterior siphonal notch.

Discussion. — Beisel (1977, 1983) placed *Khetella* in the extinct family Colombellinidae, which is characterised by the presence of both anterior and posterior channels (*e.g.* Wenz 1940). *Khetella* has only an anterior siphonal notch. The smooth, low-spired protoconch and strong axial ornamentation is similar to that of the Purpurinidae (see Kaim 2004).

Range. — Late Jurassic to Early Cretaceous.

Khetella bojarkae Beisel, 1977
(Fig. 2)

1977 *Khetella bojarkae* sp. n.; Beisel 1977: 146, fig. 1.

1983 *Khetella bojarkae* Beisel, 1977; Beisel 1983: 74, pl. 3: 18–19, pl. 4: 1.

Holotype: Beisel 1977: fig. 1A–B.

Type horizon: Early Kimmeridgian.

Type locality: Levaja Bojarka River, northern part of Central Siberian Plateau, Russia.

Material. — Two juvenile specimens from Levaja Bojarka River, outcrop 23 of Beisel (1983), Kimmeridgian.

Dimensions. — The protoconch (ZPAL Ga.10/44), consisting of 2.25 whorls, is 0.27 mm high and 0.43 mm wide. The holotype (MIGiG 553/260), consisting of about five teleoconch whorls, is 20 mm high and 13 mm wide.

Occurrences. — Kimmeridgian to Berriasian of northern Siberia.

Emended diagnosis. — Shell conical with weakly convex whorls. Protoconch whorls low-spired, rounded and smooth. Teleoconch whorls ornamented with strong axial ribs (12–14 per whorl). Spiral ornament absent on juvenile shells. Peristome wide, D-shaped with short siphonal notch.

Description. — The demarcation between protoconch 1 and 2 is not clearly visible on the examined specimens. The demarcation between protoconch and teleoconch is well developed and orthocline. Axial ribs only in the adapical part ornament the early teleoconch. Later in ontogeny weak spiral lirae appear and the axial ribs are more sturdy.

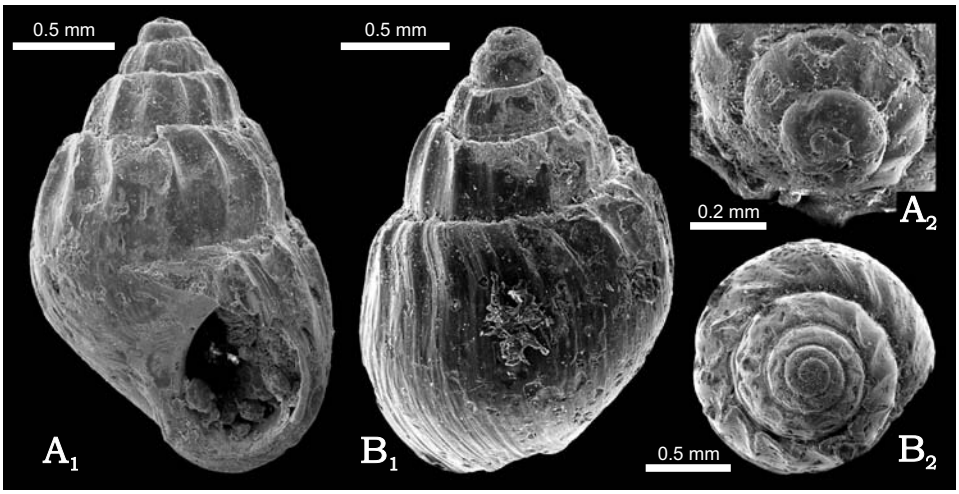

Fig. 2. Possible purpurinid *Khetella bojarkae* Beisel, 1977 from Levaja Bojarka River, outcrop 23, northern part of Central Siberian Plateau, Russia, Kimmeridgian. **A**. ZPAL Ga.10/44; A_1 lateral view, A_2 close-up of apex in apical view. **B**. ZPAL Ga.10/45; B_1 lateral view, B_2 apical view.

Remarks. — *K. bojarkae* differs from other species of *Khetella* by having the weakest development of spiral ornamentation.

Khetella sp.
(Fig. 3)

Material. — One incomplete shell from Strukturnaja borehole, interval 285.85–296.85 m, northern part of Central Siberian Plateau, Russia, unspecified Late Jurassic.

Dimensions. — The shell (ZPAL Ga.10/46) of about four teleoconch whorls is 11.11 mm high and 9.11 mm wide.

Description. — The shell is conical with strongly expanding the whorls. The protoconch is not preserved. Whorls of the teleoconch are ornamented with strong and weakly prosocline axial ribs and weak spiral lirae. The ribs are shouldered near the suture. There are ten axial ribs on the preserved half of the whorl. The aperture is not preserved.

Remarks. — This species differs from all other *Khetella* species (Beisel 1977, 1983; Gerasimov 1992) from European and Siberian parts of Russia in having largest expansion of the whorls and the strongest axial ribs.

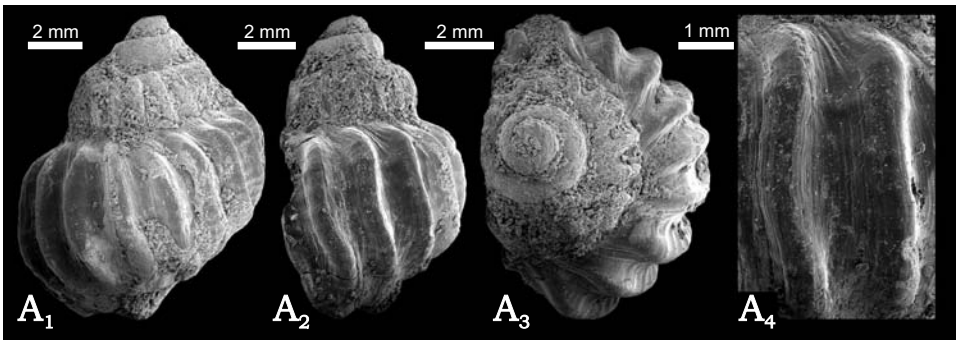

Fig. 3. Possible purpurinid *Khetella* sp. from Strukturnaja borehole, interval 285.85-296.85, northern part of Central Siberian Plateau, Russia, unspecified Late Jurassic. **A**. ZPAL Ga.10/46; A_{1-2} lateral views, A_3 apical view, A_4 details of teleoconch ornamentation.

Superfamily Muricoidea Rafinesque, 1815
Family Turbinellidae Swainson, 1835
Genus *Exilia* Conrad, 1860

Type species: *Exilia pergracilis* Conrad, 1860; monotypy, Eocene, Midway Group, Alabama, United States.

Diagnosis. — Shell narrowly fusiform, slender. Aperture narrowly elongated. Anterior canal long, straight and narrow. Columella may be smooth or bear one to four plaits of variable strength. Surface with well developed axial and spiral sculpture. Protoconch smooth, paucispiral or multispiral, depending on the type of larval development (from Kantor *et al.* 2001).

Discussion. — In their review Kantor *et al.* (2001) synonymized Late Cretaceous *Graphidula* Stephenson, 1941 with Eocene-to-Recent *Exilia* Conrad, 1860. This interpretation is followed here.

Range. — Late Cretaceous to Recent.

Exilia narymensis (Beisel, 1991)
(Fig. 4)

1991 *Graphidula narymensis* sp. n., Beisel 1991: 181, pl. 28: 7.

Holotype: Beisel 1991: pl. 28: 7.

Type horizon: Gankin Fm, Maastrichtian.

Type locality: Narym (= Narymskaja herein), borehole 1-k, Western Siberia, Russia.

Material. — One juvenile specimen from Narymskaja borehole 28-k.

Dimensions. — The protoconch, consisting of three whorls, is 1.34 mm high and 1.07 wide. The shell (ZPAL Ga.10/47), consisting of about six whorls, is 5.47 mm high and 2.43 mm wide.

Occurrences. — Maastrichtian of Western Siberia.

Emended diagnosis. — Shells slender, fusiform with last whorl of about half-total length. Protoconch high spired with dome-like apex. Demarcation between protoconch and teleoconch clearly visible and opisthocyrt. Teleconch with weakly convex whorls ornamented with wide and flat-topped spiral ribs. Axial ribs

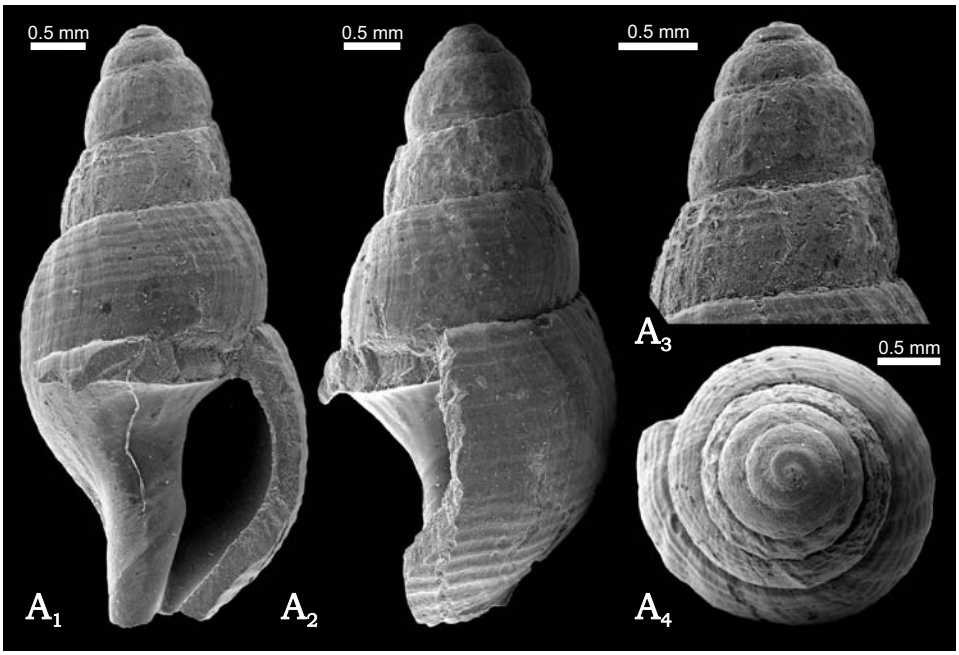

Fig. 4. Turbinellid *Exilia narymensis* (Beisel, 1991) from Narymskaja borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/47; A_1–A_2 lateral views, A_3 protoconch in lateral view, A_4 apical view.

absent or weakly developed. Peristome elongated with long siphonal canal. One columellar plait present.

Description. — The protoconch 1 is not preserved. The protoconch 2 has no ornament preserved. The teleoconch is ornamented by about nine spiral ribs on the visible part of whorl. The growth lines are opisthocyrtic.

Remarks. — The Siberian species differs from other species of *Exilia* by having the axial ribs weakly developed.

Exilia sp.
(Fig. 5)

Material. — One juvenile shell from Krasnyj Agronom, borehole 28-k, Western Siberia, Russia, Gankin Fm, Maastrichtian.

Dimensions. — The shell (ZPAL Ga.10/48), consisting of about six teleoconch whorls, is 9.10 mm high and 3.80 mm wide.

Description. — The shell is high spired with weakly rounded whorls. The protoconch is not preserved. The teleoconch is ornamented by weakly opisthocline strong axial ribs and numerous weaker spiral ribs. The peristome is not visible.

Remarks. — The shell is most similar to the shells of *Exilia lincolnensis* Weaver, 1916 from Eocene of Washington (USA) illustrated by Kantor *et al.* (2001). The latter species differs in more elongated shell shape.

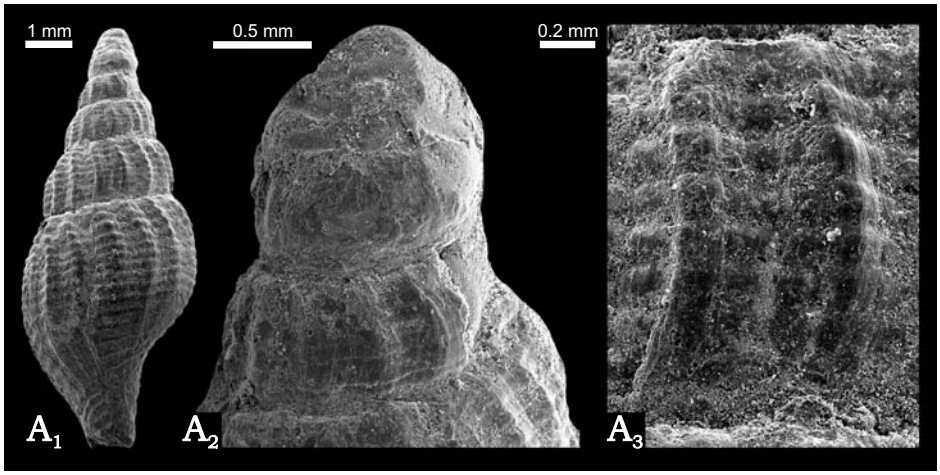

Fig. 5. Turbinellid *Exilia* sp. from Krasnyj Agronom, borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/48; A_1 lateral view, A_2 apex in lateral view, A_3 details of teleoconch ornamentation.

Gen. et sp. indet.
(Fig. 6)

Material. — One juvenile shell from Narymskaja, borehole 28-k, Western Siberia, Russia, Gankin Fm, Maastrichtian.

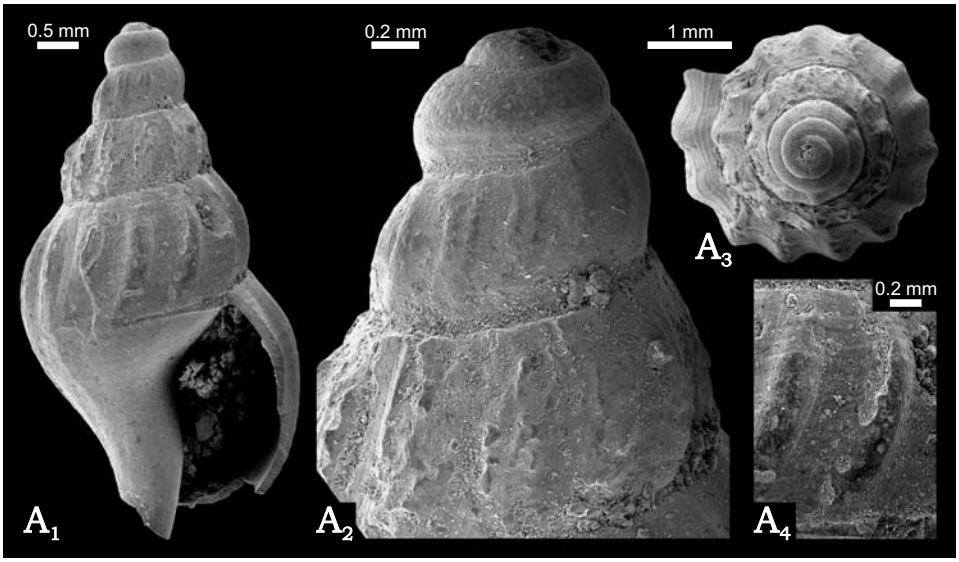

Fig. 6. Turbinellidae gen. et sp. indet. from Narymskaja borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/47; A_1 lateral view, A_2 apex in lateral view, A_3 apical view, A_4 details of teleoconch ornamentation.

Dimensions. — The shell (ZPAL Ga.10/52) consisting of about 5.5 whorls is 5.94 mm high and 3.18 mm wide.

Description. — The shell is high spired with rounded whorls. The protoconch 1 is not preserved. The protoconch 2 is high spired with flat apex, smooth. The teleoconch is ornamented with opisthocline axial ribs (15 ribs at the last whorl preserved) and weak spiral ribs (about 14 per whorl). The growth lines are opisthocline. The peristome is incompletely preserved. The collumellar lip is smooth with no plaits.

Remarks. — This shell under consideration may be related to *Exilia* but shells of the latter are usually more elongated. Most *Exilia* species have columellar plaits (Kantor *et al.* 2001), which appear to be absent at this Siberian species.

Family Fasciolariidae Gray, 1853
Gen. et sp. indet.
(Fig. 7)

Material. — One juvenile shell from Ust'-Silga, borehole 9k, Western Siberia, Russia, Gankin Fm, Maastrichtian.

Dimensions. — The shell (ZPAL Ga.10/49), consisting of about 5.5 whorls, is 9.00 mm high and 4.80 mm wide.

Description. — The shell is high spired with weakly rounded whorls and a short subsutural ramp. The protoconch is dome-shaped, poorly preserved. The teleoconch is ornamented with strong spiral ribs. The peristome has a short siphonal canal, which is bent anteriorly.

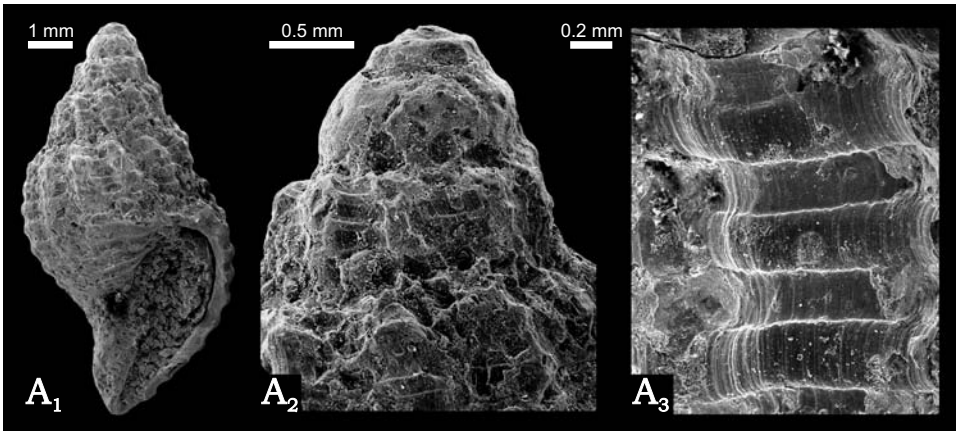

Fig. 7. Fasciolariidae gen. et sp. indet. from Ust'-Silga, borehole 9k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/49; A_1 lateral view, A_2 apex in lateral view, A_3 details of teleoconch ornamentation.

Remarks. — This shell could belong to many different families of Neogastropoda. The pattern of the ornamentation is suggestive of Fasciolariidae.

Family uncertain
Gen. et sp. indet.
(Fig. 8)

Material. — One juvenile shell from Narymskaja, borehole 28-k, Western Siberia, Russia, Gankin Fm, Maastrichtian.

Dimensions. — The shell (ZPAL Ga.10/50), consisting of about four teleoconch whorls, is 4.56 mm high and 2.65 mm wide.

Description. — The shell is high spired with rounded whorls. The protoconch is not preserved. The teleoconch is ornamented with acute spiral ribs and indistinctive, wide axial ribs. On the intersection of the spiral and axial ornamentation nodes appear. The growth lines are densely packed and sinusoidal. The peristome is elongate. The inner lip has two oblique folds. A narrow umbilical chink is present.

Remarks. — The presence of oblique folds on the inner lip suggests that the shell may belong to the family Mitridae, Volutomitridae, or Pholidotomidae. The pattern of ornamentation is similar to that of mitrid genera *Ziba* Adams and Adams, 1853 and *Subcancilla* Olsson and Harbison, 1953 and pholidotomid genera *Longoconcha* Stephenson, 1941 and *Volutoderma* Gabb, 1876.

Family Pseudolividae de Gregorio, 1880
Gen. et sp. indet.
(Fig. 9)

Material. — Four juvenile shells from Ust'-Silga, borehole 9-k, Western Siberia, Russia, Maastrichtian.

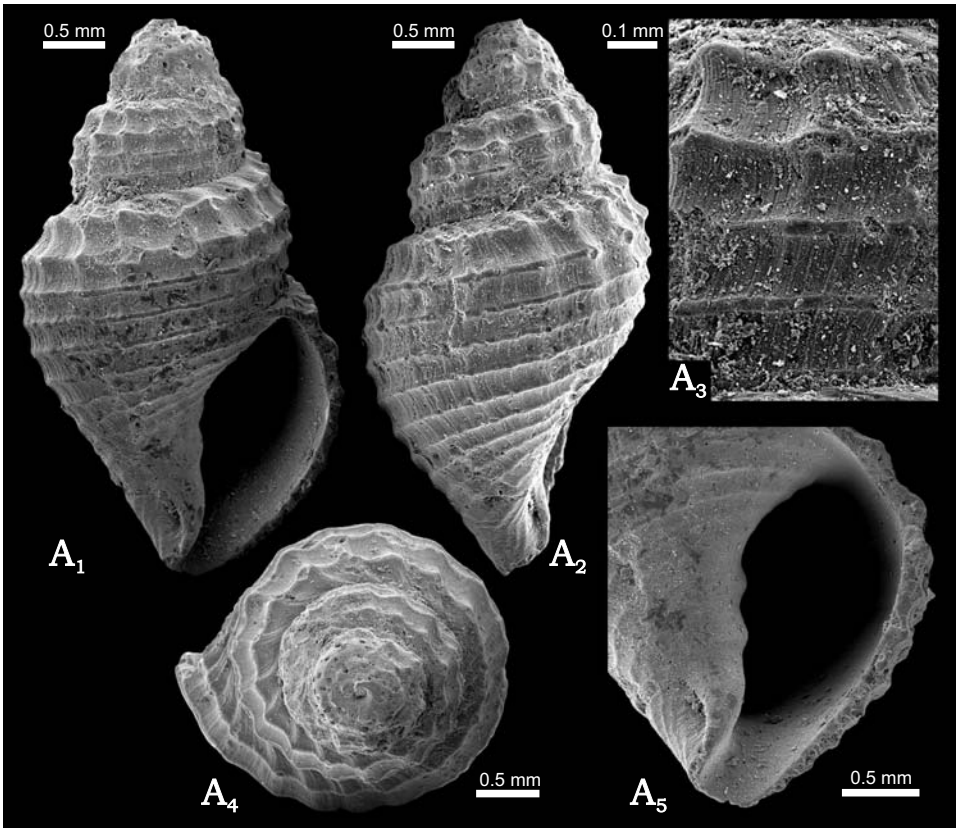

Fig. 8. Mitridae, Volutomitridae, or Pholidotomidae gen. et sp. indet. from Narymskaja, borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/50; A_{1-2} lateral views, A_3 details of teleoconch ornamentation, A_4 apical view, A_5 peristome, note oblique folds at the columellar lip.

Dimensions. — The shell (ZPAL Ga.10/54) of about four whorls is 3.78 mm high and 2.11 mm wide.

Description. — The shell is high spired with whorls angulated on the adapical part of the whorl. The protoconch 1 is not preserved. The protoconch 2 is dome-like with its surface eroded. The teleoconch is ornamented with wide and flat-topped spiral ribs and orthocline axial ribs curved anteriorly in the adapicalmost part of the whorl. The pseudolivid groove is high on the spire. The peristome is narrow and elongate.

Remarks. — The presence of a pseudolivid groove (Fig. 9A_1, A_3, B_3, C_1, C_2, C_4) suggests possible affinity of the specimens under consideration with the family Pseudolividae (see discussion in Vermeij 1998). The Siberian species resembles *Cryptoconus macnairyensis* (Wade, 1917) from the Maastrichtian of the United States (compare Sohl 1964), which may also belong to the family. There is also some similarity to Paleogene species of *Fusulsulcus* Bouchet and Ver-

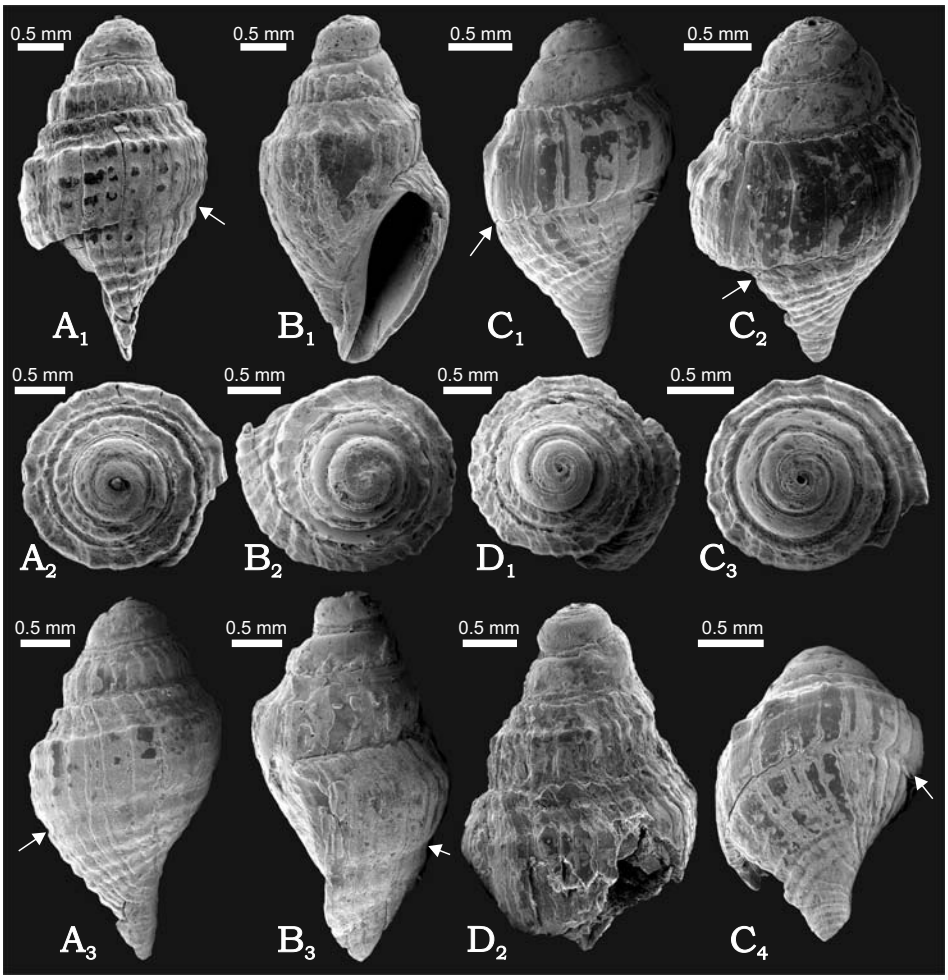

Fig. 9. Pseudolividae gen. et sp. indet. from Ust'-Silga, borehole 9-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/55; A_1, A_3 lateral views, A_2 apical view. **B**. ZPAL Ga.10/54; B_1, B_3 lateral views, B_2 apical view. **C**. ZPAL Ga.10/56; C_1–C_2 lateral views, C_3 apical view, C_4 latero-umbilical view. **D**. ZPAL Ga.10/53; D_1 apical view, D_2 lateral view. The arrows indicate pseudolivid groove.

meij, 1998 illustrated by Pacaud and Schnetler (1999) and Pacaud and Tracey (2000).

Superfamily Conoidea Fleming, 1822
Family Turridae Gray, 1853
Genus *Amuletum* Stephenson, 1941

Type species: *Turricula macnairyensis* Wade, 1926; original designation, Maastrichtian, Neylandville Marl, Texas, United States.

Diagnosis. — Small, rather slender shells with spire about half-total shell height. Protoconch proportionally large, consisting of three to four smooth whorls.

Whorls rounded, slightly constricted posteriorly to sloping subsutural collar. Transverse and spiral sculpture sometimes nodose. Siphonal canal elongate, slender, and curved somewhat; outer lip with rather shallow subsutural sinus. Columella lacking plications and narrowing to thin edge at anterior extremity (from Sohl 1964).

Discussion. — *Amuletum* is very similar to other co-occurring turrids in the Late Cretaceous of United States (e.g. *Lutema* and *Remnita*) and most probably closely related.

Range. — Maastrichtian.

Amuletum obensis Beisel, 1991
(Fig. 10)

1991 *Amuletum obensis* sp. n., Beisel 1991: 182, pl. 28: 8–9.

Holotype: Beisel 1991: pl. 28: 8.

Type horizon: Gankin Fm, Maastrichtian.

Type locality: Narym (= Narymskaja herein), borehole 28-k, Western Siberia, Russia.

Material. — One juvenile specimen from Narymskaja borehole 28-k, Western Siberia, Maastrichtian.

Dimensions. — The shell (ZPAL Ga.10/51), consisting of about 4.5 whorls is 9.66 mm high and 3.80 mm wide.

Occurrences. — Maastrichtian of Western Siberia.

Emended diagnosis. — Shell elongated, with last whorl of about half-total length. Teleconch with weakly convex whorls angulated slightly above middle part of the whorl. Ornament consisting of spiral ribs and axial nodes. Peristome elongated with long anterior siphonal canal.

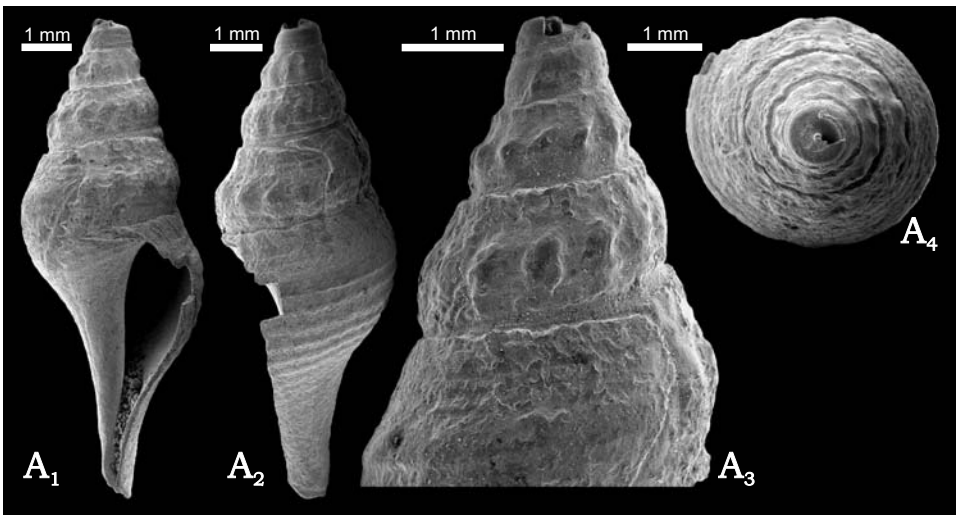

Fig. 10. Turrid *Amuletum obensis* Beisel, 1991 from Narymskaja borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/47; A_1–A_2 lateral views, A_3 apex in lateral view, A_4 apical view.

Description. — The protoconch is not preserved. There are seven spiral ribs on the penultimate whorl of the holotype and 13 nodes on the third whorl of the specimen illustrated herein (Fig. 10). The nodes become obsolete on later whorls. Columellar lip smooth with no plaits.

Remarks. — The species under consideration is most similar to *A. fasciolatum* (Wade, 1926), the latter differs in stronger spiral sculpture.

Subclass Heterobranchia Gray, 1840
Order Heterostropha Fischer, 1885
Superfamily Actaeonelloidea Gill, 1871
Family Bullinidae Gray, 1850
Genus *Sulcoactaeon* Cossmann, 1895
(= *Parvulactaeon* Gründel, 1997; = *Ragactaeon*, Gründel, 1997)

Type species: *Actaeonina striato-sulcata* Zittel and Gobert, 1861, original designation. ?Oxfordian, Glos, Normandie, France.

Diagnosis. — Shell relatively high-spired, slim to broadly oval. Protoconch strongly medioaxial to coaxial, smooth. Teleoconch with narrow, sometimes indistinct ramp. Whorls ornamented by spiral striae usually more numerous toward base. Spiral striae commonly absent or seldomly distributed on surface between ramp and abapical suture. Growth lines prosocyrt, bent from suture to basis center. Peristome narrowly oval, anteriorly channelled, posteriorly with short broad notch. Outer lip evenly convex. Columellar region with umbilical chink or covered by broad projection of inner lip. Columellar folds absent (from Kaim 2004).

Discussion. — The shells of *Parvulactaeon* and *Ragactaeon* differ only by their more distinct adapical ramp. Both genera are synonymized with *Sulcoactaeon* here.

Range. — Callovian to Valanginian.

Sulcoactaeon uralicus sp. n.
(Fig. 11)

Holotype: ZPAL Ga.10/57, Fig. 11.

Type horizon: Valanginian.

Type locality: Saranpaulskaja, borehole 28u, interval 1544–1550 m, Western Siberia, Russia.

Derivation of the name: after Ural Mountains.

Material. — Holotype only.

Dimensions. — The shell of the holotype consists of 3.5 whorls is 6.24 mm high and 3.57 mm wide.

Occurrences. — Type locality only.

Diagnosis. — Shell spindlelike with angulated adapical ramp. Base of teleoconch ornamented with striae. Teleoconch otherwise smooth apart from prosocyrt growth lines.

Description. — The protoconch is not preserved. The peristome is badly preserved.

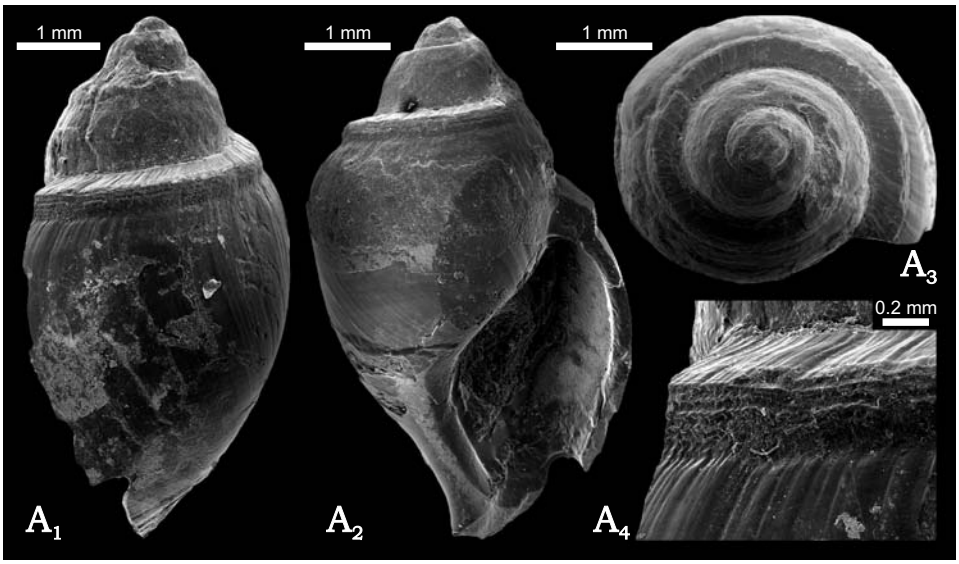

Fig. 11. Bullinid *Sulcoactaeon uralicus* sp. n. from Saranpaulskaja, borehole 28u, Western Siberia, Russia, Valanginian. **A**. ZPAL Ga.10/57 (holotype); A_1–A_2 lateral views, A_3 apical view, A_4 close-up of the adapical ramp.

Remarks. — *S. uralicus* has a strongly angulate adapical ramp, which clearly distinguishes this species from other Sulcoactaeons.

Sulcoactaeon timanicus sp. n.
(Fig. 12)

Holotype: ZPAL Ga.10/58, Fig. 12.

Type horizon: unspecified Late Jurassic.

Type locality: Sevierno-Timanskaja borehole 218, Timan region, Russia.

Derivation of the name: after Timan, the type region.

Material. — One shell from Sevierno-Timanskaja borehole 218 and two shells from Sevierno-Timanskaja borehole 7.

Dimensions. — The protoconch, consisting of 1.25 whorls, is 0.76 mm wide. The shell of the holotype, consisting of three whorls, is 2.17 mm high and 1.73 mm wide.

Occurrences. — Type region only.

Diagnosis. — Shell spindlelike with weakly angulated adapical ramp. At angulation, one distict rib present. Prosocline growth lines thickened into narrow riblets when crossing the ramp. Riblets pointed at angulation. Teleoconch densely ornamented with spiral grooves.

Description. — The protoconch is almost coaxial, clearly demarcated from teleoconch, smooth. In between the grooves weak striae are developed (Fig. 12A_4). The peristome is badly preserved.

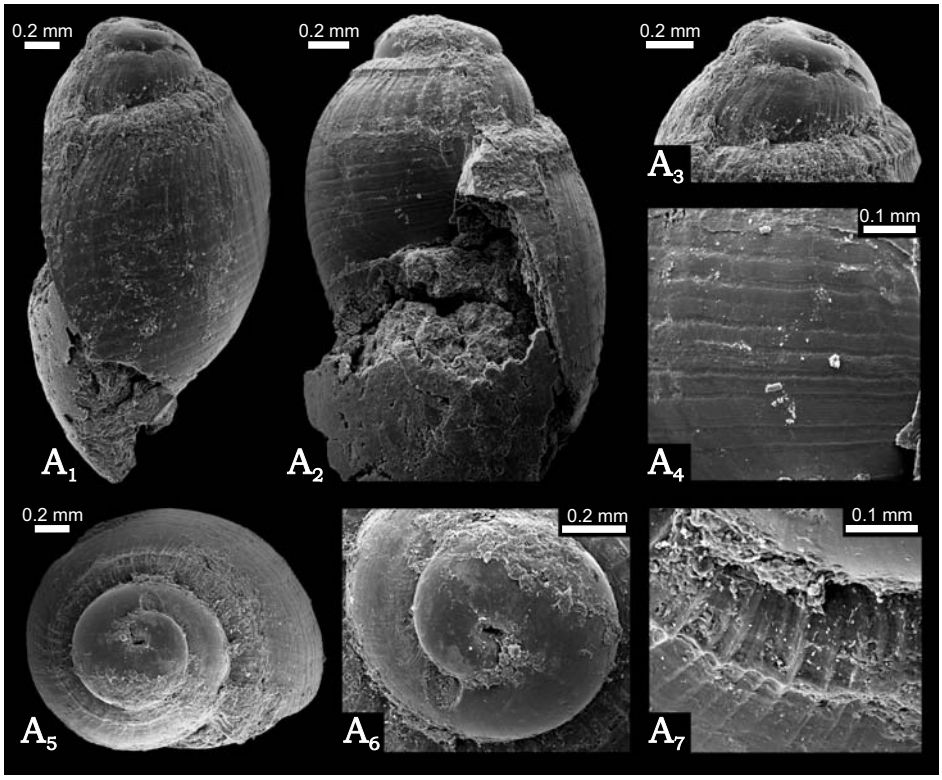

Fig. 12. Bullinid *Sulcoactaeon timanicus* sp. n. from Sevierno-Timanskaja, borehole 218, Timan region, Russia, unspecified Late Jurassic. **A**. ZPAL Ga.10/58 (holotype); A_1–A_2 lateral views, A_3 protoconch in lateral view, A_4 details of teleoconch ornamentation, A_5 apical view, A_6 protoconch in umbilical view, A_7 close-up of the adapical ramp.

Remarks. — *Sulcoactaeon timanicus* differs from other species of the genus by the presence of the spiral rib at the angulation of the ramp.

Sulcoactaeon bojarkensis sp. n.
(Fig. 13)

Holotype: ZPAL Ga.10/61, Fig. 13.

Type horizon: Early Kimmeridgian.

Type locality: outcrop 23 of Levaja Bojarka River, northern part of Central Siberian Plateau, Russia.

Derivation of the name: after type locality.

Material. — Holotype only.

Dimensions. — The teleoconch consisting of 3.25 whorls is 5.93 mm high and 4.29 mm wide.

Occurrences. — Type region only.

Diagnosis. — Shell turbiniform with strongly convex whorls. Adapical ramp indistinct. Lateral flanks ornamented with pitted striae.

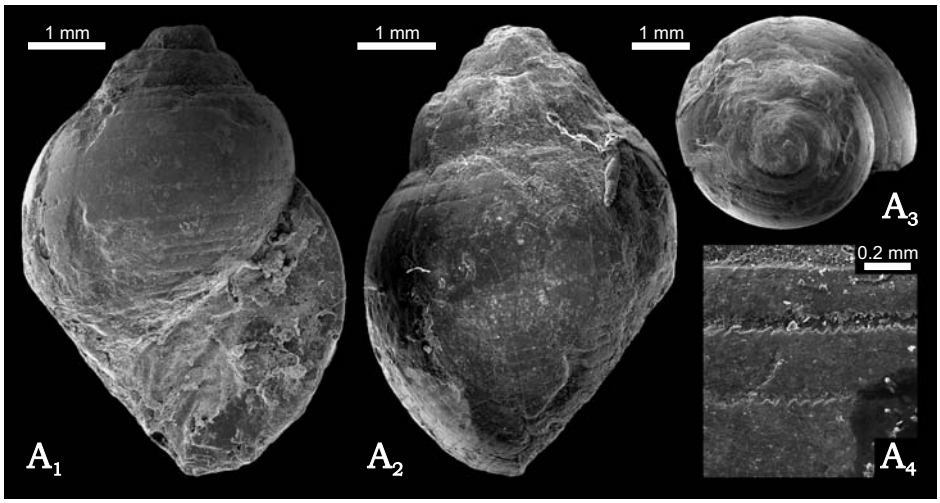

Fig. 13. Bullinid *Sulcoactaeon bojarkensis* sp. n. from Levaja Bojarka River, outcrop 23, northern part of Central Siberian Plateau, Russia, Early Kimmeridgian. **A**. ZPAL Ga.10/61 (holotype); A_1–A_2 lateral views, A_3 apical view, A_4 details of teleoconch ornamentation.

Description. — The protoconch is not preserved. The peristome is badly preserved.

Remarks. — *S. bojarkensis* differs from other species of the genus by its strongly convex whorls and its indistinct adapical ramp.

Sulcoactaeon sp.
(Fig. 14)

Material. — One incomplete shell from the Volgian of the Kamiennaja River, outcrop 101 of Zakharov (1970), Taymyr Peninsula, Siberia, Russia.

Dimensions. — The protoconch consists of 1.5 whorl and is 0.23 mm wide. The shell (ZPAL Ga.10/62) consists of about 3.5 whorls, and is 1.28 mm high, and 1.11 mm wide.

Description. — The shell is low-spired with high expansion of the whorl. The protoconch is poorly preserved, almost coaxial, consisting of 1.5 whorl. The whorls of the teleoconch are ornamented with spiral grooves, weak and rare at the upper flank and distinct and dense at the lower flank. The aperture is not preserved.

Remarks. — This species differ from the other *Sulcoactaeon* species in having largest expansion of the whorls.

Superfamily Acteonoidea d'Orbigny, 1842
Family Acteonidae d'Orbigny, 1842
Genus *Vasjugania* gen. n.

Type species: *Vasjugania vasjuganensis* sp. n., Maastrichtian, Vasjuganskij, borehole pr-1 2-k, Western Siberia, Russia.

Derivation of the name: after the type locality.

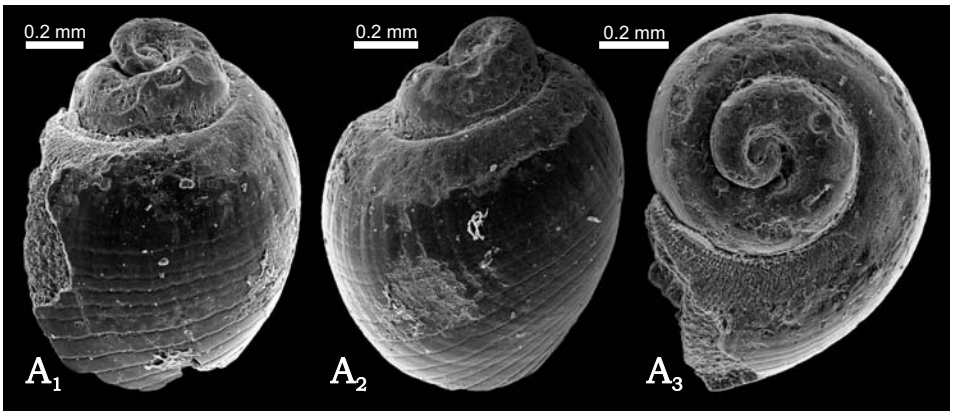

Fig. 14. Bullinid *Sulcoactaeon* sp. from Kamiennaja River, outcrop 101, Taymyr Peninsula, Siberia, Russia, Volgian. **A**. ZPAL Ga.10/62; A_1–A_2 lateral views, A_3 apical view.

Diagnosis. — Protoconch almost coaxial. Shell subovate, spire less than half total shell height. Sculpture consisting of spiral furrows narrower than their interspaces. Peristome posteriorly narrowed. Inner lip callused over columellar area bearing four oblique folds.

Discussion. — *Vasjugania* is very similar to *Tornatellaea* d'Orbigny, 1842 but differs in having four teeth on the inner lip. Ringiculids have a similarly complicated peristome but they are usually much lower spired. Similar to *Vasjugania* is *Acteon ringens* d'Orbigny, 1842 from Hauterivian of France, which also has four teeth on the inner lip but a much more involute shell. This species can also be classified as *Vasjugania*.

Range. — Hauterivian to Maastrichtian.

Vasjugania vasjuganensis sp. n.
(Fig. 15)

Holotype: ZPAL Ga.10/63, Fig. 15.

Type horizon: Gankin Fm, Maastrichtian.

Type locality: Vasjuganskij, borehole pr-1 2-k, Western Siberia, Russia.

Derivation of the name: after type locality.

Material. — Holotype only.

Dimensions. — The teleoconch consists of 6.5 whorls, is 6.21 mm high, and is 3.20 mm wide.

Occurrences. — Type locality only.

Diagnosis. — Protoconch almost coaxial. Shell subovate, spire less than half of total shell height. Teleoconch ornamented with spiral grooves, evenly spaced over entire shell surface. Callus of inner lip thin, widely extended over columellar area. Collumellar lip bearing two stronger and one weaker oblique fold. Parietal lip bearing one fold.

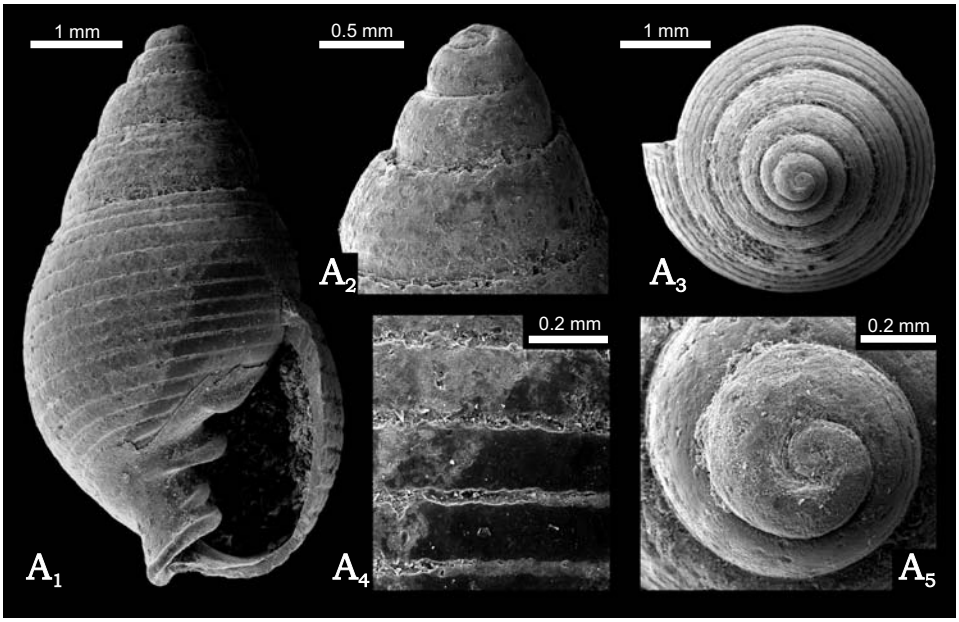

Fig. 15. Acteonid *Vasjugania vasjuganensis* sp. n. from Vasjuganskij, borehole pr-1 2-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/63 (holotype); A_1 lateral view, A_2 apex in lateral view, A_3 apical view, A_4 details of teleoconch ornamentation, A_5 apex in apical view.

Description. — The protoconch and the early teleoconch are poorly preserved with their surfaces eroded. The outer lip is broken.

Remarks. — The shell shape of *V. vasjuganensis* is most similar to that of *Tornatellaea matura* (Schröder, 1995) from Valanginian of Poland (Schröder 1995, Kaim 2004) but the latter differs in having only two teeth and pitted striae.

Superfamily Ringiculoidea Philippi, 1853
Family Ringiculidae Philippi, 1853
Genus *Biplica* Popenoe, 1957

Type species: *Biplica heteroplicata* Popenoe, 1957; original designation. Early Senonian (Late Cretaceous), south side of Clover Creek valley, Shasta County, California, United States.

Diagnosis. — Ovoid to globose ringiculids with labrum smooth within, anterior labral margin adjacent to columella shallowly emarginate, inner lip more or less thickened with a callus overlay, columella generally bearing two folds, the posterior usually strong, sharp prominent, transverse to the columella, anterior fold in the geologically older forms equal and parallel to the posterior; in later forms becoming progressively weaker and more oblique, and finally disappearing in the Late Upper Cretaceous specimens; folds limited externally by the callus layer of the inner lip (from Popenoe 1957).

Discussion. — There are some genera of globose ringiculids, which are very similar to *Biplica*. *Avellana* d'Orbigny, 1842; *Eriptycha* Meek, 1876; and *Ringiculopsis* Chavan, 1947 differ from *Biplica* in having a dentate outer lip (Popenoe 1957, Squires and Saul 2001). *Oligoptycha* Meek, 1876 has only one columellar fold (Squires and Saul 2001).

Range. — Albian to Maastrichtian.

Biplica siberica sp. n.
(Fig. 16)

Holotype: ZPAL Ga.10/64, Fig. 16B

Type horizon: Gankin Fm, Maastrichtian.

Type locality: Narymskaja borehole 28-k, Western Siberia, Russia.

Derivation of the name: after Siberia.

Material. — Three specimens from the type locality.

Dimensions. — The shell of the holotype, consisting of 3.75 whorls, is 3.58 mm high and 4.71 mm wide.

Occurrences. — Type locality only.

Diagnosis. — Shell globose, spire depressed. Sculpture of incised spirals consisting of series of chainlike links. Outer lip thickened and edentate within. Columella bearing one strong anterior fold. One weaker fold situated slightly anteriorly to former one.

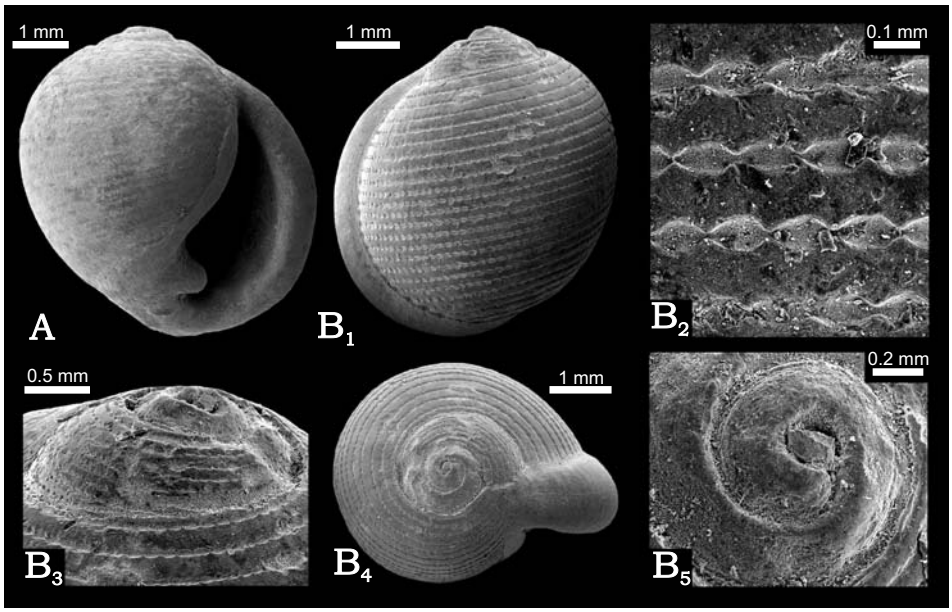

Fig. 16. Ringiculid *Biplica siberica* sp. n. from Narymskaja, borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/66; lateral view. **B**. ZPAL Ga.10/64 (holotype); B_1 lateral view, B_2 details of teleoconch ornamentation, B_3 apex in lateral view, B_4 apical view, B_5 apex in apical view.

Description. — The protoconch and the early teleoconch are poorly preserved with its surface eroded. The spiral grooves are evenly spaced and usually there are 24 grooves on the body whorl.

Remarks. — *Biplica siberica* is most similar to *Biplica heteroplicata* Popenoe, 1957 from the Pacific Coast of United States but the latter species differs in larger size of the adult individuals. According to Popenoe (1957) the shell height of *B. heteroplicata* varies from 4.5 to 8.0 (with majority between 6.0–7.0 mm; data of Popenoe 1957) while *B. siberica* do not exceed 4.0 mm in height. Moreover the anterior fold of *B. heteroplicata* is only present in the last whorl while it is present constantly through the ontogeny of *B. siberica*.

Order Cephalaspidea Fischer, 1883
Superfamily Philinoidea Gray, 1850
Family Cylichnidae Adams and Adams, 1854
Genus *Cylichna* Lovén, 1846

Type species: *Bulla cylindracea* Pennant, 1777; subsequent designation by Herrmannsen (1852).

Diagnosis. — Small slender cylindrical shells. Spire involute, apically truncate, and perforate in early growth stages. Surface smooth or with fine incised spiral grooves. Aperture posteriorly narrow but expanding to rounded anterior end. Columellar lip with low fold (from Sohl 1964).

Discussion. — The shells of *Cylichna* have extremely similar shape to those of the family Retusidae. The latter differs usually only in having thinner shell, and possibly in different mineralogical composition (Burn and Thompson, 1998).

Range. — Late Cretaceous to Recent.

Cylichna sp.
(Fig. 17)

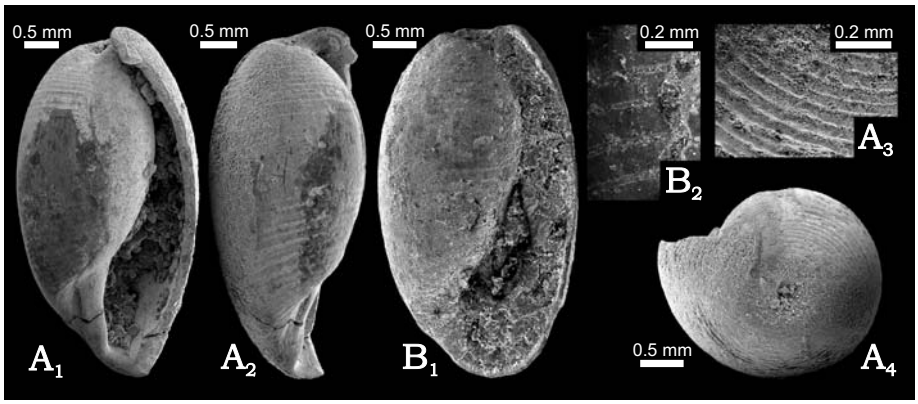

Fig. 17. Cylichnid *Cylichna* sp. from Narymskaja, borehole 28-k, Western Siberia, Russia, Maastrichtian. **A**. ZPAL Ga.10/68; A_1–A_2 lateral view, A_3 details of teleoconch ornamentation in apical view, A_4 apical view. **B**. ZPAL Ga.10/67; B_1 lateral view, B_2 details of teleoconch ornamentation in lateral view.

Material. — Two, most probably juvenile, incomplete shells from Narymskaja, borehole 28-k, Western Siberia, Russia, Gankin Fm, Maastrichtian.

Dimensions. — The shell ZPAL Ga.10/68 is 3.79 mm high and 1.97 mm wide.

Description. — The shell is slender and involute. The protoconch is not preserved. The teleoconch is ornamented with dense but shallow spirae. The peristome is elongated, adapically narrow and widened abapically. The apex has a shallow hollow. The columellar lip is narrow with a small umbilical chink present.

Remarks. — The species of *Cylichna* are extremely hard to define. They differ conchologically almost exclusively in obesity and density of the spirae. The shells under consideration are most similar to the Late Cretaceous *Cylichna intermissia* Sohl, 1964 from the United States (Sohl 1964). Because of imperfect preservation we leave the species unnamed.

Discussion

The material described herein as well as that already published by Tullberg (1881), Beisel (1977, 1983, 1991), and Kaim *et al.* (2004) show remarkable diversity of the Jurassic and Cretaceous gastropod fauna in Siberia. This assemblage is comparable to those already known from Europe (*e.g.* Kaunhowen 1887, Holzapfel 1888, Abdel-Gawad 1986, Kaim 2004 and references therein) and North America [*e.g.* US Gulf Coast (Sohl 1960, 1964; Dockery 1993), US Pacific Coast (Stewart 1930, Popenoe 1983, Saul 1983, Elder and Saul 1996, Saul 1998, Squires and Saul 2001), Dakota and Wyoming (Sohl 1967, Erickson 1974), and others]. The scarcity of data on Siberian gastropods is caused mainly by lack of natural outcrops and/or difficulties in sampling.

The data obtained in this paper supports the earlier conclusion (Kaim *et al.* 2004) that Siberian Mesozoic gastropods are rather of cosmopolitan than endemic character. The Late Jurassic–Early Cretaceous gastropods in Siberia show significant similarity to their counterparts from Russian Platform (Gerasimov 1955, 1992) and, less clearly, to the gastropod fauna from Poland and Germany (*e.g.* Gründel 1990, 1993; Kaim 2004). A single group of gastropods which is unknown outside of Siberia (Beisel 1977, 1983, and this paper) and Russian Platform (Gerasimov 1992) is the genus *Khetella*. This group apparently belongs to Purpurinidae, a potential sister group of Neogastropoda (Taylor *et al.* 1980). Moreover, Purpurinidae are related to Maturifusidae, which were postulated to be a stem group for neogastropods (Kaim 2004). The protoconch morphology of *Khetella bojarkae* described here as well as the protoconchs of other purpurinids illustrated by Kaim (2004) may suggest that Purpurinidae form a stem group of Neogastropoda while Maturifusidae is their sister group.

The Maastrichtian gastropods described herein and those described by Beisel (1991) belong mainly to cosmopolitic or North American genera (e.g. *Exilia*, *Amuletum*, *Biplica*, and *Cylichna*), but they usually represent endemic species. We

Table 1

A list of the species described in this paper with localities and their geological age.

No.	Species	Locality	Age
	Family Purpurinidae		
1	*Khetella bojarkae* Beisel, 1977	Levaja Bojarka	Kimmeridgian
2	*Khetella* sp.	Strukturnaja	unspecified Late Jurassic
	Family Turbinellidae		
3	*Exilia narymensis* (Beisel, 1991)	Narymskaja	Maastrichtian
4	*Exilia* sp.	Krasnyj Agronom	Maastrichtian
5	Gen. et sp. indet.	Narymskaja	Maastrichtian
	Family Fasciolariidae		
6	Gen. et sp. indet.	Ust' Silga	Maastrichtian
	Family uncertain		
7	Gen. et sp. indet.	Narymskaja	Maastrichtian
	Family Pseudolividae		
8	Gen. et sp. indet.	Ust' Silga	Maastrichtian
	Family Turridae		
9	*Amuletum obensis* Beisel, 1991	Narymskaja	Maastrichtian
	Family Bullinidae		
10	*Sulcoactaeon uralicus* sp. n.	Saranpaulskaja	Valanginian
11	*Sulcoactaeon timanicus* sp. n.	Sevierno-Timanskaja	unspecified Late Jurassic
12	*Sulcoactaeon bojarkensis* sp. n.	Levaja Bojarka	Kimmeridgian
13	*Sulcoactaeon* sp.	Kamiennaja	Volgian
	Family Acteonidae		
14	*Vasjugania vasjuganensis* sp. n.	Vasjuganskij	Maastrichtian
	Family Ringiculidae		
15	*Biplica siberica* sp. n.	Narymskaja	Maastrichtian
	Family Cylichnidae		
16	*Cylichna* sp.	Narymskaja	Maastrichtian

described only one new genus *Vasjugania* of tiny acteonids from this period. An another group of small heterobranchs, Bullinidae, is well diversified in the Jurassic and Cretaceous of Siberia, similar to its occurrence in Europe (Gründel 1997, Kaim 2004). Notable is the presence of five neogastropod families in the Maastrichtian of Siberia in the small sample of gastropods described so far. It suggests than the overall diversity of Siberian gastropods is much higher and biased by limited sampling.

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References

ABDEL-GAWAD G.I. 1986. Maastrichtian non-cephalopod mollusks (Scaphopoda, Gastropoda and Bivalvia) of the Middle Vistula Valley, Central Poland. *Acta Geologica Polonica* 36: 69–224.

BEISEL A.L. 1977. *Khetella* – novyj rod gastropod iz vierchniej jury i nizhnievo mela seviera Eurazji. *Paleontologicheskij Zhurnal* 1: 146–147.

BEISEL A.L. 1983. Pozdniejurskije i ranniemielovyje gastropody seviera sredniej Sibirii. *Trudy Instituta Geologii i Geofizyki ANSSSR* 484: 1–94.

BEISEL A.L. 1991. Novyje vidy gastropod iz vierhniego miela Zapadnoj Sibiri. *Trudy Instituta Geologii i Geofizyki ANSSSR* 796: 176–183.

BURN R. and THOMPSON T.E. 1998. Order Cephalaspidea *In*: P.L. Beesley, G.J.B. Ross and A. Wells (eds) *Mollusca: The Southern Synthesis. Fauna of Australia,* 5. CSIRO Publishing, Melbourne: 943–959.

DOCKERY D.T. III 1993. The streptoneuran gastropods, exclusive of the Stenoglossa, of the Coffee Sand (Campanian) of northeastern Mississippi. *Mississippi Department of Environmental Quality Office of Geology Bulletin* 129: 1–191.

ELDER W.P. and SAUL L.R. 1996. Taxonomy and biostratigraphy of Coniacian through Maastrichtian *Anchura* (Gastropoda: Aporrhaidae) of the North American Pacific Slope. *Journal of Paleontology* 70: 381–399.

ERICKSON J.M. 1974. Revision of the Gastropoda of the Fox Hills Formation, Upper Cretaceous (Maestrichtian) of North Dakota. *Bulletins of American Paleontology* 66: 131–253.

GERASIMOV P.A. 1955. *Rukovodiashchiye iskopayemyye mezozoya centralnych oblastey evropeyskoy chasti SSSR. Chast' I. plastinchatozhabernoye mollyuski i plechenogiye jurskich otlozhenii.* Gosgeoltehizdat, Moskva: 375 pp.

GERASIMOV P. A. 1992. *Gastropody yurskih i pogranichnyh nizhniemielovyh otlozhenii evropeiskoi Rossii*. Nauka, Moskva: 190 pp.

GOLBERT A.B., KLIMOVA I.G. and SAKS V.N. 1972. *Opornyj razriez neokoma Zapadnoj Sibiri v Pripoliarnom Zauralie.* Nauka, Novosibirsk: 184 pp.

GRÜNDEL J. 1990. Gastropoden aus Callov-Geschieben aus dem Nordosten Deutschlands. II. Mathildidae, Trochacea, Palaeotrochacea, Amberleyacea, Rissoinidae, Pleurotomariidae und Purpurinidae. *Zeitschrift für Geologische Wissenschaften* 18: 1137–1151.

GRÜNDEL J. 1993. Gastropoden aus Callov-Geschieben aus dem Nordosten Deutschlands. III. Aporrhaidae, Actaeonidae und Rissoinidae. *Zeitschrift für Geologische Wissenschaften* 21: 359–370.

GRÜNDEL J. 1997. Heterostropha (Gastropoda) aus dem Dogger Norddeutschlands und Nordpolens. III. Opisthobranchia. *Berliner Geowissenschaftliche Abhandlungen, Reihe E* 25: 177–223.

HERRMANNSEN A.N. 1852. *Indicis Generum Malacozoorum Supplementa et Corrigenda*. Naturwissenschaftlicher Verlag von Theodor Fischer, Cassel: 136 pp.

HOLZAPFEL E. 1888. Mollusken der Aachener Kreide. *Palaeontographica* 34: 29–180.

KAIM A. 2004. The evolution of conch ontogeny in Mesozoic open sea gastropods. *Palaeontologia Polonica* 62: 3–183.

KAIM A., BEISEL A.L. and KURUSHIN N.I. 2004. Mesozoic gastropods from Siberia and Timan (Russia). Part 1: Vetigastropoda and Caenogastropoda (exclusive of Neogastropoda). *Polish Polar Research* 25: 241–266.

KANTOR Y. I., BOUCHET P. and OLEINIK A. 2001. A revision of the Recent species of *Exilia*, formerly *Benthovoluta* (Gastropoda: Turbinellidae). *Ruthenica* 11: 81–136.

KAUNHOWEN F. 1897. Die Gastropoden der Maestrichter Kreide. *Palaeontologische Abhandlungen. Neue Folge* 4: 3–132.

KIEL S. 2002. Notes on the biogeography of Campanian–Maastrichtian gastropods. *Österreichische Akademie der Wissenschaften Schriftenreihe der Erdwissenschaftlichen Kommissionen* 15: 109–127.

PACAUD J.-M. and SCHNETLER K.I. 1999. Revision of the family Pseudolividae from the Paleocene of West Greenland and Denmark. *Bulletin of the Geological Society of Denmark* 46: 53–67.

PACAUD J.-M. and TRACEY S. 2000. The occurrence of the genus *Fusulculus* Bouchet and Vermeij (Gastropoda, Pseudolividae) in the Eocene of England, with a description of two new species. *Tertiary Research* 20: 53–58.

PODOBINA V.M. 2000. *Foraminifery i biostratigrafija vierhniego miela Zapadnoj Sibiri*. Izdatielstvo Tomskogo Univeristeta, Tomsk: 388 pp.

POPENOE W.P. 1957. The Cretaceous gastropod genus Biplica. Its evolution and biostratigraphic significance. *University of California Publications in Geological Sciences* 30: 425–454.

POPENOE W.P. 1983. Cretaceous Aporrhaidae from California: Aporrhainae and Arrhoginae. *Journal of Paleontology* 57: 742–765.

SAKS V.N. (ed.). 1969. *Opornyj razriez vierhniejurskih otlozhenii bassiejna r. Khety (Khatangskaja vpadina)*. Nauka, Leningrad: 208 pp.

SAUL L.R. 1983. Turritella Zonation across the Cretaceous–Tertiary Boundary, California. *University of California Publications in Geological Sciences* 125: 1–165.

SAUL L.R. 1998. Eight aporrhaid gastropod species from the Cretaceous of the Pacific slope of North America and clarification of the type species of *Perissoptera*. *Nautilus* 111: 119–142.

SCHRÖDER M. 1995. Frühontogenetische Schalen jurassicher und unterkretazischer Gastropoden aus Norddeutschland und Polen. *Palaeontographica A* 238: 1–95.

SHURYGIN B.N. (ed.). 2000. *Stratigrafija neftiegazonosnych bassiejnov Sibiri. Jurskaja sistiema*. Geo, Novosibirsk: 480 pp.

SOHL N.F. 1960. Archeogastropoda, Mesogastropoda and stratigraphy of the Ripley Owl Creek, and Prairie Bluff Formations. *Geological Survey Professional Paper* 331-A: 1–151.

SOHL N.F. 1964. Gastropods from the Coffee Sand (Upper Cretaceous) of Mississippi. *Geological Survey Professional Paper* 331-C: 345–394.

SOHL N.F. 1967. Upper Cretaceous gastropods from the Pierre Shale at Red Bird, Wyoming. *Geological Survey Professional Paper* 393-B: 1–46.

SQUIRES R.L. and SAUL L.R. 2001. New Late Cretaceous gastropods from the Pacific slope of North America. *Journal of Paleontology* 75: 46–65.

STEWART R.B. 1927. Gabb's California fossil type gastropods. *Proceedings of the Academy of Natural Sciences of Philadelphia* 78: 287–447.

TAYLOR J.D., MORRIS N. and TAYLOR C. 1980. Food specialization and the evolution of predatory prosobranch gastropods. *Palaeontology* 23: 375–409.

TULLBERG S.A. 1881. Ueber Versteinerungen aus den Aulacellen–Schichten Novaja-Semljas. *Bihang Till Kunlige Svenska Vetenskap Akademie Handlingar* 6: 1–25.

VERMEIJ G.J. 1998. Generic revision of the neogastropod family Pseudolividae. *Nautilus* 111, 53–84.

WENZ W. 1940. Gastropoda. Teil 4: Prosobranchia *In*: O.H. Schindewolf (ed.) *Handbuch der Paläozoologie,* Band 6. Verlag von Gebrüder Borntraeger, Berlin: 721–960.

ZAKHAROV V.A. 1970. Late Jurassic and Early Cretaceous Bivalves of Northern Siberia and their Ecology, Part 2, Fam. Astartidae. *Trudy Instituta Geologii i Geofizyki ANSSSR* 113: 1–144.

ZAKHAROV V.A., BOGOMOLOV Y.I., ILJINA V.I., KONSTANTINOV A.G., KURUSHIN N.I., LEBEDEVA N.K., MELEDINA S.V., NIKITENKO B.L., SOBOLEV E.S. and SHURYGIN B.N. 1997. Borealnyj zonalnyj standart i biostratigrafija mezozoja Sibiri. *Russian Geology and Geophysics* 38: 927–956.

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