



## Notes on Fossil Chitons. 6. A new species of *Stenoplax* (Mollusca: Polyplacophora) from the Miocene of NW Italy

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**KEY WORDS** - *Polyplacophora, Fossil Stenoplax, Miocene, Rio di Bocca d'Asino, North Italy.*

**ABSTRACT** - A new species of *Stenoplax* from the Miocene (Tortonian) of Rio di Bocca d'Asino (Alessandria, Piedmont) is described in this paper. Valves of *Stenoplax paviae n. sp.* are frequent in the fossiliferous deposit in the lower part of the Marne di Sant'Agata Fossili at Rio di Bocca d'Asino. The new species is characterized by the depressed and elongate tail valve and the characteristic sculpturing of the head valve, lateral areas of intermediate valves, and postmucronal area of tail valve, which all have close-set, irregularly undulate concentric grooves. *S. paviae n. sp.* differs from the four *Stenoplax* species known from Eocene/Oligocene deposits of Europe and represents the last occurrence in Europe of this genus, that is presently documented in the tropical eastern Pacific, the Caribbean, the Indo Pacific, Japan, and the western Atlantic (Brazil).

**RIASSUNTO** - [Note sui chitoni fossili. 6. Una nuova specie di *Stenoplax* (Mollusca: Polyplacophora) dal Miocene dell'Italia nord-occidentale] - Viene descritta una nuova specie di *Stenoplax* dal Miocene (Tortoniano) di Rio di Bocca d'Asino (Alessandria, Piemonte). Piastre di *Stenoplax paviae n. sp.* sono frequenti nei depositi fossiliferi di Rio di Bocca d'Asino, situati nella parte inferiore della formazione delle Marne di Sant'Agata Fossili. Questa nuova specie è caratterizzata dalla piastra posteriore depressa ed allungata e dalla caratteristica scultura della piastra anteriore, delle aree laterali delle piastre intermedie e dell'area postmucronale della piastra posteriore, formata da deboli costolature concentriche, irregolarmente ondulate. Il genere *Stenoplax* non è rappresentato nel Neogene europeo, ed i confronti effettuati con le quattro specie di *Stenoplax* note per i giacimenti europei dell'Eocene e dell'Oligocene confermano l'attribuzione del nostro materiale ad una nuova entità specifica. Questa nuova specie, nota solo per il Miocene del bacino del Piemonte, viene descritta come *S. paviae n. sp.* e rappresenta la prima segnalazione del genere *Stenoplax* per il Miocene dell'Europa.

### INTRODUCTION

In recent years a substantial number of works on the Plio-Pleistocene chitons from Italy has been published (e.g., Laghi, 1977; Dell'Angelo & Forli, 1995, 1996; Dell'Angelo & Palazzi, 1989; Dell'Angelo et al., 2001, 2012, 2013), but there has been little new information concerning Italian Miocene chitons (Laghi, 1977; Dell'Angelo et al., 1999). The study of material from the Tortonian of Rio di Bocca d'Asino (Alessandria, Piedmont) allowed us to identify a collection of valves as all belonging to a new fossil species of *Stenoplax*.

The aim of this paper is to document, for the first time, a Miocene record of the genus *Stenoplax* still unknown in Neogene deposits from Italy and Europe.

The studied material comes from the Barbera-Grue zone pertaining to the "Bacino Terziario Piemontese" (BTP). This area, including the Barbera, Lemme and Scrivia Valleys, represents the south-eastern end of BTP (Ghibaudo et al., 1985; d'Atri et al., 2002). The Oligocene deposits, overlying an Apennine-type basement, consist of coarse-grained clastic facies of deep water deposition, originated by turbiditic flows. The pre-Langhian Miocene deposits are mainly pelitic. After a stratigraphic hiatus, encompassing the Burdigalian-Early Langhian, marly-sandy sediments were deposited during the Late Langhian (Marne di Cessole). A Serravallian sandy formation follows (Arenarie di Serravalle), overlaid by the Marne di S. Agata Fossili (S. Agata Fossili Marls)

of Tortonian age. The well known fossiliferous localities of Monterosso, S. Agata, Stazzano, Tortona, Volpedo and Villarvernia have documented this formation which consists of marls and intercalating arenaceous-conglomeratic beds. In the surroundings of Stazzano, this formation is made up of sandy facies with interbedded pelitic levels and an upper, mainly clayey facies with intercalating conglomeratic beds, of gravitational origin. Mollusc and coral associations are well preserved and point to deepening, from the outer shelf-slope transition to bathyal depths, with an increased content of allochthonous fauna (Ghibaudo et al., 1985).

The uppermost formations in the "BTP" sequence are the Messinian evaporites overlaid by clayey and sandy Pliocene deposits (Lugagnano Clays and Asti Sands).

The specimens under investigation were collected from the classical locality of Rio di Bocca d'Asino (Fig. 1), 44°53'21"N, 08°53'14"E, 2.5 km NW from Stazzano (Alessandria), already known for its rich mollusc fauna (Bellardi & Sacco, 1873-1904; Bongo, 1914; Caprotti, 2011), and attributed to the lower part of the Marne di S. Agata Fossili of Tortonian age (Boni & Casnedi, 1970; Ghibaudo et al., 1985).

The Rio di Bocca d'Asino stratigraphic succession has never been described in the recent literature and no stratigraphic log is available. Specimens here reported were collected from the outcrop shown in Fig. 2. The succession here exposed consists of about 20 meters of clayey levels intercalating with conglomeratic lenses of

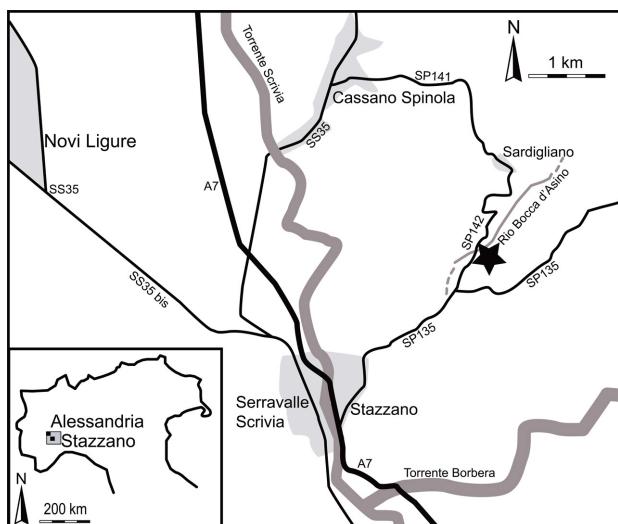


Fig. 1 - Geographic location of the study area. Asterisk indicates the position of the Rio di Bocca d'Asino outcrop.

gravitative origin containing molluscs. More in detail, the valves analyzed in this paper have been collected from the conglomeratic level visible in the upper part of the outcrop and emphasized in Fig. 2 by the dashed line.

The previous information on chitons from this locality are those by Dell'Angelo & Palazzi (1989), who identified *Lepidopleurus cajetanus* (Poli, 1791) and *Leptochiton scabridus* (Jeffreys, 1880), while Laghi (1977) reported *Lepidochitona cinerea* (Linnaeus, 1767) from the near locality of "Tortona" (Stazzano and Sant'Agata Fossili).

## MATERIAL AND METHODS

The present work is focused on samples collected by the authors between 1980 and 2010. The bulk sediment has been washed in sieves (diameter 0.5, 1.0, 2.0 mm), and the material retained in the 1.0 mm and 2.0 mm fractions was then examined to identify chiton valves under a stereomicroscope. Valve sculpture definition was

performed using a Cambridge S-360 scanning electron microscope (SEM) at the Dipartimento di Scienze della Terra dell'Università di Torino. Digital photos were acquired with Leica M205C microscope and Leica Application Suite 3.1.

The specimens analyzed in this paper are deposited in the following institutions:

BD	B. Dell'Angelo Collection, Genova, Italy;
MGPT	Museo di Geologia e Paleontologia, Università di Torino, Italy;
MSNG	Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy;
MZB	Museo di Zoologia, Università di Bologna, Italy;
NHMW	Natural History Museum Vienna, Austria;
PG	Piero Giuntelli Collection, Turin, Italy;
ZISP	Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.

## SYSTEMATIC PALAEONTOLOGY

Class POLYPLACOPHORA Gray, 1821

Order CHITONIDA Thiele, 1909

Suborder CHITONINA Thiele, 1909

Family ISCHNOCHITONIDAE Dall, 1889

Genus *Stenoplax* Dall, 1879

Type species - *Chiton limaciformis* Sowerby, 1832, by original designation. For synonymy of the type species, see Kaas & Van Belle (1987).

Remarks - *Stenoplax* is a distinct taxon whose members are highly elongate, and whose intermediate valves have prominent sutural laminae and generally raised lateral areas. The depressed and much more elongated (relative to other valves) tail valve with prominent diagonal line is diagnostic for this genus.

Geographic and stratigraphic distribution - East Pacific Ocean (from Canada to Perù), Indo-Pacific Ocean



Fig. 2 - The Rio di Bocca d'Asino outcrop of the Marne di S. Agata Fossili. The succession here exposed consists of about 20 m of marls, the asterisk shows the point where the specimens described in this paper have been collected and the dashed line outlines the sampled conglomeratic lens. a) General view of the outcrop; b) a detail of the fossiliferous level.

(from Japan to India), Indian Ocean (Madagascar), West Atlantic Ocean (from Florida to Brazil). Eocene-Recent.

*Stenoplax paviae* n. sp.  
(Pl. 1, figs 1-9)

*Derivation of the name* - The specific name honours Prof. Giulio Pavia, for his contribution to the study of fossil mollusks.

*Type locality* - Rio di Bocca d'Asino (Alessandria), Piedmont, Italy, Miocene (Tortonian), Marne di S. Agata Fossili. The locality is shown in Fig 2.

*Type series* - Holotype: MGPT-PU 108791 (a tail valve, Pl. 1, fig. 6a-b); 13 Paratypes: MGPT-PU 108792 (an incomplete intermediate valve, Pl. 1, figs 3a-b, 4a-b); MGPT-PU 108793 (an head valve, Pl. 1, fig. 2); MGPT-PU 108794 (a tail valve, Pl. 1, fig. 7); MGPT-PU 108795 (a tail valve, Pl. 1, fig. 9); MSNG 57252 (an incomplete head valve, and a tail valve); ZISP 2199 (an head valve); ZISP 2200 (a tail valve); MZB 60085 (an head valve, Pl. 1, fig. 1a-b); MZB 60086 (an incomplete intermediate valve); MZB 60087 (a tail valve, Pl. 1, figs 5, 8); NHMV 2013/0272/0001 (an head valve, and a tail valve).

*Additional material* - Rio di Bocca d'Asino: 10 valves (an head, width 3.4 mm, and 9 tail, maximum width 4.8 mm) (BD, PG).

*Diagnosis* - Head valve semicircular. Intermediate valves with lateral areas little raised, poorly defined, and apices not indicated. Tail valve semicircular, depressed, mucro subcentral, antemucronal and postmucronal slopes almost straight. Sculpture formed by many close-set, irregularly undulate concentric grooves on head valve, lateral areas of intermediate valves, and postmucronal area of tail valve, and by some longitudinal grooves on central and antemucronal areas. Apophyses triangular, widely separated by a straight sinus, insertion plates short, slit formula 10-13 / 2 / 14, teeth sharp.

*Description* - Head valve semicircular, posterior margin widely V-shaped. Intermediate valves with side

margins rounded, posterior margin about straight, apices not indicated, lateral areas little raised, poorly defined. Tail valve semicircular, depressed, length little more than 2/3 of the width, anterior margin straight, mucro subcentral, weak indicated, antemucronal and postmucronal slopes almost straight.

Head valve, lateral areas of intermediate valves, and postmucronal area of tail valve sculptured with many close-set, irregularly undulate concentric grooves, better defined towards the periphery; central area of intermediate valves, and antemucronal area of tail valve smooth, with some longitudinal grooves (that continue without interruption the concentric grooves) towards the margins, slightly obliquely directed.

Articulamentum: apophyses triangular (almost always incomplete in the studied material), widely separated by a straight sinus, insertion plates short, slit formula 10-13 / 2 / 14, slit rays neatly indicated by distinct rays of pores, teeth sharp, eaves narrow.

*Remarks* - There is a noticeable variability in the shape of the tail valve, the length/width ratio of all tail valves has a range between 0.61 (Pl. 1, fig. 12) and 0.69 (Pl. 1, fig. 8). The ornamentation and the profile of these tail valves are identical, and are thus considered to be conspecific.

*Discussion* - The genus *Stenoplax* is known for about 22 living worldwide species, more than half of which occur in the temperate or tropical eastern Pacific, few other species occur exclusively in the Caribbean (one species, *Stenoplax bogii* [Haddon, 1886] is reported in both regions), and the remaining occur in the Indo Pacific, Japan, and western Atlantic (Brazil) (Kaas & Van Belle, 1987, 1990). No living species are known from the European coasts or the Mediterranean Sea.

The fossil record for *Stenoplax* is largely incomplete, and the few available records do not allow us to suggest a diversification scenario for the group. The oldest records are from the Eocene deposits of Europe (United Kingdom and Ukraine) and from the latest Eocene or earliest Oligocene of Washington, U.S.A. (Puchalski et al., 2008; Dell'Angelo et al., 2011), but these species differ from *S. paviae* n. sp. as described below: *S. anglica* Wrigley, 1943 and *S. selseiensis* Wrigley, 1943 from UK are both based on a single tail valve from the same

EXPLANATION OF PLATE 1

*Stenoplax paviae* n. sp., Miocene (Tortonian) of Rio di Bocca d'Asino, Marne di S. Agata Fossili. Where not indicated differently, scale bar is 1 mm.

Fig. 1 - Paratype MZB 60085:

- a - head valve, dorsal view;
- b - detail of the sculpture. Scale bar is 800  $\mu$ m.

Fig. 2 - Paratype MGPT-PU 108793, head valve, ventral view.

Fig. 3 - Paratype MGPT-PU 108792, incomplete intermediate valve:

- a - dorsal view;
- b - ventral view.

Fig. 4 - Paratype MGPT-PU 108792, detail of the sculpture at different scale:

a - scale bar is 1mm;

b - scale bar is 400  $\mu$ m.

Fig. 5 - Paratype MZB 60087, tail valve, lateral view.

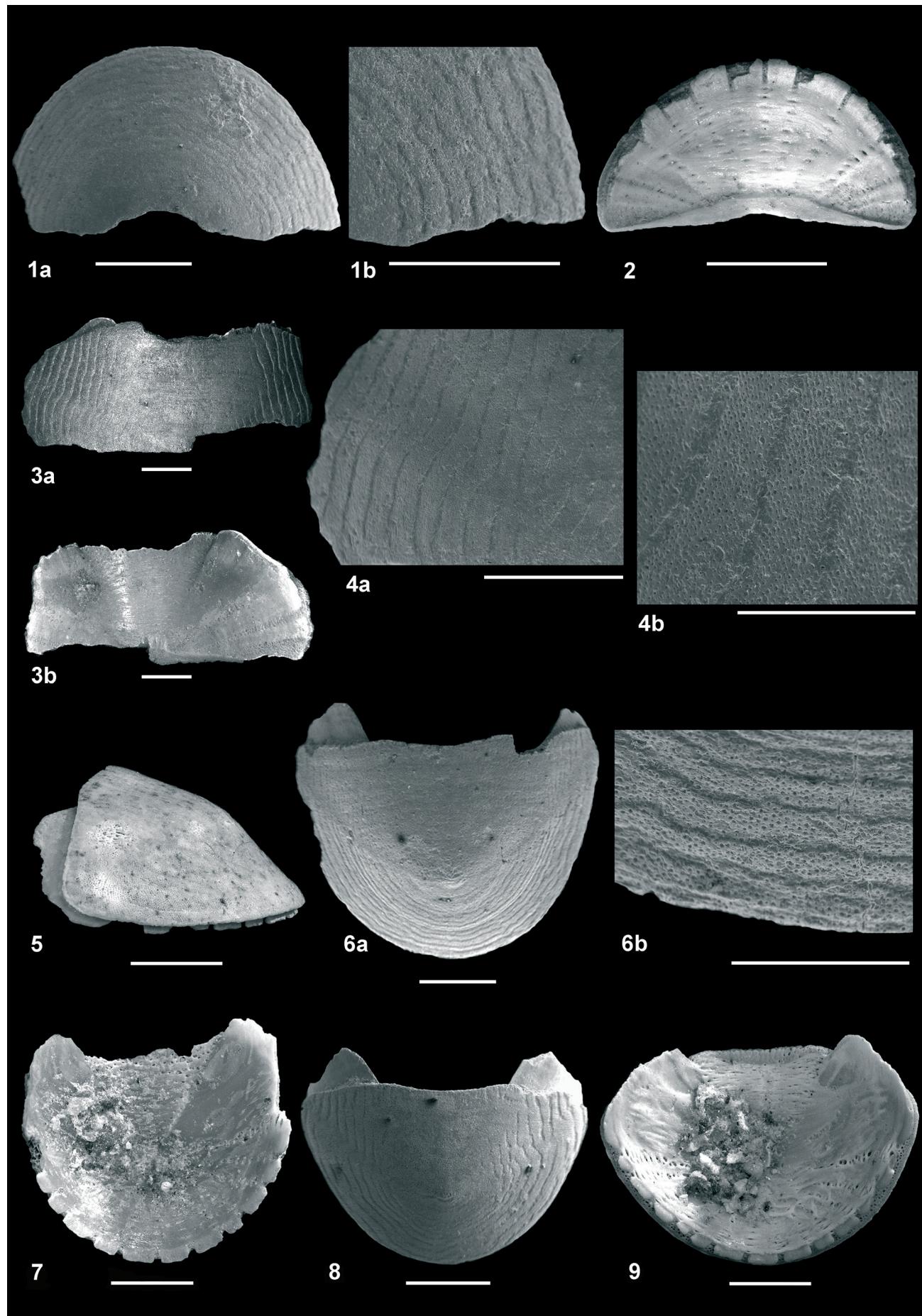
Fig. 6 - Holotype MGPT-PU 108791:

- a - tail valve, dorsal view;
- b - detail of the sculpture of the postmucronal area. Scale bar is 400  $\mu$ m.

Fig. 7 - Paratype MGPT-PU 108794, tail valve, ventral view.

Fig. 8 - Paratype MZB 60087, tail valve, dorsal view.

Fig. 9 - Paratype MGPT-PU 108795, tail valve, ventral view.



Eocene locality (Medmerry Farm, Selsey, England), with a nearly smooth sculpturing; *S. sigillarius* Bielokrys, 1999 is based on valves from the Eocene of Dniepr River (Dnepropetrovsk, Ukraine) with a sculpture of nodulose ribs; *S. quimperensis* Dell'Angelo, Bonfitto & Taviani, 2011 is based on a single intermediate valve from the late Eocene of Woodman's Wharf (Washington, U.S.A.) with a completely different sculpture (many longitudinal striae on each side of the central area and radial striae in lateral areas).

*Stenoplax veneta* Dell'Angelo & Palazzi, 1992, described on head and tail valves from the Oligocene of Case Soghe (Vicenza, Italy) has a finely beaded sculpture comprised of small granules. The only other fossil records of the genus *Stenoplax* are from the Plio-Pleistocene deposits of California, U.S.A. (Berry, 1922; Vendrasco et al., 2012 and the references listed therein), and an undetermined species from the Pleistocene of Japan (Itoigawa et al., 1976, 1978).

*Stenoplax* was previously unknown in Europe from Miocene to the Recent, so the new species extends the European record of this genus to the Miocene. The finding of a species of the genus *Stenoplax* in the Tortonian of Italy, characterized by a warm temperate or perhaps even subtropical climate, is consistent with the distribution of extant species of this genus, and with the disappearance of the genus from the proto Mediterranean-Atlantic Region (sensu Harzhauser et al., 2002, 2007) at the upper Burdigalian-lower Langhian boundary, as other fossil mollusks (e.g. the family Olividae, see Davoli, 1989).

*Stenoplax paviai* n. sp. is superficially similar to *Tegulaplast hululensis* (E. A. Smith, 1903), a living species with a widespread distribution in the Indo-Pacific, and also in the Mediterranean coast of Israel, from which it differs by the different shape of the valves, the sculpture of the central and antemucronal areas, the pectinate teeth (Kaas et al., 2006).

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