

## Luis Mariano Vidal (1842-1922) rudist taxa revisited

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### Resumen

PONS, J.M., VICENS, E., TROYA, L. y LUCENA, G., Revisión de los taxa de rudistas de Luis Mariano Vidal (1842-1922). La revisión de los 323 registros de bivalvos rudistas de la colección Vidal, depositada en el Museu de Geologia de Barcelona (MCNB), ha permitido identificar y refigurar treinta y tres ejemplares holotipo o sintipo correspondientes a veinte especies establecidas por Vidal. De entre ellas, trece se consideran especies válidas, cuatro resultan sinónimos de especies descritas anteriormente y tres (una de ellas no figurada) no muestran suficientes caracteres para su identificación. No han sido localizados los cuatro sintipos de *Hippurites castroi*, especie atribuida actualmente al género *Hippuritella*, ni los otros dos ejemplares publicados posteriormente por el autor. Tampoco se localizaron tres de los cuatro sintipos de *Hippurites maestrei*, especie tipo de *Hippuritella*. En cambio, sí se localizaron los ejemplares descritos como *Sphaerulites posae* pero no figurados. Por otro lado, se han identificado y se refiguran doce ejemplares, sintipos o figurados como nuevas especies por otros autores (Matheron y Douvillé) a partir de material facilitado por Vidal; en su mayoría, sobre una de las partes en que fueron seccionados los ejemplares para su estudio y que fue devuelta a Vidal. Asimismo, se han identificado y se documentan diecisiete ejemplares figurados por Douvillé, también en su mayoría partes de ejemplar.

Palabras clave: Colección Vidal, Rudistas, Taxonomía.

### Abstract

The revision of the 323 register numbers of rudist bivalves in the Vidal Collection, kept at the Museu de Geologia de Barcelona (MCNB), allowed the identification and re-figuration of thirty-three holotype or syntype specimens corresponding to twenty species established by Vidal. Among them, thirteen are considered as valid species, four resulted to be synonymous with other senior species, and three (one not figured) do not display enough characters to be properly identified. The four syntypes of *Hippurites castroi*, currently attributed to genus *Hippuritella*, have not been localised, nor the other two specimens subsequently figured by the author. Similarly, three of the four syntypes of *Hippurites maestrei*, type species of *Hippuritella*, have not been localised. Contrarily, the specimens described as *Sphaerulites posae* but not figured, were localised. On the other hand, twelve specimens, syntypes or figured as new species by other authors (Matheron and Douvillé), have also been identified and are re-figured; most of them are part of the specimens that were sectioned for study and then returned to Vidal. In addition, other seventeen specimens figured by Douvillé have been identified and are documented; most of them also being part of a sectioned specimen.

Key words: Vidal Collection, Rudists, Taxonomy.

### INTRODUCTION

Luis Mariano Vidal (1842-1922) published several papers on the geology and palaeontology of Catalonia, meanwhile assembling a relevant collection of fossils as a result of his field work. The collection, originally denominated *Colección de Minerales, Rocas, Fósiles y Objetos de Prehistoria*, was donated by Vidal in 1922 to the Museu Martorell (currently Museu de Geologia de Barcelona [MGB], as part of the Museu de Ciències Naturals de Barcelona, MCNB). Many of the original 6,076 register numbers of fossils correspond to the Cretaceous (2,727) and, 323 among them, to rudist bivalve specimens.

In three of his publications Vidal (1874, 1878 and 1921) established a total of twenty new rudist species. He also sent specimens in his collection to renowned foreign specialists, for their study and subsequent publication (Matheron, 1880; Douvillé, 1895 and 1904). In some

cases, these specimens were used to establish new species (seven), while other were figured because they showed relevant characteristics for already established species (sixteen). Some of these specimens were returned to the collection, other remained abroad, mainly incorporated in the collection of the École nationale supérieure des Mines de Paris (EM), currently kept in the Université Claude Bernard Lyon I, Villeurbanne (France), and still other, mainly hippuritids whose study requires a transverse section of the right valve close to the commissural plane, only one part was returned, generally the adapical part.

Most Vidal rudist specimen's figures, particularly all those in Vidal (1874 and 1878), are beautiful but sometimes slightly idealized designs, not photographs.

The main aim of this paper is the revision and re-figuration of the rudist species erected by Vidal, as well as of those by other authors based on specimens provided by him. Among the last, only specimens currently in the Vidal Collection are re-figured. In addition, the specimens of the Vidal Collection figured by other authors are documented and new data are provided on some of the mentioned taxa.

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MGB	YEAR, PL.(FIG.)	ORIGINAL NAME	ACTUAL NAME	LOCALITY
<b>2215a</b>	1878, 5(1)	<i>Requienia Moroi</i>	<b><i>Monopleura moroi</i></b>	Moror
<b>2215b</b>	1878, 5(2)	<i>Requienia Moroi</i>	<i>Monopleura moroi</i>	Moror
<b>2215c</b>	1878, 6(5)	<i>Requienia Moroi</i>	<i>Monopleura moroi</i>	Moror
<b>2215d</b>	1878, 6(6)	<i>Requienia Moroi</i>	<i>Monopleura moroi</i>	Moror
<b>1780</b>	1878, 2(3)	<i>Monopleura Falgasi</i>	<i>Monopleura falgasi</i>	Pobla de Lillet
<b>1726</b>	1878, 7(3)	<i>Monopleura Figolina</i>	<i>Monopleura figolina</i>	Fígols
<b>1421</b>	1878, 3(7)	<i>Monopleura minuta</i>	<b><i>Biradiolites ? sp.</i></b>	Montsec d'Àger
<b>1422</b>	1878, 4(4)	<i>Monopleura Montsecana</i>	<i>Monopleura montsecana</i>	Montsec d'Àger
<b>2017a</b>	1921, 4(1)	<i>Gyropleura Tartareui</i>	<i>Gyropleura tartareui</i>	Tartareu
<b>2017b</b>	1921, 4(2)	<i>Gyropleura Tartareui</i>	<i>Gyropleura tartareui</i>	Tartareu
<b>759</b>	1878, 6(1)	<i>Radiolites angulosus</i> var. <i>ibericus</i>	<b><i>Biradiolites ibericus</i></b>	Mas de Gasol
<b>1729</b>	1878, 7(4)	<i>Radiolites Fumanyae</i>	<b><i>Biradiolites royanus</i></b>	Fígols
<b>1729</b>	1878, 7(5)	<i>Radiolites Fumanyae</i>	<i>Biradiolites royanus</i>	Fígols
<b>751</b>	1878, 6(4)	<i>Radiolites laciniatus</i>	<i>Radiolites laciniatus</i>	Montsec d'Àger
<b>2217a</b>	1878, 5(3)	<i>Radiolites Moroi</i>	<b>Nov. gen.?</b> <i>moroi</i>	Moror
<b>2217b</b>	1878, 5(4)	<i>Radiolites Moroi</i>	Nov. gen.? <i>moroi</i>	Moror
<b>1822a</b>	1878, 7(1)	<i>Radiolites Osensis</i>	<b>Nov. gen.?</b> <i>osensis</i>	Tartareu
<b>1822b</b>	1878, 7(2)	<i>Radiolites Osensis</i>	Nov. gen.? <i>osensis</i>	Tartareu
<b>2015a</b>	1921, 2(6), 4(10)	<i>Biradiolites osensis</i>	Nov. gen.? <i>osensis</i>	Tartareu
<b>2015b</b>	1921, 4(11)	<i>Biradiolites osensis</i>	Nov. gen.? <i>osensis</i>	Tartareu
<b>1154a</b>	1878, 2(1)	<i>Sphaerulites Aagerensis</i>	<b><i>Praeradiolites paillettei</i></b>	Àger
<b>1154b</b>	1878, 2(2)	<i>Sphaerulites Aagerensis</i>	<i>Praeradiolites paillettei</i>	Àger
<b>1279a</b>	1878, 6(3)	<i>Sphaerulites minor</i>	<b><i>Praeradiolites ? sp.</i></b>	Carbonills
<b>1279b</b>	1878, 7(6)	<i>Sphaerulites minor</i>	<i>Praeradiolites ? sp.</i>	Carbonills
<b>1782</b>	1878, 6(2)	<i>Sphaerulites planicostatus</i>	<b><i>Hippuritella lapeirousei</i></b>	Pobla de Lillet
2179a	1878, not figured	<i>Sphaerulites Posae</i>	<b><i>Radiolitidae indeterminate</i></b>	Isona
2179b	1878, not figured	<i>Sphaerulites Posae</i>	<i>Radiolitidae indeterminate</i>	Isona
2179c	1878, not figured	<i>Sphaerulites Posae</i>	<i>Radiolitidae indeterminate</i>	Isona
2179d	1878, not figured	<i>Sphaerulites Posae</i>	<i>Radiolitidae indeterminate</i>	Isona
2179e	1878, not figured	<i>Sphaerulites Posae</i>	<i>Radiolitidae indeterminate</i>	Isona
<b>1733a</b>	1878, 4(1)	<i>Sphaerulites pulchellus</i>	<b><i>Radiolitella pulchellus</i></b>	Fígols
<b>1733b</b>	1878, 4(2)	<i>Sphaerulites pulchellus</i>	<i>Radiolitella pulchellus</i>	Fígols
<b>1733c</b>	1878, 4(3)	<i>Sphaerulites pulchellus</i>	<i>Radiolitella pulchellus</i>	Fígols
***	1874, 6(35)	<i>Hippurites Castroi</i>	<b><i>Hippuritella castroi</i></b>	Isona
***	1874, 6(35)	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
***	1874, 6(35)	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
***	1874, 6(35)	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
***	1907, text-f. 44.1 1917, 8			
***	1918, text-f. no núm.	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
***	1907, text-f. 44.2	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
2150a	not figured	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
2150b	not figured	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
2179f	not figured	<i>Hippurites Castroi</i>	<i>Hippuritella castroi</i>	Isona
***	1878, 1(5)	<i>Hippurites Maestrei</i>	<b><i>Hippuritella maestrei</i></b>	Montsec
<b>1680a</b>	1878, 1(6)	<i>Hippurites Maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
***	1878, 1(7)	<i>Hippurites Maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
***	1878, 1(8)	<i>Hippurites Maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
<b>1567</b>	1878, 1(2)	<i>Hippurites Montsecanus</i>	<i>Hippurites montsecanus</i>	Serrat de P. Oliva
<b>1678</b>	1878, 1(1)	<i>Hippurites Montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
<b>1679a</b>	1878, 1(4)	<i>Hippurites Montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
<b>(EM)</b>	1878, 1(3)	<i>Hippurites Montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger

Table 1. Type and figured specimens of rudists, from Vidal (1874, 1878, 1907, 1917, 1918, and 1921), housed in the Vidal Collection at Museu de Geologia de Barcelona (MGB). In bold, register numbers of type specimens as well as taxonomical changes.\*\*\* Specimen not localised.

Tabla 1. Ejemplares tipo y figurados de rudistas, de Vidal (1874, 1878, 1907, 1917, 1918 y 1921), conservados en la Colección Vidal del Museu de Geologia de Barcelona (MGB). Los números de registro de los ejemplares tipo están indicados con negritas, al igual que los cambios taxonómicos. \*\*\*Ejemplar no localizado.

MGB	EM	YEAR, pl.(fig)	ORIGINAL NAME	ACTUAL NAME	LOCALITY
1935a		1904, 13(1)	<i>Mitrocaprina vidali</i>	<i>Mitrocaprina vidali</i>	La Pobla de Segur
	<b>15884</b>	1904, 13(2)	<i>Mitrocaprina vidali</i>	<i>Mitrocaprina vidali</i>	La Pobla de Segur
	***	1904, 13(3)	<i>Mitrocaprina vidali</i>	<i>Mitrocaprina vidali</i>	La Pobla de Segur
	***	1904, 13(4)	<i>Mitrocaprina vidali</i>	<i>Mitrocaprina vidali</i>	La Pobla de Segur
1935b		1904, 13(5)	<i>Mitrocaprina vidali</i>	<i>Mitrocaprina vidali</i>	La Pobla de Segur
1681	15885	1895, 28(7)	<i>Hippurites microstylus</i>	<i>Hippurites microstylus</i>	Montsec d'Àger
<b>1158</b>		1895, 28(8)	<i>Hippurites microstylus</i>	<i>Hippurites microstylus</i>	Collades de Basturs
<b>1666a</b>	<b>15886</b>	1895, 26(11)	<i>Hippurites praecessor</i>	<i>Hippurites praecessor</i>	Collades de Basturs
	<b>15887</b>	1895, 26(12)	<i>Hippurites praecessor</i>	<i>Hippurites praecessor</i>	Collades de Basturs
<b>1114</b>		1895, 22(5)	<i>Hippurites praemoulini</i>	<i>Vaccinites moulinsi</i>	Montsec
752		1895, 22(6)	<i>Hippurites praemoulini</i>	<i>Vaccinites beaussetensis</i>	Montsec d'Àger
	<b>15752</b>	1895, 26(4)	<i>Hippurites resectus</i> var. <i>incisa</i>	<i>Hippurites incisus</i>	Espluga de Serra
	15888	1895, 26(5)	<i>Hippurites resectus</i> var. <i>incisa</i>	<i>Hippurites incisus</i>	Espluga de Serra
1148	15889	1895, 26(6)	<i>Hippurites resectus</i> var. <i>incisa</i>	<i>Hippurites incisus</i>	Espluga de Serra
1148		1895, 26(7)	<i>Hippurites resectus</i> var. <i>incisa</i>	<i>Hippurites incisus</i>	Espluga de Serra
<b>1763</b>	<b>15890</b>	1895, 27(5)	<i>Hippurites serratus</i>	<i>Hippurites vidali</i>	Pas de les Eugues
<b>1677</b>	<b>15891</b>	1895, 26(10)	<i>Hippurites</i> cf. <i>socialis</i>	<i>Hippurites</i> cf. <i>socialis</i> (n. sp.?)	Montsec d'Àger
	<b>15892</b>	1895, 27(1)	<i>Hippurites vidali</i>	<i>Hippurites vidali</i>	Pas de les Eugues
(1773)	15755	1895, 27(2)	<i>Hippurites vidali</i>	<i>Hippurites vidali</i>	Pas de les Eugues
	15756	1895, 27(3)	<i>Hippurites vidali</i>	<i>Hippurites vidali</i>	Montsec
	15765	1895, 27(4)	<i>Hippurites vidali</i>	<i>Hippurites vidali</i>	Montsec
1957		1904, 13(6)	<i>Rousselia guilhoti</i>	<i>Rousselia guilhoti</i>	La Pobla de Segur
	15893	1895, 23(5)	<i>Hippurites archiaci</i>	<b>Vaccinites archiaci</b>	Rendisclera d'Alòs
1871	15780	1895, 23(6)	<i>Hippurites archiaci</i>	<i>Vaccinites archiaci</i>	Montsec d'Àger
1670	15895	1895, 26(8)	<i>Hippurites canaliculatus</i>	<i>Hippurites canaliculatus</i>	Montsec d'Àger
1417	15896	1895, 26(9)	<i>Hippurites canaliculatus</i>	<i>Hippurites canaliculatus</i>	Montsec d'Àger
1672	15773	1895, 22(4)	<i>Hippurites dentatus</i>	<b>Vaccinites galloprovincialis</b>	Collades de Basturs
1671	15777	1895, 23(7)	<i>Hippurites carezi</i>	<b>Hippuritella sulcatissima</b>	Montsec d'Àger
	15754	1895, 25(3)	<i>Hippurites castroi</i>	<b>Hippuritella castroi</b>	Isona
	15897	1895, 25(4)	<i>Hippurites castroi</i>	<i>Hippuritella castroi</i>	Isona
	***	1895, 25(5)	<i>Hippurites castroi</i>	<i>Hippuritella castroi</i>	Isona
	15898	1895, 21(1)	<i>Hippurites galloprovincialis</i>	<b>Vaccinites galloprovincialis</b>	Collades de Basturs
1663		1895, 21(3)	<i>Hippurites galloprovincialis</i>	<i>Vaccinites galloprovincialis</i>	Collades de Basturs
1147	15757	1895, 22(1)	<i>Hippurites giganteus</i>	<b>Vaccinites giganteus</b>	Espluga de Serra
694	15899	1895, text-fig. 67	<i>Hippurites</i> cf. <i>gosaviensis</i>	<b>Vaccinites giganteus major</b>	Collades de Basturs
1696	15900	1895, 26(1)	<i>Hippurites heberti</i>	<i>Hippurites lamarcki</i>	Carbonills
1664		1895, 21(2), 22(2)	<i>Hippurites jeani</i>	<b>Vaccinites galloprovincialis</b>	Collades de Basturs
1662		1895, 22(3)	<i>Hippurites jeani</i>	<i>Vaccinites galloprovincialis</i>	Collades de Basturs
	15768a	1895, 24(1)	<i>Hippurites maestrei</i>	<b>Hippuritella maestrei</b>	Montsec
1680b		1895, 24(2)	<i>Hippurites maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
	1576b	1895, 24(3)	<i>Hippurites maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
1680c		1895, 24(4)	<i>Hippurites maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
	***	1895, 24(5)	<i>Hippurites maestrei</i>	<i>Hippuritella maestrei</i>	Montsec
	15882	1895, 28(2)	<i>Hippurites montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
<b>1679a</b>		1895, 28(3)	<i>Hippurites montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
1679b	15788	1895, 28(4)	<i>Hippurites montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
	<b>15753</b>	1895, 28(5)	<i>Hippurites montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec d'Àger
	15883	1895, 28(6)	<i>Hippurites montsecanus</i>	<i>Hippurites montsecanus</i>	Montsec
1111		1895, 22(7)	<i>Hippurites moulinsi</i>	<b>Vaccinites beaussetensis</b>	Montsec d'Àger
	***	1895, 26(1)	<i>Hippurites resectus</i>	<i>Hippurites resectus</i>	Montsec
	***	1895, 26(2)	<i>Hippurites resectus</i>	<i>Hippurites resectus</i>	Montsec
	***	1895, 26(3)	<i>Hippurites resectus</i>	<i>Hippurites resectus</i>	Montsec
1765		1895, only descr.	<i>Hippurites verneuilli</i>	<i>Hippurites vidali</i>	Pas de les Eugues

Table 2. Type and figured specimens of rudists, from Douvillé (1895 and 1904), housed in the Vidal Collection at Museu de Geologia de Barcelona (MGB). In bold, register numbers of type specimens as well as taxonomical changes. \*\*\* Specimen not localised.

Tabla 2. Ejemplares tipo y figurados de rudistas, de Douvillé (1895 y 1904), conservados en la Colección Vidal del Museu de Geologia de Barcelona (MGB). Los números de registro de los ejemplares tipo están indicados con negritas, al igual que los cambios taxonómicos. \*\*\* Ejemplar no localizado.

## MATERIAL

Specimens of the Vidal Collection described or figured are kept in the Museu de Geologia de Barcelona-MCNB (MGB). Some of these specimens still preserve the original label with the register number given by Vidal, although all the specimens received a new register number when donated to the MGB in 1922. A MGB register number may correspond to a single specimen but also to a group of specimens all conspecific and from the same locality. Among type and figured specimens, those bearing the same register number have been distinguished each other by adding a letter to the number. Other mentioned specimens (or a part of them) are kept in the EM collection. Specimens in the Palaeontological Collections of the Universitat Autònoma de Barcelona (PUAB) have been used to complete some of the descriptions.

The specimens figured by Vidal (1874, 1878, 1907, 1917, 1918, and 1921) are documented in Table 1 and those figured by Douvillé (1895 and 1904) in Table 2.

## SYSTEMATIC PALAEOLOGY

This section is organised in two parts: first, the species established by Vidal (1874, 1878, and 1921), and second, the species established by Matheron (1880) and Douvillé (1895 and 1904). Synonymy lists are not exhaustive, only original references or those relevant to the scope of this paper are included. Readers may check Steuber (2002) for more complete synonymies.

Abbreviations and conventions in text and figures: AT = anterior tooth; CT = central tooth; L = ligament scar (external) or ligament ridge (internal); LV = left valve; MC = main cavity; P1 = first pillar; P2 = second pillar; PB = posterior radial band; PC = posterior cavity; PM = posterior myophore; PS = posterior radial sinus; PT = posterior tooth; RV = right valve; VB = ventral radial band; VS = ventral radial sinus. In monopleurids, radiolitids, and plagiptychids, stereo pairs have been used to illustrate three-dimensionally the external view. All scale bars represent 10 mm.

## VIDAL'S (1874, 1878 and 1921) NEW SPECIES BASED ON SPECIMENS OF THE VIDAL COLLECTION

Family MONOPLEURIDAE Munier-Chalmas, 1873

### *Monopleura* Matheron, 1843

*Type species.* *Monopleura varians* Matheron, 1843 by subsequent designation of Kutassy, 1934.

### *Monopleura falgasi* Vidal, 1878

Fig. 1.1-6

*Type.* Holotype, MGB 1780 (Vidal, 1878, pl. 2, figs. 3, 3a) from the upper Campanian of Solei de Serra Pigota, S of Pobra de Lillet (Berguedà, Barcelona province).

#### *Synonymy*

1878 *Monopleura Falgasi* Vidal: 350, pl. 2, figs. 3, 3a

*Material.* Only the type, a specimen with both valves articulated, is preserved in the Vidal Collection at MGB.

*Description.* Moderately large specimen, dorsal-ventral diameter measures 55 mm and anterior-posterior diameter 45 mm at the commissural plane. Both valves have very fine radial ribs, also very fine growth lines, and present two radial sinuses (one ventral, the other slightly posterior) starting faintly near the apex and accentuating near the commissure, thus producing a trilobate profile of both valves. LV is moderately convex with a more prominent umbo near the dorsal margin of the valve. RV is conical, curved, and with the umbo extending far beyond the dorsal margin of the commissure; its apical part is broken.

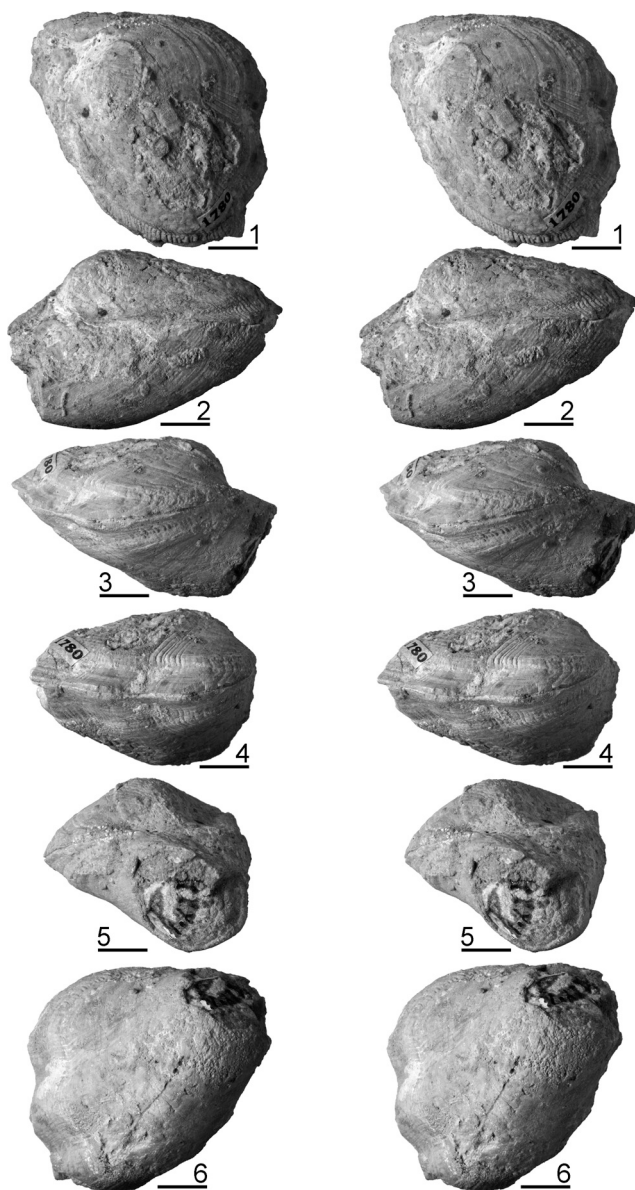


Fig. 1. *Monopleura falgasi* Vidal, 1878. Holotype, MGB 1780; Solei de Serra Pigota, S of Pobra de Lillet. Stereo pairs. 1-6: upper, anterior, posterior-dorsal, posterior, dorsal, and lower views, respectively, of a bivalve specimen.

Fig. 1. *Monopleura falgasi* Vidal, 1878. Holotipo, MGB 1780; Solei de Serra Pigota, S de Pobra de Lillet. Pares estereoscòpicas. 1-6: vistas superior, anterior, postero-dorsal e inferior, respectivament, de un exemplar bivalvo.

*Remarks.* Nothing is known about the inner characters of the shell, as far as the available material has not been sectioned nor disarticulated isolated valves have been found. Nevertheless, external characters fit with the present understanding of *Monopleura*.

*Occurrence.* Several other specimens have been subsequently collected from the upper Campanian of l'Espà (Berguedà), that are kept in PUAB.

### *Monopleura figolina* Vidal, 1878

Fig. 2.1-4

*Type.* Holotype, MGB 1726 (Vidal, 1878, pl. 7, figs. 3, 3a) from the upper Campanian of Fígols (Berguedà, Barcelona province).

#### *Synonymy*

1878 *Monopleura Figolina* Vidal: 351, pl. 7, figs. 3, 3a

*Material.* Besides the holotype, five more specimens are preserved in the Vidal Collection under the same register number. Also, two more specimens (MGB 1296) from Falgars and one (MGB 1038) from Vallcebre, Berguedà.

*Description.* Small specimen with nearly circular section at the commissural plane, dorsal-ventral diameter measures 20 mm and anterior-posterior diameter 17 mm. LV is moderately convex, with the apex close to the dorsal margin, and nearly smooth, very faint growth lines are barely noticeable. RV is much more convex, with the apex close to the dorsal margin of the commissure, and with coarse steeped growth lines. No inflexions of the growth lines are noticed in any of both valves and, thus, no sinuses are evident at the commissure.

*Remarks.* Nothing is known about the inner characters of the shell, as far as the available material has not been sectioned nor disarticulated isolated valves have been found. Nevertheless, external characters fit with the present understanding of *Monopleura*.

*Occurrence.* Fígols, Vallcebre, Pobra de Lillet (Berguedà).

### *Monopleura montsecana* Vidal, 1878

Fig. 2.5-8

*Type.* Holotype, MGB 1422 (Vidal, 1878, pl. 4, figs. 4, 4a, 4b) from the upper Santonian of Mas de Gasol in the

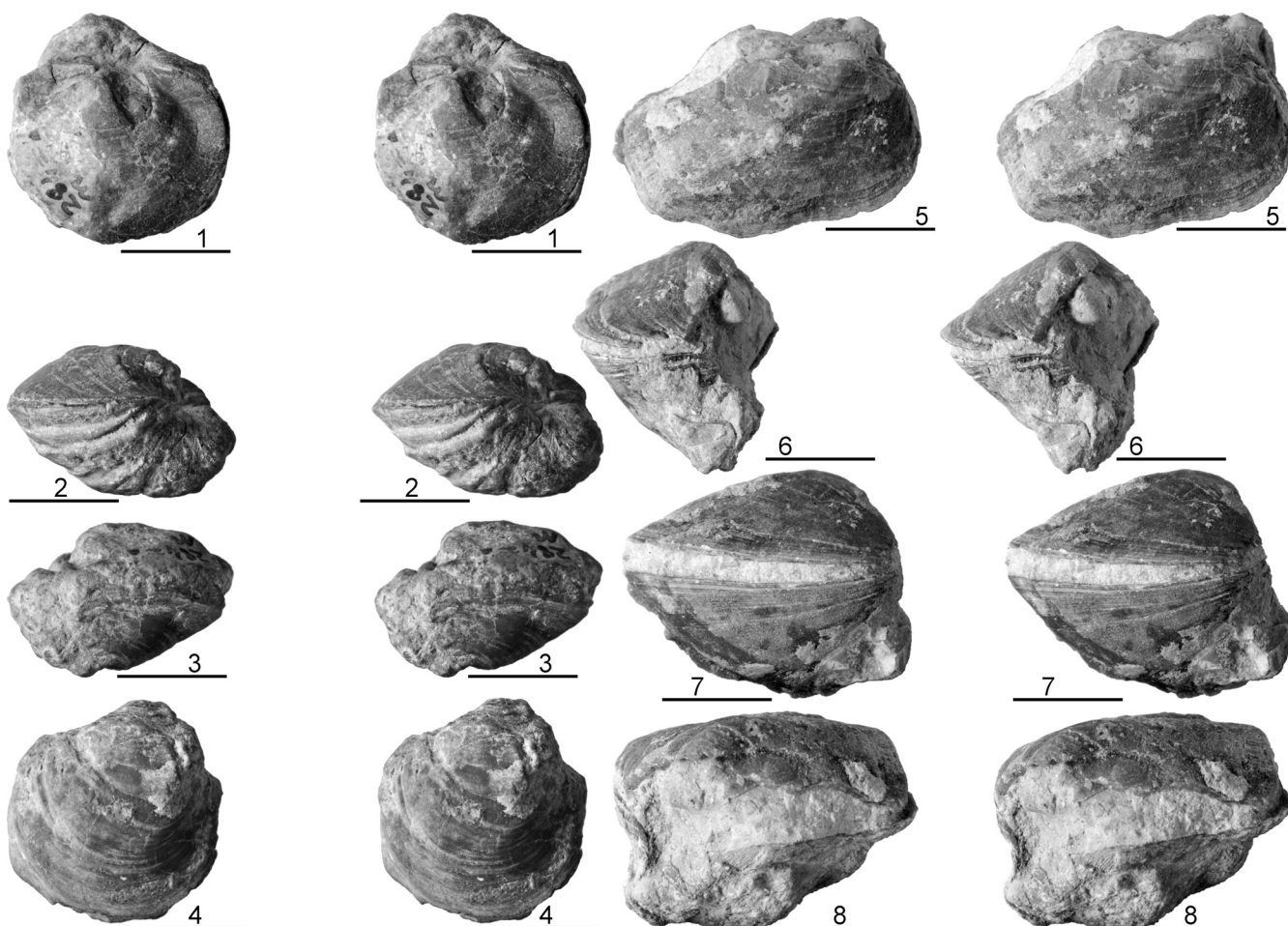


Fig. 2. 1-4, *Monopleura figolina* Vidal, 1878. Holotype, MGB 1726; Fígols. Stereo pairs: upper, posterior, anterior, and lower views, respectively, of a bivalve specimen. 5-8, *Monopleura montsecana* Vidal, 1878. Holotype, MGB 1422; Mas de Gasol, Montsec d'Àger. Stereo pairs: upper, dorsal, posterior, and anterior views, respectively, of a bivalve specimen.

Fig. 2. 1-4, *Monopleura figolina* Vidal, 1878. Holotipo, MGB 1726; Fígols. Pares estereoscópicas: vistas superior, posterior, anterior e inferior, respectivamente, de un ejemplar bivalvo. 5-8, *Monopleura montsecana* Vidal, 1878. Holotipo, MGB 1422; Mas de Gasol, Montsec d'Àger. Pares estereoscópicas: vistas superior, dorsal, posterior y anterior, respectivamente, de un ejemplar bivalvo.

Montsec d'Àger (Noguera, Lleida province).

*Synonymy*

1878 *Monopleura Montsecana* Vidal: 351, pl. 4, figs. 4, 4a, 4b

*Material.* Besides the holotype, four more specimens are preserved in the Vidal Collection under the same register number.

*Description.* Moderately small specimen. At the commissural plane, dorsal-ventral diameter measures 13 mm and anterior-posterior diameter 27 mm. Both valves are

oblique cones, RV higher than LV; smooth, only faint growth lines and two faint radial sinuses are noticed at the outer surface.

*Remarks.* *M. montsecana* differs from *M. falgasi* by its smaller size, lack of radial ribs, less accentuated radial sinuses, and different profile of the shell evidenced by the relation ventral-dorsal/anterior-posterior diameters at the commissural plane. As in previously treated species, even being the internal shell characters unknown, other characters fit with the current understanding of *Monopleura*.

*Occurrence.* Upper Santonian of the Montsec (Noguera).

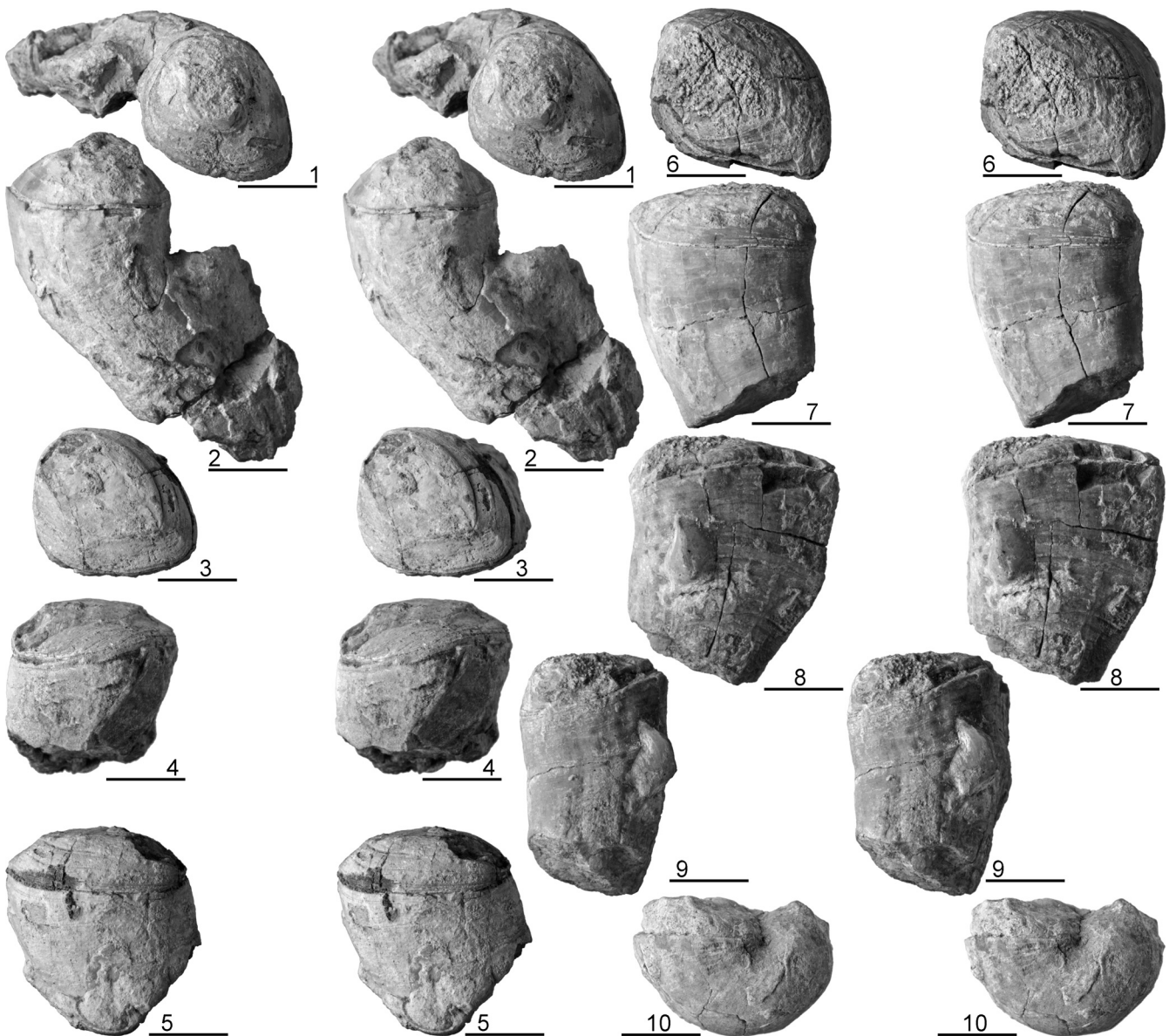


Fig. 3. *Monopleura moroi* (Vidal, 1878). Syntypes; Moror. Stereo pairs. 1-2, MGB 2215a: upper and posterior-dorsal views, respectively, of a bivalve specimen; 3-5, MGB 2215c: upper, anterior, and posterior views, respectively, of a bivalve specimen; 6-9, MGB 2215b: upper, posterior, anterior, and dorsal views, respectively, of a bivalve specimen with a young individual attached at its anterior-dorsal side; 10, MGB 2215d: posterior view of a strongly curved right valve.

Fig. 3. *Monopleura moroi* (Vidal, 1878). Sintipos; Moror. Pares estereoscòpicas. 1-2, MGB 2215a: vistas superior y postero-dorsal, respectivamente, de un ejemplar bivalvo; 3-5, MGB 2215c: vistas superior, anterior y posterior, respectivamente, de un ejemplar bivalvo; 6-9, MGB 2215b: vistas superior, posterior, anterior y dorsal, respectivamente, de un ejemplar bivalvo con un individuo joven pegado a su lado antero-dorsal; 10, MGB 2215d: vista posterior de una valva derecha fuertemente curvada.

***Monopleura moroi* (Vidal, 1878)**

Fig. 3.1-10

*Type.* Syntypes MGB 2215a, b, c, d (Vidal, 1878, pl. 5, figs. 1, 1a, 1b, 2, 2a, 2b, pl. 6, figs. 5, 5a, 6) from the lower Maastrichtian of Moror, at the pathway from Cellers to the St. Miquel chapel (Pallars Jussà, Lleida province).

*Synonymy*

1878 *Requienia Moroi* Vidal: 353, pl. 5, figs. 1, 1a, 1b, 2, 2a, 2b; pl. 6, figs. 5, 5a, 6

1977 *Monopleura moroi* (Vidal); Pons: 55, pl. 3, figs. 6-7

*Material.* Besides the syntypes, thirteen more specimens are preserved in the Vidal Collection under the same register number and three under MGB 2216.

*Description.* Shell very inequivalve. LV is operculiform, moderately convex to nearly flat, with the apex near de dorsal margin, smooth but with evident growth lines; the profile at the commissural plane is somewhat triangular with curved sides. RV is conical very high, nearly cylindrical; most valves are more or less curved, twisted at early growth stages, but straight valves are also common. Outer surface is smooth, with only faint growth lines. Small bouquets composed of a few individuals, attached to each other, are common.

*Remarks.* The original attribution to a requieniid genus is unsustainable: shells are fixed by the RV, valves are not coiled, and the ligament is internal. Although lacking a description of the inner characters of the shell, attribution to *Monopleura*, as Pons (1977) proposed, seems the most reasonable option.

*Occurrence.* Lower Maastrichtian of Moror (Pallars Jussà)

***Gyropleura* Douvillé, 1887**

*Type species.* *Requienia cenomaniensis* d'Orbigny, 1850, by original designation.

***Gyropleura tartareui* Vidal, 1921**

Fig. 4.1-5

*Type.* Syntypes, MGB 2017a, b (Vidal, 1921, pl. 4, figs. 1, 2) from the Campanian of Tartareu (Noguera, Lleida province).

*Synonymy*

1921 *Gyropleura Tartareui* Vidal: 107, pl. 4, figs. 1, 2

*Material.* Only the two syntypes, two right valves of different size, are preserved in the Vidal Collection.

*Description.* RV gyropleuriform. Dorsal-ventral and anterior-posterior diameters at the commissural plane measure 40 mm and 25 mm, respectively, in the larger specimen and 21 mm and 15 mm in the smaller one. Outer shell surface is ornamented by strong rounded radial ribs, interrupted by growth rugae, and enlarging from the apex to the commissure.

*Remarks.* Although lacking a description of the inner characters of the shell, attribution to *Gyropleura*, as originally, seems the most reasonable option.

*Occurrence.* Tartareu (Noguera).

Family RADIOLITIDAE d'Orbigny, 1847  
(originally misspelled as RADIOLIDAE, emended to RADIOLITIDAE by Gray 1848)

***Radiolites* Lamarck, 1801**

*Type species.* *Ostracites angeiodes* Picot de Lapeirouse, 1781 by monotypy.

***Radiolites laciniatus* Vidal, 1878**

Fig. 5.1-5

*Type.* Holotype, MGB 751 (Vidal, 1878, pl. 6, fig. 4, 4a, 4b) from the lower Santonian of the Montsec d'Àger (Noguera, Lleida province).

*Synonymy*

1878 *Radiolites laciniatus* Vidal: 362, pl. 6, figs. 4, 4a, 4b

*Material.* Only the type, a specimen with both valves articulated, is preserved in the Vidal Collection at MGB.

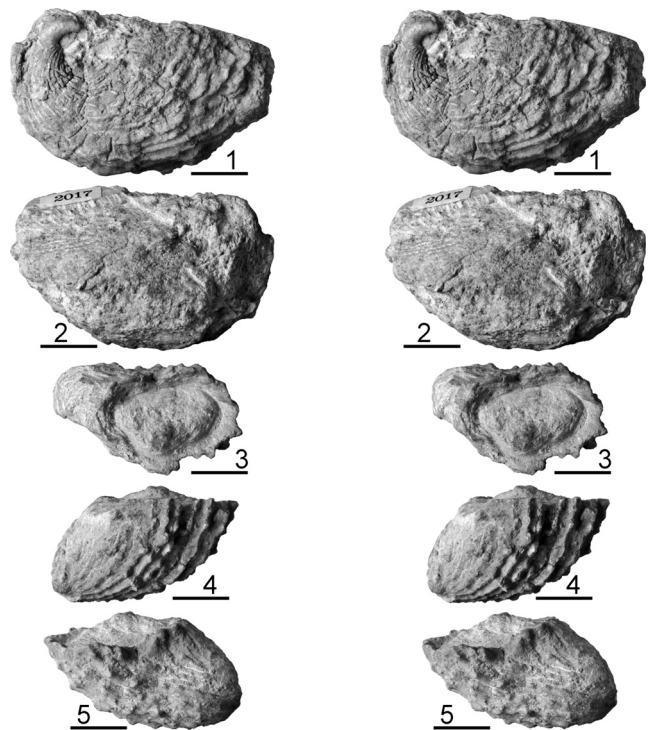


Fig. 4. *Gyropleura tartareui* Vidal, 1921. Syntypes; Tartareu. Stereo pairs. 1-2, MGB 2017a: anterior (slightly lower) and posterior (slightly upper) views, respectively, of a right valve; 3-5, MGB 2017b: upper, anterior, and posterior views, respectively, of a right valve.

Fig. 4. *Gyropleura tartareui* Vidal, 1921. Sintipos; Tartareu. Pares estereoscópicas. 1-2, MGB 2017a: vistas anterior (ligeramente inferior) y posterior (ligeramente superior), respectivamente, de una valva derecha; 3-5, MGB 2017b: vistas superior, anterior y posterior, respectivamente, de una valva derecha.

*Description.* RV conical, 60 mm long and 50 mm maximal diameter at the commissural plane, ornamented by narrow rounded radial ribs intercalated with slightly wider sinuses. Two among these sinuses, much wider and with flat bottom, corresponding to up-and-inward folds of the growth lamellae, and limited by narrow costae (down-and-outward folds), are interpreted as the radial bands. Costae and sinuses are gently interrupted by successive growth cycles. LV smooth, nearly flat, with a sub-central faintly convex apex and a concave marginal part adapted to the folds of the right valve.

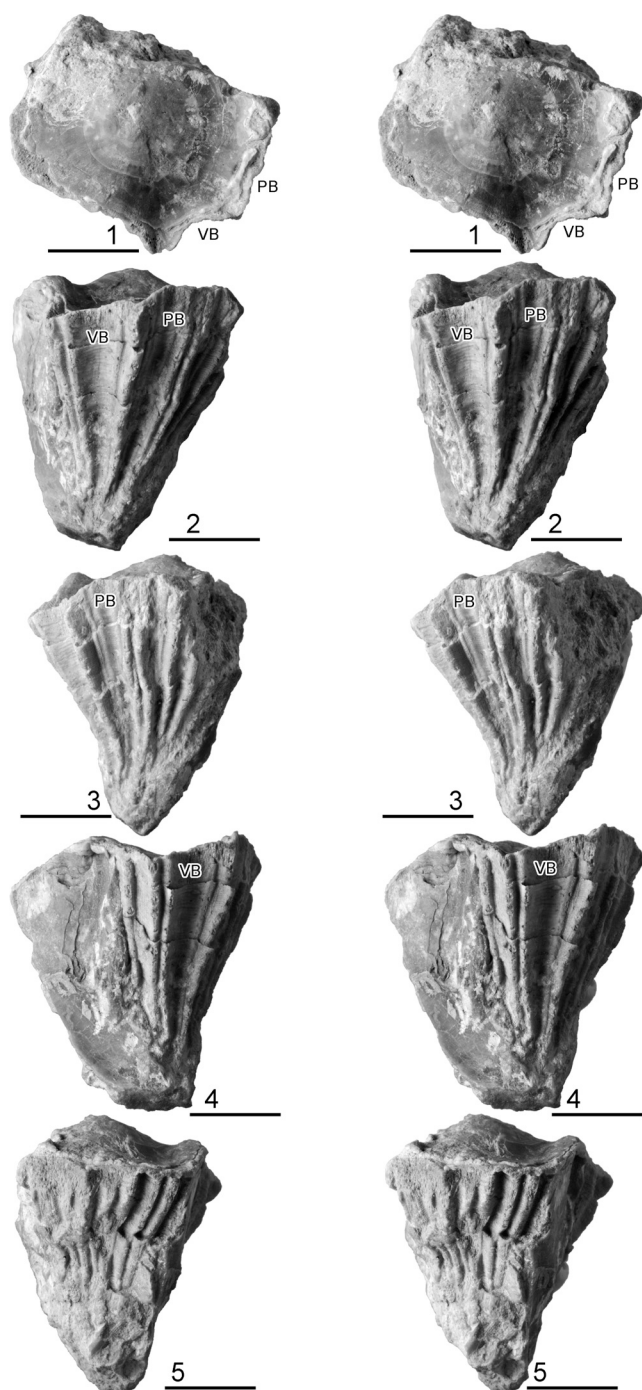


Fig. 5. *Radiolites laciniatus* Vidal, 1878. Holotype, MGB 751; Montsec. Stereo pairs. 1-5: upper, ventral, posterior, anterior, and dorsal views, respectively, of a bivalve specimen.

Fig. 5. *Radiolites laciniatus* Vidal, 1878. Holotipo, MGB 751; Montsec. Pares estereoscópicos. 1-5: vistas superior, ventral, posterior, anterior y dorsal, respectivamente, de un ejemplar bivalvo.

*Remarks.* Several specimens identified as *R. laciniatus*, collected in the lower Santonian of the Montsec, have been sectioned and all of them show a ligament ridge and mostly compact outer shell structure (see Pons & Vicens, 2008, fig. 6). The very simple morphology of *R. laciniatus* better recalls the one displayed by some Turonian *Radiolites* species (see e.g. *R. lefebvrei* Rolland, 1881) than that shown by other Coniacian or Santonian species.

*Occurrence.* Lower Santonian of the Montsec (Noguera).

### *Biradiolites* d'Orbigny, 1850

*Type species.* *Biradiolites canaliculatus* d'Orbigny, 1850 by subsequent designation of Toucas, 1909.

### *Biradiolites ibericus* (Vidal, 1878)

Fig. 6.1-4

*Type.* Holotype, MGB 759 (Vidal, 1878, pl. 6, figs. 1, 1a) from the upper Santonian of Mas de Gasol, Montsec d'Àger (Noguera, Lleida province).

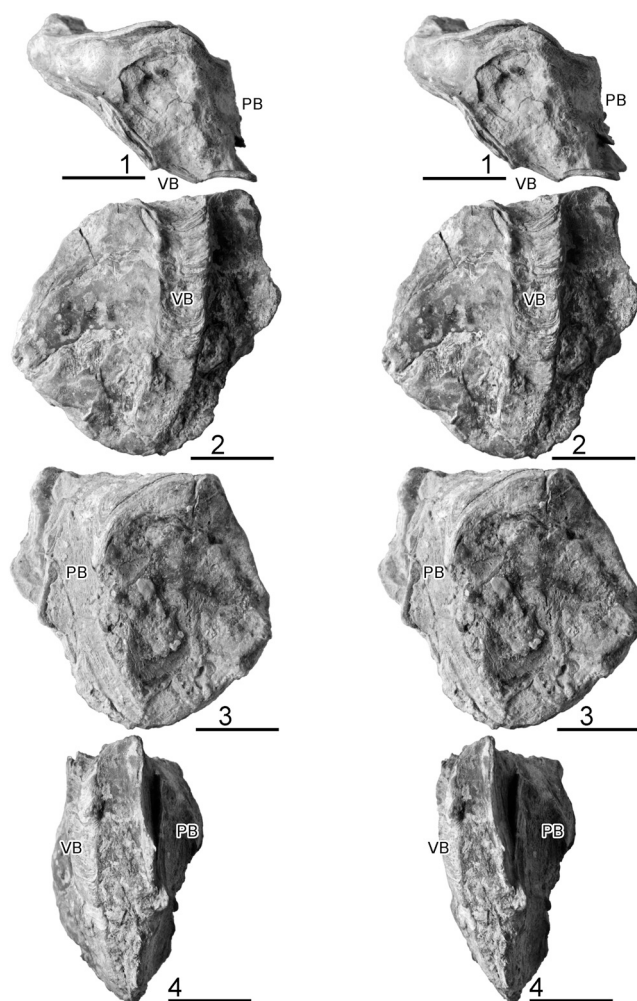


Fig. 6. *Biradiolites ibericus* (Vidal, 1878). Holotype, MGB 759; Mas de Gasol, Montsec d'Àger. Stereo pairs. 1-4: upper, anterior, posterior, and ventral views, respectively, of a bivalve specimen.

Fig. 6. *Biradiolites ibericus* (Vidal, 1878). Holotipo, MGB 759; Mas de Gasol, Montsec d'Àger. Pares estereoscópicos. 1-4: vistas superior, anterior, posterior y ventral, respectivamente, de un ejemplar bivalvo.



*Synonymy*

1878 *Radiolites angulosus* D'Orb. var. *ibericus* Vidal:  
361, pl. 6, figs. 1, 1a

1909 *Biradiolites ibericus* (Vidal); Toucas: 108

*Material.* Besides the holotype, fourteen more specimens are preserved in the Vidal Collection at MGB under the same register number.

*Description.* RV is wide conical and dorsal-ventrally flattened. It is 35 mm high, measuring 35 mm the anterior-

posterior diameter and 15 mm the ventral-dorsal. A narrow, much developed down-and-outward fold of the growth lamellae, at the anterior side, together with another, acute but less developed at the inter-band, are mainly responsible for the flattened profile of the valve. The ventral radial structure is a flat down-and-outward fold of the growth lamellae forming a slightly protruding flat radial band. The posterior radial structure is also a flat down-and-outward fold of the growth lamellae, but narrower and depressed between the inter-band fold and a posterior-dorsal fold. LV has a centred slightly convex apex

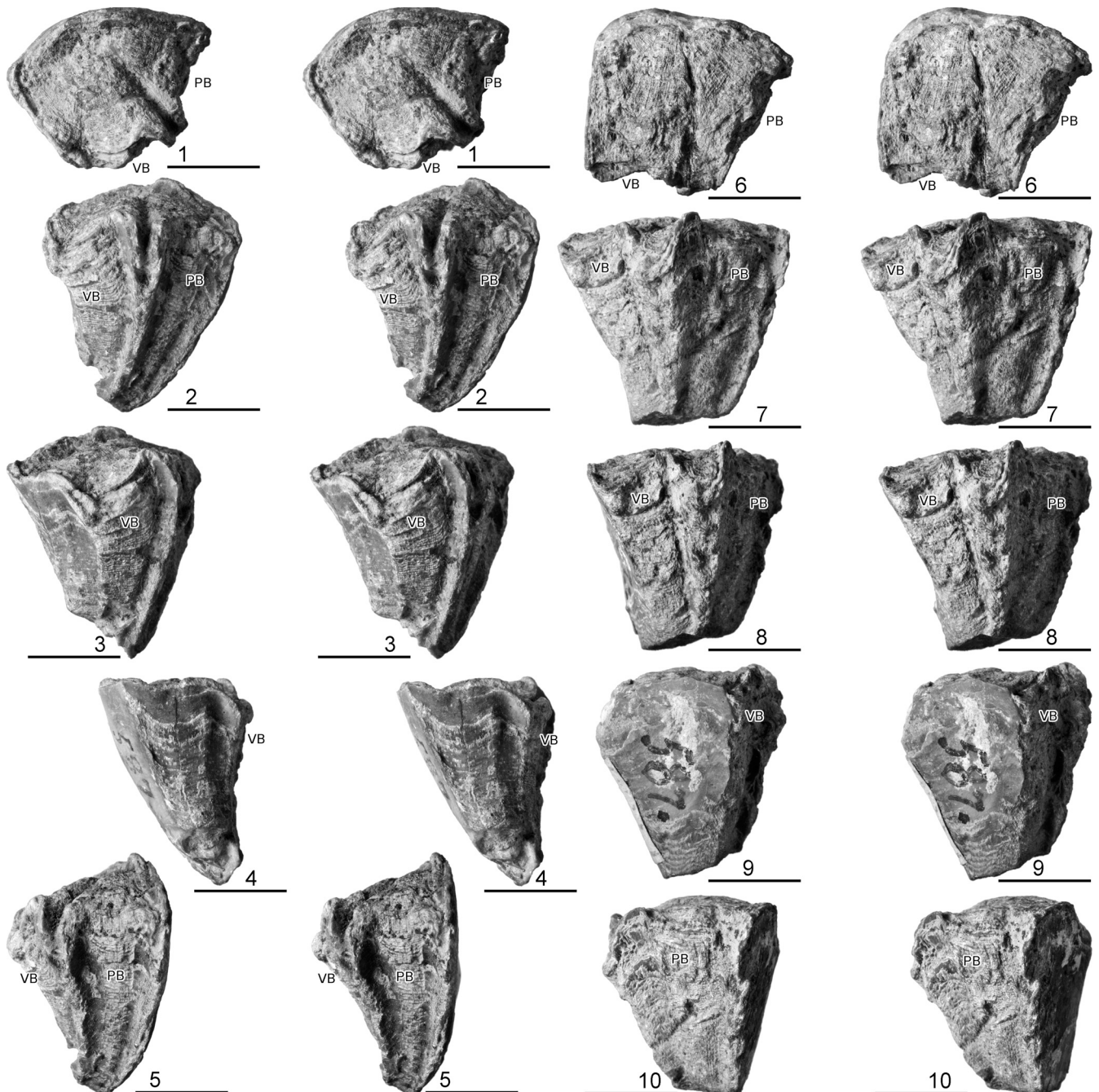


Fig. 7. *Biradiolites royanus* (d'Orbigny, 1850). Syntypes of *Radiolites fumanyae* Vidal, 1878; Fumanya. Stereo pairs. 1-5, MGB 1729a: upper, ventral-posterior, ventral, anterior, and posterior views, respectively, of a bivalve specimen; 6-10, MGB 1729b: upper, ventral-posterior, ventral, anterior, and posterior views, respectively, of a bivalve specimen.

Fig. 7. *Biradiolites royanus* (d'Orbigny, 1850). Sintipos de *Radiolites fumanyae* Vidal, 1878; Fumanya. Pares estereoscópicas. 1-5, MGB 1729a: vistas superior, ventral-posterior, ventral, anterior y posterior, respectivamente, de un ejemplar bivalvo; 6-10, MGB 1729b: vistas superior, ventral-posterior, ventral, anterior, y posterior, respectivamente, de un ejemplar bivalvo.

and extends marginally adapted to the folds in the RV. Transverse sections of other specimens collected from the same locality show the myo-cardinal apparatus characteristic of *Biradiolites* and an outer shell layer structure with radial ridges pattern.

*Remarks.* The species was validated and recognized as a *Biradiolites* by Toucas (1909).

*Occurrence.* Upper Santonian of the Montsec (Noguera).

### *Biradiolites royanus* (d'Orbigny, 1850)

Fig. 7.1-10

*Type.* Lectotype B09081 (C.O. 7717) Muséum national d'Histoire Naturelle de Paris (d'Orbigny, 1850, pl. 571, figs. 1-3) from Royan (Charente-Maritime, France) by subsequent designation of Macé-Bordy (2007).

#### *Synonymy*

- 1850 *Radiolites royanus* d'Orbigny: 228, pl. 571, figs. 1-3  
 1878 *Radiolites Fumanyae* Vidal: 357, pl. 7, figs. 4, 4a, 4b, 5  
 1907 *Agria Fumanyae* (Vidal); Toucas: 23, pl. 1, fig. 16  
 1909 *Biradiolites royanus* (d'Orbigny); Toucas: 103, pl. 19, figs. 34-38

*Material.* Besides the two specimens MGB 1729a and MGB 1729b, figured as types of *R. fumanyae* by Vidal (1878), sixteen more specimens under the same number from Fígols, and thirteen specimens under MGB 1865 from Fumanya (Fígols municipality) are preserved in the Vidal Collection at MGB.

*Description.* RV is small, conical and slightly quadrangular in upper view. Anterior-posterior diameter measures between 23 and 30 mm and dorsal-ventral diameter between 12 and 18 mm. Radial structures are two wide, flat down-and-outward folds of the growth lamellae limited each one by very narrow up-and-inward folds, that form, at the outer shell surface, two wide radial bands depressed between an acute down-and-outward fold in the inter-band and two similar although less developed folds, respectively, at the anterior and posterior side. The costae produced at the outer shell surface by these three folds, together with that of an anterior-dorsal one, are mainly responsible for the quadrangular transverse section or upper view profile of the shell. LV is slightly convex, with a dorsally located apex and three narrow radial sulci and two wide flat costae in correspondence with the folds of the growth lamellae in the RV. The transverse sections of the specimens from Serra de Catllaràs, S of Pobla de Lillet and Serrat de la Figuerassa, N of Berga, figured by Vicens (1992, pl. 57, figs. 9-11; pl. 62, fig. 1) show, besides the myo-cardinal apparatus, the outer shell layer with compact structure in most of both valves, and only poorly developed non compact structure at the radial structures.

*Remarks.* Vicens (1992) first recognized *R. fumanyae* Vidal as a junior synonym of *B. royanus* (d'Orbigny).

*Occurrence.* *B. royanus* occurs in France (Charente-Maritime, Charente, Dordogne) and South-central Pyrenees in Spain (Campanian from Fígols, Fumanya, S of Pobla de Lillet and N of Berga (in Berguedà, Barcelona province).

### *Praeradiolites Douvillé, 1903*

*Type species.* *Sphaerulites ponsiana* d'Archiac, 1837, subsequent designation by Pons and Vicens, 2011. Opinion 2314 (Case 3546), ICZN (2013).

### *Praeradiolites paillettei* (d'Orbigny, 1842)

Fig. 8.1-6

*Type.* Lectotype R07959 (C.O.6936-III), paralectotypes R08813 (C.O.6936-I), R63754 (C.O.6936-II) Muséum national d'Histoire Naturelle de Paris (d'Orbigny, 1850, pl. 558, figs. 1-3) from the mid-upper Turonian of Rennes-Bains (Aude, France), by subsequent designation of Macé-Bordy (2007).

#### *Synonymy*

- 1842 *Radiolites Pailletteana* d'Orbigny: 184  
 1850 *Radiolites Pailletteana* d'Orb.; d'Orbigny: 217, pl. 558, figs. 1-3  
 1878 *Sphaerulites Aagerensis* Vidal: 363, pl. 2, figs. 1, 1a, 1b, 2  
 1907 *Praeradiolites paillettei* (d'Orb.); Toucas: 44, pl. 8, figs. 1-2

*Material.* Besides the two specimens MGB 1154a and MGB 1154b, figured as types of *S. aagerensis* by Vidal (1878), another specimen under the same number from the Montsec d'Àger is preserved in the Vidal Collection at MGB.

*Description.* RV is conical, short and wide; around 30 mm high and 50 mm of anterior-posterior diameter. LV has a convex apex located slightly dorsal and a thin flat margin extending over the very much expanded commissural lip. The growth lamellae of the RV, are slightly inclined inwards and develop gently undulated radial folding. The radial structures are two deep and flat up-and-inward folds, limited by three deep and narrower down-and outward folds. The outer shell surface bears two wide radial sinuses and three narrower costae at the ventral-posterior side and regular rounded costae at the rest. Thick lamellae sets, separated by growth interruptions, are conspicuous at the outer shell surface. Vidal specimens have not been cut, but abundant newly collected material from the same locality was sectioned and shows a characteristic ligament ridge and myo-cardinal apparatus, as well as the structure of the outer shell layer, normal cellular with radially elongated cells in coincidence with major folds of the growth lamellae, thus shell width more expanded.

*Remarks.* Toucas (1907) first recognized *S. aagerensis* Vidal as a junior synonym of *P. paillettei* (d'Orbigny).

*Occurrence.* *P. paillettei* has been widely reported from southern France (Aude). In Spain it occurs in Serra del Montsec (Noguera, Lleida province).

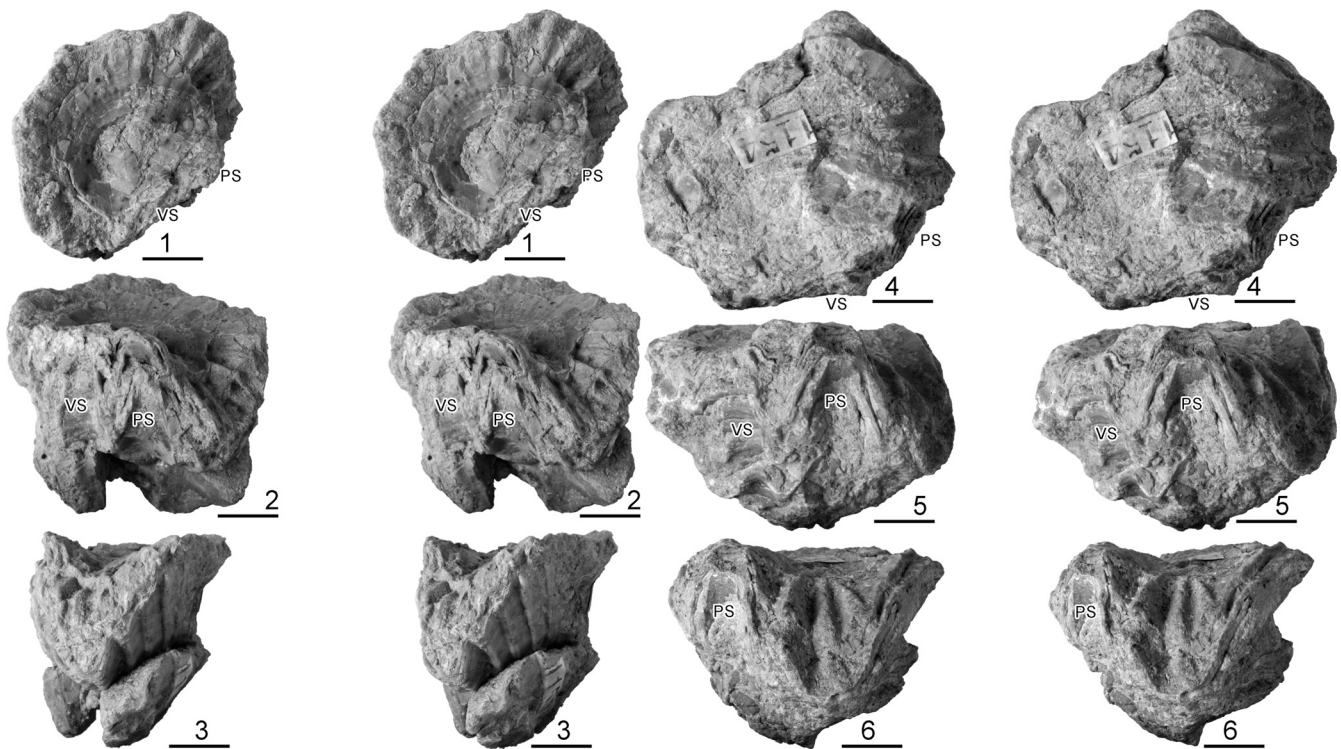


Fig. 8. *Praeradiolites paillettei* (d'Orbigny, 1842). Syntypes of *Sphaerulites aagerensis* Vidal, 1878; Montsec. Stereo pairs. 1-3, MGB 1154b: upper, ventral-posterior, and posterior-dorsal views, respectively, of a bivalve specimen; 4-6, MGB 1154a: upper, ventral-posterior, and posterior views, respectively, of a bivalve specimen.

Fig. 8. *Praeradiolites paillettei* (d'Orbigny, 1842). Sintipos de *Sphaerulites aagerensis* Vidal, 1878; Montsec. Pares estereoscópicas. 1-3, MGB 1154b: vistas superior, ventral-posterior y postero-dorsal, respectivamente, de un ejemplar bivalvo; 4-6, MGB 1154a: vistas superior, ventral-posterior y posterior, respectivamente, de un ejemplar bivalvo.

### *Radiolitella* Douvillé, 1904

*Type species.* *Chama forojuliensis* Pirona, 1869 by original designation.

### *Radiolitella pulchellus* (Vidal, 1878)

Fig. 9.1-15

*Type.* Syntypes MGB 1733a, b, c (Vidal, 1878, pl. 4, figs. 1-3), from the lower Maastrichtian of Fígols (Berguedà, Barcelona province).

#### *Synonymy*

1878 *Sphaerulites pulchellus* Vidal: 364, pl. 4, figs. 1, 1a, 1b, 1c, 1d, 2, 2a, 3

1907 *Praeradiolites pulchellus* (Vidal); Toucas: 39, pl. 5, figs. 13, 13a, 14

1977 *Radiolitella pulchellus* (Vidal); Pons: 73, pl. 63, figs. 1-3

*Material.* Besides the three syntypes, five more specimens from Fígols are preserved in the Vidal Collection under the same register number.

*Description.* RV is conical, with narrow acute apex curved towards the ventral-posterior side. Anterior-posterior and dorsal-ventral diameters measure 30 mm and 22 mm, respectively, in a shell 40 mm high. The outer surface is nearly smooth; besides the growth lines, only two gentle radial sinuses close each other and limited by three rounded costae, at the ventral posterior side, and a narrow

radial furrow at the dorsal side, are conspicuous. LV is nearly flat, with the apex located dorsally, from which thin radial costae arise, reaching the commissural margin.

*Remarks.* The species was currently attributed to genus *Praeradiolites* since Toucas (1907). Pons (1977) described its canalculated outer shell structure and identified it as *Radiolitella*.

*Occurrence.* Lower Maastrichtian of Fígols, Fumanya, Pobra de Lillet (Berguedà, Barcelona province), Isona (Pallars Jussà, Lleida province), and many other south-central Pyrenean localities in Noguera, Solsonès, Alt Urgell (Lleida province), and Cerdanya (Lleida province). Toucas (1907) reported the species from St. Mametz and Beaumont (Dordogne, France).

#### **New genus?**

RV characterised by: growth lamellae deeply inclined inwards; radial structures are two close wide flat down-and-outward folds of the growth lamellae, commonly subdivided, producing two unequal radial bands at the outer surface, commonly depressed, without inter-band fold; outer shell layer structure compact and non-compact with continuous radial ridges; no ligament ridge. LV is deeply concave.

This new genus differs from *Eoradiolites* Douvillé, 1909 by lacking a ligament ridge and from *Biradiolites*, besides the outer shell layer structure, by its close radial bands without an inter-band fold. Although it appears similar to some species currently attributed to *Bournonia* Fischer, 1887, a

genus needing a revision and a re-definition, it is completely different from its type species *Bournonia bournoni* (des Moulins, 1826).

**New genus? *moroi* (Vidal, 1878)**

Fig. 10.1-8

*Type.* Syntypes, MGB 2217a, b (Vidal, 1878, pl. 5, figs. 3, 3a, 3b, 4, 4a) from the lower Maastrichtian of Moror (Pallars Jussà, Lleida province).

**Synonymy**

1878 *Radiolites Moroi* Vidal: 359, pl. 5, figs. 3, 3a, 3b, 4, 4a

1907 *Agria Moroi* (Vidal); Toucas: 23, pl. 1, figs. 17, 17a

2004 *Biradiolites moroi* (Vidal); Vicens *et al.*: 119, text-figs. 6.5, 7.1, 8.1

*Material.* Besides the syntypes, twelve more specimens are preserved in the Vidal Collection at MGB under the same register number.

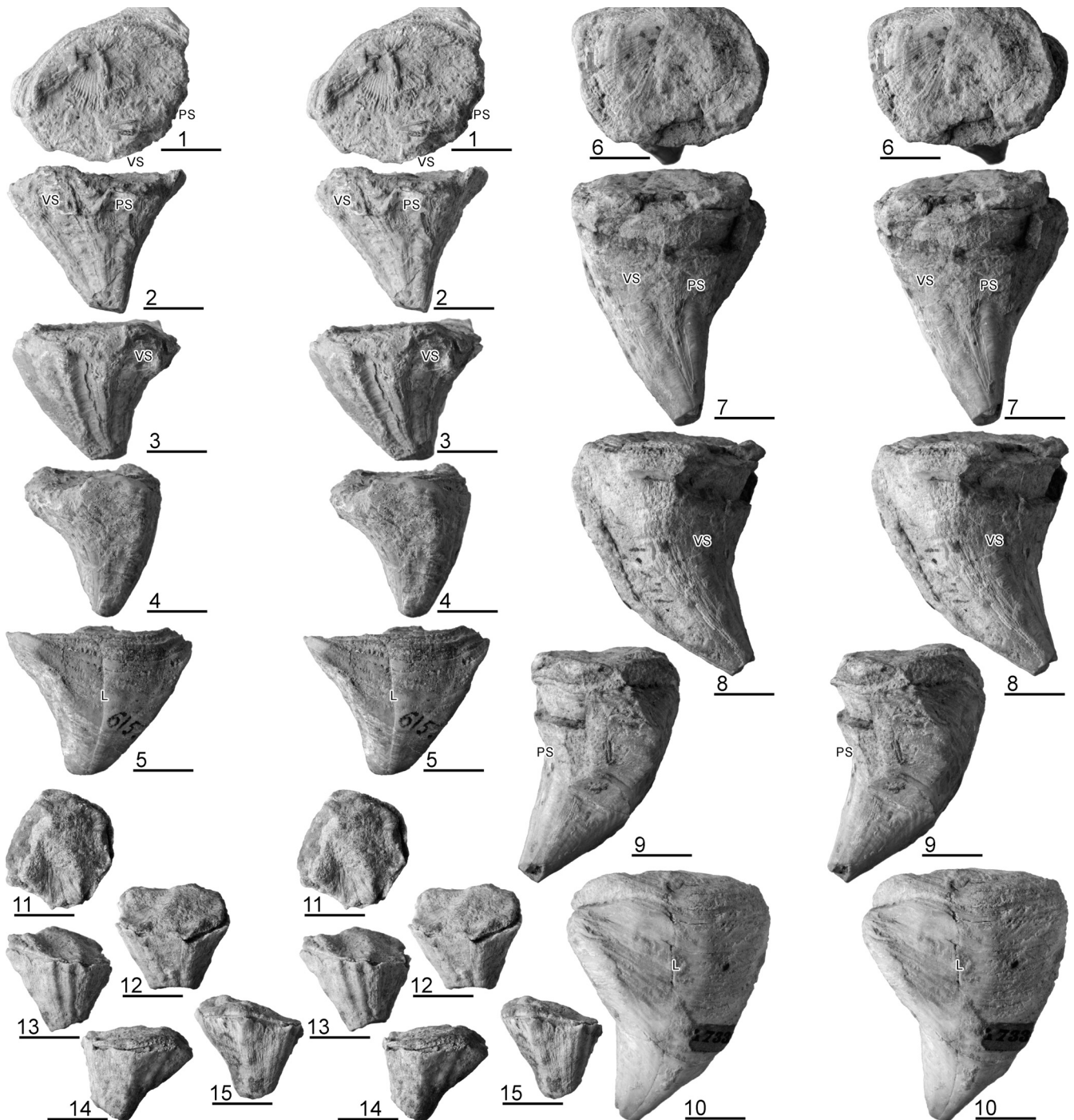


Fig. 9. *Radiolitetella pulchellus* (Vidal, 1878). Syntypes; Fígols. Stereo pairs. 1-5, MGB 1733a: upper, ventral, anterior, posterior, and dorsal views, respectively, of a bivalve specimen; 6-10, MGB 1733b: upper, ventral-posterior, anterior, posterior, and dorsal views, respectively, of a bivalve specimen; 11-15, MGB 1733c: upper, ventral, anterior, posterior, and dorsal views, respectively, of a young bivalve specimen.

Fig. 9. *Radiolitetella pulchellus* (Vidal, 1878). Sintipos; Fígols. Pares estereoscópicas. 1-5, MGB 1733a: vistas superior, ventral, anterior, posterior y dorsal, respectivamente, de un ejemplar bivalvo; 6-10, MGB 1733b: vistas superior, ventral-posterior, anterior, posterior y dorsal, respectivamente, de un ejemplar bivalvo; 11-15, MGB 1733c: vistas superior, ventral, anterior, posterior y dorsal, respectivamente, de un ejemplar joven bivalvo.

*Description.* RV is long conical with a flat ventral-posterior face, bearing two close wide flat depressed radial bands, ventral one wider than posterior one; the rest of the outer shell surface is smooth or presents tender rounded costae. There is no trace of a ligament ridge. LV is deeply concave, with sub-central apex, and bears conspicuous growth lines.

*Remarks.* Toucas (1907) recognised the genus *Agria* Matheron, 1878 (emended to *Agriopleura* by Kuhn, 1932), considering *Hippurites Blumenbachi* Studer, 1834 as the type species, and distinguishing two groups of species according to the development of the costae and sinuses, differently interpreted as the radial structures. Both groups include species with or without a ligament ridge. Subsequently, some of the species considered by Toucas (1907) have been ascribed to other genera (Masse & Philip 1974), namely *Eoradiolites* or *Bournonia*.

The species, currently attributed to *Agriopleura* since Toucas (1907) was assigned to *Biradiolites* by Vicens *et al.* (2004). Its outer shell layer structure, non-compact with continuous radial ridges, was illustrated by Pons and Vicens (2008, text-figs. 7, 16a-c). We consider that this species should be attributed to a new genus, defined by the characters reported above.

*Occurrence.* Lower Maastrichtian of Moror (Pallars Jussà).

#### New genus? *osensis* (Vidal, 1878)

Fig. 11.1-15

*Type.* The syntypes of *Radiolites osensis* are MGB 1822a, b and those of *Biradiolites osensis* are MGB 2015a, b, all of them from Riu de Farfanya in Tartareu, N of Os de Balaguer (Noguera, Lleida province).

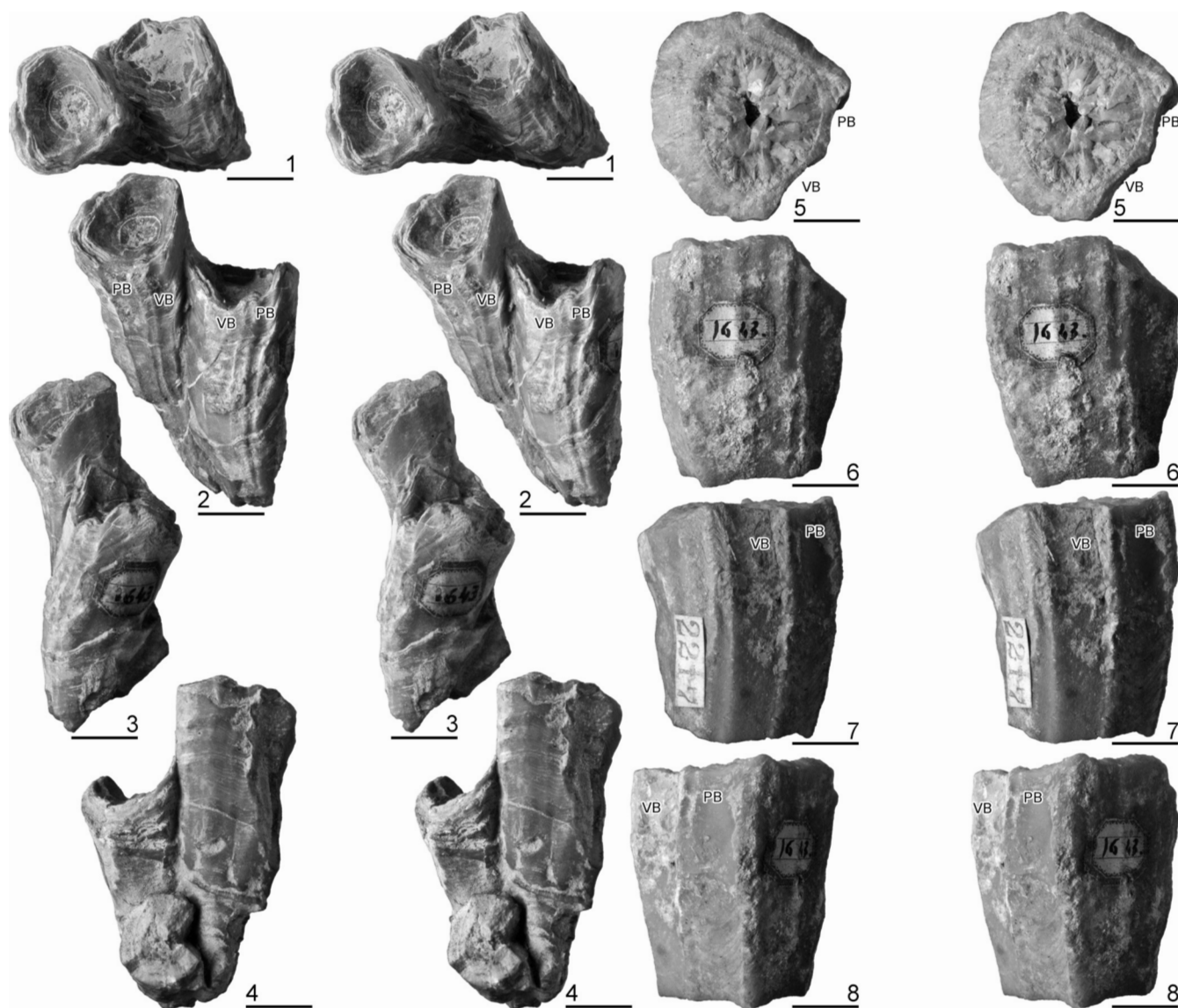


Fig. 10. New genus? *moroi* (Vidal, 1878). Syntypes; Moror. Stereo pairs. 1-4, MGB 2217a: upper, ventral, posterior, and dorsal views, respectively, of two attached bivalve specimens; 5-8, MGB 2217b: upper, posterior, ventral, and dorsal views, respectively, of a right valve fragment.

Fig. 10. Género nuevo? *moroi* (Vidal, 1878). Sintipos; Moror. Pares estereoscópicas. 1-4, MGB 2217a: vistas superior, ventral, posterior y dorsal, respectivamente, de dos ejemplares bivalvos pegados; 5-8, MGB 2217b: vistas superior, posterior, ventral y dorsal, respectivamente, de un fragmento de valva derecha.

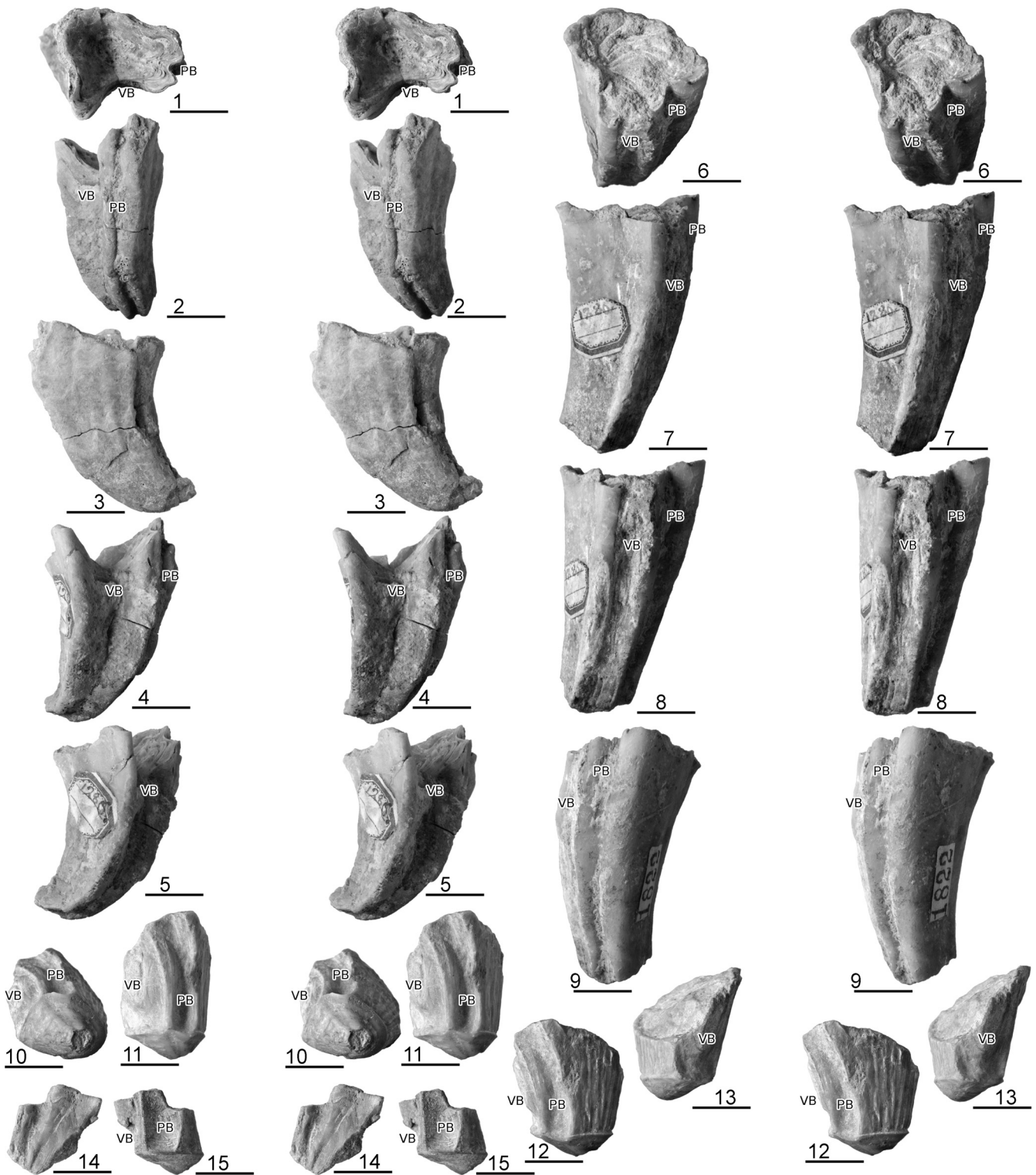


Fig. 11. New genus? *osensis* (Vidal, 1878). Syntypes of *Radiolites osensis* Vidal, 1878 and of *Biradiolites osensis* Vidal, 1921; Riu de Farfanya, Os de Balaguer. Stereo pairs. 1-5, MGB 1822a: upper, ventral-posterior, posterior, ventral, and anterior views, respectively, of a bivalve specimen; 6-9, MGB 1822b: upper-ventral, anterior, ventral, and posterior views, respectively, of a bivalve specimen; 10-13, MGB 2015a: lower-posterior, posterior, posterior-dorsal, and anterior-ventral views, respectively, of the commissural lip of a left valve; 14-15, MGB 2015b: outer and inner views, respectively, of a posterior fragment of a left valve.

Fig. 11. Género nuevo? *osensis* (Vidal, 1878). Sintipos de *Radiolites osensis* Vidal, 1878 y de *Biradiolites osensis* Vidal, 1921; Riu de Farfanya, Os de Balaguer. Pares estereoscópicas. 1-5, MGB 1822a: vistas superior, ventral-posterior, posterior, ventral y anterior, respectivamente, de un ejemplar bivalvo; 6-9, MGB 1822b: vistas superior-ventral, anterior, ventral y posterior, respectivamente, de un ejemplar bivalvo; 10-13, MGB 2015a: vistas inferior-posterior, posterior, postero-dorsal y anterior-ventral, respectivamente, del labio comisural de una valva izquierda; 14-15, MGB 2015b: vistas externa e interna, respectivamente, de un fragmento posterior de valva izquierda.

*Remarks on the type.* After the study of the type material, it becomes evident that Vidal (1921) named *Biradiolites osensis* two specimens that correspond, in fact, to incomplete disarticulated left valves of the species *Radiolites osensis* he had already established in 1878, as pointed out by Vicens (1992). Thus, the two species become secondary homonyms, *R. osensis* being the senior.

#### Synonymy

- 1878 *Radiolites Osensis* Vidal: 359, pl. 7, figs. 1, 1a, 1b, 1c, 2, 2a  
 1907 *Agria Osensis* (Vidal); Toucas: 22, pl. 1, figs. 15, 15a  
 1921 *Biradiolites osensis* Vidal: 107, pl. 2, fig. 6; pl. 4, figs. 10, 11  
 1992 *Biradiolites osensis* (Vidal); Vicens: 176, pl. 58, figs. 1-7; pl. 59, figs. 2, 3, 4; pl. 62, figs. 2, 3, 4

*Material.* Besides the syntypes of both species, forty-one more specimens, from Tartareu, are preserved in the Vidal Collection under the same register number (MGB 1822).

*Description.* Small size shells, largest specimens measure 50 mm high and 25 mm in maximum diameter at the commissural plane. RV is long conical, with the apex curved towards the dorsal side. Radial structures are two very close down-and-outward folds of the deeply inwards inclined growth lamellae that produce two radial bands at the outer shell surface, VB wider than PB, without an inter-band rib (fold). As the wide central part of the folds is subdivided, the bands appear as deeply depressed. The rest of the outer shell surface is smooth or bears tender rounded costae. LV is deeply concave and presents the same folds than the RV.

*Remarks.* The species, currently attributed to *Agriopleura* since Toucas (1907) was assigned to *Biradiolites* by Masse and Philip (1974). Vicens (1992), besides recognising the synonymy between the two species established by Vidal (1878 and 1921), figured several transverse sections showing the myo-cardinal apparatus and the structure of the outer shell layer, compact in juvenile shells and in thin parts of adult shells and non-compact with continuous radial ridges in thicker parts, particularly in folds. We consider this species should be attributed to a new genus, defined by the characters reported above.

*Occurrence.* Lower Maastrichtian of Os de Balaguer (Noguera), Alinyà and Odén (Alt Urgell, Lleida province).

#### Radiolitidae indeterminate, *Biradiolites?* sp.

Fig. 12.1-3

#### Synonymy

- 1878 *Monopleura minuta* Vidal: 352, pl. 3, figs. 7, 7a  
 non 1977 *Monopleura minuta* Vidal; Pons: 55, pl. 3, figs. 1, 2

*Material.* Only the specimen MGB 1421 from the Montsec d'Àger (Noguera, Lleida province), figured as holotype of *M. minuta* by Vidal (1878), is preserved in the Vidal Collection.

*Description.* The specimen is an internal mould of a radiolitid, preserving, only in some points, the inner shell layer and the innermost part of the outer shell layer. Dor-

sal-ventral diameter measures 12 mm and anterior-posterior one 10 mm at the commissural plane; height is 13 mm. Location of the myo-cardinal apparatus is discernible at the dorsal side, and there is no evidence of a ligament ridge. It probably corresponds to a small *Biradiolites*.

*Remarks.* Pons (1977) described as *M. minuta* Vidal a small specimen of *Monopleura*, with well preserved radial ribs at the outer surface of both valves, from the Santonian of Collades de Basturs, that can not correspond to Vidal species.

*Occurrence.* Montsec d'Àger (Noguera).

#### Radiolitidae indeterminate, *Praeradiolites?* sp.

Fig. 12.4-9

#### Synonymy

- 1878 *Sphaerulites minor* Vidal: 366, pl. 6, figs. 3, 3a, 3b, 3c; pl. 7, fig. 6

*Material.* Only the two specimens MGB 1279a and MGB 1279b from Mina Santiago, Solana de Casa Roquill, Carbonills (Albanyà municipality, Alt Empordà, Girona province), figured as syntypes of *S. minor* by Vidal (1878), are preserved in the Vidal Collection.

*Description.* The two specimens preserve both valves. One measures 17 mm of maximal diameter and 15 mm of height, while the other does 12 mm and 10 mm respectively. RV is conical, with an eccentric apex located ventrally, and two up- and inward folds of the growth lamellae producing two radial sinuses limited by three costae at the flat ventral-posterior side and remaining smooth at the rest of the outer surface. LV is flat, with slightly prominent eccentric apex and two flat radial costae in correspondence with the radial sinuses of the RV.

*Remarks.* The shell characters observed on both specimens do not allow a generic or specific identification and, even less, the proposal of a new taxon. They probably correspond to young individuals of *Praeradiolites*.

*Occurrence.* Solana de Casa Roquill, Carbonills (Alt Empordà).

#### Radiolitidae indeterminate

#### Synonymy

- 1878 *Sphaerulites Posae* Vidal: 367, with no figure

Vidal (1878: 367) named as *Sphaerulites Posae* new species several specimens of radiolitids from Barranc de les Freixoneres, Isona (Pallars Jussà, Lleida province), indicating that the badly preserved right valve reminded, in size and depth, that of *Sphaerulites Leymeriei* (= *Praeradiolites leymeriei*), succinctly describing the ornament of the left valve, and with no figures.

Five specimens, under the register number MGB 2179 and indicating *Sphaerulites Posae* in the label, are preserved in the Vidal collection. One is an isolated radiolitid LV with a fragment of another young radiolitid shell fixed on the upper (outer) surface and showing the crest of the

ligament and the base of the broken cardinal arch at the lower (inner) surface. A second specimen is a radiolitic with both valves, RV with a curved apex and LV slightly convex, but both with the outer surface highly eroded. A third specimen is a short, seemingly young, radiolitic RV fixed on a *Hippuritella castroi* LV fragment; a deep radial furrow is evident on the better preserved dorsal side and two very close up-and-inward folds are slightly indicated on the badly preserved, abraded ventral side. A fourth specimen is an isolated RV of radiolitic, showing at the interior the crest of the ligament ridge and the cardinal sockets; two close up-and inward folds, as those in the

last specimen, are barely noticeable on the abraded outer surface. A fifth specimen is a small fragment, probably of a radiolitic LV. Summarizing, the shell characters observed on these specimens, besides a ligament ridge, do not allow a generic or specific identification and, even less, the proposal of a new taxon.

Family HIPPURITIDAE Gray, 1848  
*Hippurites* Lamarck, 1801

*Type species.* *Hippurites bioculata* Lamarck, 1801 by monotypy.

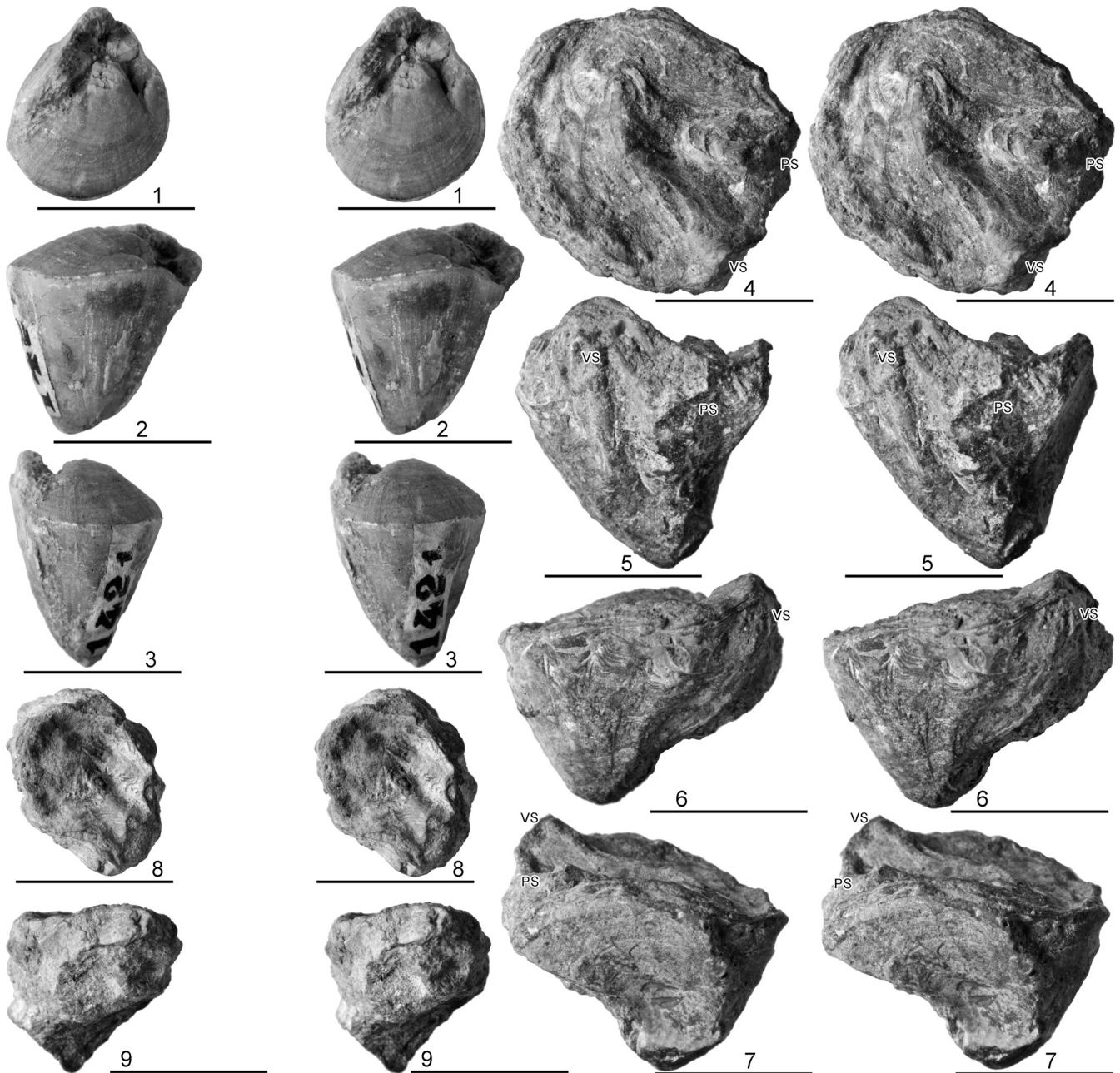


Fig. 12. 1-3, *Biradiolites?* sp. Holotype of *Monopleura minuta* Vidal, 1878; MGB 1421, Montsec d'Àger. Stereo pairs: upper, posterior, and anterior views, respectively, of the inner mould of a bivalve specimen. 4-9, *Praeradiolites?* sp. Syntypes of *Sphaerulites minor* Vidal, 1878. Carbonills. Stereo pairs. 4-7, MGB 1279a: upper, ventral-posterior, anterior, and posterior views, respectively, of a bivalve specimen; 8-9, MGB 1279b: upper and anterior views, respectively, of a bivalve specimen.

Fig. 12. 1-3, *Biradiolites?* sp. Holotipo de *Monopleura minuta* Vidal, 1878; MGB 1421, Montsec d'Àger. Pares estereoscópicas: vistas superior, posterior y anterior, respectivamente, del molde interno de un ejemplar bivalvo. 4-9, *Praeradiolites?* sp. Sintipos de *Sphaerulites minor* Vidal, 1878. Carbonills. Pares estereoscópicas. 4-7, MGB 1279a: vistas superior, ventral-posterior, anterior y posterior, respectivamente, de un ejemplar bivalvo; 8-9, MGB 1279b: vistas superior y anterior, respectivamente, de un ejemplar bivalvo.



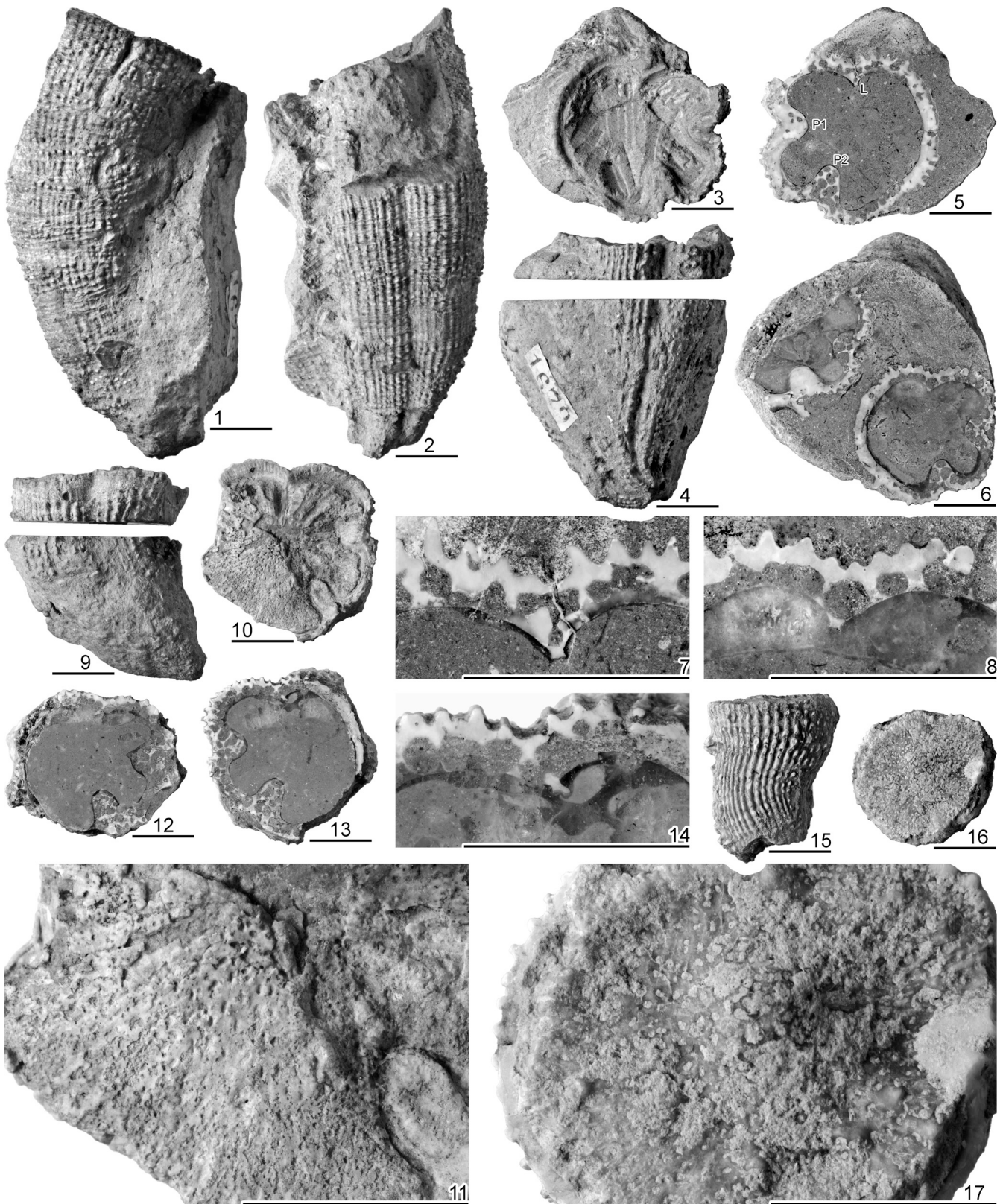


Fig. 13. *Hippurites montsecanus* Vidal, 1878. 1-2, syntype MGB 1678 (Montsec d'Àger): lateral views of a right valve; 3-8, MGB 1679b (Montsec): upper view, lateral view, transverse sections, and details of the ligament ridge, respectively, of a right valve; 9-14, syntype MGB 1679a (Montsec d'Àger): lateral view, upper view, detail of the latter, transverse sections of the right valve, and detail of the ligament ridge, respectively, of a bivalve specimen; 15-17, syntype MGB 1567 (Serrat de Pere Oliva, Montsec): lateral view, upper view, and detail of the latter, respectively, of a bivalve specimen.

Fig. 13. *Hippurites montsecanus* Vidal, 1878. 1-2, sintipo MGB 1678 (Montsec d'Àger): vistas laterales de una valva derecha; 3-8, MGB 1679b (Montsec): vista superior, vista lateral, secciones transversals y detalles de la cresta del ligamento, respectivamente, de una valva derecha; 9-14, sintipo MGB 1679a (Montsec d'Àger): vista lateral, vista superior, detalle de esta última, secciones transversals de la valva derecha y detalle de la cresta del ligamento, respectivamente, de un ejemplar bivalvo; 15-17, sintipo MGB 1567 (Serrat de Pere Oliva, Montsec): vista lateral, vista superior y detalle de esta última, respectivamente, de un ejemplar bivalvo.

***Hippurites montsecanus* Vidal, 1878**

Fig. 13.1-17

*Type.* Syntypes MGB 1678, 1567, 1679a, and EM 15882 (Vidal, 1878, pl. 1, figs. 1-4) from the upper Santonian of the Montsec (Noguera, Lleida province).

*Synonymy*

1878 *Hippurites Montsecanus* Vidal: 354, pl. 1, figs. 1, 1a, 2, 3, 4

1895 *Hippurites montsecanus* Vidal; Douvillé: 180, pl. 28, figs. 2, 2a, 3, 3a, 4, 5, 6

*Material.* Only three of the four Vidal syntypes are preserved in the Vidal Collection: MGB 1567, 1678, and 1679a. The fourth specimen was re-figured by Douvillé (1895, pl. 28, figs. 2, 2a) and remained in France (EM 15882). Two other specimens figured by Douvillé (1895) are in the Vidal Collection, the syntype MGB 1679a and two pieces of another (MGB 1679b). In addition, there are eight more specimens under MGB 1348, eight under MGB 1567, three under MGB 1678, and two under MGB 1679.

*Description.* RV is small, 30 mm in maximal diameter and around 30 to 40 mm in height, although this last may attain 80 mm in some specimens with cylinder-conical form. The outer surface bears prominent rounded ribs, intercalated with narrower furrows, interrupted by growth lines producing a characteristic granulate or scaly ornamentation, and presenting three deep radial furrows corresponding to the three inner folds. A transverse section close below the commissural plane shows: the outer shell layer is thin, between 2 and 4 mm; the ligament ridge is

short, triangular, and has a wide truncated distal end; the first pillar is very short, merely almost a fold of the outer shell layer; the second pillar is somewhat longer although remaining short and robust. The myo-cardinal apparatus is located very close to the ligament ridge, leaving space only for a minuscule anterior-dorsal cavity. LV is flat. Pores are linear, short, very spaced, and located at the bottom of polygonal depressions. Canals are more than 1 mm wide. Oscules are marginal.

*Remarks.* In disparity with Douvillé (1895), Toucas (1903) considered *H. montsecanus* as a simple variety of *H. matheroni* and not a valid species. In our opinion, and accordingly to Douvillé's statements, the characters of *H. montsecanus*, particularly the pattern of the pore-canal system of the left valve, justify the individualisation and validity of this species.

*Occurrence.* Upper Santonian of the Montsec (Noguera).

***Hippuritella* Douvillé, 1908**

*Type species.* *Hippurites maestrei* Vidal, 1878 by original designation.

***Hippuritella maestrei* (Vidal, 1878)**

Fig. 14.1-6

*Type.* Syntypes MGB 1680 (Vidal, 1878, pl. 1, figs. 5-8), from the upper Santonian of the Montsec (Noguera, Lleida province).

*Remarks on the type.* Among the four specimens figured by Vidal (1878), only one (MGB 1680a) could be

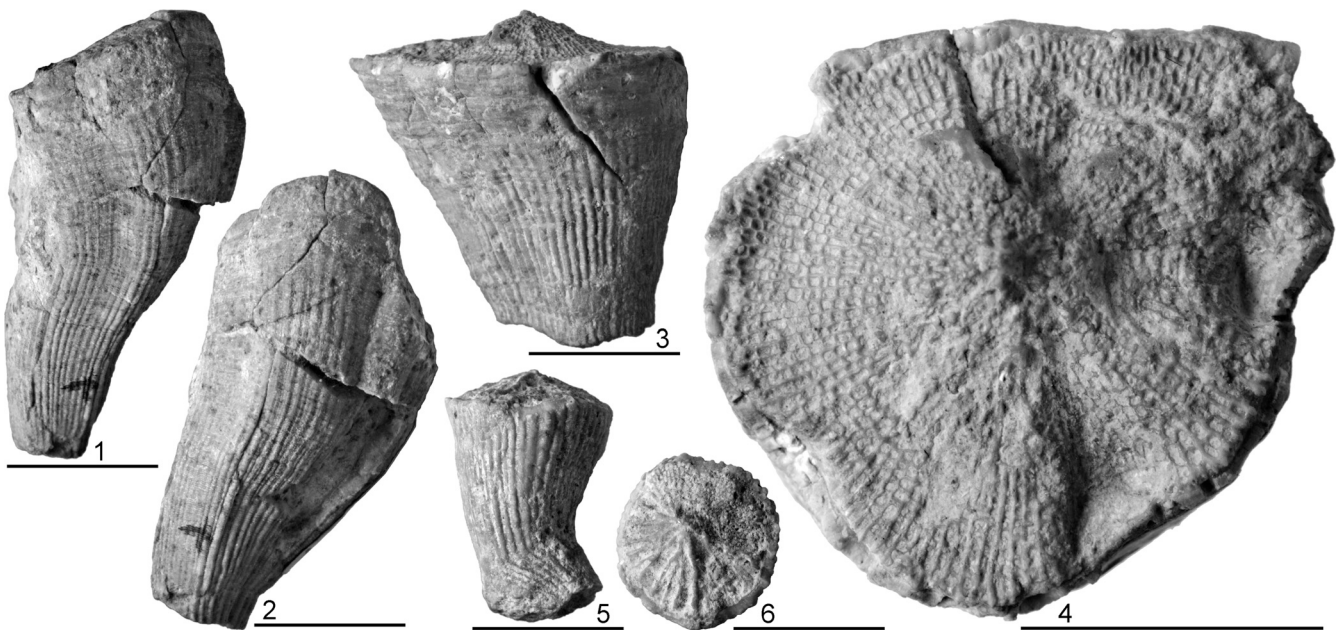


Fig. 14. *Hippuritella maestrei* (Vidal, 1878); Montsec. 1-2, MGB 1680: lateral views of a right valve; 3-4, MGB 1680b: lateral and upper views, respectively, of a bivalve specimen; 5-6, syntype MGB 1680a: lateral and upper views, respectively, of a bivalve specimen.

Fig. 14. *Hippuritella maestrei* (Vidal, 1878); Montsec. 1-2, MGB 1680: vistas laterales de una valva derecha; 3-4, MGB 1680b: vistas lateral y superior, respectivamente, de un ejemplar bivalvo; 5-6, sintipo MGB 1680a: vistas lateral y superior, respectivamente, de un ejemplar bivalvo.

traced. We consider the possibility of finding the remaining original syntypes among the non registered specimens in the EM. We know that Vidal sent, besides non figured specimens, also figured ones to Douvillé (see *H. montsecanus* section above). In case Douvillé did not figure any of the latter, they could remain unregistered in the EM instead of being returned. Only figured specimens were given a register number.

#### Synonymy

- 1878 *Hippurites Maestrei* Vidal: 355, pl. 1, figs. 5, 5a, 6, 6a, 7, 7a, 8  
 1895 *Hippurites Maestrei* Vidal, 1878; Douvillé: 163, pl. 24, figs. 1, 1a, 2, 3, 4, 5, 6  
 1969 *Hippuritella maestrei* (Vidal); Dechaseaux *et al.*: N802, figs. E224.1 and E263.4a [copy of Douvillé's 1895, pl. 24, figs. 4 and 5, respectively]

*Material.* Besides one of the syntypes (MGB 1680a) and two of the specimens figured by Douvillé (1895) (MGB 1680b, c), three more specimens under MGB 996 and three under MGB 1680, all from the upper Santonian of the Montsec (Noguera), are preserved in the Vidal Collection.

*Description.* RV is conical, small (largest specimen is 30 mm high and has a maximal diameter of 20 mm) and provided of fine and regular rounded costae at the outer surface. LV is flat although with a sub-centred prominent apex. The pores are rectangular and radially aligned, the canals are less than 1 mm wide, and the oscules are marginal. The inner characters, as observed in a transverse section of the shell, were already described by Douvillé (1895) and Toucas (1903) and can be summarised as follows: the outer shell layer is thin, around 2 mm; the ligament ridge is extremely short, triangular, and has a trun-



Fig. 15. *Hippuritella castroi* (Vidal, 1874); Isona. 1-5, MGB 2150a; 1-3: ventral, dorsal, and upper views, respectively, of a bivalve specimen; 4-5: transverse sections of the right valve close to the commissural plane; 6-8, MGB 2179f: upper, ventral, and posterior views, respectively, of a bivalve specimen. 9-11, MGB 2179: ventral, posterior, and upper views, respectively, of a bivalve specimen. 12-14, MGB 2150b: ventral and posterior views, and transverse section, respectively, of a right valve.

Fig. 15. *Hippuritella castroi* (Vidal, 1874); Isona. 1-5, MGB 2150a; 1-3: vistas ventral, dorsal y superior, respectivamente, de un ejemplar bivalvo; 4-5: secciones transversales de la valva derecha cerca de la comisura; 6-8, MGB 2179f: vistas superior, ventral y posterior, respectivamente, de un ejemplar bivalvo. 9-11, MGB 2179: vistas ventral, posterior y superior, respectivamente, de un ejemplar bivalvo. 12-14, MGB 2150b: vistas ventral, posterior y sección transversal, respectivamente, de una valva derecha.

cated distal end; both pillars are very short, merely a fold of the outer shell layer, the second somewhat more developed. The myo-cardinal apparatus is located very close to the ligament ridge, without leaving space for an anterior-dorsal cavity.

*Remarks.* Douvillé (1892) described *Hippurites Bayani*, from Rennes-les-Bains (Aude, France), that is a junior synonym of *H. maestrei*.

*Occurrence.* Lower Santonian of Collades de Basturs (Pallars Jussà, Lleida province) and upper Santonian of the Montsec (Noguera).

#### *Hippuritella castroi* (Vidal, 1874)

Fig. 15.1-14

*Type.* The syntypes (Vidal, 1874, pl. 6, figs. 35-38) from Isona (Pallars Jussà) are lost. Consequently, neotypes have to be chosen.

*Remarks on the type.* Any of the specimens figured originally by Vidal (1874) could be traced, nor the specimens figured subsequently by Vidal (1907, 1917, and 1918). Neotypes may be chosen among other specimens of the Vidal Collection or among the specimens figured by Douvillé (1895), both from the same locality. Nevertheless, we still consider the possibility of finding the original syntypes among the non registered specimens in the EM (see above, in *H. maestrei* section).

#### *Synonymy*

- 1874 *Hippurites Castroi* Vidal: 245, pl. 6, figs. 35, 36, 36a, 37, 38  
 1895 *Hippurites Castroi* Vidal, 1874; Douvillé: 171, pl. 25, figs. 3, 3a, 4, 4a, 5  
 1907 *Hippurites Castroi* Vidal; Vidal: 519, text-figs. 44.1, 2  
 1917 *Hippurites Castroi* Vidal; Vidal: 124, pl. 8  
 1918 *Hippurites Castroi* Vidal; Vidal: 154, text-fig. s/n (p. 153)  
 1981 *Hippuritella castroi* (Vidal); Sánchez: 10

*Material.* Three specimens, MGB 2150a, b, and MGB 2179f are preserved in the Vidal Collection. Two of them have been sectioned.

*Description.* RV is conical-cylindrical, larger specimens measure 120 mm in height and 60 mm of maximal diameter, and the outer surface bears regular rounded ribs and three radial furrows in correspondence with the inner folds. LV is flat with a sub-central apex. The pores are rectangular and radially aligned, the canals are 2 mm wide, and the two oscules are marginal. The inner characters, as observed in a transverse section of the shell, were already described by Douvillé (1895) and Toucas (1903) and can be summarised as follows: the outer shell layer is very thick, reaching 4 mm; the ligament ridge is reduced to a slight inflexion of the outer shell layer; both pillars are robust and very short, the second, somewhat more developed, may have straight parallel sides. The myo-cardinal apparatus is distant from the inner margin of the outer shell layer.

*Remarks.* The species was first assigned to genus *Hippuritella* by Sánchez (1981: 10).

*Occurrence.* Besides the type locality Isona, it is common in many other localities on the northern and southern flanks of the Tremp Syncline (Pallars Jussà). Although reported outside Pyrenees, in our opinion these are misidentifications.

#### *Hippuritella lapeirousei* (Goldfuss, 1840)

Fig. 16.1-6

*Type.* Paläontologisches Institut (Goldfuss collection) Bonn, from the Maastrichtian of St. Petersburg in Maastricht (Limburg, the Netherlands).

#### *Synonymy*

- 1840 *Hippurites Lapeirousei* Goldfuss: 303, pl. 165, figs. 5a, b, c, e, f, (non d)  
 1878 *Sphaerulites planicostatus* Vidal: 365, pl. 6, figs. 2, 2a  
 1981 *Hippuritella lapeirousei* (Goldfuss); Sánchez: 10

*Material.* The specimen MGB 1782 from Pobla de Lillet (Berguedà, Barcelona province), figured as holotype of *S. planicostatus* by Vidal (1878) is preserved in the Vidal Collection.

*Description.* The specimen is a small conical RV, lacking its apical part and covered with sediment at the upper part. Maximal diameter measures 30 mm and the preserved part is 15 mm high. The wide flat radial ribs, intercalated with very narrow furrows, of the outer shell surface give good reason for the specific name *planicostatus* given

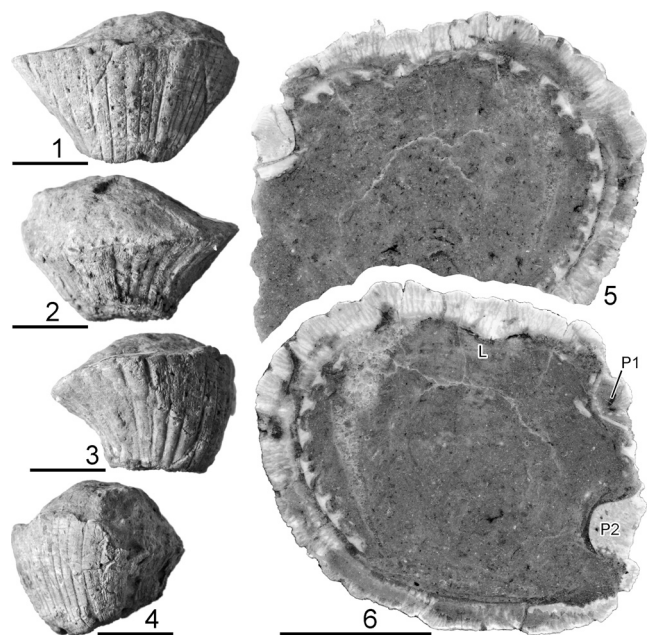


Fig. 16. *Hippuritella lapeirousei* (Goldfuss, 1840). Holotype of *Sphaerulites planicostatus* Vidal, 1878; MGB 1782, Pobla de Lillet. 1-4: lateral views of a bivalve specimen; 5-6: transverse sections of the right valve. Fig. 16. *Hippuritella lapeirousei* (Goldfuss, 1840). Holotipo de *Sphaerulites planicostatus* Vidal, 1878; MGB 1782, Pobla de Lillet. 1-4: vistas laterales de un ejemplar bivalvo; 5-6: secciones transversales de la valva derecha.

by Vidal. Careful observation on the margin of the sediment covered part of the shell revealed the presence of the left valve below the sediment and the section of what seemed to be canals. The specimen was sectioned very close to the commissural plane and, effectively, it corresponds to a small hippuritid whose inner characters allow its attribution to *Hippuritella lapeirousei*: ligament ridge reduced to a slight inflexion of the outer shell layer and pillars also reduced to weak inner protuberances. The marginal part of the left valve, with its radial canals appears also in the section.

*Remarks.* The species *lapeirousei* was first assigned to genus *Hippuritella* by Sánchez (1981).

*Occurrence.* The species *H. lapeirousei* is widespread in the upper Campanian-lower Maastrichtian of the South-central Pyrenees, besides being reported from many other distant areas.

### MATHERON'S (1880) and DOUVILLÉ'S (1895, 1904) NEW SPECIES BASED ON SPECIMENS OF THE VIDAL COLLECTION

Family HIPPURITIDAE Gray, 1848  
*Hippurites* Lamarck, 1801

*Type species.* *Hippurites bioculata* Lamarck, 1801 by monotypy.

*Hippurites incisus* Douvillé, 1895  
Fig. 17.1-10

*Type.* Holotype EM 15752 (Douvillé 1895, pl. 26, figs 4, 4a) from the Coniacian of Espluga de Serra (Pallars Jussà, Lleida province).

#### Synonymy

1895 *Hippurites resectus* var. *incisa* Douvillé: 168, pl. 26, figs. 4, 4a, 5, 6, 6a, 7

1903 *Orbignya incisus* (Douvillé); Toucas: 22, text-fig. 33

*Material.* Besides one of the two specimens and part of the other figured by Douvillé (1895), MGB 1148a, b, two more specimens under MGB 1148, nine specimens under MGB 1289, and three specimens and a bouquet of several specimens under MGB 1290, all from Espluga de Serra (Pallars Jussà), are preserved in the Vidal Collection.

*Description.* The RV is long cylindrical, with larger specimens reaching a maximal diameter of 30 mm. The outer surface bears characteristic much accentuate acute costae, intercalated with acute or rounded furrows. Three deep radial furrows, commonly developed, indicate the position of the three inner folds. The LV is strongly postulate, the pores are linear although short, and the oscules are marginal. The transverse section close below the commissural plane shows that: the characteristic costae are produced by strong radial folds of the growth lamellae; the ligament ridge is triangular, extremely short and with a clearly truncated distal end; the myo-cardinal apparatus

is very close to the inner margin of the outer shell layer, leaving only space for a minuscule anterior-dorsal cavity; the first pillar is short and robust; the second pillar is longer and lamellar, with parallel sides.

*Remarks.* Toucas (1903), besides recognising *H. incisus* as a proper species (it was originally considered only a variety *incisa* by Douvillé (1895)), also included *H. vasseuri* Douvillé, 1894 in it. In our opinion *H. vasseuri* and *H. incisus* are sufficiently different to be considered as two different species.

*Occurrence.* Besides the type locality Espluga de Serra (Pallars Jussà), the species is found in other Coniacian localities of the South-central Pyrenees. It is also common in southern France.

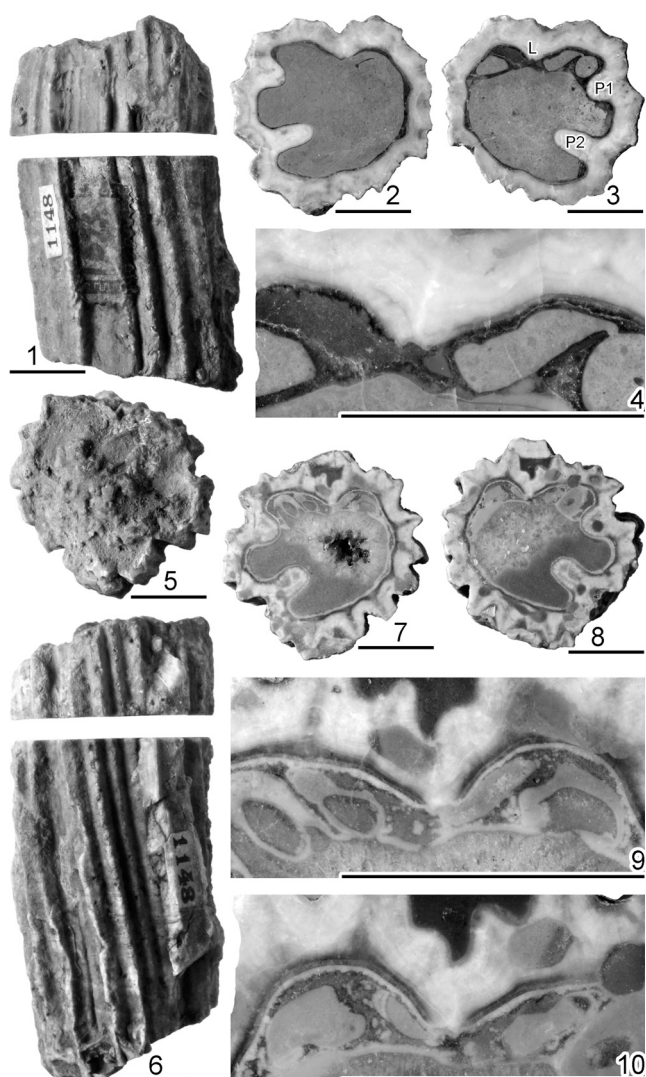


Fig. 17. *Hippurites incisus* Douvillé, 1895. Espluga de Serra. 1-4, MGB 1148a: lateral view, transverse sections, and detail of the ligament ridge, respectively, of a right valve; 5-10, MGB 1148b: upper view, lateral view, transverse sections of the right valve, and details of the ligament ridge, respectively, of a bivalve specimen.

Fig. 17. *Hippurites incisus* Douvillé, 1895. Espluga de Serra. 1-4, MGB 1148a: vista lateral, secciones transversales y detalle de la cresta del ligamento, respectivamente, de una valva derecha; 5-10, MGB 1148b: vista superior, vista lateral, secciones transversales de la valva derecha y detalles de la cresta del ligamento, respectivamente, de un ejemplar bivalvo.

*Hippurites microstylus* Douvillé, 1895

Fig. 18.1-11

*Type.* Holotype is MGB 1158 (Douvillé, 1895, pl. 28, figs 8, 8a) from Collades de Basturs (Pallars Jussà, Lleida province).

*Synonymy*

1895 *Hippurites microstylus* Douvillé: 183, pl. 28, figs. 7, 8

*Material.* Besides the holotype (MGB 1158) from Collades de Basturs and part of the other specimen figured by Douvillé (MGB 1681) from the Montsec d'Àger, four more specimens under MGB 698 and four under MGB 1159 from Collades de Basturs, are preserved in the Vidal Collection.

*Description.* The RV is short conical, larger specimens may attain 60 mm in maximal diameter although those

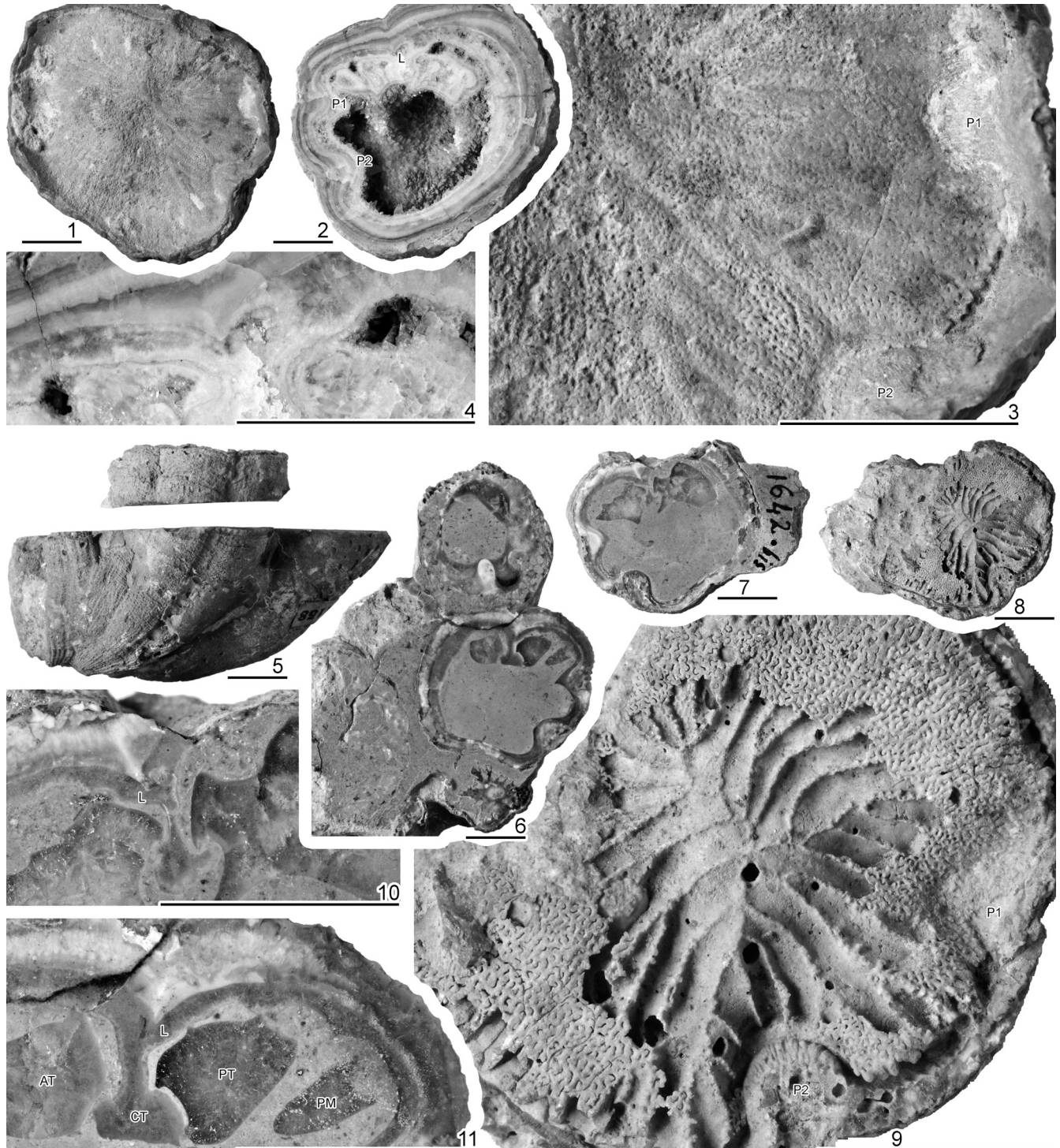


Fig. 18. *Hippurites microstylus* Douvillé, 1895. 1-4, MGB 1681 (Montsec d'Àger): upper view, transverse section of the right valve, and details of both, respectively, of a bivalve specimen; 5-11, holotype MGB 1158 (Collades de Basturs): posterior view, transverse sections, upper view, detail of the same, and details of the ligament ridge, respectively, of a small *bouquet*.

Fig. 18. *Hippurites microstylus* Douvillé, 1895. 1-4, MGB 1681. (Montsec d'Àger): vista superior, sección transversal de la valva derecha y detalles de ambas, respectivamente, de un ejemplar bivalvo; 5-11, holotipo MGB 1158 (Collades de Basturs): vista superior, secciones transversales, vista superior, detalle de esta última y detalles de la cresta del ligamento, respectivamente, de un pequeño *bouquet*.

measuring around 30 mm are most common. The outer shell surface bears rounded costae that may appear spiny when interrupted by growth lines; this ornamentation is well developed in juveniles and considerably much reduced in adult shells. Three furrows in coincidence with the inner folds are well distinguishable. The transverse section close to the commissural plane shows that: the ligament ridge is triangular, very short and has a truncated distal end; the myo-cardinal apparatus is very robust and there is no trace of an anterior-dorsal cavity; the two pillars are sub-equal, very wide and short, appearing as simple enlargements of the outer shell layer. The LV is nearly flat, the pores are linear vermiculate and very close to each other, the canals are large (between 1.5 and 2 mm wide), and the oscules are marginal.

*Remarks.* Although quite similar to *H. montsecanus* in its external appearance and ornamentation, both species clearly differ in the pore-canal pattern of the LV, the distal end of the ligament ridge, and the development of the pillars.

*Occurrence.* Santonian of South-central Pyrenees.

#### *Hippurites cf. socialis*, *Hippurites* new species?

Fig. 19.1-2

##### *Synonymy*

1895 *Hippurites cf. socialis* Douvillé; Douvillé: 175, pl. 26, fig. 10

Douvillé (1895) named *H. cf. socialis* a hippuritid (MGB 1677, EM 15891) occurring in the Montsec d'Àger together with *H. canaliculatus* and differing from it, mainly, in having a rounded instead of truncated crest of the ligament. The cardinal apparatus, the external ornament and the deep furrows corresponding to the three inner folds are completely similar. The reference to *H. socialis* Douvillé, 1893 was due to the rounded crest of the ligament and to the general pattern of the left valve as far as it could be observed, differing instead on both the cardinal apparatus and external ornament. *H. socialis* occurs in the Montsec in a lower horizon (Coniacian-lower Santonian) than *H. canaliculatus* and *H. cf. socialis* (upper

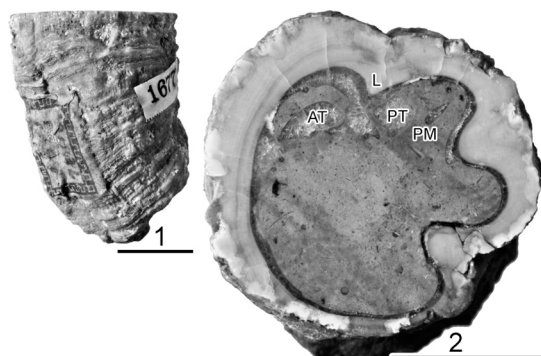


Fig. 19. 1-2, *Hippurites cf. socialis* Douvillé, 1895; MGB 1677. (Montsec d'Àger): lateral view and transverse section, respectively, of a right valve.  
Fig. 19. 1-2, *Hippurites cf. socialis* Douvillé, 1895; MGB 1677. (Montsec d'Àger): vista lateral y sección transversal, respectivamente, de una valva derecha.

Santonian). We collected abundantly well preserved specimens of this hippuritid in several localities in the Montsec and we consider that the characters of the left valve will justify the proposal of a new taxon in the near future.

#### *Hippurites vidali* Matheron, 1880

Fig. 20.1-10

*Type.* Holotype EM 15892 (Matheron, 1880, pl. F-41, fig. 1a-c; Douvillé, 1895, pl. 27, figs. 1-4) from Pas de les Eugues, Montsec de Rúbies (Noguera, Lleida province).

*Remarks on the type.* The holotype, originally figured only as a design by Matheron (1880), was sectioned and photographed by Douvillé (1895).

##### *Synonymy*

1880 *Hippurites vidali* Matheron, pl. F-41, figs. 1a-c

1895 *Hippurites vidali* Matheron; Douvillé: 177, pl. 27, figs. 1, 1a, 2, 2a, 3, 3a, 4

1895 *Hippurites serratus* Douvillé: 178, pl. 27, figs. 5, 5a

*Material.* A part of the specimen MGB 1763, figured as holotype of *H. serratus* by Douvillé (1895) from Pas de les Eugues, Montsec de Rúbies (Noguera). Any of the specimens donated by Vidal and figured by Douvillé (1895) as *H. vidali* is preserved in the Vidal Collection, only a replica (MGB 1773) of the specimen in pl. 27, fig. 2. Nevertheless, the collection preserves numerous other specimens from the type locality: thirteen specimens under MGB 753, three under MGB 1766, five under MGB 1768, four under MGB 1769, five under MGB 1770, four under MGB 1771, eight under MGB 1772, and two under MGB 1773.

*Description.* The specimen is composed of two slices, the upper part of the right valve with the left valve, and the one immediately below of the section figured by Douvillé. Although somewhat eroded, the upper valve shows the absence of pustules and the linear pores; the sub-central apex is slightly prominent and the first oscule is marginal. The transverse sections show that: the ligament ridge is triangular, long, with a lamellar distal part with a rounded distal end; the myo-cardinal apparatus is robust and the posterior myophore appears long and narrow in the lower section; there is no trace of an anterior-dorsal cavity; the first pillar is short and robust; the second pillar is moderately longer and has parallel sides.

*Remarks.* Douvillé (1895), although provisionally, distinguished as *H. serratus* a specimen from the same level and locality than *H. vidali*, based mainly on the costae of the right valve and the pustules of the left valve. The study and comparison of numerous specimens of *H. vidali* make us consider that both species are synonymous. In our opinion, most specimens reported in literature as *H. serratus* from younger levels should be referred to another species, probably *H. lamarcki* Bayle, 1858.

*Occurrence.* Lower Campanian of the Montsec (Noguera), and also Ariège in France.

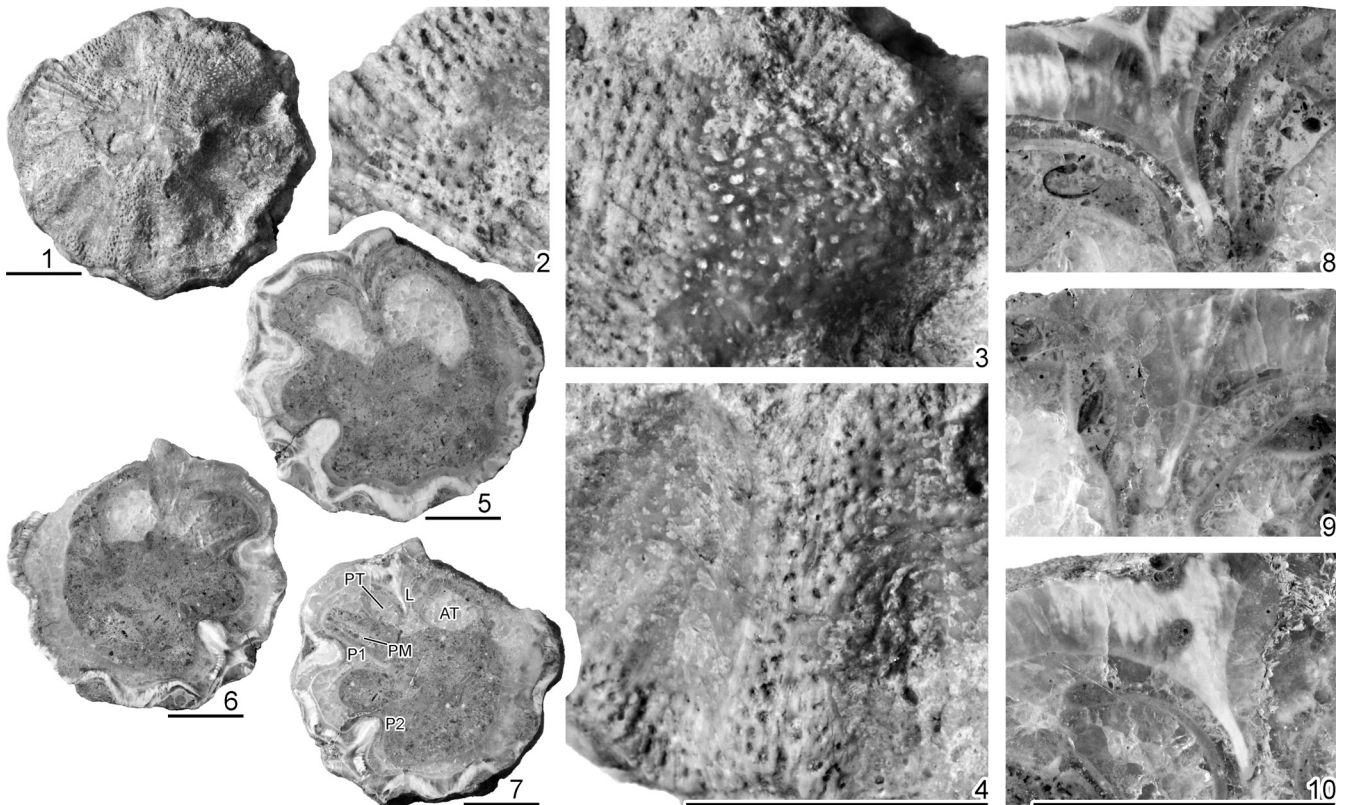


Fig. 20. 1-10, *Hippurites vidali* Matheron, 1880. Holotype of *Hippurites serratus* Douvillé, 1895; MGB 1763 (Pas de les Eugues): upper view, details of the same, transverse sections of the right valve, and details of the ligament ridge, respectively, of a bivalve specimen.

Fig. 20. 1-10, *Hippurites vidali* Matheron, 1880. Holotipo de *Hippurites serratus* Douvillé, 1895; MGB 1763 (Pas de les Eugues): vista superior, detalles de ésta, secciones transversals de la valva derecha y detalles de la cresta del ligamento, respectivamente, de un ejemplar bivalvo.

### *Hippurites praecessor* Douvillé, 1895

Fig. 21.1-2

*Type.* Syntypes MGB 1666a / EM 15886 and EM 15887 (Douvillé, 1895, pl. 26, figs. 11, 12) from the lower Santonian of Collades de Basturs (Pallars Jussà, Lleida province).

#### *Synonymy*

1895 *Hippurites praecessor* Douvillé: 185, pl. 26, figs. 11, 11a, 12, 12a

*Material.* Besides a part of one of the two syntypes (MGB 1666a), two more specimens under MGB 699, one under MGB 704, four under MGB 1666, and four under MGB 1667, all them from the same locality, are preserved in the Vidal Collection at MGB.

*Description.* The specimen measures 21 mm in diameter and corresponds to the upper slice of the RV with the LV. The LV is flat, slightly concave and presents spaced linear pores and two oscules very far from the shell margin. The transverse section of the right valve shows that: the outer shell layer is thick, around 4 mm; the ligament ridge is a very short and very wide triangle with a rounded distal end; the two pillars are well developed, sub-equal, being the second somewhat longer and slightly pinched at the base.

*Occurrence.* Lower Santonian of Collades de Basturs (Pallars Jussà) and also Corbières and Sougraine in southeastern France.

### *Vaccinites* Fischer, 1887

*Type species.* *Hippurites cornuvaccinum* Bronn, 1831 by monotypy.

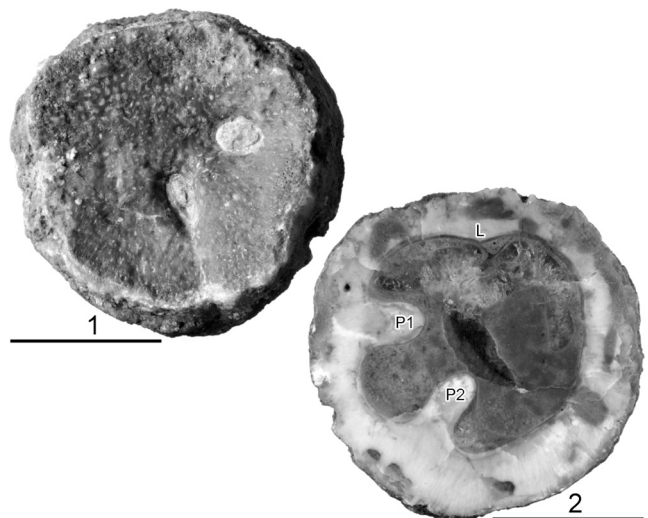


Fig. 21. 1-2, *Hippurites praecessor* Douvillé, 1895; syntipo. MGB 1666 (Collades de Basturs): upper view and transverse section of the right valve, respectively, of a bivalve specimen.

Fig. 21. 1-2, *Hippurites praecessor* Douvillé, 1895; sintipo. MGB 1666 (Collades de Basturs): vista superior y sección transversal de la valva derecha, respectivamente, de un ejemplar bivalvo.



***Vaccinites moulinsi* (d'Hombres Firmas, 1838)**

Fig. 22.1-6

*Type.* École Nationale Supérieure des Mines d'Alès? (d'Hombres-Firmas, 1838, pl. 4, fig. 6; Douvillé, 1891, pl. 3, fig. 1) from the Coniacian of Gatigues (Gard, France).

*Remarks on the type.* The specimen was available to Douvillé, who published a photograph of it. The original figure of d'Hombres-Firmas was a lithograph.

*Synonymy*

1838 *Hippurites Moulinsii* d'Hombres-Firmas: 199, pl. 4, fig. 6

1891 *Hippurites Moulinsi* d'Hombres-Firmas; Douvillé: 17, pl. 3, figs. 1, 2 (non 3 = *V. beaussetensis*)

1895 *Hippurites praemoulinsi* Douvillé: 156, pl. 22, fig. 5, (non 6 = *V. beaussetensis*)

non 1895 *Hippurites Moulinsi* d'Hombres Firmas, 1838; Douvillé: 158, pl. 22, fig. 7 [= *V. beaussetensis*]

*Material.* The specimen MGB 1114, figured as holotype of *H. praemoulinsi*. Also the other specimens: MGB 752, figured as "*forme de passage à l'H. Moulinsi*", and MGB 1111, figured as *H. Moulinsi* by Douvillé (1895), as well as two more specimens under MGB 1111, corresponding to *V. beaussetensis* are preserved in the Vidal Collection at MGB. These specimens come probably from different horizons in the Montsec (Noguera).

*Description.* The holotype of *H. praemoulinsi* (MGB 1114) is a short and wide conical shell, with a maximal diameter of 60 mm, transversely cut close below the commissural plane. We consider it may correspond to a young specimen. The LV is partially eroded and shows the wide (3 mm) radial canals and the large round orifices of the eroded pores preserved only above one of the canals. The transverse section shows that: the ligament ridge is triangular, very long, prolonged distally in a thin lamella with a truncated distal end; the first pillar is short and robust; the second pillar is long, lamellar and curved towards the ligament ridge; in the myo-cardinal apparatus, AT is much larger than PT, and AT, CT, PT and PM are aligned in the central part of the shell; the presence of an anterior cavity nearly as large as the main cavity.

*Remarks.* We consider useful and reasonable Toucas' (1904) point of view, considering two species: a Coniacian one, *Vaccinites moulinsi*, and a Santonian one, *Vaccinites beaussetensis*, mainly distinguished by the distal end, truncate or not, of the ligament ridge besides other minor differences. Probably, Douvillé (1895) proposed the species *praemoulinsi* because he did not notice this character in the specimens of *moulinsi* he described.

*Occurrence.* Coniacian of the Montsec (Noguera, Lleida province) and also other localities in northern Spain (Castrojimeno, Segovia province) and in southeastern France (Gard, Drôme, Vaucluse).

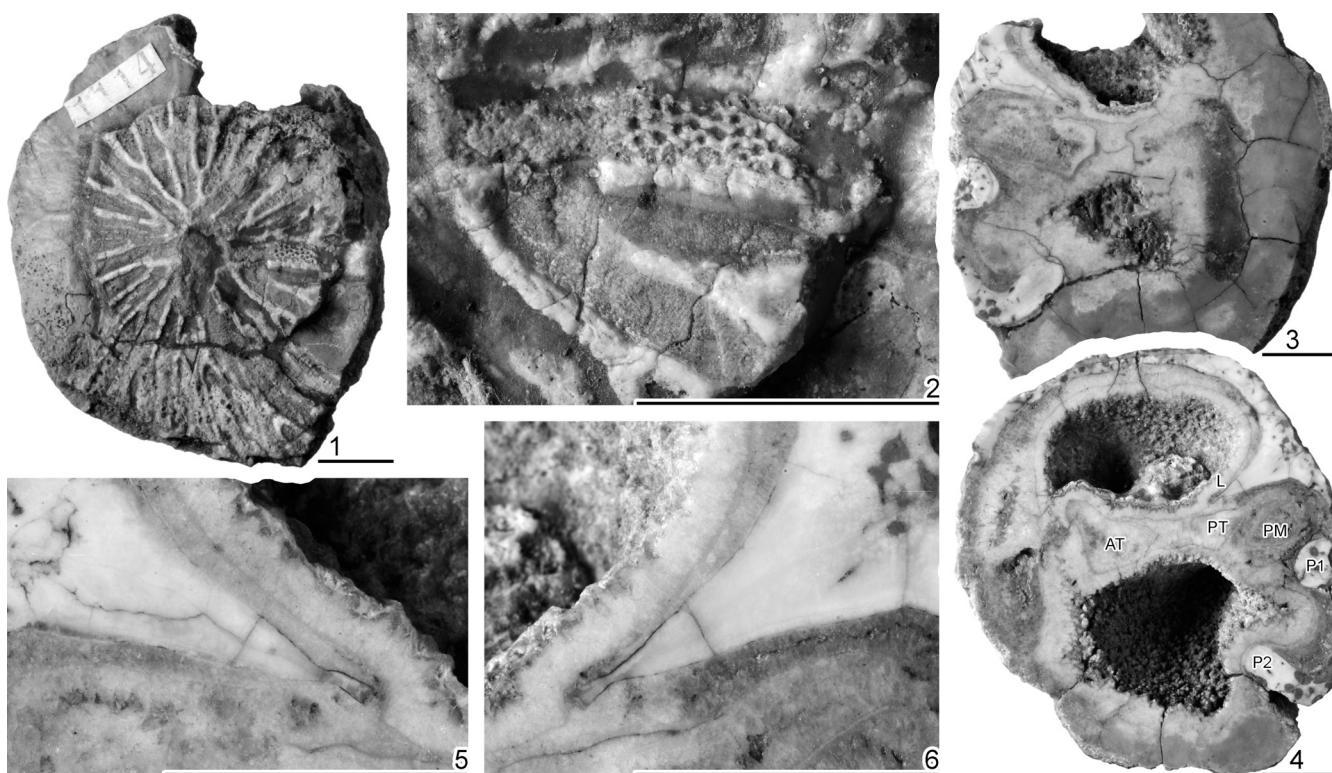


Fig. 22. 1-6, *Vaccinites moulinsi* (d'Hombres Firmas, 1838). Holotype of *Hippurites praemoulinsi* Douvillé, 1895; MGB 1114 (Montsec): upper view, detail of the same, transverse sections of the right valve, and details of the ligament ridge, respectively, of a bivalve specimen.

Fig. 22. 1-6, *Vaccinites moulinsi* (d'Hombres Firmas, 1838). Holotipo de *Hippurites praemoulinsi* Douvillé, 1895; MGB 1114 (Montsec): vista superior, detalle de ésta, secciones transversales de la valva derecha y detalles de la cresta del ligamento, respectivamente, de un ejemplar bivalvo.

Family PLAGIOPTYCHIDAE Douvillé, 1888

***Mitrocaprina* Böhm, 1895**

*Type species. Coralliochama bayani* Douvillé, 1888 by original designation.

***Mitrocaprina vidali* Douvillé, 1904**

Fig. 23.1-6

*Type.* Holotype EM 15884 (Douvillé, 1904, pl. 13, fig. 2) from the mid Campanian of Pobla de Segur (Pallars Jussà, Lleida province).

*Synonymy*

- 1904 *Mitrocaprina vidali* Douvillé, 1904: 525, pl. 13, figs. 1-5  
 1969 *Mitrocaprina vidali* Douvillé; Dechaseaux *et al.*: N795, fig. E259.2b-c [copy of Douvillé 1904, pl. 13, figs. 1, 5]

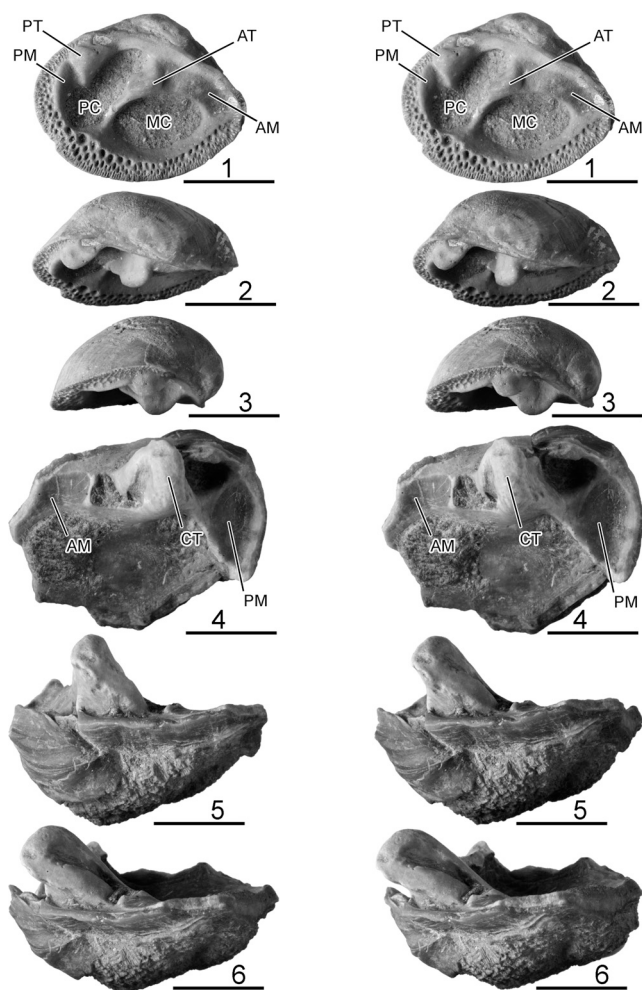


Fig. 23. *Mitrocaprina vidali* Douvillé, 1904. Pobla de Segur. 1-3: MGB 1935a; inner, dorsal, and posterior views, respectively, of a left valve. 4-6: MGB 1935b; inner, dorsal, and anterior views, respectively, of a right valve. Fig. 23. *Mitrocaprina vidali* Douvillé, 1904. Pobla de Segur. 1-3: MGB 1935a; vistas interior, dorsal y posterior, respectivamente, de una valva izquierda. 4-6: MGB 1935b; vistas interior, dorsal y anterior, respectivamente, de una valva derecha.

*Material.* Besides two of the specimens figured by Douvillé (1904, pl. 13, figs. 1 and 5) and reproduced by Dechaseaux *et al.* (1969, fig. E259.2b-c), one specimen more under MGB 809, three under MGB 814, twenty-eight under MGB 1934, a single specimen under MGB 1935a (LV) and MGB 1935b (RV), one under MGB 2006, and one under 2030, from Pobla de Segur (all them LV, but MGB 1935b) are preserved in the Vidal Collection at MGB. The specimens figured by Douvillé (1904, pl. 13, figs. 3 and 4) have not been localised.

*Description.* The left valve is small, 25 mm long and 13 mm high at the commissural plane; its coiled apex is only slightly prominent and located close to the dorsal margin of the commissure. Other larger specimens in the collection have a much more prominent apex and are much higher than longer at the commissure. Where preserved, the outer shell layer is very thin, around 0.5 mm. Inner characters, as described by Douvillé (1904), are well visible on the commissural view: PT is larger and more prominent than AT; PM is a prominent lamella parallel to the posterior margin; AM is large and located on an inward inclined platform; AT is prolonged ventrally in a septum separating the MC cavity from the PC which includes the CT socket; pallial canals are developed at the anterior, ventral and posterior sides of the valve; they are polygonal in section, arranged alternate in up to four concentric rows, and diminishing in size from the inner part to the outer margin. The RV is very short, 11 mm, gyropleuriform, its anterior-posterior diameter measures 30 mm, and presents a curved ligament furrow at the outer surface. It probably corresponds to a young specimen. As seen on the commissural view, CT is large, robust, very prominent and has a crescent section at its base. The socket of AT and AM, and the socket of PT and PM are located at each side of CT and oriented perpendicular to each other.

*Occurrence.* Mid Campanian of several localities (Torallola, Toralla, Sensui, Pumanyons) around Pobla de Segur (Pallars Jussà).

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## REFERENCES

- Archiac, E.J.A. d'. 1837. Mémoire sur la formation crétacée du S-O de la France. Mémoires de la Société Géologique de France, 2(6), Mémoire 7: 157-192, pls. 11-13.
- Böhm, G. 1895. Beiträge zur Kenntnis der Kreide in den Südalpen. I. Die Schiosi- und Calloneghe-Fauna. Palaeontographica, 41: 81-148.
- Bronn, H.G. 1831. Hippurites. In Ersch, J.S. & Gruber, J.G. (eds.), "Allgemeine Encyclopädie der Wissenschaften und Künste", 2(8): 371-376.
- Dechaseaux, C., Perkins, B.F. & Cox, C.R. 1969. Family Caprinidae d'Orbigny, 1850. In Moore (dir. & ed.), "Treatise on Invertebrate Paleontology", Part N, Mollusca 6 Bivalvia, vol 2 (of 3): N787-N799. The Geological Society of America and The University of Kansas Press, Lawrence.
- Dechaseaux, C., Coogan, A.H. & Cox, C.R. 1969. Family Hippuritidae Gray, 1848. In Moore (dir. & ed.), "Treatise on Invertebrate Paleontology", Part N, Mollusca 6 Bivalvia, vol 2 (of 3): N799-N803. The Geological Society of America and The University of Kansas Press, Lawrence.
- Douvillé, H. 1887. Sur quelques formes peu connues de la famille des chamides. Bulletin de la Société géologique de France, (3ème série), 15: 756-802.
- Douvillé, H. 1888. Études sur les caprines. Bulletin de la Société géologique de France, (3ème série), 16: 699-730.
- Douvillé, H. 1891-97 (1890). Études sur les rudistes. Première partie: Révision des principales espèces d'Hippurites. Deuxième partie: Distribution régionale des Hippurites. Mémoires de la Société géologique de France. Paléontologie, 1-6. Mémoire 6: 230 p., pls. 1-34 [1-31, pls. 1-3 (1891); 33-56, pls. 4-7 (1892); 57-94, pls. 8-15 (1893); 95-135, pls. 16-20 (1894); 139-186, pls. 21-28 (1895); 187-230, pls. 29-34 (1897)].
- Douvillé, H. 1903. Classification des Radiolites. Bulletin de la Société Géologique de France, (4ème série), 2: 461-477, pl. 15 (pars).
- Douvillé, H. 1904. Sur quelques rudistes à canaux. Bulletin de la Société géologique de France, (4ème série), 4: 519-538, pls. 13-14.
- Douvillé, H. 1908. Sur la classification des Radiolitidés. Comptes Rendus des Séances de la Société géologique de France, (4ème série), 8: 308-310.
- Douvillé, H. 1909. Sur le genre *Eoradiolites* nov. Comptes Rendus des Séances de la Société géologique de France, (4ème série), 9: 77.
- Fischer, P.H. 1887. Manuel de conchyliologie et de paléontologie conchyologique, fasc. 11: 1009-1369. F. Savy, Paris.
- Goldfuss, G.A. 1840. Petrefacta Germaniae. Part 2 (7): 225-312, pls. 147-165. Arnz, Düsseldorf.
- Gray, J.E. 1848. On the arrangement of the Brachiopoda. Annals and Magazine of Natural History, 2(2): 435-440.
- Hombres Firmas, L.A. d'. 1838. Extrait d'une mémoire sur les Hippurites et les Sphérulites du département du Gard. Bulletin de la Société géologique de France, 9: 190-196.
- ICZN. 2013. Opinion 2314 (Case 3546) *Praeradiolites* Douvillé, 1903 (Bivalvia, Radiolitidae): proposed designation of *Sphaerulites ponsiana* d'Archiac, 1837 as the type species. Bulletin of Zoological Nomenclature, 70 (1): 54-56.
- Kuhn, O. 1932. Fossilium Catalogus. I Animalia. Pars 54: Rudistae. 1-200. W. Junk, Berlin.
- Lamarck, J.B. de. 1801. Système des animaux sans vertèbres ou tableau général des classes, des ordres et des genres de ces animaux. viii + 432. Leroux, Paris.
- Macé-Bordy, J. 2007. Révision des rudistes crétacés (Bivalvia) de la *Paléontologie française* d'Alcide d'Orbigny. Deuxième partie. Annales de Paléontologie, 93: 67-105
- Masse, J.-P. & Philip, J. 1974. Définition, position systématique, répartition stratigraphique et évolution du genre *Agriopleura* Kühn (Rudiste). Géologie Méditerranéenne, 1(2): 53-62.
- Matheron, P. 1843. Catalogue méthodique et descriptif des corps organisés fossiles du Département des Bouches-du-Rhône et lieux circonvoisins. 1-269, pls. 1-41. Carnaud fils, Marseille.
- Matheron, P. 1878-1880. Recherches paléontologiques dans le Midi de La France. 7 volumes with 45 plates; unfinished. The author. Marseille.
- Moulins, C. des. 1826. Essai sur les Sphérulites qui existent dans les collections de Mm. F. Jouanet et Ch. des Moulins et considérations sur la famille à laquelle ces fossiles appartiennent. Bulletin d'Histoire naturelle de la Société Linnéenne de Bordeaux, 1: 148-303.
- Moulins, C. des. 1827. Description de trois genres nouveaux de coquilles fossiles du terrain tertiaire de Bordeaux. Bulletin d'Histoire Naturelle de la Société Linnéenne de Bordeaux, 2: 226-255.
- Munier-Chalmas, H. 1873. Prodrôme d'une classification des Rudistes. Journal de Conchyliologie, (3), 13: 71-75.
- Orbigny, A. d'. 1842. Quelques considérations zoologiques et géologiques sur les Rudistes. Annales des Sciences Naturelles, série 2, 17: 173-192.
- Orbigny, A. d'. 1847. Sur les Brachiopodes ou Palliobranches (deuxième Mémoire). Compte Rendu des Séances de l'Académie des Sciences, 25(7): 266-269.
- Orbigny, A. d'. 1847-1851. Paléontologie française. Terrains crétacés, v. 4, Brachiopodes. 1-390, pls. 490-599. [Rudists part: 157-267, pls. 526-599 (1850)].
- Picot de Lapeirouse, P.-I. 1781. Description de plusieurs nouvelles espèces d'Orthocératites et d'Ostracites. 1-45, pls. 1-13. Wolfgang Walter, Erlangen.
- Pons, J.M. 1977. Estudio estratigráfico y paleontológico de los yacimientos de rudistidos del Cretácico sup. del Prepirineo de la prov. de Lérida. Publicaciones de Geología, Universidad Autónoma de Barcelona, 3: 1-105, pls. 1-87.
- Pons, J.M. & Vicens, E. 2008. The structure of the outer shell layer in radiolitid rudists, a morphoconstructional approach. Lethaia, 41: 219-234.
- Pons, J.M. & Vicens, E. 2011. Case 3546. *Praeradiolites* Douvillé, 1903 (Bivalvia, Radiolitidae): proposed designation of *Sphaerulites ponsiana* d'Archiac, 1837 as the type species. Bulletin of Zoological Nomenclature, 68 (2): 105-108.
- Rolland, G. 1881. Sur le terrain crétacé du Sahara septentrional. Bulletin de la Société géologique de France, (3ème série), 9: 508-551.
- Sánchez, M.V. 1981. Hippuritidae y Radiolitidae (Bivalvia). Catálogo de especies. Publicaciones de Geología, Universidad Autónoma de Barcelona, 15: 1-228.
- Steuber, T. 2002. A palaeontological database of rudist bivalves. Taxonomic Database. <<http://www.paleotax.de/rudists/index.htm>>
- Studer, B. 1834. Geologie der westlichen Schweizer Alpen. x + 1-420. Karl Groos, Heidelberg-Leipzig.
- Toucas, A. 1903-04. Études sur la classification et l'évolution des hippurites. Mémoires de la Société Géologique de France. Paléontologie 11-12, Mémoire 30: 1-127, pls. 1-17. [Première partie, 11: 1-63, pls. 1-7 (1903); Deuxième partie, 12: 65-127, pls. 8-17 (1904)].
- Toucas, A. 1907-09. Études sur la classification et l'évolution de radiolitidés. Mémoires de la Société Géologique de France. Paléontologie 14, 16, 17, Mémoire n° 36: 1-132, pls. 1-26, tbs. 1-4. [Première partie. *Agria* et *Praeradiolites*, 14: 1-46, pls 1-8 (1907); Deuxième partie. *Sphaerulites* et *Radiolites*, 16: 47-78, pls. 9-15 (1908); Troisième partie. *Sauvagesia* et *Biradiolites*, 17: 79-132, pls. 16-26 (1909)].

- Vicens, E. 1992. Estudio de la fauna de rudistas (Hippuritidae y Radiolitidae) de los materiales cretácicos del Pirineo oriental: Implicaciones bioestratigráficas. 5 volumes; Text: 1-247; Plates: 1-79; Figures: 1-189; Tables: 1-42; Appendix: 1-22. PhD Thesis, Universitat Autònoma de Barcelona. [Published in microfiche edition, 1994].
- Vicens, E., Ardèvol, L, López-Martínez, N. & Arribas, M.E. 2004. Rudists biostratigraphy in the Campanian-Maastrichtian of the south-central Pyrenees, Spain. *Courier Forschungsinstitut Senckenberg*, 247: 113-127.
- Vidal, L.M. 1874. Datos para el conocimiento del terreno Garumniense de Cataluña. *Boletín de la Comisión del Mapa Geológico de España*, 1: 209-247, pls. 1-8.
- Vidal, L.M. 1878. Nota acerca del sistema Cretáceo de los Pirineos de Cataluña. Cámidos y Rudistos. *Boletín de la Comisión del Mapa Geológico de España*, 4 (for 1877): 257-372, pls. 1-7.
- Vidal, L.M. 1907. Contribución de la provincia de Lérida a los progresos de las ciencias geológicas. *Boletín de la Sociedad Aragonesa de Ciencias Naturales*, 6: 517-522.
- Vidal, L.M. 1917. Geología del Montsech. *Publicacions de la Junta de Ciències Naturals de Barcelona. Anuari 1917*: 115-128, pls. 1-12.
- Vidal, L.M. 1918. Geología del Montsech. *Ibérica*, 9 (2) (218): 152-155.
- Vidal, L.M. 1921. Contribución a la paleontología del Cretácico de Cataluña. *Memorias de la Real Academia de Ciencias y Artes de Barcelona*, (3), 17(2): 89-107, pls. 1-8.