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# FOUR NEW SPECIES AND ONE NEW GENUS OF JURASSIC CHITONS (MOLLUSCA: POLYPLACOPHORA: LEPIDOPLEURIDA) FROM THE MIDDLE RUSSIAN SEA

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**ABSTRACT**

Four new species and one new genus: *Leptochiton shapovalovi* Sirenko **sp. nov.**, *L. liapini* Sirenko **sp. nov.**, *L. dellangelloi* Sirenko **sp. nov.**, and *Hoarechiton guzhovi* Sirenko **gen. nov.** et **sp. nov.** are described from the Middle Russian Sea (Jurassic). *L. shapovalovi* is probably a xylophagous chiton because this species was found along with pieces of sunken wood and has an aesthete group very similar to some recent xylophagous species. It speculated that the genus *Leptochiton* was formed under rather temperate or cold conditions in the end of the Paleozoic.

**Key words:** *Leptochiton,* Jurassic chitons, Middle Russian Sea, xylophagous

# ЧЕТЫРЕ НОВЫХ ВИДА И ОДИН НОВЫЙ РОД ЮРСКИХ ХИТОНОВ (MOLLUSCA: POLYPLACOPHORA: LEPIDOPLEURIDA) ИЗ СРЕДНЕРУССКОГО МОРЯ

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**РЕЗЮМЕ**

Четыре новых вида *Leptochiton shapovalovi* Sirenko **sp. nov.**, *L. liapini* Sirenko **sp. nov.**, *L. dellangelloi* Sirenko **sp. nov.** и *Hoarechiton guzhovi* Sirenko **gen. nov.** et **sp. nov.** описаны из юрских отложений Среднерусского моря. *L. shapovalovi*, по-видимому, был ксилофагом, поскольку найден вместе с кусочками затонувшей древесины и эстетная группа этого вида очень похожа на таковую некоторых рецентных видов – ксилофагов. Предполагается, что род *Leptochiton* сформировался в умеренных или холодных водах в конце Палеозоя.

**Ключевые слова:** *Leptochiton,* хитоны юры, Среднерусское море, ксилофаги

## INTRODUCTION

About fifty species of Mesozoic chitons were described mainly from Western Europe and also from North America, North Africa and China (Dubar 1948; Smith 1973; Van Belle 1981; Laghy 1982, 2005; Fiedel and Keupp 1988; Geyer and Kukla 1990; Feng Ru-Lin 1992; Kaim 2010). Only one species of chiton from Siberia (Lower Jurassic) was described from the vast territory of Russia (Shurygin 2001).

The aim of this paper is to describe new Jurassic species of the genus *Leptochiton*, recorded in Russia.

## MATERIAL AND METHODS

New collections of chitons from European Russia were made in 2007–2008 by Kiril Shapovalov (Moscow), Vjacheslav Liapin (Moscow) and Alexandr Guzhov (Paleontological Institute of Russian Academy of Sciences, Moscow). The collections were

made in the Kostroma Region, Russia (57°59′41′′N; 44°00′09′′E), in Moscow, Russia (55°44′34′′N; 37°26′29′′E) and in the Moscow region, Russia (57°45′20′′N; 38°18′50′′E) (Fig. 1). The valves were found in clay. Standard measurements were taken using ruler in order to find dorsal elevation which is equal to the ratio of the height: width ratio of an intermediate valve (Kaas and Van Belle1985). Scanning electron microscope (SEM) was used for examination of valves. All valves examined by SEM were observed in high vacuum mode with a platinum coating. Material described in this paper is housed in the Zoological Institute of the Russian Academy of Sciences, Saint Petersburg (ZIN).

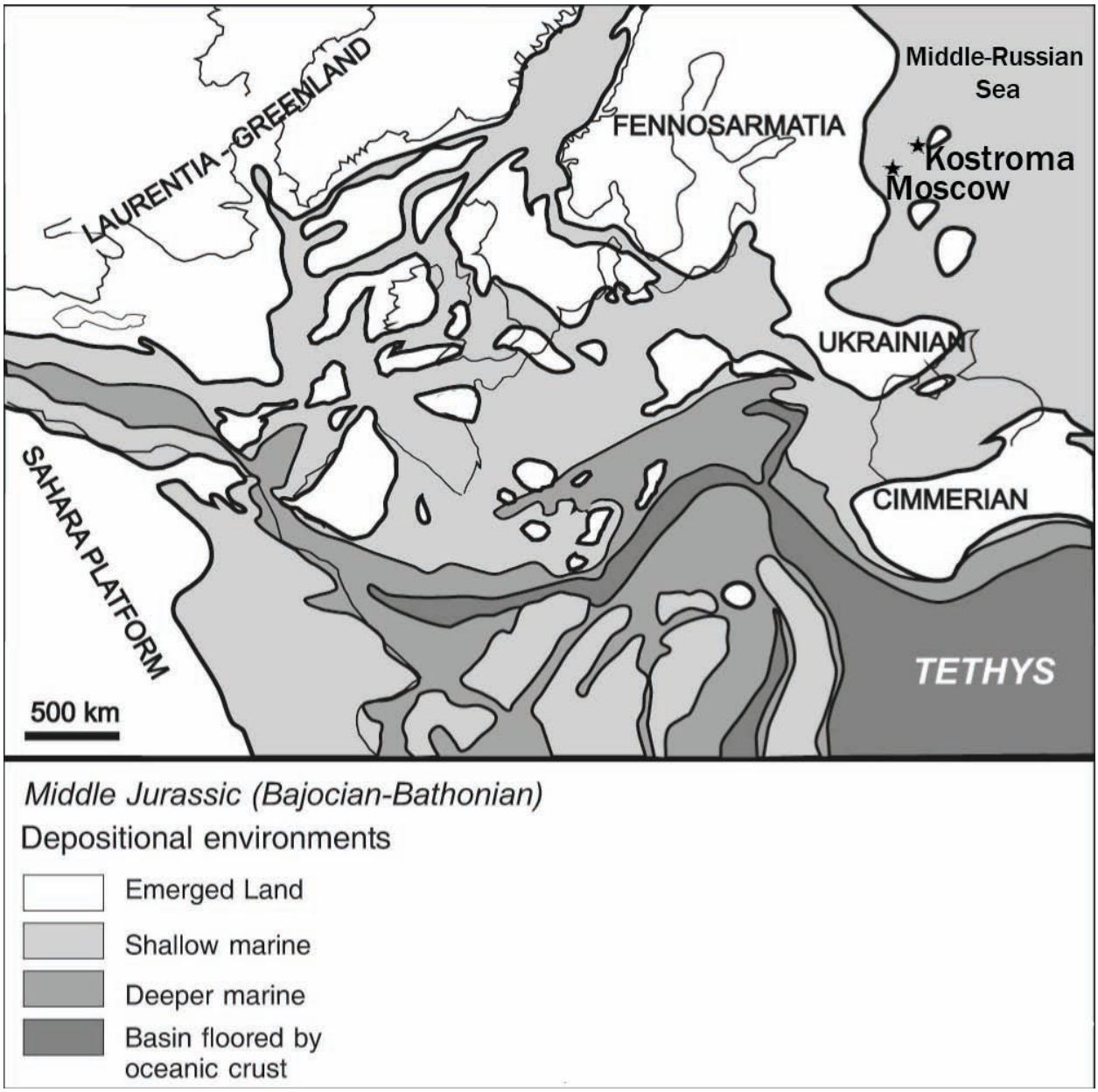


**Fig. 1**. Paleogeography of the Middle Jurassic in Europe (modified from Ziegler 1988 and Fernandez-Lopez et al. 2009). Stars are the place where materials were collected.

## SYSTEMATICS

**Class Polyplacophora Gray, 1821**
**Subclass Loricata Schumacher, 1817**
**Order Lepidopleurida Thiele, 1909**
**Family Leptochitonidae Dall, 1889**
**Genus *Leptochiton* Gray, 1847**

**Type species**. *Chiton cinereus* Montagu, 1803, non Linnaeus, 1767 (= *Chiton asellus* Gmelin, 1791) by subsequent designation (Gray 1847).

**Remarks.** Analysis of descriptions and drawings of four fossil chitons: *Chiton deshayesi* Terquem, 1852 (Lower Jurassic), *Ischnochiton marloffsteinensis* Fiedel et Keupp, 1988 (Middle Jurassic), *Pterygochiton sibiricus* Shurygin, 2001 (Lower Jurassic) and "leptochitonid polyplacophoran" (Kaim 2010) showed that they belong to the genus *Leptochiton* because their valves are sculptured very similarly by radial ribs of granules on the head valve, on the lateral areas of intermediate valves and on the postmucronal area of the tail valve, and by longitudinal ribs of granules on the central area of intermediate valves and on the antemucronal area of the tail valve, which is very characteristic of the genus *Leptochiton,* but not of *Ischnochiton*. The presence of slits on insertion plates of *Ischnochiton marloffsteinensis* shown by Fiedel and Keupp (1988) in their drawings (fig. 5 in Fiedel and Keupp 1988) is very doubtful and the broad apophyses are characteristic of Jurassic leptochitons. Smith (1973) also indicated that *Chiton deshayesi* has "normal structure and sculpture for the genus *Lepidopleurus* (or *Leptochiton*) although it may not be that genus". Van Belle (1981) included this species in the genus *Leptochiton* under question. In this way the genus *Leptochiton* together with three newly described species in the Jurassic inhabited a very wide space in the north of Tethys Ocean from France to North Siberia.

During the last 40 years several species that belonged to the genus *Leptochiton* were removed from it and placed in new genera: *Hanleyella* Sirenko, 1973, *Ferreiraella* Sirenko, 1988 and *Nierstraszella* Sirenko, 1992. The genus *Deschayesiella* Carpenter in Dall, 1879 was synonymised with *Leptochiton* by Van Belle (1983), when the latter genus was revised (Sirenko 1997). Several new species of the genus *Leptochiton* were described in recent years. Taking into considerations all changes in the composition of the genus *Leptochiton,* I provide a revised diagnosis of this genus.

**Diagnosis.** Usually animals of rather small size. Intermediate valves rectangular, side margin rounded. Mucro anterior, submedian or slightly posterior. Tegmentum of intermediate valves divided into central and two lateral areas. Shell surface finely granulose. Granules arranged either in radiating rows on head valve, lateral areas of intermediate valves and postmucronal area of tail valve, or in longitudinal rows on central areas of intermediate valves and antemucronal area of tail valve, or quincuncially on all valves or on some areas of valves. Girdle dorsally covered with spicules or scales with or without fine ribs and scattered among them needles or spines.

### *Leptochiton shapovalovi* Sirenko sp. nov.
(Figs. 2–4, 8A)

**Diagnosis.** Body length up to about 35 mm. Shell subcarinated; rather high. Intermediate valves rectangular, with weakly developed apex and well divided areas. Tail valve with anterior mucro. Underfolded part of tegmentum of head and intermediate valves forming wide and thick ridge inside of posterior margin. Head valve, lateral areas of intermediate valves and postmucronal area of tail valve sculptured with radial ribs of oval flattened granules; radial ribs on lateral areas of intermediate valves interrupted; central area of intermediate valves and antemucrunal area of tail valve sculptured with longitudinal ribs of flattened granules, interstices as wide as chains, the ridges sometimes anastomosing. Each granule contains 1 megalaesthete and 13–26 micraesthetes. Sutural lamina rather wide.

**Description.** Animal rather large for genus. Shell subcarinated, moderately elevated (dorsal elevation 0.47).

Head valve semicircular, posterior margin widely V-shaped. Intermediate valves roughly rectangular, somewhat obliquely truncated at sides, anterior margin slightly convex, posterior margin almost straight, apices inconspicuous; lateral areas not raised but well marked by difference in sculpture. Head and intermediate valves have wide and thick ridge of underfolded part of tegmentum in their posterior margins. Tail valve semicircular, anterior margin slightly convex, mucro anterior.

Tegmentum sculptured with ribs of oval flattened weakly separated granules. On head valve, lateral

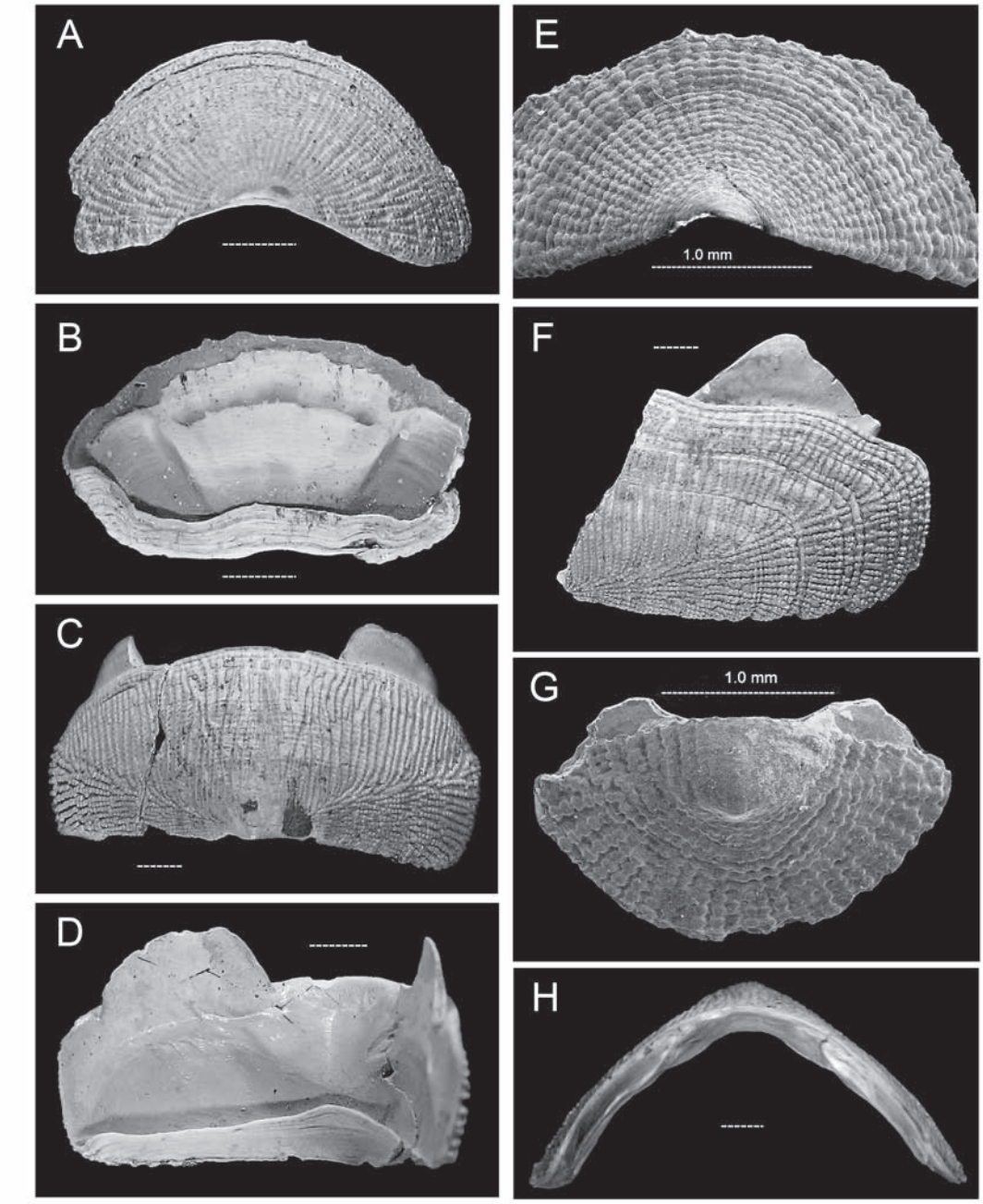


**Fig.** 2. *Leptochiton shapovalovi* sp. nov. A, B – paratype dorsal and ventral views, head valve, ZIN 2191; C, D, H – holotype dorsal, ventral and frontal views, ZIN 2190; E – paratype dorsal view, head valve, ZIN 2191; F – paratype dorsal view, intermediate valve, ZIN 2191; G – paratype dorsal view, tail valve, ZIN 2191. Scale bar = 1 mm.

areas of intermediate valves and postmucronal area of tail valve ribs arranged in radial order with very small interstices. On lateral areas radial ribs are not continuous but interrupted. 35–50 ribs on head valve, 12–16 on lateral areas, and 50–60 on central areas present. On central area of intermediate valve and antemucronal area of tail valve, ribs arranged in longitudinal order with interstices as wide as ribs.

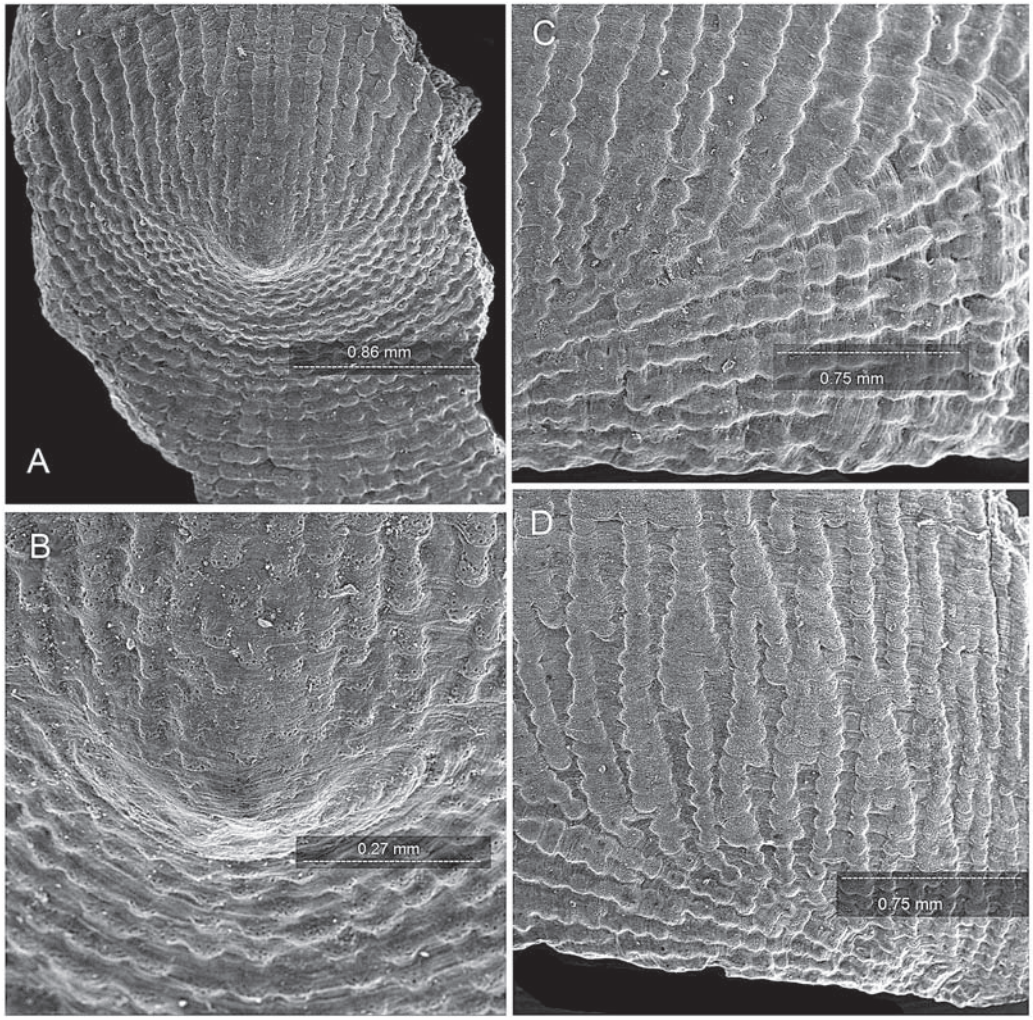


**Fig. 3**. *Leptochiton shapovalovi* sp. nov. A, B – paratype dorsal view, tail valve, ornamentation of antemucronal and postmucronal areas, ZIN 2191; C, D – paratypes dorsal view, right and left halves of intermediate valves, ornamentation of peural and lateral areas, ZIN 2191.

Sometimes ribs on central areas interrupted and anastomosing. Each granule with 1 megalaesthete and surrounded by semicircle of either 13–16 micraeasthetes (on head valve, lateral areas of intermediate valves and postmucronal area of tail valve) or 18–26 micraesthetes (on central area of intermediate valves) (Fig. 8, A).

Articulamentum well developed, apophyses rather wide, jugal sinus as wide as apophyses.

**Type Material.** Russia, Kostroma Region: 74 valves (6 head, 64 intermediate and 4 tail valves). Holotype, ZIN 2190 (intermediate valve, Fig. 2, C,D,H) and 73 paratypes ZIN 2191 (2 head valves, Fig. 2, A,B,E, 4,B; 3 intermediate valves, Fig. 2, F; 3, C,D; 4 A,C,D; 2 tail valves, Fig. 2, G, 3, A, B; 66 valves, unfigured lot), coll. K. Shapovalov and A. Guzhov.

**Occurrence.** Upper Oxford, Serratum Zone, Subserratum Subzone (Upper Jurassic), right bank of the Unzha River at 0.5 km above the village Mikhalenino, Makarjev District, Kostroma Province, Russia (57°59´41´´N; 44°00´09´´E).

**Etymology.** The specific name in honor of Kiril Shapovalov (Moscow) who collected part of the material and made it available to the author.

**Comparison.** Most of the available type material consists of poorly preserved incomplete valves. *Leptochiton shapovalovi* sp. nov. is similar to the Pleistocene *L. finlayi* (Ashby, 1929) in having the radial

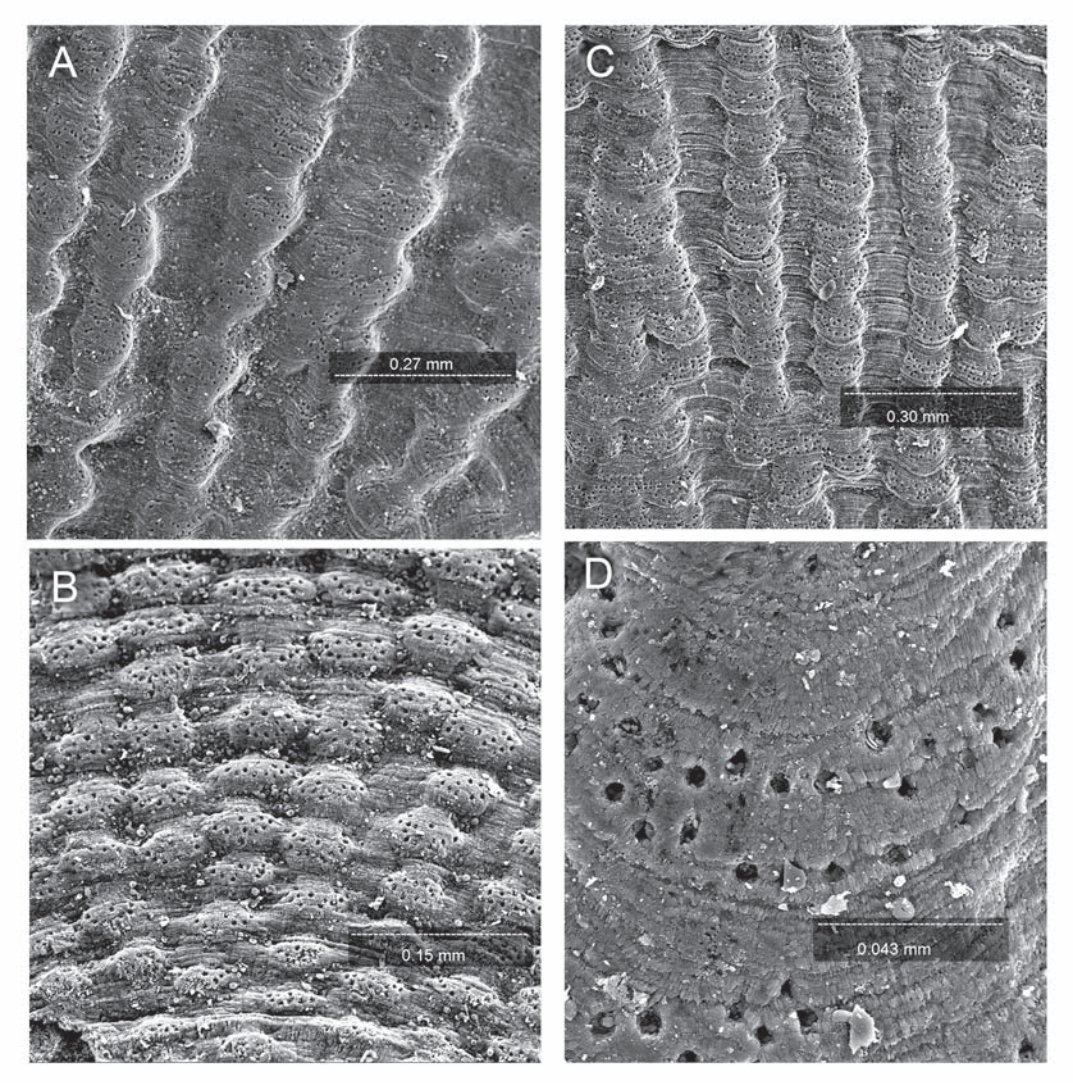


**Fig. 4**. *Leptochiton shapovalovi* sp. nov. A – paratype ornamentation of central area of intermediate valve, ZIN 2191; B – paratype ornamentation of head valve, ZIN 2191; C – paratype ornamentation of central area, intermediate valve, ZIN 2191; D – paratype, aesthete group on central area of intermediate valve.

ribs of granules on the valve I and the longitudinal ribs of granules with the large interstices between chains on the intermediate valves but differs from it by the subcarinated shell (rounded in *L. finlayi*) and the radial ribs of granules on the lateral areas of the intermediate valves and the postmucronal area of the tail valve (with no any order in *L. finlayi*). The new species differs from other leptochitons known from the Jurassic: *Leptochiton deshayesi* (Terquem, 1852) (Lower Jurassic, France), *L. marloffsteinensis* (Fiedel et Keupp, 1988) (Middle Jurassic, Germany), *Leptochiton sibiricus* (Shurygin, 2001) (Lower Jurassic, Siberia), and *Leptochiton* sp. (Kaim 2010) (Middle Jurassic, Poland) by having the interrupted rows on the lateral areas of the intermediate valves and large interstices between the rows on the central areas of the intermediate valves.

The new species is very similar to some recent xylophagous chitons such as *Leptochiton binghami* (Boone, 1928) and *L. vietnamensis* Sirenko, 1998 by having the numerous micraesthetes in the aesthete group but differs from them by having the radial rows of granules on the lateral areas of the intermediate valves.

***Leptochiton liapini* Sirenko sp. nov.**
(Figs. 5, 8, B)

**Diagnosis.** Intermediate valves broadly rectangular, side margins obtusely rounded, rather flat. Tegmentum of central areas sculptured with 36 longitudinal well-defined ridges with wider flat interspaces; each ridge consists of merged granules. Lateral areas with granules arranged quincuncially. Each granule of tegmentum with 1 megalaesthete, surrounded by either circle of 11–12 micraesthetes (on lateral areas) or semicircle of 11–13 micraesthetes (on central area). Apophyses short and wide.

**Description.** Head and tail valves not available. Intermediate valve rectangular, rather flat, rounded, anterior and posterior margins practically straight, apex not evident, lateral margins rounded; lateral areas not raised but pronounced by a difference in

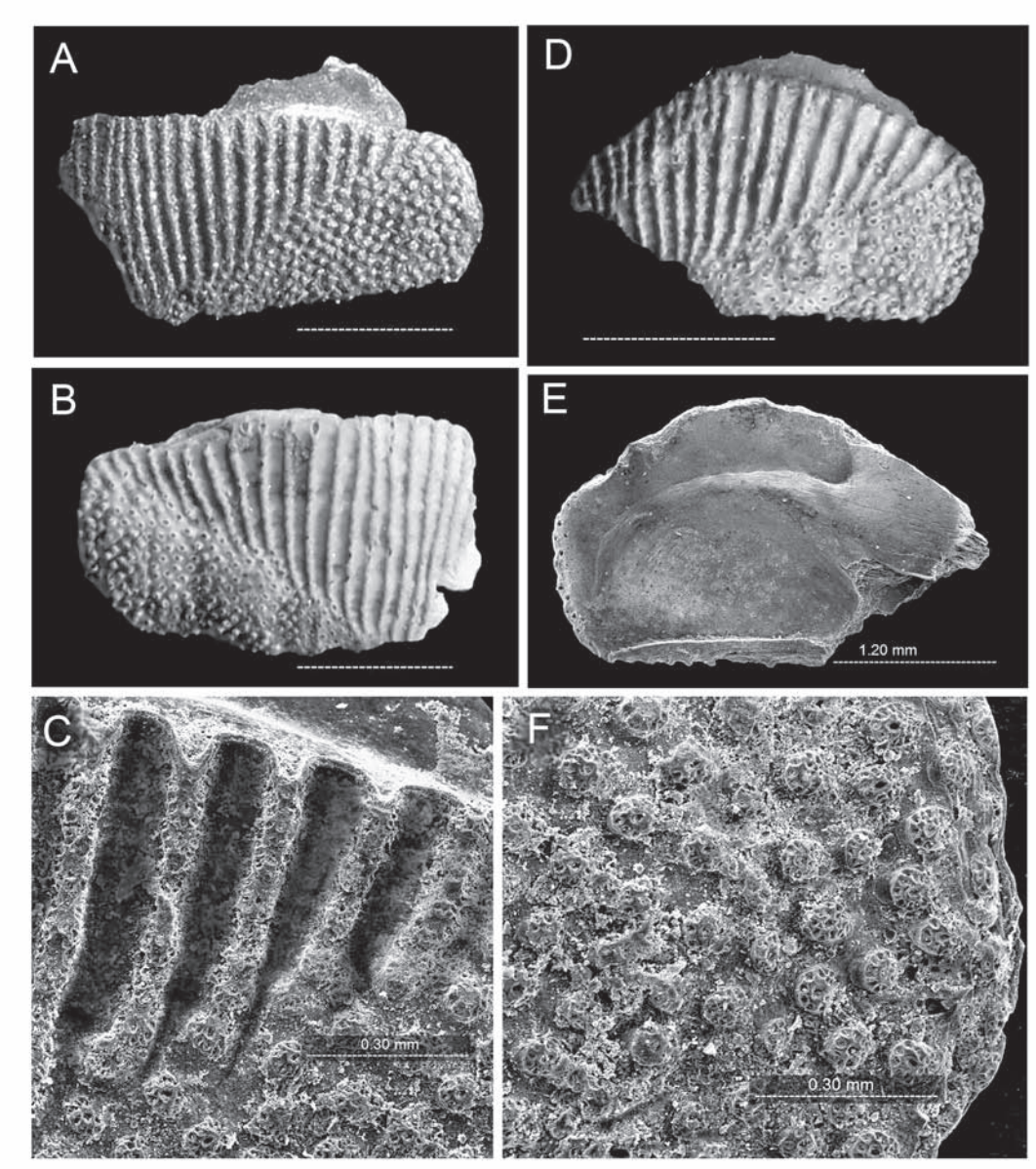


**Fig. 5**. *Leptochiton liapini* sp. nov. A, G, F – holotype dorsal view, pleural area and lateral area, ZIN 2192; B – paratype, dorsal view, intermediate valve, ZIN 2193; D – paratype, dorsal view, intermediate valve, ZIN 2193; E – paratype, ventral view, intermediate valve, ZIN 2193.

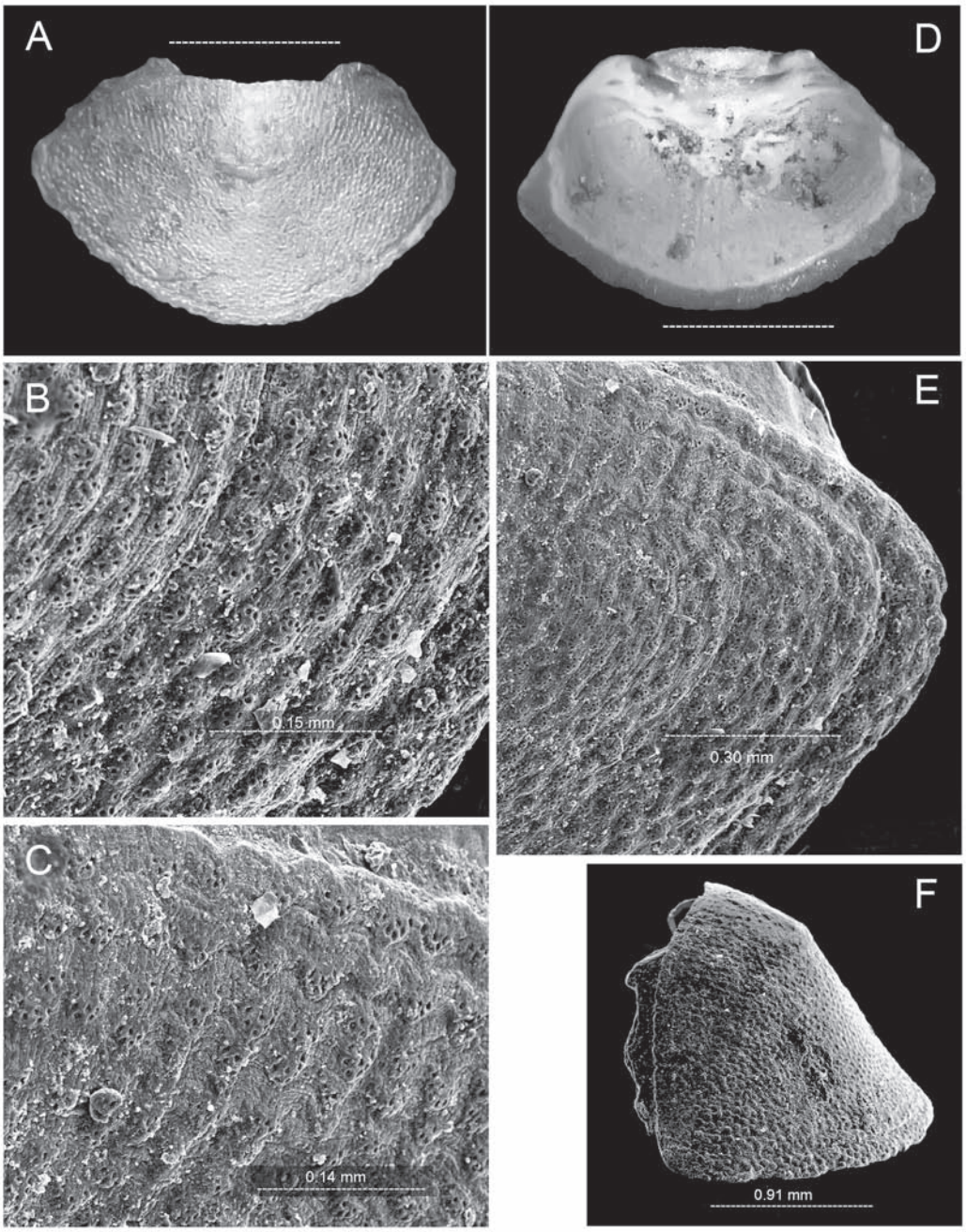


**Fig. 6**. *Leptochiton dellangelloi* sp. nov., holotype, ZIN 2194. A, D, F – dorsal, ventral and lateral views; B – ornamentation of postmucronal area; C – ornamentation of antemucronal area; E, ornamentation of antemucronal and postmucronal areas. Scale bar for A, D = 1 mm.

sculpture. Tegmentum of central areas sculptured with 36 longitudinal well-defined raised ridges, interstices wide, twice as broad as ridges; each ridge consists of merged oval granules. Tegmentum of lateral areas sculptured by round granules arranged quincuncially. Each granule of tegmentum with 1 megalaesthete, surrounded either by circle of 11–12 micraesthetes (on lateral areas) or semicircle of 11–13 micraesthetes (on central area) (Fig. 8, B). Surface of tegmentum on lateral area in paratypes

granulated or pitted where abraded indicating presence of aesthete canals.

Articulamentum well developed, apophyses widely separated, short and wide.

**Type Material.** Russia, Moscow Region: 3 incomplete intermediate valves. Holotype ZIN 2192 (intermediate valve, Fig. 5, A,C,F) and 2 paratypes ZIN 2193 (intermediate valves, Fig. 5, B,D,E), coll. V. Lapin.

**Occurrence.** Upper Callovian, Lamberti Zone, Paucicostatum subzone (Middle Jurassic), village Timokhovo, Ramensky District, Moscow Province, Russia (57°45´20´´N; 38°18´50´´E).

**Etymology.** New species named after Vjacheslav Liapin (Moscow) who collected valves and made them available to the author.

**Comparison.** *Leptochiton liapini* sp. nov. has the aesthete group (Sirenko 1992) rather similar with *Leptochiton saitoi* Sirenko, 2001, *L. vietnamensis* Sirenko, 1998 and some others. It differs from these species of the genus by having the well-defined raised ridges separated by wide interstices on the central area of the intermediate valves.

### *Leptochiton dellangelloi* Sirenko sp. nov.

(Figs. 6, 8, C)

**Diagnosis.** Shell rather elevated. Tail valve semicircular with anterior mucro, antemucronal and postmucronal slopes almost straight. Tegmentum sculptured with oval or round well-separated granules only slightly raised above tegmental surface. Granules arranged in longitudinal rows on antemucronal area and nearly quincuncially on postmucronal area. Apophyses short and wide.

**Description.** Animal small in size. Head and intermediate valves not available. Tail valve rather elevated, semicircular; posterior margin evenly rounded; anterior margin convex towards sides, slightly concave in middle; mucro anterior; antemucronal and postmucronal slope almost straight.

Tegmentum evenly granulose and sculptured with oval or round well-separated granules only slightly raised above tegmental surface. On antemucronal area granules rather oval and arranged in longitudinal rows. On postmucronal area round granules arranged nearly quincuncially. Each granule of tegmentum with 1 megalaesthete, surrounded either by circle of 5–6 micraesthetes (on postmucronal area) or a semicircle of 5–6 micraesthetes (on antemucronal area) (Fig. 8, C). Few concentric lines of growth present on valve.

Articulamentum well developed, apophyses rather short, broadly triangular, wide apart, leaving shallow, very wide jugal sinus.

**Type Material.** Russia, Moscow Region: Holotype ZIN 2194 (tail valve, Fig. 6).

**Occurrence.** Upper Callovian, Lamberti zone, Paucicostatum subzone (Middle Jurassic), village Timokhovo, Ramensky District, Moscow Province, Russia (55°45´20´´N; 38°18´50´´E).

**Etymology.** This species was named after my friend Bruno Dell'Angello (Italy) who devoted his life to investigation of fossil and recent chitons.

**Comparison.** *Leptochiton dellangelloi* differs from *L. sibiricus* (Lower Jurassic, Siberia) by having the less developed mucro and straight postmucronal slope. The new species differs from *L. marloffsteinensis* (Middle Jurassic, Germany), *L. liapini* (Middle Jurassic, Russia) and *L. shapovalovi* (Upper Jurassic, Russia) by the less developed and closely situated longitudinal rows in the antemucronal area. The new species also differs from *L. liapini* and *L. shapovalovi* by the smaller number of the micraesthetes in the esthete groups.

*L. dellangelloi* is similar to some recent species such as *L. arcticus* (G.O. Sars, 1878) by having a similar shape of tail valve and sculpture of tegmentum, but differs from the latter by the number of micraesthetes in an aesthete group (5–6 micraesthetes in *L. dellangelloi* and 2 in *L. arcticus*).

## Genus *Hoarechiton* Sirenko gen. nov.

**Type species.** *Hoarechiton guzhovi* sp. nov.

**Diagnosis.** Intermediate valve relatively thick, subtriangular, short and wide. Lateral areas not rise. Tegmentum sculptured with longitudinal grooves in central area, near the side margins grooves become posteriorly converging; jugal and lateral areas smooth. Megal- and micraesthetes distributed evenly on whole surface of tegmentum, granules absent. Articulamentum well developed, apophyses very broad; jugal sinus very narrow; slits or insertion plates absent.

**Etymology.** The genus was named after Dr. Richard Hoare (Bowling Green State University, Ohio, USA) who has contributed very much to the knowledge of Paleozoic chitons.

**Comparison.** Grooves on the pleural areas appear similar to those of *Mesochiton* Van Belle, 1975 and

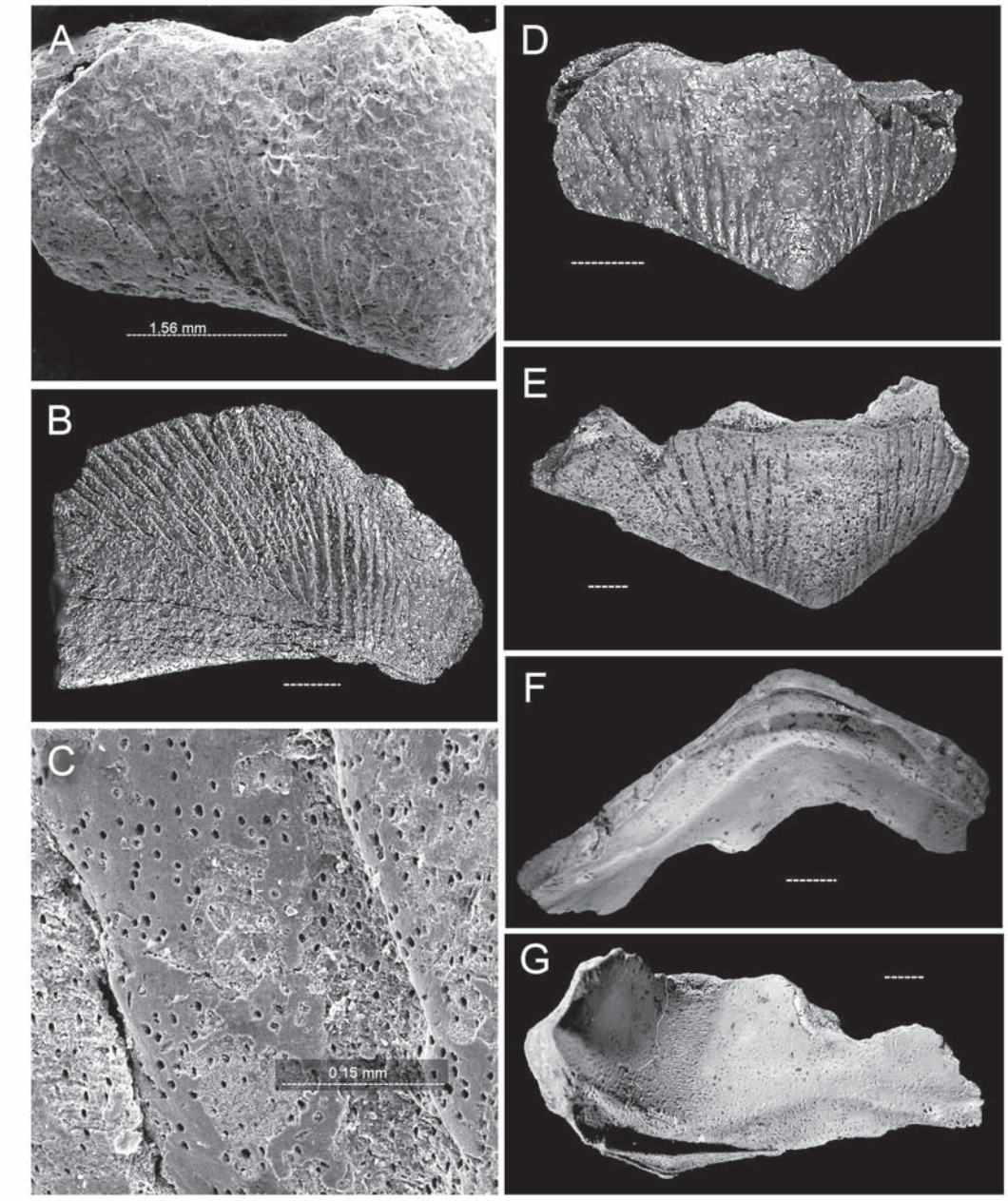


**Fig. 7**. *Hoarechiton guzhovi* gen. n. et sp. nov. A, C, D – holotype, dorsal view, ZIN 2195; B – paratype, dorsal view, intermediate valve, ZIN 2196; E, F, G – paratype, dorsal, back and ventral views, ZIN 2196. Scale bar for B, D, E, F, G = 1 mm.

*Panarthron* Laghy, 2005, but the grooves of *Hoarechiton* are much longer and reach the anterior margin of the valve and near the side margins grooves become posteriorly converging. Moreover, the lateral areas do not rise and the anterior margin of the valves is wavy.

***Hoarechiton guzhovi* Sirenko sp. nov.**
(Figs. 7, 8D, E)

**Diagnosis.** Intermediate valve rectangular, subcarinated anterior margin wavy with jugum protrud-

ed anteriorly, posterior margin with little projecting apex. Tegmentum of central area sculptured with 11 longitudinal narrow grooves on each side; these grooves becoming posteriorly converging near side margins; grooves on pleural area reaching anterior margin; 2 grooves near jugal area short; jugal and lateral areas smooth. 6 micraesthetes surrounding 1 megalaesthete in aesthete group present.

**Description.** Head and tail valves not available. Intermediate valve rectangular, subcarinated, anterior margin wavy with jugum protruding with slightly projecting apex; side margins rounded. Central area sculptured with 11 longitudinal narrow grooves on each side, grooves becoming posteriorly converging near side margins; 2 grooves near jugal area shorter, not reaching anterior margin of valve. Central area without granules but with openings of aesthetes; 1 megalaesthete surrounded by 6 micraesthetes (Fig. 8, D).

Articulamentum distinctly developed, apophyses short and broadly separated by very narrow jugal sinus. Many openings of nerve-fibre of aesthetes under the jugal and lateral areas present like in other lepidopleurids.

**Type Material.** Russia, Moscow city: 3 incomplete intermediate valves. Holotype, ZIN 2175 (Fig. 7, A, C, D) and 2 paratypes ZIN 2176 (Fig. 7, B, E, F, G).

**Occurrence.** Middle Volgian, Virgatus zone, Virgatus subzone (Upper Jurassic), Moscow, Kuntsevo, Suvorovskiy Park, Russia (55°44´34´´N; 37°26´290´´E).

**Etymology.** The species was named after my colleague A. Guzhov (Paleontological Institute of the Russian Academy of Sciences, Moscow), who has contributed to the knowledge of Mesozoic molluscs and made studied material available to me.

## DISCUSSION

There was climatic zonation in the Northern Hemisphere throughout the Mesozoic (Zakharov et al. 2010). Tropical climatic zone (Biogeographical Tethys – Pantalassa super region) with average water temperature of 25–30 °C was in the near-equatorial part. Subtropical zone (Peritethys) was situated about 45–50°N and to the north of it was a temperate warm boreal climatic zone (Panboreal biogeographical super region). Near the North Pole, the climate ranged from temperate to cold. Boreal paleogeographical region included areas of north-eastern Asia, modern Arctic Islands, Arctic Canada, Nevada and British Columbia. By the early Jurassic the Arctic biogeographical region has become clearly distinct within the Panboreal biogeographical subregion

It is very interesting to analyze the distribution of polyplacophorans in the Northern Hemisphere during Triassic–Jurassic. It appears that in Jurassic the most evolutionary advanced taxa of the genera *Allochiton* and *Heterochiton* inhabited the tropical climatic zone (Biogeographical Tethys – Pantalassa super region) (Morocco, Sicily, Table 1), whereas the most primitive chitons of the genus *Leptochiton* inhabited subtropical (Peritethys) or boreal climatic zones. At the same time it is necessary to note that the subtropical zone was influenced by boreal fauna owing to mollusk migrations via the Middle Russian Sea during climate temperature fluctuations. The European part of Russia seems to be one of the most suitable areas for the recognition of both the Boreal and Tethyan influences in the Middle – Late Jurassic due to its unique position between the Arctic Basin, Tethys and West Europian shallow seas (Rogov et al. 2009).

Primary distribution of chitons of the genus *Leptochiton* in colder than tropical waters in Jurassic suggests that they have originated in relatively cold water, which is consistent with the distribution of Recent species of the genus. Indeed, of more than one hundred Recent species of the genus *Leptochiton* only two species (*L. nierstraszi* Leloup, 1981 and *L. muellerі* Sirenko et Schwabe, 2011) inhabit warm tropical waters in the Indian ocean and one species (*L. hiriensis* Schwabe et Lozouet, 2006) from Rapa Isl., French Polynesia. All other species of the genus live in subtropical, Boreal, Natal, Arctic and Antarctic waters or in cold bathyal, abyssal and hadal waters below a warm tropical layer. Probably this genus was formed under rather temperate or cold conditions in the end of Paleozoic. Perhaps one of the first species of the genus *Leptochiton* is *L. dalriensis* (Etheridge, 1882) from Scotland, Lower Carboniferous. This species was erroneously included in the genus *Cymathochiton* by Van Belle (1981), in spite of a non-triangular form of its valves and the presence of granulated tegmentum. Two more species of *Leptochiton* [*L. davolii* (Laghi, 2005) and *L. reiectus* (Laghi, 2005)] are known from northern Italy, Upper Triassic.

One of the new species (*L. shapovalovi*) has an aesthete group with the number of micraesthetes very similar to recent xylophagous chitons: *L. binghami* and *L. vietnamensis*. It is necessary to note that *L. shapovalovi* was found in clay with numerous

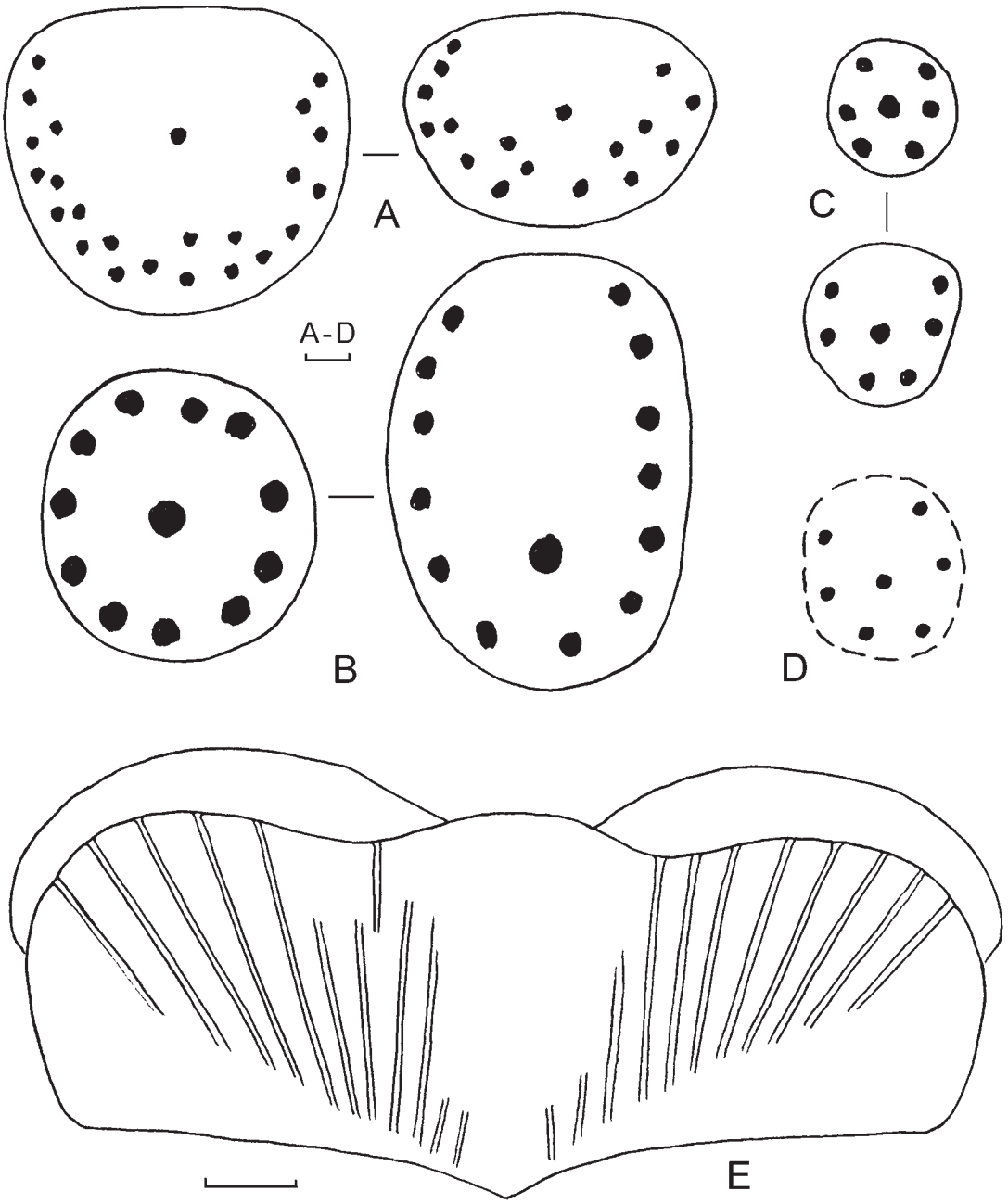


**Fig. 8**. Aesthete elements of four lepidopleurid species and reconstruction of valve. A – *Leptochiton shapovalovi* sp. nov., aesthete elements of central area of intermediate valve (left) and of head valve (right); B – *Leptochiton liapini* sp. nov., aesthete elements of lateral area (left) and central area (right); C – *Leptochiton dellangelloi* sp. nov., aesthete elements of lateral area (above) and central area (below); D, E – *Hoarechiton guzhovi* gen. n. et sp. nov., aestete group of central area (D) and reconstruction of intermediate valve (E). Scale bar: A–D = 100 μm, E = 1 mm.

**Table 1**. Eurasian Trassic and Jurassic chitons with known genus

| Species | Age | Locality | References |
|---|---|---|---|
| *Allochiton altus* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *A. costulatus* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *A. gemellaroi* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *A.* sp. | Lower Jurassic | Morocco | Dubar 1948 |
| *Heterochiton buccai* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *H. compressus* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *H. giganteus* Fucini, 1912 | Lower Jurassic | Sicily, Morocco | Fucini 1912; Dubar 1948 |
| *H. zitteli* Fucini, 1912 | Lower Jurassic | Sicily, Morocco | Fucini 1912; Dubar 1948 |
| *H. vivassai* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *H.* sp. | Lower Jurassic | Morocco | Dubar 1948 |
| *Leptochiton davolii* (Laghi, 2005) | Upper Triassic | Northern Italy | Laghi 2005 |
| *L. reiectus* (Laghi, 2005) | Upper Triassic | Northern Italy | Laghi 2005 |
| *L. deshayesi* (Terquem, 1852) | Lower Jurassic | France | Terquem 1852 |
| *L. sibiricus* (Shurygin, 2001) | Lower Jurassic | Siberia | Shurygin 2001 |
| *L. morloffsteinensis* (Fiedel et Keupp, 1988) | Middle Jurassic | Germany | Fiedel and Keupp 1988 |
| *L. shapovalovi* sp. nov. | Upper Jurassic | Kostroma Region, Russia | Present paper |
| *L. liapini* sp. nov. | Middle Jurassic | Moscow Region | Present paper |
| *L. dellangelloi* sp. nov. | Middle Jurassic | Moscow Region | Present paper |
| *L.* sp. | Middle Jurassic | Poland | Kaim 2010 |
| *Hoarechiton guzhovi* sp. nov. | Upper Jurassic | Moscow, Russia | Present paper |
| *Mesochiton busambrensis* (Fucini, 1912) | Lower Jurassic | Sicily | Fucini 1912 |
| *M. dolomiticus* Laghi, 2005 | Upper Triassic | Northern Italy | Laghi 2005 |
| *M. zardinii* Laghi, 1982 | Upper Triassic | Northern Italy | Laghi 1982 |
| *Panarthron triadicum* Laghi, 2005 | Upper Triassic | Northern Italy | Laghi 2005 |
| *Pterygochiton terguemii* Eudes-Deslongchamps, 1859 | Lower Jurassic | France | Eudes-Deslongchamps 1859 |
| *P. destefanoi* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |
| *P. muricus* Fucini, 1912 | Lower Jurassic | Sicily | Fucini 1912 |

pieces of fossil wood. A. Guzhov (personal communication) said that along with the valves of this species of chiton there were many belemnites and the gastropod *Dragonia* sp., which is associated with biotopes of "sunken wood", because it is a wood borer. It is possible that *L. shapovalovi* was also a Jurassic xylophagous chiton like *Leptochiton* sp. from Poland (Middle Jurassic) (Kaim 2010).

Group of species of other Triassic and Jurassic lepidopleurids from the genera *Mesochiton, Pterygochiton, Panarthron, Hoarechiton* and *Schizoproctus* (Table 1) have thick shells with an unusual structure of tegmentum. They are very different from the genus *Leptochiton*. The genera *Mesochiton* and *Panarthron* have short grooves on the border of pleural and lateral areas, like the genera of the families Loricidae and Callochitonidae. *Hoarechiton* has long grooves a little bit similar to the genus *Stenosemus*. The genus *Pterygochiton* has the structure similar to the genera *Ischnochiton* and *Stenosemus*. *Schizoproctus* has a deep fissure on the tail valve like *Incissiochiton* and *Schizochiton*. But all of them distinctly differ from above mentioned genera and families of the order Chitonida by not having slits and insertion plates characteristic of the family Lepidopleuridae. It is difficult to say whether or not some of them were ancestral forms of the above mentioned advanced group of chitons of the order Chitonida.

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