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Late Ordovician Bivalvia Heteroconchia (Cycloconchidae and Glyptarcidae) from western Argentina

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Abstract On the basis of existing and new collections from northwestern Argentina (Sierra de Zapla and Sierra de Mojotoro) as well as from the Precordillera (San Juan Province), two new genera of the Superorder Heteroconchia Hertwig are erected. Specimens from the Santa Gertrudis Formation (Late Llanvirn-Early Caradoc, Quebrada del Gallinato, Sierra de Mojotoro) assigned to *Cycloconcha* cf. *C. oblonga* Foerste were revised, and on the basis of new collections from the Capillas Formation (Sierra de Zapla) a new taxon of Glyptarcidae Cope, *Zaplaella capillaensis* gen. and sp. nov., is erected. *Poladonta sanjuanina* gen. and sp. nov. is proposed for unnamed, previously studied specimens of Cycloconchidae Ulrich from Early Caradoc pebbles contained in the basal diamictite of the Don Braulio Formation (Precordillera basin).

Resumen. BIVALVIA HETEROCONCHIA (CYCLOCONCHIDAE Y GLYPTARCIDAE) DEL ORDOVÍCICO TARDÍO DEL OESTE DE ARGENTINA. En base a colecciones previas y recientes procedentes del noroeste argentino (Sierra de Zapla y Sierra de Mojotoro) y de la Precordillera (Provincia de San Juan) se definen dos nuevos géneros del Superorden Heteroconchia Hertwig. Se revisó el material de la Formación Santa Gertrudis (Llanvirniano tardío-Caradociano temprano), aflorante en la Quebrada del Gallinato (Sierra de Mojotoro) asignado previamente a *Cycloconcha* cf. *C. oblonga* Foerste. Este material junto con ejemplares adicionales procedentes de la Formación Capillas (Sierra de Zapla) sirvió para la erección del nuevo taxón *Zaplaella capillaensis* gen. et sp. nov. incluido en la Familia Glyptarcidae Cope. Asimismo, se propone *Poladonta sanjuanina* gen. et sp. nov. para cycloconchidos provenientes de bloques de la diamictita basal de la Formación Don Braulio (Precordillera), de edad Caradociana temprana.

Key words. Cycloconchids. Glyptarcids. Late Ordovician. Western Argentina.

Palabras clave. Cycloconchidos. Glyptarcidos. Ordovícico Tardío. Oeste de Argentina.

Introduction

The purpose of this contribution is to redescribe and reassess the generic assignment of two heteroconchian bivalves which were previously reported by one of the authors (T.M.S.) from Late Ordovician successions of western Argentina. The species *Cycloconcha* cf. *C. oblonga* Foerste comes from the Santa Gertrudis Formation of the Cordillera Oriental, Salta Province (Sánchez, 1986). Additional information obtained from specimens better preserved than those available at the time the first publication provides the basis for the redescription of this form and the erection of *Zaplaella* gen. nov., assigned to the Family Glyptarcidae Cope. The other form discussed herein is an unnamed cycloconchid associated with the diverse Early Caradoc bivalve fauna from the boulders contained in the basal glacigenic diamictite of the Don Braulio Formation, Argentine Precordillera. Although this material was recognized as belonging to a new genus (Sánchez, 1999) it was not formally named then. In the present paper the available specimens are redescribed and the new genus *Poladonta* is proposed.

Poladonta gen. nov. together with *Famatinadonta* Sánchez from Middle Arenig beds of the Famatina Range (Sánchez, 2001), represent an important proportion of all known Cycloconchidae, which up to the present includes a total of eight genera. This is a typical Ordovician family, with the exception of *Actinodonta* Phillips, reported from the Silurian of Pembrokeshire (Morris, 1978). The Early Arenig of Wales has yielded *Fortowensia* Cope and *Carminodonta* Cope (Cope, 1996). *Copidens* Pojeta and Gilbert-Tomlinson comes from the Early Llanvirn of Australia (Pojeta and Gilbert-Tomlinson, 1977), and *Ananterodonta* Babin and Gutiérrez-Marco comes from the Llanvirn of Iberia (Babin and Gutiérrez-Marco, 1991). In the Ordovician, a genus reported as *Actinodonta* Phillips has been recorded from the

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Arenig of the Armoricain Massif, and ranges into the Llanvirn-Early Caradoc of Morocco and Great Britain (Pojeta, 1971). According to Cope (pers. com., 2003) all Ordovician species referred to *Actinodonta* are in need of revision, and consequently this genus should be restricted to the Silurian. The type-genus of the family, *Cycloconcha* Miller, comes from the Late Ordovician of Laurentia (Pojeta, 1971), the only known record outside Gondwana. Thus, an outstanding feature of cycloconchids is their distribution almost entirely confined to Gondwana and peripheral palaeoplates, in both the mid- to high-latitude northwestern region and the low latitude eastern part.

Zaplaella capillaensis gen. and sp. nov. is the first record of glyptarcoideans in Argentina. Glyptarcoideans include several genera, most of which are restricted to the Ordovician. *Glyptarca* Hicks has been recorded in the Lower Arenig of South Wales and also in the Llanvirn of Mid-Wales where it occurs together with *Camnantia* Cope. *Celtoconcha* Cope comes from the Lower Arenig of South Wales, and *Hemiprionodonta* Cope has been reported from the Middle Ordovician of Spain, Armorica, and Saudi Arabia, as well as from the Late Llanvirn and Caradoc of Morocco (Cope, 2002, and additional references therein).

Stratigraphy and age of the fossils

The type species of *Zaplaella* gen. nov. comes from calcareous mudstones of the lower third of the Capillas Formation exposed along the Capillas and Zanjón rivers (figure 1). Material of this species is also recorded in dark gray mudstone beds associated with abundant and well preserved specimens of *Cadomia typa* de Tromelin, previously described by Sánchez (1986). A very similar bivalve association has been recorded in the Santa Gertrudis Formation croping out in the Quebrada del Gallinato of the Sierra de Mojotoro (Sánchez, 1986).

The Capillas Formation is a silty-muddy unit, clearly contrasting with the underlying and overlying units because of its thin stratofabric, remarkable lateral continuity and internal homogeneity. The lower part contains a limited number of thin calcareous levels with bioclastic accumulations (figure 3.A). Shell concentrations are mostly composed of well preserved bivalves and few trilobite remains. Internally, they are disorganised and poorly segregated, and show an open fabric with common shelter structures. Geopetal structures suggest scarce reworking and little post-mortem clastic infilling. Fossil preservation is relatively good with weak fragmentation and scarce individual abrasion of shells. Altogether, these factors allows us to infer a parautochthonous origin, consistent with a storm removal and nearby concentration.

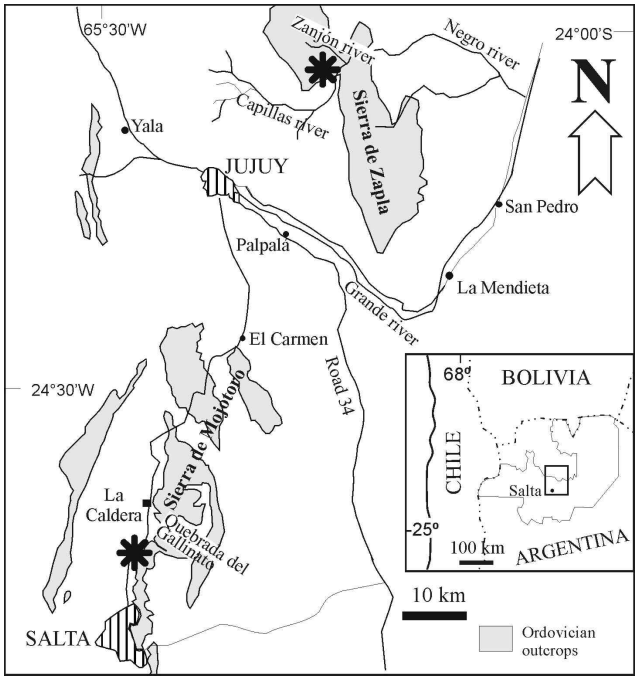

Figure 1. Location map of the northwestern Argentina localities yielding *Zaplaella* gen. nov. / *Mapa de ubicación de las localidades del Noroeste Argentino de donde proviene* Zaplaella *gen. nov.*

The silty-mudstones are intensely bioturbated and locally contain thin-tabular graded sandstones with parallel lamination and wavy tops. Few well-preserved wave ripple trains allow us to infer that the basal portion of the unit was deposited in subtidal environments, under the normal weather wave base. The upper part of the unit shows an increasing proportion of thicker-bedded sandstones with abundant *Skolithos*, indicating gradual shallowing. Whereas the transition with the overlying Centinela Formation is gradual, the contact with the underlying Labrado Formation is sharp and can be interpreted as a flooding surface related to a major transgression. This interpretation is consistent with what occurs across the Cordillera Oriental (e.g. Sierra de Mojotoro, Los Colorados), where correlative units (e.g. the Santa Gertrudis Formation) are arranged in a similar way, reflecting the regional nature of this allocyclic event. Several specimens come from the upper half of the Santa Gertrudis Formation croping out in the Quebrada del Gallinato (Sierra de Mojotoro). This unit is composed of fine to medium grained wackes, with some intercalated thin calcareous levels. The faunal content of the upper half of the Santa Gertrudis Formation is similar to those of the lower third of the Capillas Formation. In the two units there are abundant specimens of bivalves and trilobites, but the absence of typical benthic open-shelf faunas such as brachiopods, echinoderms and bryozoans is

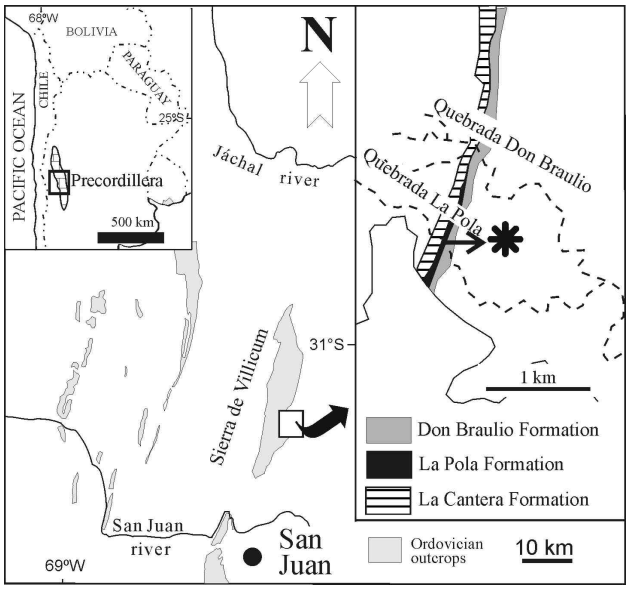

Figure 2. Location map of the Precordilleran locality yielding *Poladonta* gen. nov./ *Mapa de ubicación de la localidad de la Precordillera de donde proviene* Poladonta *gen. nov.*

noticeable. This could be linked to a poorly oxygenated substrate. Shells of the *Z. capillaensis* gen. and sp. n. in the muddy levels are by far thinner than those from the calcareous beds which suggests a better oxygenation of the substrate in the latter.

On the basis of the trilobite *Brogniartella*, Monaldi and Monaldi (1978) refer the Santa Gertrudis Formation to the Llandeilo, although posteriorly Monaldi (1982) assigned this unit to the Early Llanvirn based on *Hoekaspis schlagintweiti* Harrington and Leanza. However, the presence of the bivalve *Cadomia typa* de Tromelin led Sánchez (1986) to reassign this unit to the Llandeilo. According to Albanesi and Rao (1996) the conodonts recovered from the calcareous shell beds of the upper part of the Santa Gertrudis Formation indicate an Early Caradocian age (upper part of the *P. anserinus* Zone to lower part of the *A. tvaerensis* Zone). The Capillas Formation, which shares with the Santa Gertrudis Formation the bivalves *Z. capillaensis* gen. and sp. n., and *Cadomia typa* de Tromelin (Sánchez, 1986) as well as the trilobite *Hoekaspis* sp. nov. (Waisfeld, 1996) is probably coeval with the latter.

The second genus described, *Poladonta* gen. nov., comes from boulders embedded in the lower diamictite member of the Don Braulio Formation exposed at the Quebrada La Pola, in the eastern flank of the Sierra de Villicum (figure 2). The Don Braulio Formation consists of a lower member composed of diamictite with glacially derived pebbles, and an upper member of channelized conglomerates, bioturbated fossiliferous siltstones and calcareous lenses capped by dark gray graptolitic mudstones interbedded with oolitic sandstones (Sánchez *et al.*, 1991; Buggisch and Astini, 1993) (figure 3.B). The Late Ashgill age of the Don Braulio Formation is now well constrained on the basis of brachiopods of the *Hirnantia* Fauna (Benedetto, 1986, 1990) and the graptolite *Normalograptus persculptus* (Sánchez *et al.*, 1988, 1991). The diamictite, resulting from the widespread Late Ordovician glaciation, has been interpreted as glacimarine in origin (Peralta and Carter, 1990), even though new sedimentological evidence suggests that the glacial record is mainly product of wet-based continental glaciers and probably of a floating nearshore ice shelf (Astini, 2001a).

According to the associated brachiopods (Benedetto, 1998) the age of the pebbles yielding *Poladonta* gen. nov. is Early Caradoc. The fossiliferous clasts are thought to be eroded from the underlying La Pola Formation (Astini, 1993; 2001b) which, according to the graptolite content is Early Caradoc in age (Peralta, 1990; Brussa, 2000).

Systematics

by Teresa M. Sánchez

Systematic ordering follows Carter *et al.* (2000). Material used in this study is housed in the Paleontological collections of the Cátedra de Estratigrafía y Geología Histórica, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, prefix CEGH-UNC, and in the Instituto de Geología y Minería, Universidad Nacional de Jujuy, prefix JUY-P.

Superorder HETEROCONCHIA Hertwig, 1895
Order ACTINODONTOIDA Douvillé, 1912
Superfamily GLYPTARCOIDEA Cope, 1996

Remarks. The superfamily diagnosis given by Cope (1996) requires emendation with respect to which are the teeth involved in the distinction between the glyptarcoideans and the actinodontoideans. Cope's definition states that the glyptarcoidean cardinal teeth fan out in opposite direction to that of the actinodontoideans (1996, p. 990), that is, the cardinal teeth radiate towards the dorsal margin instead of ventrally from the umbo. In the glyptarcoideans, however, the teeth that radiate dorsally are the anterior pseudolateral ones, not the cardinals. Indeed, the cardinal teeth pattern in the glyptarcoideans is basically similar to that of actinodontoideans (see *Glyptarca serrata* Cope, 1996, text-fig. 5; *Celtoconcha foveata* Cope, 1996, text-fig. 6, B; *Hemiprionodonta lusitanica* (Sharpe) figured in Babin and Gutiérrez-Marco, 1991, text-fig. 7; and *Zaplaella capillaensis* gen. and sp. nov.).
Emended diagnosis. Actinodontoids in which the lateral anterior teeth, instead of radiating out from beneath the umbo, as in the Actinodontoidea, radiate

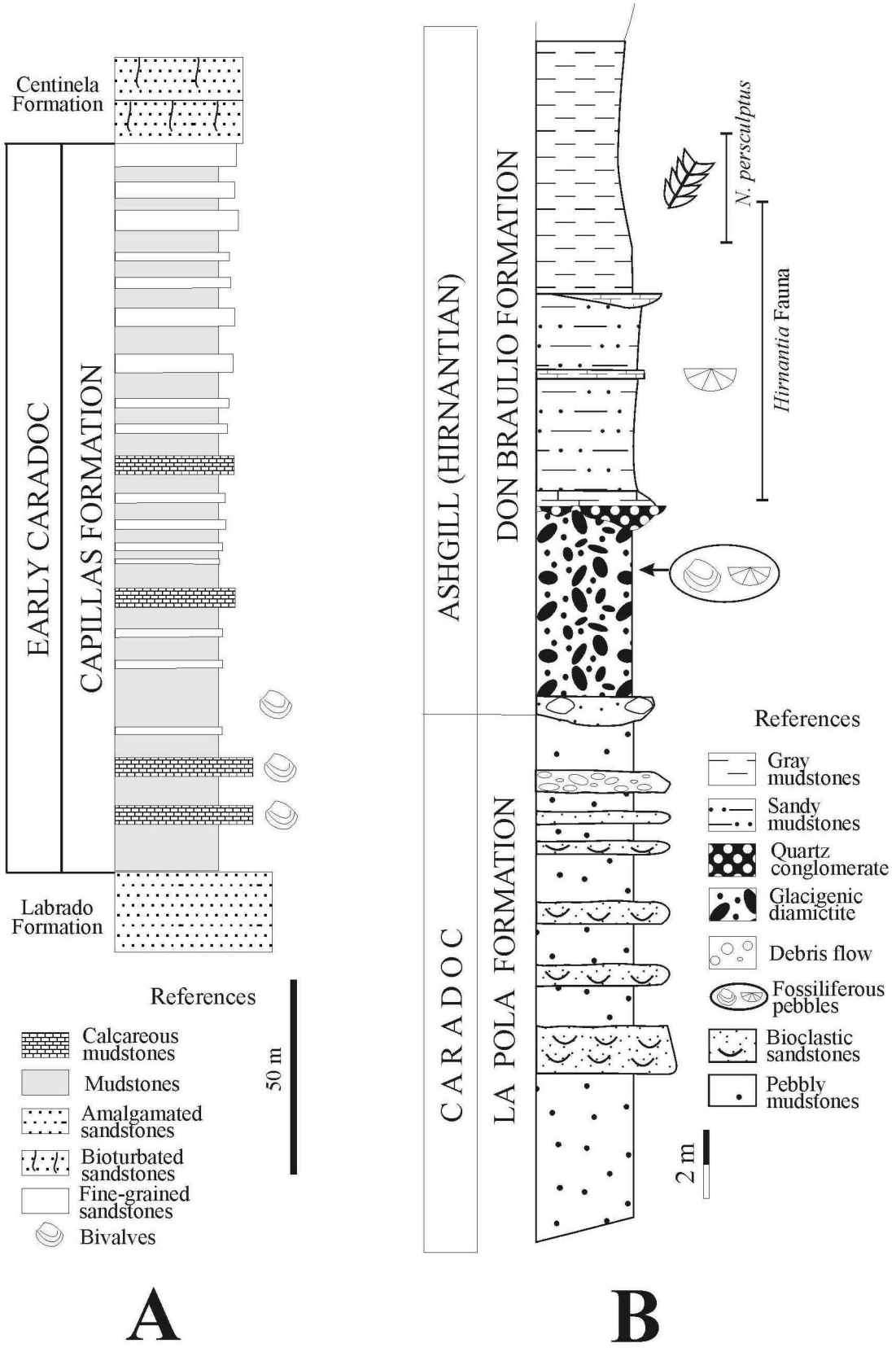

Figure 3. Stratigraphic columns. **A,** The Capillas Formation, the Capillas river, **B,** The Don Braulio Formation, Quebrada La Pola. / *Columnas estratigráficas.* ***A,*** *Formación Capillas, río Capillas,* ***B,*** *Formación Don Braulio, Quebrada La Pola.*

out from a point whose origin is anterior to the umbo but well ventral of the hinge plate and towards the centre of the valves.

Family GLYPTARCIDAE Cope, 1996

Remarks. The taxonomic placement of glyptarcids has been the subject of some debate. Cope (1996) assigned the glyptarcids to the Subclass Heteroconchia (Order Actinodontoida) whereas Carter *et al.* (2000) consider them as arcoids (Subclass Pteriomorphia). Cope (2002) sustained the placement of glyptarcids within the Heteroconchia but he stated that *Glyptarca* "lies close to the point of divergence of heteroconchs and pteriomorphians" (Cope, 2002, p. 42), accepting that glyptarcoideans could be placed also within the pteriomorphs, as Carter *et al.* (2000) suggested.

Cope (1997, 2002) and Carter *et al.* (2000) agree that *Glyptarca* and *Catamarcaia* Sánchez and Babin are closely related genera. The arcoid *Catamarcaia*, from the Middle Arenig of the Sierra de Famatina (western Argentina), displays a unique combination of characters, as taxodont-like and actinodont-like teeth and a duplivincular ligament (Sánchez and Babin, 1993). This type of ligament led to place this genus at the base of the arcoid radiation (Sánchez, 1995; Cope, 1997; Carter *et al.*, 2000). Cope (1997) suggested that *Catamarcaia* could have originated from a *Glyptarca*-like form, probably in the earliest Ordovician. In contrast, Carter *et al.* (2000) viewed *Catamarcaia* as a possible ancestor of glyptarcids. Previously, the author (Sánchez, 1995) suggested that *Catamarcaia* could have been the ancestor of *Glyptarca* but at that time the knowledge of *Glyptarca* morphology was still incomplete. New collections allowed Cope (1996) to redefine *Glyptarca*, as well as the family Glyptarcidae and the superfamily Glyptarcoidea. Additionally, he erected the genus *Hemiprionodonta* Cope to replace *Dolabra*? *lusitanica* Sharpe (Cope, 1996). As a result of Cope's re-definition of glyptarcoids it is difficult now to find a connection between them and *Catamarcaia.* Similarities between *Catamarcaia* and glyptarcids seem to be superficial and based only in the "actinodontian-grade" of the *Catamarcaia* dentition; differences, by contrast, seem to be more relevant, particularly the opposite direction of radiation of the actinodont-like teeth in *Catamarcaia*, and more noticeably, the development of a duplivincular ligament. According to Cope (1996), differences in the teeth pattern between actinodontoideans and glyptarcoideans are not enough to separate them in different subclasses, though both superfamilies could be included in the Order Actinodontoida (Heteroconchia) (Cope, 1996). If correct, neither actinodontoideans nor glyptarcoideans are linked to *Catamarcaia.*

Cope (1995, 1997) emphasized the similarities between *Cardiolaria* Munier-Chalmas and *Glyptarca* in the overlap of the posterior and anterior dental rows in the subumbonal area, and suggested that palaeoheterodonts (as *Glyptarca*) originated from *Cardiolaria*-like palaeotaxodonts. However, the recent discovery of new taxa referred to the Family Intihuarellidae (Sánchez and Vaccari, 2003) in the Tremadoc of northwestern Argentina offers an alternative hypothesis to the origin of actinodontoids. Intihuarellids are characterized by a very simple dental pattern. The type genus *Intihuarella* Sánchez displays only a single posterior pseudolateral tooth, and lacks the anterior pseudolateral and pseudocardinal teeth. This very simple pattern is consistent with the age of the group (lower Late Tremadoc) and is believed that it gave rise to the more complex dentitions of the cycloconchids (Sánchez and Vaccari, 2003). A new genus of intihuarellid recently found in Late Tremadoc and Early Arenig beds of northwestern Argentina possesses two posterior pseudolateral and one anterior pseudolateral teeth, but the pseudocardinal teeth are still lacking (Sánchez, MS). In this genus the anterior pseudolateral tooth runs parallel to the dorsal margin, without evident convergence or divergence respect to the umbo. Morphological changes leading to the derivation of glyptarcoideans (and actinodontoids in general) from *Cardiolaria*-like forms are hard to explain. It thus seems more parsimonious that actinodontoids originated from intihuarellid-like dentition types. The author (Sánchez, in Sánchez and Vaccari, 2003) suggested that intihuarellids gave rise to the cycloconchids; they are here believed to have also given origine to the glyptarcoideans by mean of a rotation of the pseudolateral anterior teeth, the realization of convergent or divergent patterns allowing to a gradual differentiation of glyptarcoideans and cycloconchoids.

Genus ***Zaplaella*** gen. nov.

Type species. *Zaplaella capillaensis* sp. nov.
Etymology. Refers to the Sierra de Zapla.
Diagnosis. Glyptarcid with five to seven pseudocardinal teeth diverging from umbo, anterior pseudolateral teeth inverted V-shaped with the distal branch elongated, parallel to the anterior cardinal border, and three posterior, not crenulated pseudolateral teeth.
Discussion. The orientation of the anterior pseudocardinal teeth, which run parallel to the dorsal margin, slightly divergent dorsally, is similar to those of the glyptarcoideans. The dentition and shape of this genus render it readily distinguishable from all other glyptarcids. *Zaplaella* gen. n. differs from *Glyptarca* Hicks by the peculiar overlaping of the anterior and posterior dental rows in *Glyptarca* (Cope, 1996). The absence of crenulations in the pseudolateral teeth is only shared by *Celtoconcha* Cope (1996), but both gen-

era differ in the dental pattern and shell outline. The marked inverted V-shaped nature of the anterior pseudolateral teeth of *Zaplaella* gen. n. provides ready distinction from *Hemiprionodonta* Cope (1996) and *Camnantia* Cope (1999).

The previous assignation to *Cycloconcha* cf. *C. oblonga* Foerste (illustrated by Pojeta, 1971) by Sánchez (1986) was based on incomplete material. As demonstrated here, the well preserved hinge of the new specimens clearly differs from that of *Cycloconcha* as well as from the other genera of the family Cycloconchidae, but is similar to those of glyptarcids.

Zaplaella capillaensis sp. nov.
Figures 4, 6.A-E, I

1986. *Cycloconcha* cf. *C. oblonga* Foerste; Sánchez, p. 136, Lam. 1, figs. 7,8.

Holotype. A right valve preserved as internal mould, CEGH-UNC 20936, from the lower third of the Capillas Formation, Capillas river, Sierra de Zapla.
Paratypes. 14 specimens preserved as internal and composite moulds of right and left valves. CEGH-UNC 20937, 20938, 20940 to 20947, and JUY-P 7 and 8, from the Capillas Formation, Sierra de Zapla; CEGH-UNC 8073 and 20939, from the Santa Gertrudis Formation, Quebrada del Gallinato, Sierra de Mojotoro.
Derivation of name. Refers to the Rio Capillas.
Type locality and type stratus. Lower third of the Capillas Formation, Late Llanvirn-Early Caradoc, Capillas river, Sierra de Zapla.
Occurrence. Santa Gertrudis Formation, Quebrada del Gallinato, Sierra de Mojotoro, Salta Province, and Capillas Formation, Capillas and Zanjón rivers, Sierra de Zapla, Jujuy Province. Late Llanvirn-Early Caradoc.
Diagnosis. Same as for the genus.
Description. Great, rounded shell; orthogyrate umbo situated near the mid-point of the valve, projected above hinge-line; maximal convexity in the upper half of the valve near the periumbonal area. Dentition includes anterior and posterior pseudolateral, and pseudocardinal teeth. Three posterior pseudolateral teeth, the second being the longest, the ventralmost tooth comes from the umbonal area to near the mid-line of the second one, and the dorsalmost comes from the posterior third of the second tooth and reaches the same length as those of the second tooth. Both the second and the dorsal teeth, run parallel to the dorsal margin until near the posterior adductor muscle. Two anterior pseudolateral teeth are inverted V-shaped with the proximal branch short, subvertical, and with an elongated distal branch extended towards the antero dorsal extremity of the hinge; these teeth are radially arranged, with the centre of the radius lying towards the centre of the valve; the ventral tooth is smaller than the dorsal one. Five to seven small pseudocardinal teeth diverging from the umbo (figure 4). Slightly anisomyarian, with a rounded anterior adductor scar, and a subrectangular posterior adductor scar with the axis dorsoventrally directed, slightly greater than the anterior scar. Anterior and posterior adductor muscles well impressed, and relatively small with respect to the total size of shell. Pallial line entire. Shell ornamented with fine comarginal lines, normally preserved in the distal part of the valves. Measurement of the largest specimen (CEGH-UNC 20947) is 40 mm height, and 50 mm lenght.

Figure 4. Hinge details of *Zaplaella capillaensis* gen. and sp. n. Camera lucida drawing of holotype (see figure 6.C). Scale bar represents 1 mm. / *Detalles de la charnela de* Zaplaella capillaensis *gen. et sp. n. Dibujo en cámara clara del holotipo (ver figure 6.C). La escala representa 1 mm.*

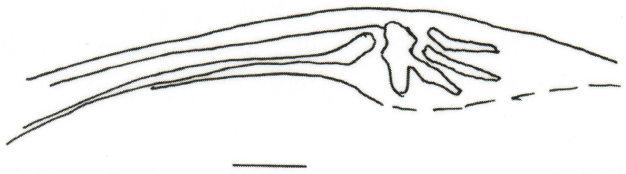

Figure 5. Hinge details of *Poladonta sanjuanina* gen. et sp. nov. Camera lucida drawing of holotype (see figure 6.F). Scale bar represents 1 mm. / *Detalles de la charnela de* Poladonta sanjuanina *gen. et sp. n. Dibujo en cámara clara del holotipo (ver figure 6.F). La escala representa 1 mm.*

Superfamily CYCLOCONCHOIDEA Ulrich, 1893
Family CYCLOCONCHIDAE Ulrich, 1893

Poladonta gen. nov.

Type species. *Poladonta sanjuanina* sp. nov.
Etymology. Refers to the Quebrada La Pola.
Diagnosis. Cycloconchid with three elongated posterior pseudolateral teeth, four pseudocardinal teeth from which three extended anteriorly, and the fourth posteriorly. Third pseudocardinal tooth bifid. Anterior pseudolateral teeth absent.
Discussion. The anteriorly extended pseudocardinal teeth of *Poladonta* gen. nov. extended along the anterior hinge seems to replace functionally the absent anterior pseudolateral teeth (figure 5). This feature is unknown in other cycloconchids. *Ananterodonta* Babin and Gutiérrez-Marco (1985) also lacks the anterior pseudolaterals, but pseudocardinals are short,

almost parallel one another and directed backward. In *Famatinadonta* Sánchez one of the two pseudocardinal teeth extends forward, probably having a similar function than to those of *Poladonta* gen. nov. (to replace the anterior pseudolaterals for the hinge occlusion). In number and size, however, it differs from the pseudocardinals of *Poladonta* gen. nov. *Carminodonta* Cope shows a series of pseudocardinal teeth radiating from the umbo, but the anterior pseudocardinals do not extend along the anterior part of the hinge (Cope, 1996). Additionally, *Poladonta* shows significant differences with *Carminodonta* in the number of pseudocardinal teeth, as well as in the pattern of the posterior pseudolateral teeth.

Poladonta sanjuanina sp. nov.
Figs. 5, 6. F-H

1999. Cycloconchidae indet., Sánchez, p. 75, fig. 7,17,18, and fig. 10.

Holotype. An incomplete right valve with well preserved hinge, CEGH-UNC 16718.
Paratypes. Three incomplete internal moulds of right and left valves, CEGH-UNC 16716, 16717, and 17350.
Etymology. Refers to the San Juan Province.
Type locality and type level. Basal diamictite of the Don Braulio Formation, Early Caradoc, Sierra de Villicum, Argentine Precordillera.
Diagnosis. Same as for the genus.
Description. Subovate shell with rounded margins,

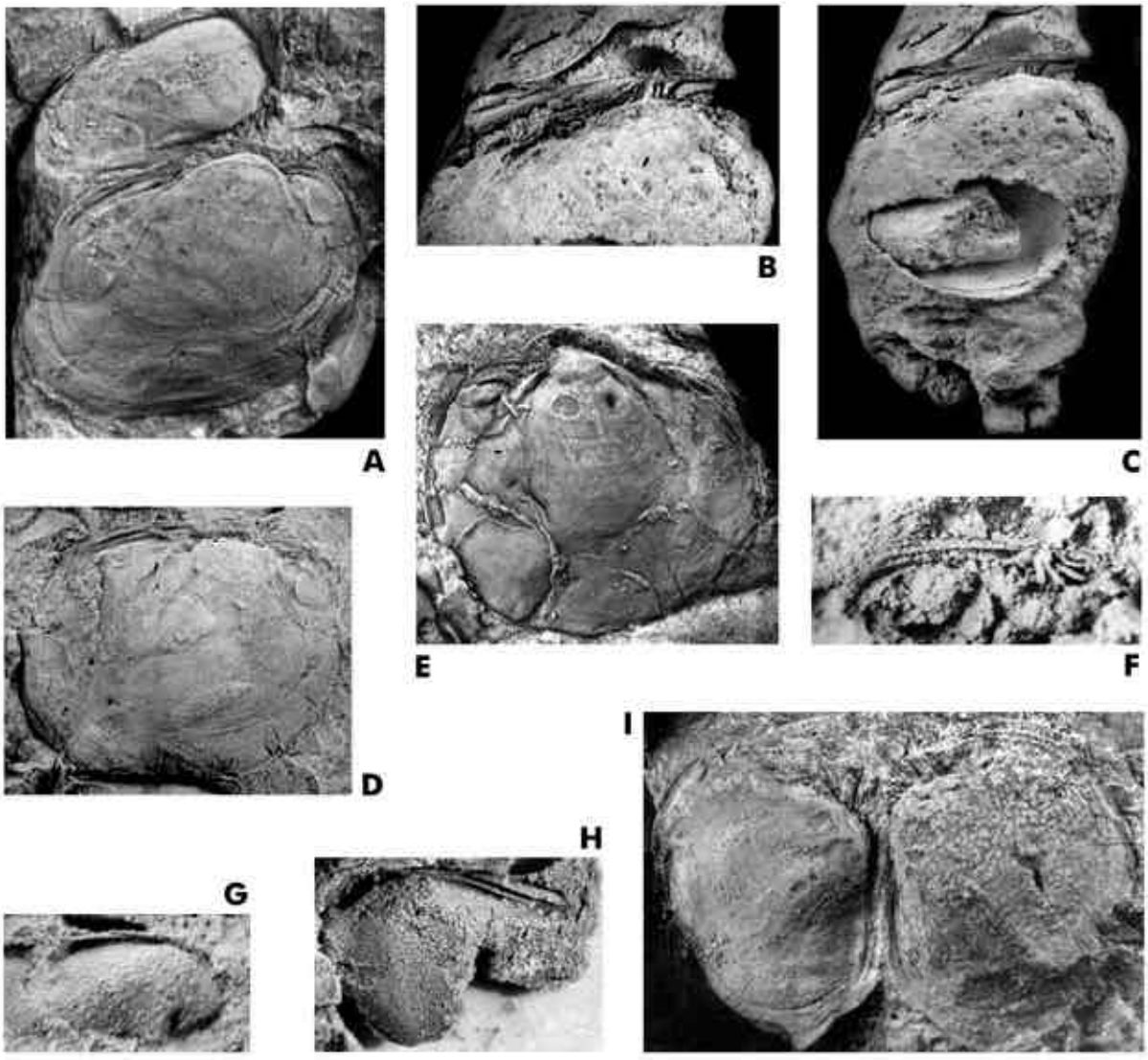

Figure 6. A-E, I, *Zaplaella capillaensis* gen. et sp. nov. **A,** Internal mould of articulated specimen, laterodorsal view / *Molde interno de un ejemplar articulado, vista laterodorsal,* CEGH-UNC 20940 (x1); **B,** Detail of hinge, see figure C / *Detalle de la charnela, ver figura C* (x 1.5); **C,** Internal mould of right valve, holotype / *Molde interno de valva derecha, holotipo,* CEGH-UNC 20936 (x1.2); **D,** Internal mould of right valve / *Molde interno de valva derecha,* CEGH-UNC 20947 (x1); **E,** Internal mould of left valve / *Molde interno de valva izquierda*, CEGH-UNC 20942 (x 1.2); **I,** Internal mould of articulated specimen, dorsal view / *Molde interno de un ejemplar articulado, vista dorsal,* CEGH-UNC 20941 (x1). **F-H, *Poladonta sanjuanina*** gen. et sp. nov. **F,** Isolated dentition of right valve, holotype / *Dentición aislada de valva derecha, holotipo,* CEGH-UNC 16718 (x7); **G,** Internal mould of right valve / *Molde interno de valva derecha,* CEGH-UNC 16716 (x 8); **H,** Incomplete mould of left valve / *Molde incompleto de valva izquierda*, CEGH-UNC 17350 (x7).

with a faint subumbonal groove running towards the ventral margin. Prosogyrate umbo placed in the anterior third of the valve. Dentition with only posterior pseudolateral and pseudocardinal teeth, without anterior pseudolaterals. Three elongated posterior pseudolaterals, the second being the longest, and the ventral the shorter. Three parallel anterior pseudocardinal teeth from which the third is bifid, directed towards the anterior margin, occupying more than the half part of the space of the anterior hinge, and a fourth pseudocardinal tooth oblique, posteriorly diverging (figure 5). Anterior adductor muscle scar gently impressed, posterior not preserved.

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References

Albanesi, G. and Rao, R. 1996. Conodont fauna form the Santa Gertrudis Formation (Middle-Late Ordovician), Eastern Cordillera, northwestern Argentina. *Sixth International Conodont Symposium* (ECOS VI), Warszawa. *Abstracts*: 3.

Astini, R. A. 1993. Facies glacigénicas del Ordovícico tardío (Hirnantiano) de la Precordillera Argentina. *Boletín de la Sociedad Española de Historia Natural, sección Geología*, 88:137-149.

Astini, R. 2001a. Pavimentos estriados en la Formación Don Braulio y naturaleza de la glaciación hirnantiana (Ordovícico tardío) en la región andina. *Revista de la Asociación Argentina de Sedimentología* 8: 1-25.

Astini, R. 2001b. La Formación La Pola (Ordovícico superior): relicto erosivo de la glaciación hirnantiana en la Precordillera argentina. *Revista de la Asociación Geológica Argentina* 56: 425-442.

Babin, C. and Gutiérrez-Marco, J.C. 1985. Un nouveau Cycloconchidae (Mollusca Bivalvia) du Llanvirn inférieur (Ordovicien) des Monts de Tolède (Espagne). *Geobios* 18: 609-616.

Babin, C. and Gutiérrez-Marco, J.C. 1991. Middle Ordovician bivalves from Spain and their phyletic and palaeogeographic significance. *Palaeontology* 34: 109-147.

Benedetto, J.L. 1986. The first typical *Hirnantia* Fauna from South America (San Juan Province, Argentine Precordillera). *Biostratigraphie du Paléozoïque* 4: 439-447.

Benedetto, J.L. 1990. Los géneros *Cliftonia* y *Paromalomena* (Brachiopoda) en el Ashgilliano tardío de la Sierra de Villicum, Precordillera de San Juan. *Ameghiniana* 27: 151-159.

Benedetto, J.L. 1998. Braquiópodos caradocianos en los bloques de la diamictita glacigénica de la Formación Don Braulio (Ashgilliano), Sierra de Villicum, Precordillera Argentina. *Ameghiniana* 35: 393-412.

Buggisch, W. and Astini, R.A. 1993. The Late Ordovician Ice age: New evidence from the Argentine Precordillera. In: R.H. Findlay, R. Unrug, M.R. Banks, and J.J. Veevers (eds.), *Gondwana Eight, Assembly, evolution and dispersal*. Balkema Press, p. 439-447.

Brussa, E.D. 2000. Una nueva asociación de graptolitos caradocianos en la Formación La Cantera, sierra de Villicum, Precordillera Argentina. *Ameghiniana, Suplemento Resúmenes* 37: 7R.

Carter, J.G., Campbell, D.C. and Campbell, M.R. 2000. Cladistic perspectives on early bivalve evolution. In: E.M. Harper, J.D. Taylor and J.A. Crame (eds.), *The Evolutionary Biology of the Bivalvia.* Geological Society, London, Special Publications, 177: 47-79.

Cope, J.C.W. 1995 (Dated 1996). The early evolution of the Bivalvia. In: J.D. Taylor (ed.), *Origin and Evolutionary Radiation of the Mollusca.* p. 361-370. Oxford University Press, Oxford.

Cope, J.C.W. 1996. Early Ordovician (Arenig) bivalves from the Llangynog Inlier, South Wales. *Palaeontology* 39:979-1025.

Cope, J.W.C. 1997. The early phylogeny of the class Bivalvia. *Palaeontology* 40: 713-746.

Cope, J.W.C. 1999. Middle Ordovician bivalves from mid-Wales and the Welsh Borderland. *Palaeontology* 42: 467-499.

Cope, J.W.C. 2002. Diversification and biogeography of bivalves during the Ordovician Period. In: J.A. Crame and A.W. Owen (eds.) *Palaeobiogeography and Biodiversity Change: the Ordovician and Mesozoic-Cenozoic Radiations*. Geological Society, London, Special Publications, 194: 25-52.

Monaldi, C.R. 1982. Reasignación genérica de *Calymenella*? *zaplensis* Harrington y Leanza, 1957 (Trilobita). *Revista de la Asociación Geológica Argentina* 37: 261-267.

Monaldi, C.R. and Monaldi, O.H. 1978. Hallazgo de una nueva fauna en la Formación Santa Gertrudis (Ordovícico), Provincia de Salta, República Argentina. *Revista de la Asociación Geológica Argentina* 33: 245-246.

Morris, N.J. 1978. The infaunal descendants of the Cycloconchidae: an outline of the evolutionary history and taxonomy of the Heteroconchia, superfamilies Cycloconchacea to Chamacea. *Philosophical Transactions, Royal Society*, London, B. 284: 259-275.

Peralta, S.H. 1990. Nuevas graptofaunas de la Formación La Cantera, Sierra de Villicum, Precordillera oriental de San Juan, Argentina. *5° Congreso Argentino de Paleontología y Bioestratigrafía*, Tucumán. 2: 59-66.

Peralta, S.H. and Carter, C. 1990. La glaciación gondwánica del Ordovícico tardío. Evidencias en fangolitas guijarrosas de la Precordillera de San Juan, Argentina. *11° Congreso Geológico Argentino*, Tucumán, *Actas* 2:181-185.

Pojeta, J. Jr. 1971. Review of Ordovician pelecypods. *Geological Survey Professional Paper* 493, 46 p.

Pojeta, J. Jr. and Gilbert-Tomlinson, J. 1977. Australian Ordovician Pelecypod Molluscs. *Department of Natural Resources, Bureau of Mineral Resources, Geology, and Geophysics Bulletin* 174: 1-64.

Sánchez, T.M. 1986. La fauna de bivalvos de la Formación Santa Gertrudis (Ordovícico) de la Provincia de Salta (Argentina). *Ameghiniana* 23:131-139.

Sánchez, T.M. 1995. Comments on the genus *Catamarcaia* Sánchez & Babin and the origin of the Arcoida. *Geobios*, 28: 343-346.

Sánchez, T.M. 1999. New Late Ordovician (Early Caradoc) bivalves from the Sierra de Villicum (Argentine Precordillera). *Journal of Paleontology*, 73: 66-76.

Sánchez, T.M. 2001. Moluscos bivalvos de la Formación Molles (Arenigiano medio), sierra de Famatina. *Ameghiniana* 38: 185-193.

Sánchez, T.M. and Babin, C. 1993. Un insolite mollusque bivalve, *Catamarcaia* nov. gen. de l'Arenig (Ordovicien inférieur) d'Argentine. *Comptes Rendus de l'Academie des Sciences* 316: 265-271.

Sánchez, T. M., Benedetto, J.L. and Brussa, E. 1988. Late Ordovician stratigraphy, paleoecology, and sea level changes in the Argentine Precordillera. Abstracts. *5th. International Symposium on the Ordovician System*, Newfoundland, p. 89.

Sánchez T.M., Benedetto, J.L. and Brussa, E. 1991. Late Ordovician stratigraphy, paleoecology, and sea level changes in the Argentine Precordillera. p. 245-258. In: C.R. Barnes and S.H. Williams (eds.), *Advances in Ordovician geology*. Geological Survey of Canada, Paper 90-9.

Sánchez, T.M. and Vaccari, N.E. 2003. Ucumariidae new family (Bivalvia, Anomalodesmata) and other bivalves from the Early Ordovician (Tremadocian) of northwestern Argentina. *Ameghiniana* 40: 415-424.

Waisfeld, B.G. 1996. Revisión de la Zona de *Hoekaspis schlagintweiti*' Harrington y Leanza, Ordovícico del Noroeste de Argentina. *12 °Congreso Geológico de Bolivia*, t. 3: 915- 923. Tarija.

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