LINGULIFORM MICROBRACHIOPODS FROM LAS AGUADITAS AND LAS CHACRITAS FORMATIONS (MIDDLE-UPPER ORDOVICIAN) OF ARGENTINE PRECORDILLERA

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Abstract. Middle-Upper Ordovician linguliform microbrachiopods are described and illustrated for the first time from the Las Aguaditas Formation at the Los Blanquitos and Mogotes Azules ranges and from the Las Chacritas Formation at the Las Chacritas River section, Central Argentine Precordillera. This systematic study includes nine families, namely Obolidae, Paterulidae, Discinidae, Acrotretidae, Scaphelasmatidae, Torynelasmatidae, Ephippelasmatidae, Biernatidae and Eoconulidae. This diverse fauna is conformed of specimens corresponding to *Lingulops* sp., *Paterula incognita* Mergl, *Schizotreta* sp., *Scaphelasma zharykensis* Popov, *Torynelasma?* sp., *Akmolina* sp., *Ephippelasma* sp., *Numericoma simplex* Holmer, and *Eoconulus* sp. However, specimens from the order Acrotretida proved to be an important component of this fauna, enabling the recognition of two new species which are thoroughly described, *Conotreta andina* n. sp. and *Biernatia rhapsody* n. sp.

INTRODUCTION

The study of Ordovician linguliform brachiopods from Argentina have received much attention in the last years, most of the material comes from localities of the Argentine Precordillera, where brachiopods are frequent fossils. In this terrene, the Ordovician System is characterized by extensive carbonate platform successions, which are overlain by siliciclastic deposits with intervening deep-water calcareous sequences (Astini 2003).

Benedetto (2015) described an important Middle Ordovician brachiopod association from the Los Azules Formation, which includes minute rhynchonelliforms, obolids, acrotretids and craniids. Later, Lavié and Benedetto (2016) reported linguliform and craniiform specimens from the top of San Juan Formation (lower–mid Darriwilian), while Holmer et al. (2016) described two assemblages of micromorphic linguliform brachiopods from the Ponón Trehué Formation (Darrirwilian) and the Lindero Formation (upper Darriwilian-lower Sandbian) in the San Rafael Block (Mendoza Province). More recently, a low-diversity fauna was documented at the Las Plantas Formation (lower Sandbian) (Lavié 2018).

The aim of the present contribution is to describe the microfauna of linguliform brachiopods from the Darriwilian-Sandbian Las Aguaditas Formation and the Darriwilian Las Chacritas Formation in San Juan Province. This systematic study includes a detailed justification of the generic and specific attributions of the analysed material, providing new data in their geographic and biostratigraphic distribution.

GEOLOGICAL SETTING

The Precordillera geological province is located in western Argentina, between the Frontal Cordillera to the West and the Pampean Ranges to the East, encompassing parts of La Rioja, Mendoza and San Juan provinces (Stelzner 1873; Furque & Cuerda 1979; Baldis et al. 1982). It is characterized by a thick Cambrian – Ordovician succession (*ca.* 2,200 m) of marine limestones that interdigitate with clastic slope deposits toward the west (Baldis et al. 1982; Astini 1995). Spanning a wide range of depositional environments, from shallow intertidal to marginal shelf and deep ramp settings, the Precordillera is the only lower Palaeozoic basin in South America having a distinctive carbonate platform (Cañas 1999). The Sassito, Las Chacritas and Las Aguaditas formations are the only remnants of carbonate deposition in the Precordillera succeeding the continuous Cambrian – Ordovician carbonate cycle, and the Las Aguaditas Formation is the only unit showing a transitional interval from platform to slope deposits of Middle Ordovician age (Astini 1995).

In the present contribution we focus on the description of linguliform brachiopods from the Las Chacritas and the Las Aguaditas formations from three localities in the area surrounding Jáchal City; namely, the Las Chacritas River section, the Las Aguaditas Creek and the Mogotes Azules sections (Fig. 1). The suited units are described below.

Las Aguaditas Formation

The Las Aguaditas Formation was formally defined by Baldis et al. (1982) at its type locality at the Los Blanquitos Range. However, in their original stratigraphic description of the unit Baldis and Blasco (1974) had previously recognized four members; only the lower and middle members of the Las Aguaditas Formation are studied herein. From a lithological viewpoint, the formation consists of marls, limestones, and reef limestones, with a characteristic yellowish weathering colour. This unit paraconformably overlies the San Juan Formation by mean of a regional hardground surface (Astini 1995) which is easily distinguished from the Las Aguaditas Formation by its nodular limestones (Baldis et al. 1982). The transitional interval between the uppermost part of the San
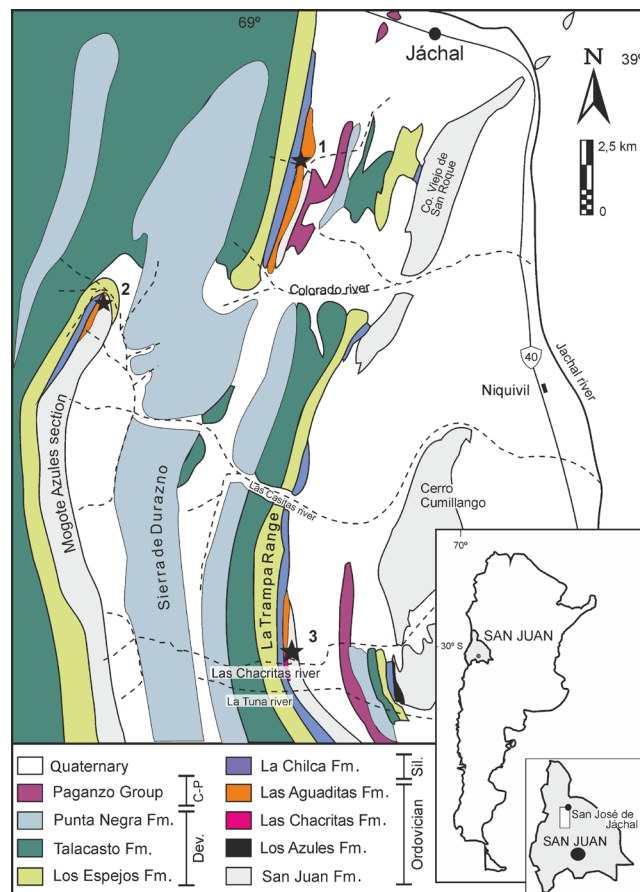

Fig. 1 - Map showing the geological framework and location of the studied localities in the Argentinian Central Precordillera: (1) Las Aguaditas Creek, (2) Cordón de Mogotes Azules and (3) Las Chacritas River sections. Abbreviations: C-P: Carboniferous – Permian, Dev.: Devonian; Sil.: Silurian; Ordov.: Ordovician; Fm: Formation.

Juan Formation and the overlying Las Aguaditas Formation is characterized by calcareous-pelitic deposits, which are interpreted to have been caused by a flooding event on the platform (Keller et al. 1993; Carrera & Astini 1998). The Las Aguaditas Formation has been interpreted as being deposited on structural highs (horsts) and lows (graben) within the basin (Astini 1995).

The type section of the Las Aguaditas Formation, 302 m thick, is located on the eastern flank of the Los Blanquitos Range in the Central Precordillera of San Juan Province, 15 km to the southwest of Jáchal City (Fig. 1). This formation is also exposed at the MogotesAzules section, located at the northern end of the Mogotes Azules range, 20 km southwest of Jáchal city (Fig. 1). In this locality, the unit has a thickness of 55 meters and is mainly composed of marls and mudstones (Salas 2003).
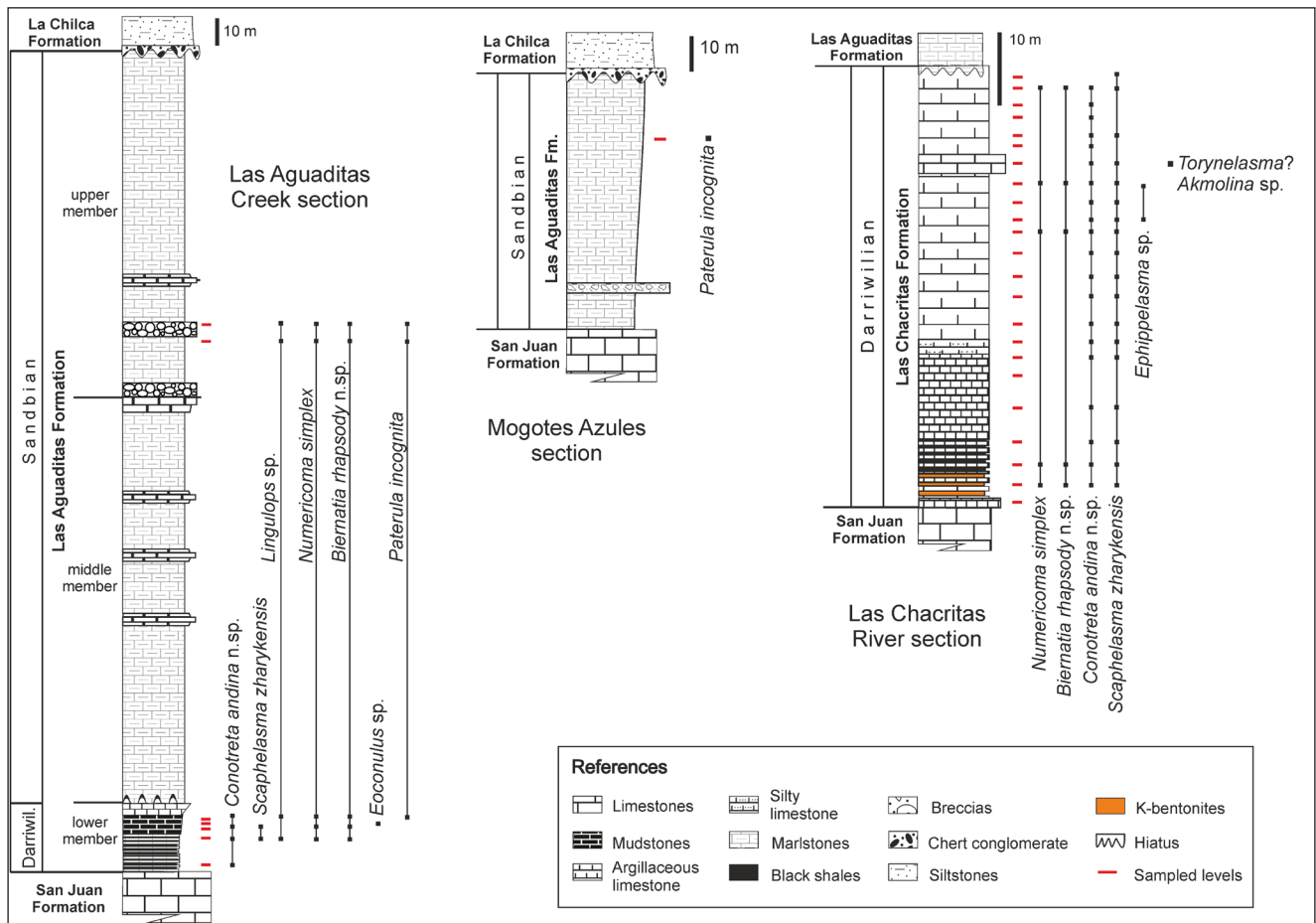
Fig. 2 - Stratigraphic columns showing species ranges of the Las Aguaditas Formation in the Las Aguaditas Creek and Mogotes Azules sections and of the Las Chacritas Formation in the Las Chacritas River section. Abbreviation: Darriwil.: Darriwilian.

The samples used in this contribution, depicted in Figure 2 come from poorly exposed laminated mudstones with abundant skeletal fragments interbedded with shales and siltstones from the lower member of the Las Aguaditas Formation (43 m thick) (Feltes et al. 2016), and also from the upper member of this formation characterized by mostly dark grey mudstones (Feltes et al. 2018).

Las Chacritas Formation

The Las Chacritas River section is located in the northern part of the La Trampa Range, 50-km south-west of Jáchal City (Fig. 1); where important Middle–Upper Ordovician rocks are exposed. At this locality, the upper Lower and lower Middle Ordovician San Juan Formation is paraconformably overlain by the Las Chacritas Formation, subject of study in the present contribution (Fig. 2). The deeper water limestone sequence overlying the Las Chacritas Formation

has been referred to as the Las Aguaditas Formation by Peralta et al. (1999).

The Las Chacritas Formation is a 60 m thick succession characterized by fine-grained siliciclastic and carbonate sediments deposited on a continental shelf setting (Carrera & Astini 1998). This unit is divided into two members, the lower member consists of tabular, thin to medium bedded fossiliferous strata, dark mudstones and wackestones, while the upper member consists of wackestones and packstones, suggesting a shallowing trend towards the top of the unit (Carrera & Astini 1998; Peralta et al. 1999). According to Astini (1995) the Las Chacritas Formation developed on structural highs (horsts) that served as a shallow platform for remnant carbonate deposition within the basin. The overlying Las Aguaditas Formation (approximately 10-m thick) is composed of platy mudstones with a yellowish alteration, interbedded with black shales (Peralta & Baldis 1994).

COMMENTS ON BIOSTRATIGRAPHY

The fossil record of Ordovician conodonts has been extensively documented in the Precordillera of Argentina, providing a robust database for a detailed biostratigraphic scheme (e.g. Heredia et al. 2005; Mestre 2010; Albanesi & Ortega 2016 and cited works). Particularly, the studied specimens of the present contribution come from middle Darriwilian and Sandbian strata.

The presence of *Yangtzeplacognathus crassus* is common in the Las Aguaditas Creek and the Las Chacritas River sections, with its range restricted to the upper part of the San Juan Formation and the basal strata of the overlying units (Serra et al. 2015; 2017; Feltes et al. 2016) (Fig. 2). Also, the presence of *H. holodentata* in association with graptolites of the *L. dentatus* Zone in the lower member of the Las Aguaditas Formation and the Las Chacritas Formation allow for the recognition of the *Y. crassus* Zone (Serra et al. 2017). The *Eoplacognathus pseudoplanus* Zone (Fig. 2), with the *Microzarkodina hagetiana* and *M. ozarkodella* subzones were recognized and described for the upper part of the lower member of the Las Aguaditas Formation (Feltes et al. 2016) and for the middle part of the Las Chacritas Formation (Serra et al. 2015). In the latter, the lower part of the *Eoplacognathus suecicus* Zone was recognized spanning the top strata of the formation (Fig. 2).

A Sandbian age was recognized for the middle and upper members of the Las Aguaditas Formation at its type locality (Los Blanquitos range), in the Mogotes Azules and Las Chacritas River sections (Brussa 1996). Diverse graptolite assemblages that belong to the *N. gracilis* Zone were documented in these strata (Brussa 1996; Feltes et al. 2018). Recently, Feltes et al. (2018) revised and updated the taxonomy according to new systematic information presented by Chen et al. (2017).

SYSTEMATIC PALEONTOLOGY

All the described specimens are housed in the collections of Cátedra de Estratigrafía y Geología Histórica, Universidad Nacional de Córdoba, Argentina. Specimens are registered with a prefix CEGH-UNC followed by a five digit number. The systematic classification follows that of the Treatise on Invertebrate Paleontology (Bassett 2000, 2007;

Holmer & Popov 2000, 2007).

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Order **Lingulida** Waagen, 1885
Superfamily Linguloidea Menke, 1828
Family Obolidae King, 1846
Subfamily Elliptoglossinae Popov & Holmer, 1994
Genus *Lingulops* Hall, 1872
Type species - *Lingulops whitfieldi* Hall, 1872; Upper Ordovician;
United States

Lingulops sp.
Pl. 1, figs. 1-4

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Material: Three specimens figured. One dorsal valve interior CEGH-UNC 27353; one ventral valve interior CEGH-UNC 27354; fragment of ventral valve CEGH-UNC 27355.

Description. Shell biconvex, elongated oval in outline, with a length/width ratio 1.46 (up to 1.72 mm long and 1.183 mm wide in one valve), with the maximum width anterior to midlength (Pl. 1, figs. 1, 2). Ventral valve with a distinct limbus, subterminal umbo, anterior and lateral margins well rounded and posterior margin slightly acuminated (Pl. 1, figs.


<div align="center">PLATE 1</div>

Figs. 1-4 - *Lingulops* sp.; 1) dorsal valve interior, CEGH-UNC 27353; 2-3) ventral valve interior and detail of the pseudointerarea, CEGH-UNC 27354; 4) fragment of posterior ventral valve exterior, CEGH-UNC 27355.

Figs. 5-8 - *Paterula incognita*; 5) ventral valve exterior, CEGH-UNC 27356; 6) dorsal valve interior, CEGH-UNC 27357; 7-8) ventral valve interior and detail of posterior region showing the pedicle notch, CEGH-UNC 27358.

Figs. 9-20 - *Conotreta andina* n. sp.; 9) ventral valve exterior in anterior view and part of posterior interior, paratype CEGH-UNC 27360; 10) 13-14) ventral valve exterior in lateral view, upper view and detail of metamorphic shell, paratype CEGH-UNC 27361; 11) conjoined shell showing ventral valve interior, partial dorsal valve exterior and lateral view of dorsal median septum, holotype CEGH-UNC 27362; 12) dorsal valve exterior, paratype CEGH-UNC 27365 15-16) dorsal valve exterior and detail of metamorphic shell, paratype CEGH-UNC 27363; 17-18) dorsal valve interior in upper and side view, paratype CEGH-UNC 27364; 19) detail showing the raised cardinal muscle scars, paratype CEGH-UNC 27397; 20) detail of dorsal median septum in side view, paratype CEGH-UNC 27366.

Figs. 21-24 - *Scaphelasma zharykensis*; 21) dorsal valve exterior, CEGH-UNC 27367; 22) side view of dorsal valve interior, CEGH-UNC 27368; 23) dorsal valve exterior, CEGH-UNC 27369; 24) dorsal valve interior, CEGH-UNC 27370.

Scale bars represent 100 µm, except 7, 9, 14 and 16 which represent 30 µm.
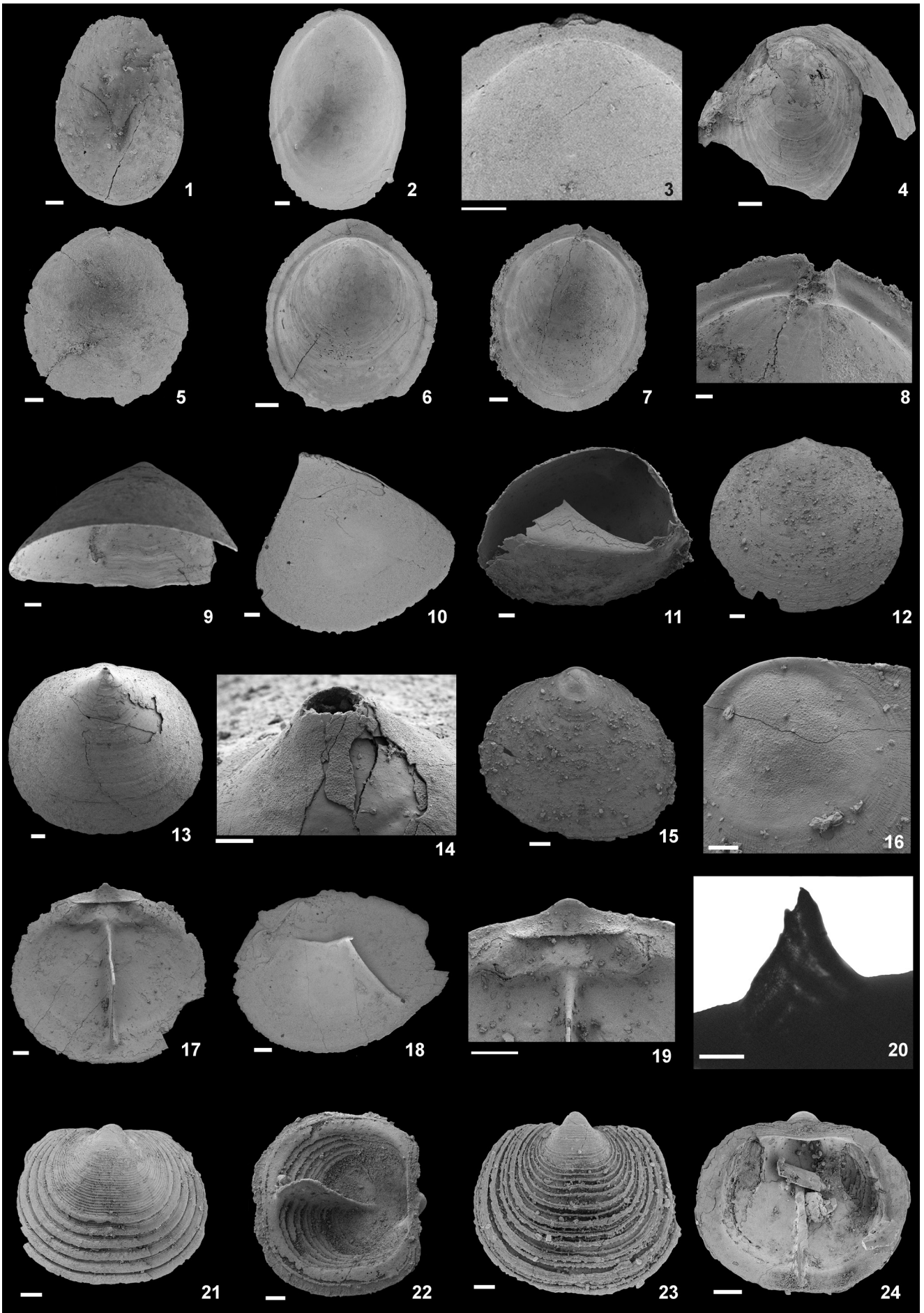
2, 3); ventral interior with absence of pseudointer-area and poorly defined visceral and muscle fields. Dorsal valve slightly wider than the ventral one, with well defined and V-shaped visceral field, extended in front of the midlength, with raised anterior edge; scars of anterior lateral muscle barely distinct (Pl. 1, fig. 1). Ornamentation consisting of concentric growth lines numbering 4-5 per 0.1 mm in the posterior half, intercalated with fine striae irregularly spaced up to 10-12 per 0.05 mm (Pl. 1, fig. 4). Larval shell not well defined, smooth.

Discussion. Specimens of *Lingulops* are very rare in the studied samples, only two complete valves and three fragmented exteriors was founded. The presence of interiors with raised visceral platforms allows referring the material to this genus, and distinguish it from the other two genera of the subfamily, *Elliptoglossa* Cooper, 1956 and *Litoperata* Sutton in Sutton et al. 1999. However, in the absence of additional ventral valve internal features and more complete shells, the material from The Las Aguaditas Formation is left in open nomenclature.

Stratigraphic and geographic distribution. Middle to Upper Ordovician (Darriwilian to Sandbian) from the Las Aguaditas Formation; Las Aguaditas Creek section, San Juan Province, Precordillera of west-central Argentina.

Family Paterulidae Cooper, 1956
Genus *Paterula* Barrande, 1879

Type species - *Paterula bohemica* Barrande 1879, by original designation; Upper Ordovician, Sandbian, Vinice Formation, Bohemia

Paterula incognita Mergl, 1999
Pl. 1, figs. 5-8

1879 *Paterula bohemica* - Barr. (partim): Barrande, Pl. 152, case I, Fig. 3.
1982 *Paterula* sp. A - Havlíček, p.50.

Material: Three specimens figured. One ventral valve CEGH-UNC 27356; one dorsal valve interior CEGH-UNC 27357; one ventral valve interior CEGH-UNC 27358. Additional material: 36 ventral valves and 81 dorsal valves, not figured.

Description. Shell thin-walled, biconvex, suboval to subcircular in outline, averaging length/width ratio 1.15 (observed range 1.05-1.33, N=23). Apex of both valves located near the posterior margin (Pl. 1, fig. 5). Ventral valve up to 1.4 mm long and 1.3 mm wide, with the maximum width at 50% of total length; the maximum is convexity

in the posterior half; anterior margin curved more acutely than the lateral margins, and the posterior margin is slightly truncated, marked by a narrow and distinct pedicle notch (Pl. 1, figs. 7, 8), continued forward as an incipient pedicle groove. Distinct impression of pedicle nerve with the two branches diverging up to one third of the total length; muscle scars and visceral area poorly defined. Dorsal valve slightly smaller than the ventral valve, up to 1.35 mm long and 1.2 mm wide; dorsal visceral area barely distinguished as darker than the inner surface and muscle scars not recognized (Pl. 1, fig. 6). Periphery of both valves bordered by a well defined, narrow and flattened limbus (Pl. 1, figs. 6, 7), internally bounded by a raised subperipheral rim, becoming lower towards the anterior margin. Ornamentation consisting of fine concentric growth lines (Pl. 1, fig. 5).

Discussion. *P. incognita* was described by Mergl (1999) from the Darriwilian of Central Bohemia. Our material resembles this species in almost circular outline, maximum size of adult shell, narrow limbus and submarginal apex in both valves, distinct pedicle notch and poorly defined ventral visceral area and muscle scars. The material described by Holmer et al (2016) referred to *P. perfecta* Cooper, 1956 differs in having smaller size, more wide than long outline, and lacking postlarval ornamentation. *P. incognita* is also similar to *P. bohemica* Barrande, 1876, *P. circina* Havlíček, 1982 and *P. linguata* Mergl, 1999, but the main difference is that our material never exceeds 1.4 mm long in adult valves, while the three mentioned species are from two to four times larger than *P. incognita*; evenly, it is likely that these four species are closely related. As mentioned by Sutton et al. (2000), *Paterula* is a taxonomically "difficult" genus, due it has a remarkably long stratigraphic range as well as extensive geographic distribution, and a high degree of conservative and similar shell morphology between most species.

Stratigraphic and geographic distribution. Middle to Upper Ordovician (Darriwilian to Sandbian) from the Las Aguaditas Formation; Las Aguaditas Creek and Mogotes Azules sections, San Juan Province, Precordillera of west-central Argentina. Also present in Middle Ordovician (*Corymbograptus retroflexus* Biozone) of Barrandian, Osek, Díly and Mýto localities, Šárka Formation, Central Bohemia.

Order **Acrotretida** Kuhn, 1949
Family Acrotretidae Schuchert, 1893
Genus *Conotreta* Walcott, 1889

Type species - *Conotreta rusti* Walcott, 1889; by original designation; Upper Ordovician, lower Katian; New York.

Diagnosis: (Holmer, 2000, p. 313-314) Ventral valve high conical; ventral pseudointerarea procline to somewhat apsacline, usually with interridge; foramen enclosed within larval shell; dorsal pseudointerarea with wide median groove; apical process forming low ridge along anterior slope of valve; apical pits shallow, placed directly lateral to apical process; ventral mantle canals pinnate; dorsal median septum high, triangular, usually with anterior denticles or spines; dorsal interior with large cardinal muscle scars and median buttress.

Conotreta andina n. sp.
Pl. 1, figs 9-20

Origin of the name: Dedicated to Andina, daughter of Fernanda Serra and Nicolás Feltes.

Holotype: One conjoined shell CEGH-UNC 27362.

Paratypes: Two ventral valve exteriors CEGH-UNC 27360, CEGH-UNC 27361; two dorsal valve exteriors CEGH-UNC 27363, CEGH-UNC 27365; two dorsal valve interiors CEGH-UNC 27364, CEGH-UNC 27366.

Additional material: 525 ventral valves and 250 dorsal valves.

Type horizon and locality: Lower member of the Las Aguaditas Formation, Las Aguaditas Creek section, San Juan Province, Precordillera of west-central Argentina.

Diagnosis: Ventral valve conical with procline pseudointerarea and well defined interridge; short external pedicle tube present. Ventral interior with apical process as low and short ridge, and raised cardinal muscle scars. Dorsal valve convex, lacking median sulcus. Dorsal interior with anacline pseudointerarea, oval and raised cardinal muscle scars, well defined median buttress, high and narrow triangular median septum with one or two anterior septal rods.

Description. The valves average 87.6% as long as wide (observed range 77.4-93.3%; N=55). The ventral valve is conical (media W 1.49 mm, OR 1.15-1.9 mm; media L 1.28 mm, OR 1.01-1.61 mm; N=29), and 55% (observed range 42.7-64,3%) as high as wide (media H 0.81; OR 0.6-1.15; N=29) (Pl. 1, fig. 11). The ventral pseudointerarea is procline, with well defined interridge and convex posterior margin (Pl. 1, fig. 13). The pedicle foramen, enclosed within the metamorphic shell, is about 33 μm wide (Pl. 1, fig. 14), not continued internally; in some specimens a very short exterior pedicle tube is developed. Ventral interior with an apical process forming a low and short ridge along anterior slope, occupying about 20% of the height of the valve in some specimens. Well developed pinnate mantle canal pattern. A pair of slightly raised ventral cardinal muscle scars are present on the pos-

terior wall (Pl. 1, fig. 9). The dorsal valve (average width 1.53 mm, OR 1.11-2.01 mm; average length 1.36 mm, OR 0.96-1.75 mm, N=26) is barely plane but mainly convex, lacking of median sulcus (Pl. 1, figs. 15, 12). The dorsal pseudointerarea is short and wide, with average length/width ratio= 20.3% (OR 14.7-32.8%; media W 0.71; media L 0.14; N=23); it has a median groove occupying approximately one third of total width of pseudointerarea and anacline propareas (Pl. 1, figs. 18, 19). The dorsal cardinal muscle scars are raised and oval, slightly longer than wide (length/width ratio 1.18, N=10), and the muscle field is about 50,4% as long as wide (OR 39.3-61.9%, N=23) and occupy about 18-25% of the total length and 35-48% of total width (Pl. 1, fig. 17). The median buttress is up to 0.18 mm long. High and narrow triangular median septum starting directly anterior to median buttress (Pl. 1, figs. 11, 18), with one or two septal rods on the anterior slope (Pl. 1, fig. 20); the septum occupies 87% (OR 81.2-91.3%) of the total length, is up to 42% as high as long and the maximum high is in anterior half of valve. Ornamentation consists in poorly developed concentric growth lines (Pl. 1, figs. 10, 12). Metamorphic shell of both valves well defined, about 0.19-0.23 mm wide and 0.17-0.19 mm long, with ornamentation of circular pits varying in size, between 0.5-3.5 μm across (Pl. 1, figs. 14, 16).

Discussion. Holmer (2000) revised the type species *Conotreta rusti* Walcott 1889 from the Katian of New York, clarifying the diagnosis of the genus and providing a list of included species. *Conotreta andina* n. sp. can be distinguished from *C. rusti* in having lower conical ventral valve, most procline ventral pseudointerarea, shorter apical process, median sulcus absent, dorsal pseudointerarea less than third of total width and anacline propareas. The four species described by Cooper (1956) differ from *C. andina* n. sp. in the following features: *C. apicalis* Cooper 1956 from the Upper Ordovician of Alabama has a higher conical ventral valve, dorsal valve longer than wide, orthocline dorsal pseudointerarea and lower dorsal median septum lacking septal rods; the other three species come from the Upper Ordovician of Virginia, *C. multisinuata* Cooper, 1956 has a catacline ventral pseudointerarea, deep and narrow median sulcus and longer dorsal median septum without septal rods in the anterior slope; *C.? plana* Cooper, 1956 has a subtriangular outline, ventral valve with straight posterior margin, broader ventral pseudoin-

terarea and indistinct interridge; and *C.? cuspidata* Cooper, 1956 has catacline ventral pseudointerarea, poorly developed interridge and presence of sulcus. *C. mica* Gorjansky, 1969 from the Dapingian to Darriwilian of Russia, Sweden and Nevada differs from *C. andina* n. sp. in having sulcus, larger number of spines in the dorsal septum, higher ventral valve, exterior pedicle tube not developed, and longer raised apical process. *C. miboshanensis* Fu, 1982 from the Ordovician of China has a low conical ventral valve and very short dorsal median septum. *C.? conoidea* Reed, 1917 from the Upper Ordovician of Girvan district (Scotland) has a higher ventral conical valve, indistinct interridge, straight ventral posterior margin, and both valves ornamented with strong concentric striae. *C. parva* Bednarczyk, 1986 from the upper Tremadocian to lower Floian of Poland has a broad rim on the dorsal valve floor, not raised dorsal cardinal muscle scars and lower and shorter dorsal median septum without spines. *C.? orbicularis* Holmer, 1986 from the Katian of Sweden has apsacline ventral valve, a longer external pedicle tube, an internal tube is present, the apical process is absent, and the median buttress is not thickened. *C. siljanensis* Holmer, 1989 from the Dapingian and Darriwilian of Newfoundland and Sweden differs from *C. andina* n. sp. in having a higher ventral valve, a flattened posterior ventral margin with poorly developed interridge, a longer exterior pedicle tube, the presence of internal tube, and up to five spines in the anterior slope of dorsal septum. *C. lepton* Williams & Curry, 1985 from Middle Ordovician of Ireland differs from *C. andina* n. sp. in having lower conical ventral valve, a catacline ventral pseudointerarea without interridge, a well-developed external pedicle tube, shorter and lower dorsal median septum lacking septal rods. *C. chernovi* Popov, 2000 from the Katian of Kazakhstan has a higher ventral valve, almost catacline ventral pseudointerarea lacking interridge, a slightly more developed external pedicle tube, a longer apical process, apsacline dorsal pseudointerarea and dorsal median septum only with one spine. *C. millardensis* Popov et al., 2002, from the Tremadocian of Utah, has catacline ventral pseudointerarea with poorly defined interridge, an apical process with anterior groove and dorsal median septum with a single anterior spine. *C. convexa* Hansen & Holmer, 2011 from the Upper Floian to Lower Dapingian has a weak median sulcus, orthocline to anacline dorsal pseudointerarea,

lower dorsal median septum, ventral pseudointerarea catacline to apsacline in some specimens, broader and longer apical process. The material described by Holmer et al. (2016) from the Lindero Formation (Darriwilian-Katian) of Ponon Trehué Creek (Argentine Precordillera) as *C. cf. multisinuata*, differs from *C. andina* n. sp. in having the catacline ventral pseudointerarea and dorsal median sulcus, also presents higher ventral valve and larger cardinal muscle fields.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Aguaditas and Las Chacritas Formations; Las Aguaditas Creek and Las Chacritas River sections, San Juan Province, Precordillera of west-central Argentina.

Family Scaphelasmatidae Rowell, 1965
Genus *Scaphelasma* Cooper, 1956

Type species - *Scaphelasma septatum* Cooper, 1956; by original designation; Middle Ordovician, upper Darriwilian; Alabama.

Scaphelasma zharykensis Popov, 2000
Pl. 1, figs. 21-24; Pl. 2, figs. 1-9

2000 *Scaphelasma zharykensis* - Popov, p. 427, fig. 8.1-19

Material: Nine figured material. Two ventral valve exteriors CEGH-UNC 27371, CEGH-UNC 27372; one ventral valve interior CEGH-UNC 27373; one conjoined shell CEGH-UNC 27374; three dorsal valve exteriors CEGH-UNC 27367, CEGH-UNC 27369, CEGH-UNC 27375; two dorsal valve interiors CEGH-UNC 27368, CEGH-UNC 27370. 8 ventral and 30 dorsal valves as additional material, not figured.

Description. Shell ventribiconvex, oval widened in outline, with the valves averaging 81.4% as long as wide (observed range 65-91%, N=24). Ventral valve is widely conical (Pl. 2, fig. 2), 40% as high as wide (OR 36-41%; N=4); the highest point is situated subcentrally towards the posterior margin. In dorsal view the ventral posterior margin is slightly straight to concave (Pl. 2, figs. 1, 4). The pseudointerarea is procline and has a well defined intertrough. The pedicle foramen is elongated oval, averaging 69% as wide as long (OR 54-88%) and crossing the posterior boundary of the metamorphic shell (Pl. 2, fig. 3). Ventral interior with a low ridge-like and slightly widened apical process anterior to the foramen, and a pair of well defined umbonal muscle scars, almost circular in outline and towards the posterior sides to the foramen, occupying 16% of the total width in one specimen (Pl. 2, fig. 5). Dorsal

valve convex in the posterior half, with a rounded apex extending beyond the posterior margin and slightly recurved inward; lateral and anterior slopes flattened; a weak median sulcus originates at about one third of the valve length from the apex (Pl. 1, fig. 21). Wide orthocline dorsal pseudointerarea, up to 25% as long as wide and forms about two thirds of the total width of the valve; the median groove is slightly concave and broad, with poorly defined propareas (Pl. 1, figs. 22, 24). The median septum originates about 0.3 mm from the posterior margin, and extends 90% of the total length (OR 85-94%, N=12); it is relatively high with an average height septum/valve width ratio of 48% (OR 34-59%; N=7); has a blade-like shape with rounded apex, almost straight posterior slope and convex anterior declivity (Pl. 1, fig. 22; Pl. 2, fig. 9). Dorsal cardinal muscle scars relatively well defined, occupying more than half the total width in one specimen (Pl. 1, fig. 24). Metamorphic shell of both valves is oval to subcircular in outline, 130-180 µm in length and 155-220 µm wide, covered by densely scattered circular micropits up to 4 µm across, separated by low ridges (Pl. 2, figs. 3, 8). The postlarval shell is ornamented with well-defined concentric fila, about 8-9 per 100 µm, and up to 4 to 6 strong concentric lamellae along the anterior half of the valve (Pl. 1, figs. 21, 23; Pl. 2, figs. 2, 6, 7).

Discussion. The specimens from the Las Aguaditas Formation are closely comparable in major features to *Scaphelasma zharykensis* Popov, 2000 from the Upper Ordovician (Katian) Bestyube Formation, north-central Kazakhstan, in having oval widened outline, procline pseudointerarea with deep intertrough, pedicle foramen with oval outline, dorsal weak median sulcus, dorsal pseudointerarea orthocline divided by a broad and slightly concave median groove, ventral interior with apical process as a low ridge anterior to pedicle foramen, high and triangular median septum, and postlarval ornamentation consisting in concentric fila and strong lamellae. Holmer et al. (2016) reports two species of genus *Scaphelasma* in the Ponon Trehue Formation (Lower Ordovician), Mendoza Province; *S. spetatum* (Cooper, 1956) differs from our material in having a lower and ridge-like dorsal median septum, deeper median sulcus, wider outline shell and different arrangement of postlarval ornamentation; and *S. cf. lamellosum* (Krause & Rowell, 1975) resembles to *S. sharykensis* in dorsal valve

outline, weakly impressed median sulcus and postlarval ornamentation, but differs in having a lower dorsal median septum with acuminated apex, best defined and larger dorsal cardinal muscle fields and larger dorsal pseudointerarea with broader median groove.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Aguaditas and Las Chacritas Formations; Las Aguaditas Creek and Las Chacritas River sections, San Juan Province, Precordillera of west-central Argentina. Also occurs in the Bestyube Formation (Upper Ordovician) from north-central Kazakhstan.

Family Torynelasmatidae Rowell, 1965
Genus *Torynelasma* Cooper, 1956

Type species - *Torynelasma toryniferum* Cooper, 1956; by original designation; Middle Ordovician, Pratt Ferry beds, Pratt Ferry, Alabama

Torynelasma? sp.
Pl. 2, fig. 10

Material: One dorsal valve interior CEGH-UNC 27376.

Discussion. Only one specimen was found, a dorsal valve with convex profile, rounded triangular outline with wide straight posterior margin (Pl. 2, fig. 10), with length/width ratio 0.72 (up to 0.78 mm long and 1.08 mm wide). The pseudointerarea is well developed, widened and poorly divided, occupying 64% of the total width. There is a small, widened posteriorly and elevated median buttress "T"- shaped, up to 0.11 mm long and 0.22 mm wide (Pl. 2, fig. 10), and in front of this originates the dorsal median septum, about 0.21 mm from the posterior margin, and extends to 90% of the total length; the superior part of the septum is broken. The specimen is included in the family Torynelasmatidae because have a wide, straight posterior margin and a broad elevated median buttress, but is assigned with doubts to genus *Torynelasma* due the more complete material of dorsal valves and the lack of ventral valves.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Chacritas Formation; Las Chacritas River section, San Juan Province, Precordillera of west-central Argentina.

Family Ephippelasmatidae Rowell, 1965
Genus *Akmolina* Popov & Holmer, 1994

Type species - *Akmolina olentensis* Popov & Holmer, 1994; by original designation; Upper Cambrian, Kujandy Formation, Aksak-Kujandy Section, northeastern Central Kazakhstan.

Akmolina sp.
Pl. 2, figs. 11-13

Material: Two specimens figured. One dorsal valve exterior CEGH-UNC 27377; one dorsal valve interior CEGH-UNC 27378.

Description. Dorsal valve plane to slightly convex, almost circular in outline (Pl. 2, fig. 13), with average length/width ratio 0.97 (up to 1.06 mm long and 1.12 mm wide); postlarval ornamentation with incipient growth lines, but most of the surface is smooth (Pl. 2, fig. 11). Metamorphic shell discoidal, almost circular in outline with length/width ratio 0.96 and slightly raised; metamorphic ornamentation consisting in micropits densely arranged, up to 2.5-3 µm in diameter (Pl. 2, fig. 12). The pseudointerarea is wide, occupying 50% of the total width, 25% as long as wide, with slightly apsacline propareas and triangular broad pedicle groove (Pl. 2, fig. 13). Dorsal cardinal muscle field barely recognizable, occupying more than half of total width. The dorsal median septum is absent .

Discussion. The two specimens here described are the only ones that lack dorsal median septum in the acrotretids studied material. Despite only having specimens of dorsal valves, the material resembles in several features to *Akmolina olentensis* Popov & Holmer, 1994 in having circular larval and valve outline, wide median groove and the absence of dorsal median septum and median buttress. However, the absence of more specimens and ventral valves makes a more precise determination difficult.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Chacritas Formation; Las Chacritas River section, San Juan Province, Precordillera of west-central Argentina.

Genus *Ephippelasma* Cooper, 1956

Type species - *Ephippelasma minutum* Cooper, 1956; by original designation; Ordovician (Upper Darriwilian to Lower Sandbian) Pratt Ferry Formation, Alabama, USA

Ephippelasma? sp.
Pl. 2, figs. 14-19

Material: Three specimens figured. One dorsal valve interior CEGH-UNC 27379; one ventral valve exterior CEGH-UNC 27380; one ventral valve fragmented CEGH-UNC 27381.

Description. Shell ventribiconvex; ventral valve subcircular in outline (Pl. 2, fig. 17) with length/width ratio 0.82 (up to 0.6 mm long and 0.75 mm wide in one specimen) and highly conical (Pl. 2, fig. 18), 120% as high as wide (N=2); wide catacline to slightly apsacline pseudointerarea with well defined intertrough, rounded umbo and apex curved backwards (Pl. 2, fig. 19); minute apical pedicle foramen, circular in outline, averaging 25.6 µm in diameter (Pl. 2, fig. 16). Internal features poorly preserved. Ventral metamorphic shell sharply delineated, almost circular in outline, up to 180 µm long and 200 µm wide in one specimen, ornamented with micropits varying in size between 1-2 µm across (Pl. 2, fig. 16). Postlarval ornamentation consisting in concentric strong lamellae numbering 6-7 per 100 µm. Dorsal valve gently convex, oval widened in outline (Pl. 2, fig. 14) with a length/width ratio 0.74 (up to 0.7 mm long and 0.95 mm wide in one specimen). Dorsal pseudointerarea with anacline propareas, averaging 15% as long as wide, occupying 45% of total width;

PLATE 2

Figs. 1-9 - *Scaphelasma zharykensis*; 1-3) ventral valve exterior in superior view, side view and detail of micropits in the metamorphic shell, CEGH-UNC 27371, 27398; 4) ventral valve exterior, CEGH-UNC 27372; 5) fragmented ventral valve interior, CEGH-UNC 27373; 6) conjoined specimen showing partially ventral exterior and dorsal interior, CEGH-UNC 27374; 7-8) dorsal valve exterior and detail of metamorphic shell, CEGH-UNC 27375; 9) dorsal valve interior in side view, CEGH-UNC 27370.

Fig. 10 - *Torynelasma?* sp.; dorsal valve interior, CEGH-UNC 27376.

Figs. 11-13 - *Akmolina* sp.; 11-12) dorsal valve exterior and detail of metamorphic shell, CEGH-UNC 27377; 13) dorsal valve interior, CEGH-UNC 27378.

Figs. 14-19 - *Ephippelasma* sp.; 14-15) dorsal valve interior in upper and lateral view, CEGH-UNC 27379; 16-18) detail of metamorphic shell, ventral valve in upper and side view, CEGH-UNC 27380; 19) lateral view of fragmented ventral valve exterior, CEGH-UNC 27381.

Figs. 20-24 - *Numericoma simplex*; 20) ventral valve exterior in posterior view, CEGH-UNC 27382; 21-22) ventral valve exterior in side view and detail of metamorphic shell, CEGH-UNC 27383; 23-24) ventral valve exterior in anterior view and detail of metamorphic shell, CEGH-UNC 27384.

Scale bars represent 100 µm, except 3, 8, 12, 16, 22 and 24 which represent 30 µm.
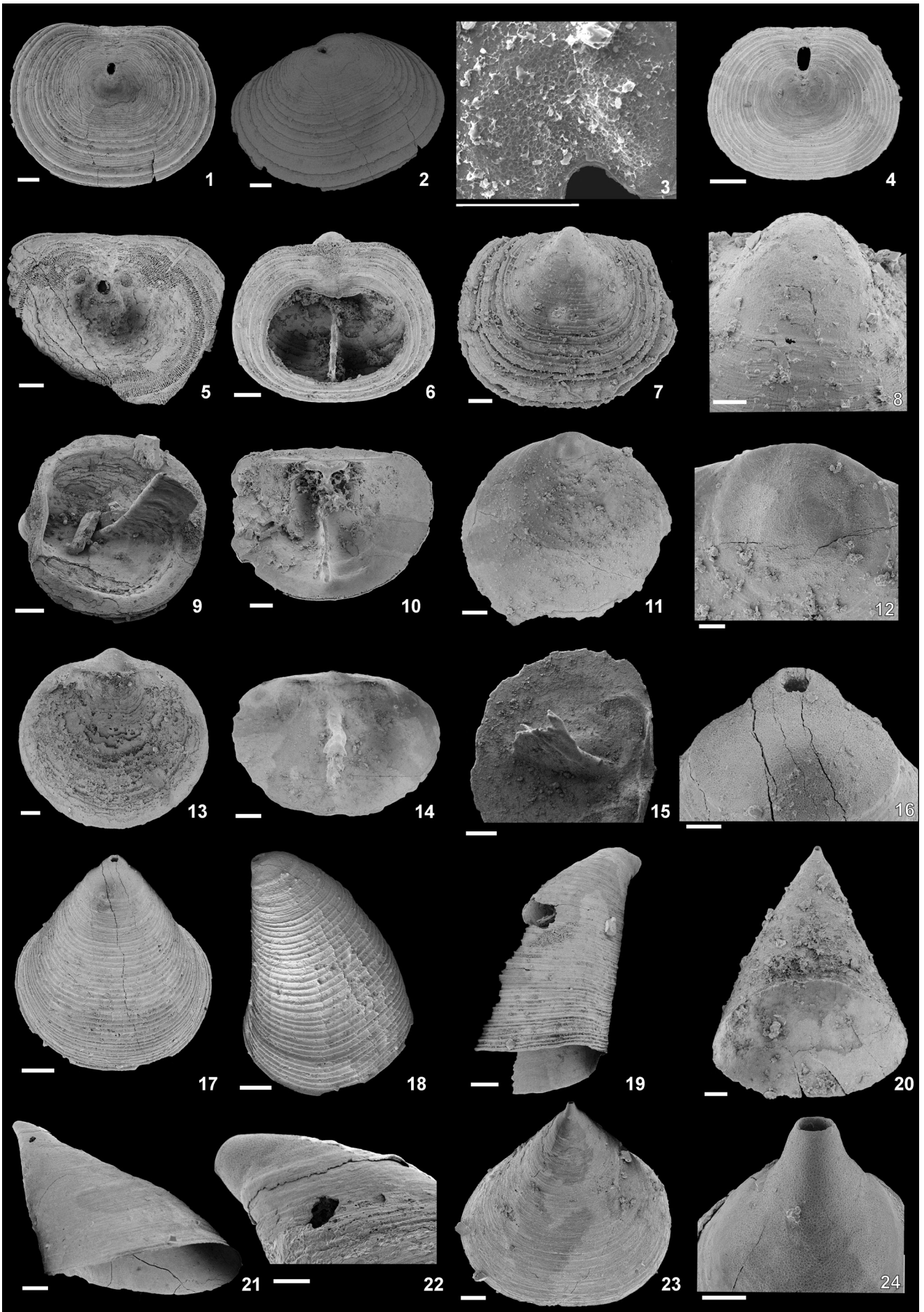
broad pedicle groove, occupying slightly more than a third of the pseudointerarea width; dorsal cardinal muscle scars are barely distinguishable, 38% as long as wide (Pl. 2, fig. 14). The median septum is partially broken in the top, originates about 0.11 mm from the posterior margin and extends 71% of the total length. The septum is relatively low and posses 5 to 6 septal rods in the anterior slope (Pl. 2, fig. 15).

Discussion. The high conical ventral valve with catacline pseudointerarea, the postlarval ornamentation with strong lamellae and the well delineated larval shell with micropitted ornamentation, allows us to refer the material to genus *Ephippelasma*. However, the only dorsal valve with the broken median septum makes the taxonomic attribution of these shells only tentative, in addition to the absence of well preserved and high amount of material. There is also the possibility that the dorsal valve belongs to the genus *Myotreta* Gorjansky, 1969, that resembles in the shape of the median septum of *M. crassa* Gorjansky, 1969, figured by Holmer et al. (2017) (Figure 16, B, H); but the absence of ventral valves corresponding to *Myotreta* and the issue of only having a single specimen of a dorsal valve with broken median septum, makes a better comparison between these two genera even more difficult.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Chacritas Formation; Las Chacritas River section, San Juan Province, Precordillera of west-central Argentina.

Genus *Numericoma* Popov in Nazarov & Popov, 1980

Type species - *Numericoma ornata* Popov in Nazarov & Popov, 1980; by original designation; Middle Ordovician, Dapingian; Kazakhstan.

***Numericoma simplex* Holmer, 1989**
Pl. 2, figs. 20-24; Pl. 3, figs. 1-8

1989 *Numericoma simplex* - Holmer, p.122, pl. 86, figs. A-H.

Material: Seven specimens figured. Three ventral valve exteriors CEGH-UNC 27382, CEGH-UNC 27383, CEGH-UNC 27384; one dorsal valve exterior CEGH-UNC 27387; two dorsal valve interiors CEGH-UNC 27385, CEGH-UNC 27386; one dorsal valve fragmented CEGH-UNC 27388. 32 ventral valves and 25 dorsal valves as additional material, not figured.

Description. Shell ventribiconvex; conical ventral valve (Pl. 2, figs. 20, 23), 68% as high as wide, oval in outline with average length/width ratio 0.76 (observed range 0.64-0.88, N=10). Ventral pseudointerarea apsacline (Pl. 2, fig. 21), slightly curved posteriorly in lateral profile, with well defined intertrough. Rounded and minute pedicle foramen, averaging 26 μm in diameter, located at the end of a short external pedicle tube (Pl. 2, fig. 24). Ventral interior with a short internal pedicle tube, slightly thickened, lying on the posterior slope, limited anteriorly by a low, ridge-like apical process; no other internal features are distinguished. Ventral metamorphic shell well defined, oval in outline, up to 0.12 mm long and 0.15 mm wide (Pl. 2, fig. 22). Dorsal valve with the maximum convexity at midlength; oval in outline (Pl. 3, fig. 6), averaging length/width ratio 0.80 (observed range 0.77-0.84, N=12); dorsal pseudointerarea occupying almost 50% of total width, averaging 17% as long as wide, with anacline propareas (Pl. 3, figs. 2, 4). The dorsal cardinal muscle field is relatively well defined, averaging 35% as long as wide, with oval elongated scars not raised (Pl. 3, fig. 5). The dorsal median septum originates about 0.14 mm from the posterior margin, and extends to 73% of the total length; the maximum height of the septum is situated anterior to centre of valve, and the height septum/valve width ratio average 0.35 (Pl. 3, figs. 1, 3). The posterior slope is concave to slightly straight; in anterior view it is asymmetrical, bifurcated on top and folded almost 90° in some specimens, bearing a variable number of septal spines, up to 10 (Pl. 3, fig. 8). Dorsal metamorphic shell poorly delineated, circular in outline, averaging 0.14 mm in diameter. Larval ornamentation of both valves consists in large pits, up to 2 μm across, separated by clusters of small pits up to 0.4 μm (Pl. 2, fig. 24; Pl. 3, fig. 7). Postlarval shell ornamented with fine concentric growth lines in number of 6 per 0.1 mm measured in the posterior half (Pl. 2, fig. 23; Pl. 3, fig. 6).

Discussion. *N. simplex* Holmer, 1989 is distinguished from other species of genus in having a simple median septum with a single 90° fold. The material here described resembles in having this shape of median septum, with a variable number of septal spines, and also resembles in having apsacline ventral pseudointerarea, well defined intertrough, short external pedicle tube, dorsal valve convex in profile, anacline dorsal pseudointerarea, well defined cardinal muscle scars, micropitted ornamentation of both metamorphic shells and postlarval shell ornamented with concentric growth fila. Oth-

er species of *Numericoma* was described in Argentina by Holmer et al. (2016), *N. rowelli*, but the main difference with our specimens in having strongly flexed and asymmetrical median septum, that bearing up to 31 septal spines and have a surmounting plate with formed by strong folding of the septal plate, ventral valve with poorly defined intertrough.

Stratigraphic and geographic distribution. Middle to Upper Ordovician (Darriwilian to Sandbian) from the Las Aguaditas and Las Chacritas Formations; Las Aguaditas Creek and Las Chacritas River sections, San Juan Province, Precordillera of west-central Argentina. Also occurs in the Kårgärde Limestone and Skärlöv Limestone of Dalarna, and the Segerstad Limestone of Jämtland, Middle Ordovician, Sweden.

Family Biernatidae Holmer, 1989
Genus *Biernatia* Holmer, 1989

Type species - *Torynelasma minor rossicum* Gorjansky, 1969; by original designation; Lower Ordovician, Kunda Stage; Russia.

Biernatia rhapsody n. sp.
Pl. 3, figs. 9-21

Origin of the name: In honor of the song of the British band Queen, Bohemian rhapsody.

Holotype: One dorsal valve interior CEGH-UNC 27393.

Paratypes: Two ventral valve exterior CEGH-UNC 27389, CEGH-UNC 27390; two dorsal valve interior CEGH-UNC 27391, CEGH-UNC 27394; one dorsal valve exterior CEGH-UNC 27392. 10 ventral and 25 dorsal valves as additional material, not figured.

Type horizon and locality: Las Chacritas Formation; Las Chacritas river section, San Juan Province, Precordillera of west-central Argentina.

Diagnosis: Ventral valve highly conical with strongly apsacline pseudointerarea. Dorsal valve gently convex, without median sulcus. Dorsal interior with anacline to ortocline pseudointerarea, cardinal muscle scars not limited by raises ridges, median septum with subtriangular surmounting plate supported anteriorly by anterior slope with varying number of septal rods.

Description. Shell ventribiconvex; ventral valve subcircular in outline with length/width ratio 0.82 (up to 0.5 mm long and 0.6 mm wide); highly conical (Pl. 3, fig. 9), 146% as high as wide. In lateral profile the anterior and posterior surfaces of the ventral valve are both flattened, with strongly acuminated apex; ventral pseudointerarea poorly defined, strongly apsacline (Pl. 3, fig. 11). The pedicle foramen circular in outline, averaging 30 μm in diameter (Pl. 3, fig. 10). The ventral interior is without recognizable features. Dorsal valve oval in outline, averaging length/width ratio 0.80 (up to

0.76 mm long and 0.93 mm wide, N=7); gently convex in lateral profile, with the maximum convexity slightly behind the midlength, lacking median sulcus (Pl. 3, fig. 15). Dorsal pseudointerarea anacline to ortocline, up to 18% as long as wide and forms about 50% of the total width of the valve (Pl. 3, figs. 13, 18). The dorsal cardinal muscle scars are poorly defined, slightly longer than wide (length/width ratio 1.3), and the muscle field is about 38% as long as wide and occupy about 22% of the total length and 47% of total width (Pl. 3, figs. 14, 19). Triangular pedicle groove, occupying slightly more than half of pseudointerarea width. Median septum originates about 0.12 mm form the posterior margin, and extends 73% of the total length; it is low, with a high septum/valve width ratio of about 0.35, and there is a slightly convex surmounting plate which is up to 0.09 mm wide (Pl. 3, figs. 12, 17, 20). In dorsal view it is subtriangular in outline, widening anteriorly and supported by the anterior slope with varying number of septal rods (Pl. 3, figs. 13, 18, 21). Ventral metamorphic shell conical, poorly delineated, up to 0.12 mm long and 0.08 mm width in one specimen; dorsal metamorphic shell is finely delineated, up to 0.10 mm long and 0.14 mm wide in one specimen; both ornamented with scattered micropits averaging 2.1 μm in diameter (Pl. 3, fig. 16). Postlarval ornamentation of both valves consists in very faint concentric lines (Pl. 3, figs. 9, 15).

Discussion. Holmer (1989) erected the genus *Biernatia* grouping species whit short dorsal pseudointerarea, surmounting plate with varying shape and metamorphic ornamentation with large pits surrounded by smaller pits. The type species *B. rossica* (Gorjansky, 1969) from Middle Ordovician of the Leningrad District and Estonia, differs from *B. rhapsody* n. sp. in having smaller maximum adult size (around 0.4 mm in width), flattened dorsal valve, dorsal pseudointerarea almost rudimentary, median septum with more convex surmounting platform and anterior end unsupported. *B. minor* (Cooper, 1956) from the Middle Ordovician Pratt Ferry beds of Alabama, differs from *B. rhapsody* n. sp. in having a minute shell, dorsal valve circular outline, spoon-shaped surmounting platform with anterior end not supported. *B. rarum* (Biernat, 1973) from the Katian of Poland differs in having widely conical ventral valve, dorsal valve with small pseudointerarea undivided, median septum with large lateral walls and ornamentation consisting in thickened macro-

lines all over the shell surface. *B. forte* (Popov, 1975) from the Middle Ordovician Tselinograd Stage of Kazakhstan is distinguished from our material in having ventral pseudointerarea with narrow median groove, distinct dorsal median sulcus, dorsal pseudointerarea almost entirely reduced, and high median septum with intricately constructed surmounting platform with two parallel plates separated by a groove. Holmer (1986) describes two species from the Upper Ordovician of Sweden, *B. curvata* (Holmer, 1986) and *B. planum* (Holmer, 1986), both differs from *B. rhapsody* n. sp. in having unsupported anterior end of surmounting platform, lacking evidence of dorsal cardinal muscle scars and dorsal metamorphic shell with distinct median depression. *B. holmi* Holmer, 1989 from the Upper Ordovician of Sweden, differs from the precordilleran species in having moderately apsacline ventral pseudointerarea, dorsal valve flattened in lateral profile and with median sulcus, surmounting platform parallel sided and strongly convex, unsupported anteriorly. The oldest species known from the Lower Ordovician (Tremadocian) of Norway, *B. circularis* Popov & Holmer, 1994 differs from *B. rhapsody* n. sp. in having adult shells at least two times smaller, less apsacline ventral pseudointerarea, minute dorsal pseudointerarea and dorsal cardinal muscle fields bounded by elevated ridges. *B. prominens* Popov, 2000 from the Upper Ordovician of Kazakhstan differs in having median sulcus, dorsal cardinal muscle field boundary posteriorly by a raised oblique plates, surmounting platform medially grooved and anterior septal slope with semicircular notch. *B. maruiaensis* Percival et. al., 2011 from the Middle Ordovician of New Zeland differs from *B. rhapsody* n. sp. in having catacline to slightly apsacline ventral pseudointerarea, postlarval ventral ornamentation with spiral ridges, flattened dorsal valve, extremely short and narrow dorsal pseudointerarea and median septum well developed posteriorly, raised and supporting the cardinal muscle fields laterally. Two species from the Upper Ordovician (Katian) from Australia differs from *B. rhapsody* n. sp.; *B. wrighti* Engelbresten in Percival et al., 2016 has a broad surmounting platform bearing a narrow median groove and the median septum only extends behind the midlength; and *B. pseudoplana* Engelbresten in Percival et al. 2016 has a blade-like median septum and the ventral valve presents a distinct pedicle tube; also both species have dorsal median sulcus and anterior end of median septum

unsupported. There are two more species assigned to the genus, but the comparison is too difficult; *B. acuta* (Troedsson, 1918) from the Upper Ordovician of Sweden that the dorsal interior is not known in detail and its assignment to genus is tentative; and *B. magnum* (Gorjansky, 1969) from the Lower Ordovician of Russia and Estonia, the dorsal valve is unknown and the species belongs questionably to *Biernatia*.

Stratigraphic and geographic distribution. Middle to Upper Ordovician (Darriwilian to Sandbian) from the Las Aguaditas and Las Chacritas Formations; Las Aguaditas Creek and Las Chacritas River sections, San Juan Province, Precordillera of west-central Argentina.

Family Eoconulidae Rowell, 1965
Genus *Eoconulus* Cooper, 1956

Type species - *Eoconulus rectangulatus* Cooper, 1956; by original designation; Ordovician (Upper Darriwilian to Lower Sandbian) Pratt Ferry Formation, Alabama, USA.


PLATE 3

Figs. 1-8 - *Numericoma simplex*; 1-2) dorsal valve interior in upper and side view, CEGH-UNC 27385; 3-5) dorsal valve interior in lateral view, upper view and detail of pseudointerarea and cardinal muscle fields, CEGH-UNC 27386; 6-7) dorsal valve exterior and detail of metamorphic shell, CEGH-UNC 27387; 8) detail of dorsal median septum, CEGH-UNC 27388.

Figs. 9-21 - *Biernatia rhapsody* n. sp.; 9-10)(ventral valve exterior in anterior view and detail of the acuminated apex, paratype CEGH-UNC 27389; 11) ventral valve in lateral view, paratype CEGH-UNC 27390; 12-14) dorsal valve interior in lateral view, upper view and detail of pseudointerarea and cardinal muscle fields, paratype CEGH-UNC 27391; 15-16) dorsal valve exterior and detail of metamorphic shell, paratype CEGH-UNC 27392; 17-19) dorsal valve interior in lateral view, upper view and detail of pseudointerarea and cardinal muscle fields, holotype CEGH-UNC 27393; 20-21) dorsal valve interior in lateral and upper view, CEGH-UNC 27394.

Figs. 22-23 - *Eoconulus* sp.; dorsal valve exterior, CEGH-UNC 27395, and interior, CEGH-UNC 27396.

Scale bars represent 100 µm, except 7, 10 and 16 which represent 30 µm.
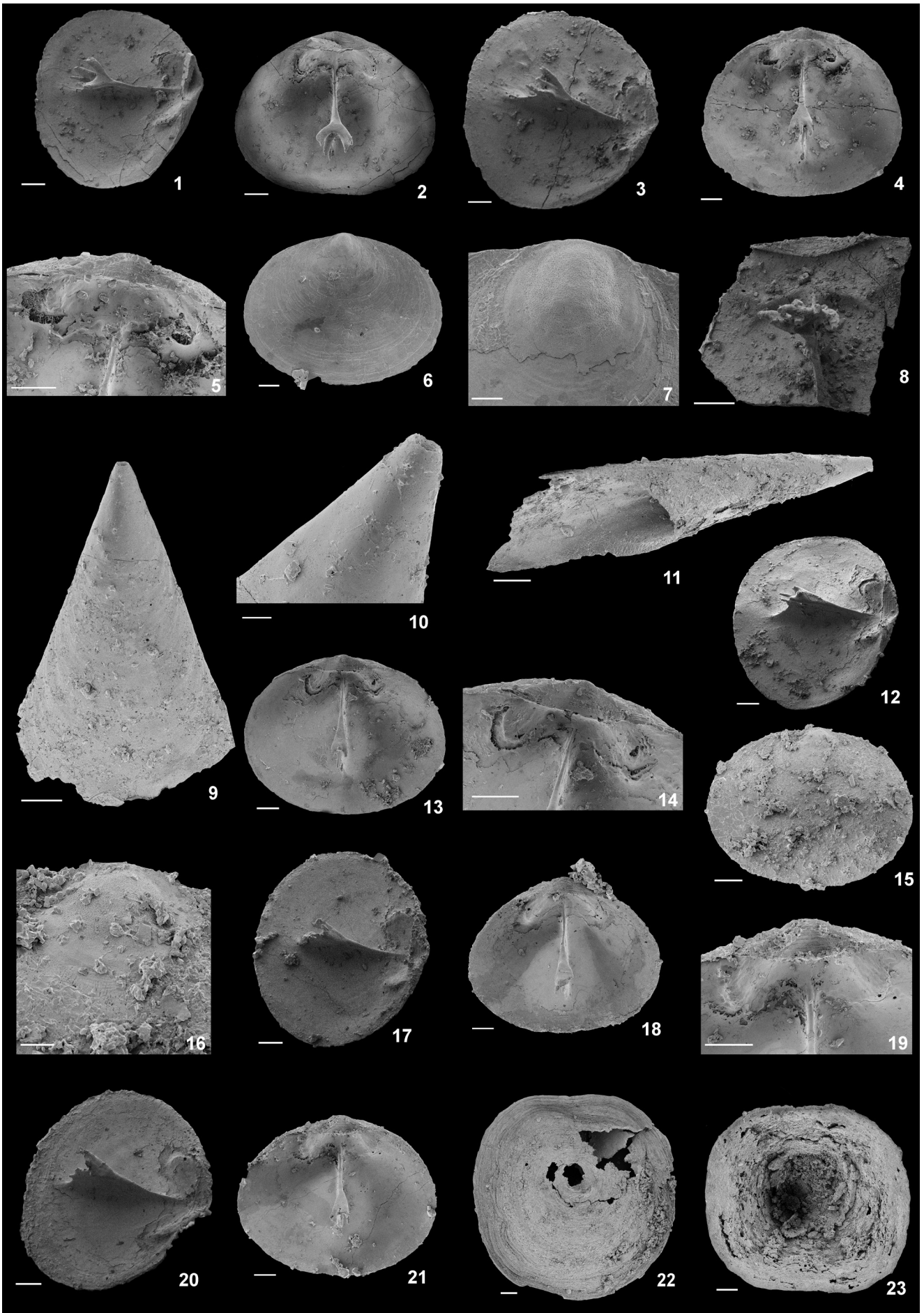
Eoconulus sp.
Pl. 3, figs. 22-23

Material: Two specimens figured. One dorsal valve exterior CEGH-UNC 27395; one dorsal valve interior CEGH-UNC 27396. 83 dorsal valves as additional material, not figured.

Discussion. There are several valves found in the samples that were referred to family Eocunulidae. Only dorsal valves was recovered, mostly with dome-shaped, with almost circular outline (Pl. 3, fig. 22), up to 1.27 mm long and 1.26 mm wide; the maximum height is slightly behind the center of the apex and is up to 0.75 mm in the largest specimen. The posterior margin it is almost straight, without pseudointerarea distinguished. The metamorphic shell is not recognizable, and shell ornamentation consists in concentric fine rugae irregularly spaced. Despite having abundant material, the internal features are poorly preserved in all specimens (Pl. 3, fig. 23) or covered with sediment makes a specific determination very difficult. The general valve dome-shape ornamented with fine rugae and the absence of pseudointerarea, allows assigning the material certainly to genus *Eoconulus*. The other genera within the family *Otariconulus* Holmer & Popov, 2000 and *Undiferina* Cooper, 1956 are easily distinguished from our material by having a well defined dorsal pseudointerarea.

Stratigraphic and geographic distribution. Middle Ordovician (Darriwilian) from the Las Aguaditas Formation; Las Aguaditas Creek section, San Juan Province, Precordillera of west-central Argentina.

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