REVISTA ESPAÑOLA DE PALEONTOLOGÍA, 9 (1), 105-114. 1994. ISSN 0213-6937.

SOME MIDDLE CAMBRIAN AGNOSTOIDS FROM THE PRECORDILLERA ARGENTINA

Osvaldo BORDONARO and Eladio LIÑÁN***

* CRICYT-UNSJ. Casilla Correo 131.
5500 Mendoza (Argentina).
** Dep. Geología. Paleontología.
Universidad de Zaragoza. 50009 Zaragoza (Spain).

ABSTRACT

Agnostoid trilobites are described from Middle Cambrian sediments in the Precordillera of Mendoza and San Juan provinces. The following taxa occur at Solitario Hill, Mendoza: *Clavagnostus canotensis, Tomagnostella exsculpta, Agnostus exsulatus, Agnostus?* sp., *Oedorhachis australis, Ptychagnostus aculeatus* and *Ammagnostus* sp. Taxa from the Ojos de Agua locality in San Juan comprise: *Kormagnostus seclusus, Peronopsis tenuis* and *Baltagnostus?* sp. There are the first agnostoids recorded from the San Juan area. *Ptychagnostus aculeatus* from Mendoza is here recorded for the first time in Argentina. A late Middle Cambrian age is assigned to the strata containing the assemblages of both Mendoza and San Juan.

Keywords: Trilobita, Agnostoids, Middle Cambrian, Precordillera, Argentina.

RESUMEN

Se estudian los trilobites agnóstidos de dos localidades de Mendoza y San Juan en la Precordillera Argentina. En el cerro Solitario de Mendoza se han determinado: *Clavagnostus canotensis, Tomagnostella exsculpta, Agnostus exsulatus, Agnostus?* sp., *Oedorhachis australis, Ptychagnostus aculeatus* y *Ammagnostus* sp. En la quebrada Ojos de Agua de San Juan hemos determinado los siguientes taxones: *Kormagnostus seclusus, Peronopsis tenuis* y *Baltagnostus?* sp. De la fauna de Mendoza, *Ptychagnostus aculeatus* es citado por primera vez para Argentina. Se considera que ambas asociaciones pertenecen a la zona de *Lejopyge laevigata*, la más moderna del Cámbrico Medio.

Palabras clave: Trilobites, Agnóstidos, Cámbrico Medio, Precordillera, Argentina.

INTRODUCTION

The Precordillera Argentina is an elongate geological province extending about 500 km north-south, located between the Andes belt to the west and the tectonic blocks of the Central Argentine Craton to the east.

Three well-defined longitudinal belts: Eastern, Central and Western are contained within Precordillera. The three of them are distributed in the provinces of La Rioja, San Juan and Mendoza (Fig. 1).

The Precordillera Cambrian is unique in South America with an abundant trilobite facies and a relatively complete sequence.

The Cambrian outcrops are distributed into two palaeogeographic areas: a carbonate platform to the east and continental slope to the west (Figs. 1-2).

The Cambrian trilobites are also linked to this biogeographical distribution with endemic species restricted to the carbonate platform, whereas cosmopolitan species are found in the mixed talus facies that interfinger with open platform facies.

PREVIOUS WORK

Middle Cambrian agnostoid trilobites from the Precordillera of Mendoza were first studied by Rusconi (1950a, 1950b, 1951 & 1952) but the taxonomic assignments are generally wrong in need of further review (Harrington *et al.*, 1959). Poulsen (1960) studied the agnostoids from Solitario hill of Mendoza creating new species, but many of these were revised and reassigned by Robison (1988). Cuerda *et al.* (1986a) as well as Bordonaro & Banchig (1990) cited the discovery of Middle Cambrian agnostoids in differents sections in the Tontal Range. Also, Benedetto *et al.* (1986) found Middle Cambrian agnostoids in Río Jáchal (Northern of San Juan) that have been studied by Vaccari & Bordonaro (in press). They describe *Ptychagnostus praecurrens* of middle Middle Cambrian age, from an allochthonous block.

The objective of this paper is to assess the agnostoid systematics of Rusconi and Poulsen, mainly based on new material from both Solitario hill in Mendoza and San Juan.

STRATIGRAPHY

The Cambrian stratigraphy of the Precordillera is only broadly known, and mainly in the carbonate platform facies, where a continuous sequence was established between the late Lower Cambrian to early Ordovician (Baldis & Bordonaro 1985). The stratigraphy of the slope sequences is, however, poorly known due to chaotic sedimentation, abrupt facies changes and isolated fossil localities. The stratigraphical knowledge is synthesized in Fig. 2. More detailed information can be obtained in Bordonaro (1992).

The fauna here described was found both in the open platform carbonate facies of the Solitario Forma-

https://doi.org/10.7203/sjp.24355

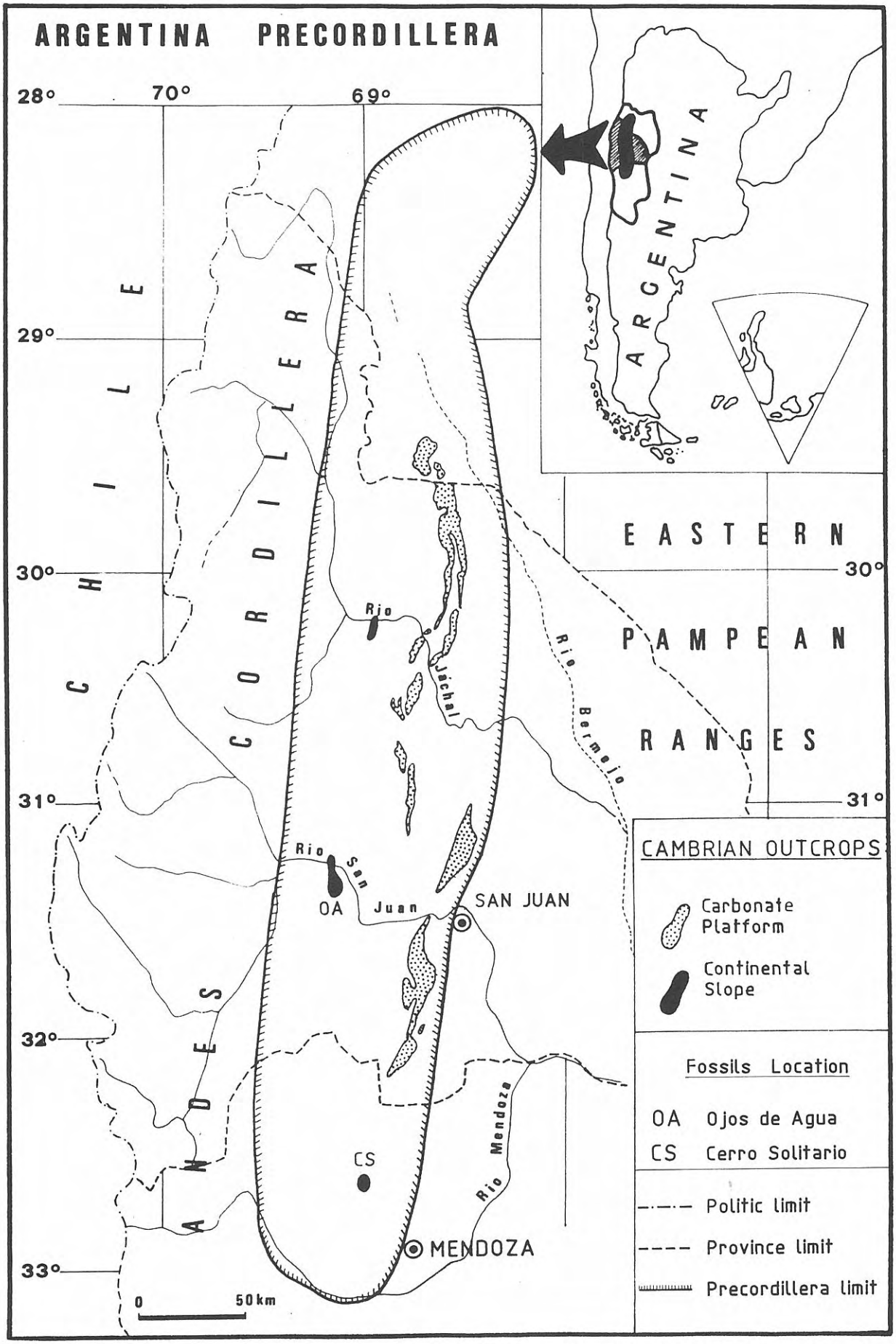


Figure 1. Geographical and geological setting of Cambrian outcrops of Precordillera Argentina. OA and CS, studied localities.

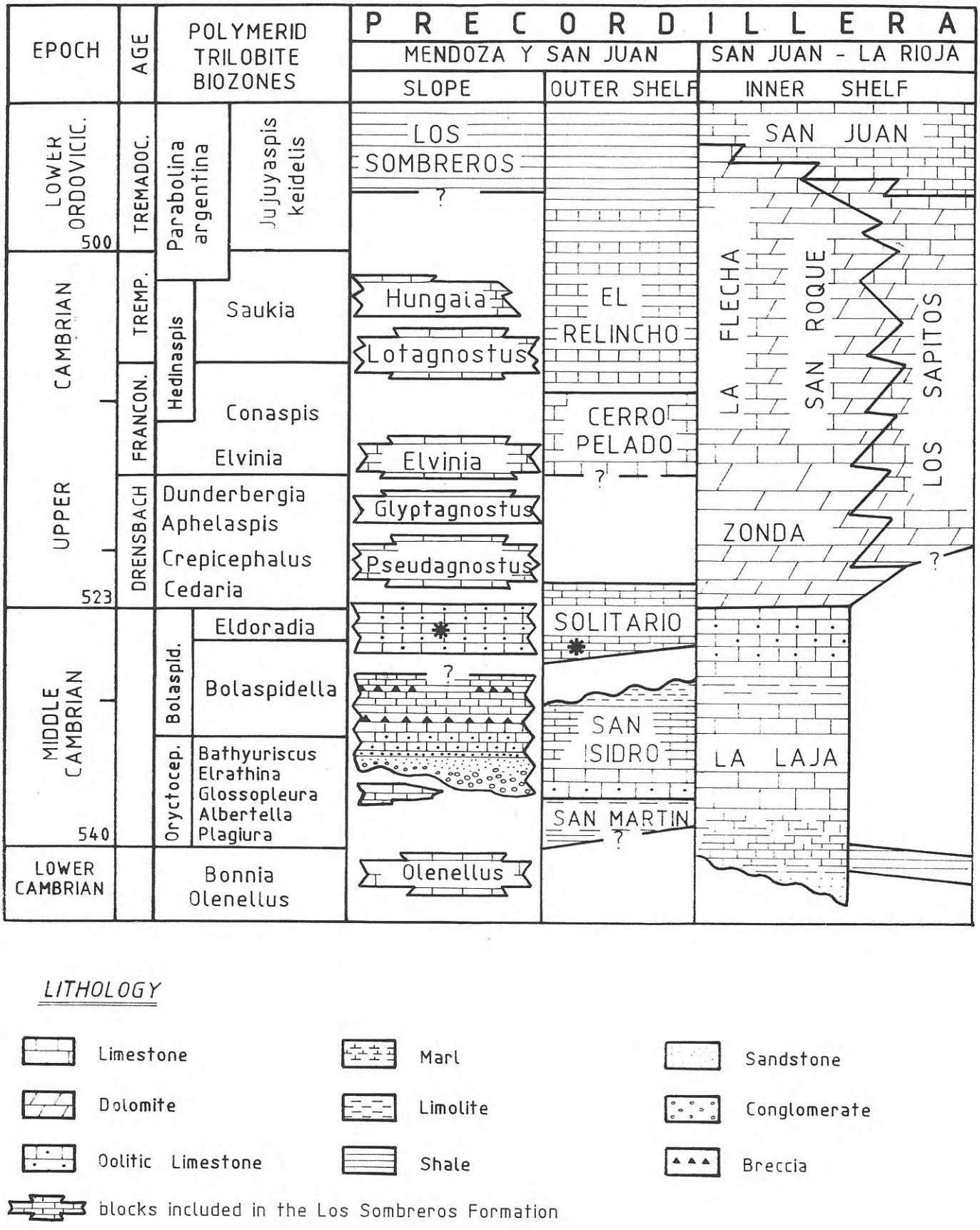


Figure 2. Cambrian stratigraphy of the Precordillera Argentina. In slope facies, the interrupted beds containing the names of the representative trilobite genera indicate allocthonous blocks within the Los Sombreros Formation. *Stratigraphical occurrence of studied fossils.

tion (Mendoza) and in the terrigenous-carbonate talus facies of the Los Sombreros Formation (San Juan).

The Solitario Formation is an isolated unit outcroping on a small hill from the Canota region located to the north of Mendoza. It contains thinly bedded black limestones and cacilimolites in a section about 20 m thick. A Late Middle Cambrian age was first assigned by Poulsen (1960) based on agnostoid and polimeroid trilobites. The new record of the agnostoids studied here confirms this age.

The Los Sombreros Formation is a thick sequence of almost one thousand meters outcroping on the eastern flank of the Tontal Range in the western Precordillera of San Juan. It contains a typical talus association of shale and thinly bedded limestone with olistolites, olistostromes, calcareous breccias and channel fill conglomerates. The sedimentation of this unit took place during the Ordovician, since the calcareous olistolites with Middle and Upper Cambrian trilobites are included within dark green shales with Early and Middle Ordovician graptolites (Cuerda *et al.*, 1983, 1986b).

SYSTEMATIC PALAEONTOLOGY

All material used in this study is identified as Bordonaro collection and its depository is in Paleontología Invertebrados, Universidad Nacional de San Juan (PIUNSJ), Argentina.

Descriptive terminology follows Harrington *et al.* (1959) and additional terms defined by Robison (1964, 1982) and Öpik (1967).

Order AGNOSTIDA Salter, 1864
Family **Agnostidae** M'Coy, 1849
Genus *Agnostus* Brongniart, 1822

Type species: *Entomostracites pisiformis* Wahlenberg, 1818.

Agnostus exsulatus Poulsen, 1960
Pl. I, Figs. 1-5

1960 *Agnostus exsulatus* Poulsen, 6, Pl. 1, Figs. 3-4.
1988 *Agnostus exsulatus* Poulsen; Robison, 32, Pl. 7, Figs. 4-11.
1982 *Agnostus exsulatus* Poulsen; Pratt, 26.

Material: A complete specimen, two cephala and four pygidia as external and internal casts (PIUNSJ 608-614).

Remarks: The new material possesses all the characters of Poulsen's species. The complete specimen has two thoracic segments poorly preserved. In the Argentine material of the species, the glabellar and pygidial furrows are deeper than in the specimens described by Robison (1988) from North Greenland.

Occurrence and age: Level 3, Solitario Formation, Canota, Mendoza. It is also found in North Greenland, where it is restricted to the upper *Lejopyge laevigata* Zone. Late Middle Cambrian age, *Lejopyge laevigata* Zone.

Agnostus? sp.
Pl. I, Figs. 6-7

Material: Internal and external casts of a cephalon (PIUNSJ 615-616).

Remarks: Cephalon semicircular, highly convex. Glabella wide, slightly convergent forward, deep lateral glabellar furrows and bulky glabellar lobes; the second glabellar furrow (F2) is curved forward, bordering a median node; trapezoidal basal lobes. Wide and deep preglabellar median furrow, effaced near the border furrow; border furrow wide and deep; cephalic border narrow. This specimen is certainly an *Agnostus*-like cephalon resembling *Agnostus exsulatus*, but wider.

Occurrence and age: Level 3, Solitario Formation, Canota, Mendoza. Late Middle Cambrian, *Lejopyge laevigata* Zone.

Family **Clavagnostidae** Howell, 1937
Genus *Clavagnostus* Howell, 1937

Type species: *Agnostus repandus* Westergård, in Holm & Westergård, 1930.

Remarks: Poulsen (1960) erected the genus *Stigmagnostus* with the only poorly preserved specimen known of ?*Tomagnostus canotensis* Rusconi, 1951. Öpik (1967) considered that this specimen is not a pygidium but that it is a cephalon of a clavagnostid, certainly of generic characters. Finally, Shergold *et al.* (1990) revised *Stigmagnostus* and placed it in *Clavagnostus*, with which we agree.

Clavagnostus canotensis (Rusconi, 1951)
Pl. I, Figs. 8-14

1951 ?*Tomagnostus canotensis* Rusconi, 14, Pl. 26, Fig. 29.
1952 *Culipagnostus chipiquensis* Rusconi, 11.
1952 ?*Triplagnostus chipiquensis* Rusconi, 11, Pl. 1, Fig. 11.
1960 *Stigmagnostus canotensis* (Rusconi); Poulsen, 15, Pl. 1, Fig. 12.
1960 *Clavagnostus chipiquensis* (Rusconi); Poulsen, 9, Pl. 1, Fig. 14.
1974 *Clavagnostus? rawlingi* Jago & Daily, 104, Pl. 12, Figs. 11-12.

Plate I

1-5 *Agnostus exsulatus* Poulsen. 1. Internal mold of cephalon. PIUNSJ 608, × 8.4. 2. Internal mold of pygidium. PIUNSJ 610, × 7.7. 3. Internal mold of complete dorsal exoskeleton. PIUNSJ 614, × 9.6. 4. External latex cast of pygidium. PIUNSJ 611, × 8.3. 5. Internal mold of pygidium. PIUNSJ 612, × 9.

6-7 *Agnostus?* sp. 6. External latex cast of incomplete cephalon. PIUNJS 615, × 10. 7. Internal mold of cephalon. PIUNSJ 616, × 7.6.

8-14 *Clavagnostus canotensis* (Rusconi). 8. Exoskeleton of complete pygidium. PIUNSJ 617, × 10. 9. Internal latex cast of small pygidium. PIUNSJ 618, × 12.8. 10. Internal mold of large pygidium. PIUNSJ 619, × 10. 11. Internal mold of pygidium. PIUNSJ 620, × 10. 12. Exoskeleton of cephalon. PIUNSJ 621, × 11. 13. Exfoliated exoskeleton of cephalon. PIUNSJ 622, × 10. 14. Internal mold of small cephalon. PIUNSJ 623, × 13.

15 *Baltagnostus?* sp. Exoskeleton of pygidium. PIUNSJ 624, × 12.2.

16-18 *Oedorhachis australis* Poulsen. 16. Fractured exoskeleton of cephalon. PIUNSJ 626, × 7.8. 17. Damaged exoskeleton of pygidium. PIUNSJ 627, × 7.5. 18. Exoskeleton of fragmentary pygidium with collar. PIUNSJ 628, × 10.

19 *Ammagnostus* sp. Exoskeleton of small cephalon. PIUNSJ 629, × 14.4.

Plate I

1

2

3

6

4

5

7

8

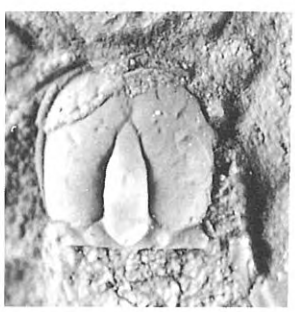
9

10

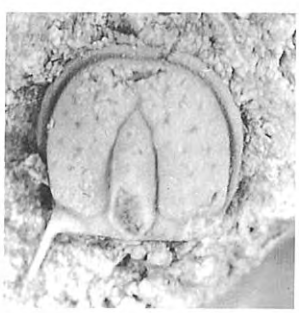
11

15

12



13



14

16

17

18

19

Material: Five cephala and two pygidia preserved as calcitic exoskeletons (PIUNSJ 617-623).

Description: Cephalon subrectangular and convex, anterior margin arched not pointed, anterior border narrow and convex, border furrow narrow; pitted genae with some radiating scrobicules touching the axial furrow. Preglabellar median furrow well defined near the anteroglabella, faint forward and effaced before touching the border furrow. Posteroglabella cylindrical, anteroglabella tapered, simple basal lobes but transversely elongate; posterior lobe faint, median node slightly forward of the mid-point of glabella. Posterior border wide and straight with long posterolateral spines.

Pygidium quadrangular, axial furrows deep, axis ogival, reaching the posterior furrow with buntly tapered rear; three well defined axial lobes with median tubercule in the median lobe; posteroaxis ogival, depressed, with two intranotular furrows bordering an intranotular ridge. Pleural field faintly convex, pitted and scrobiculate; marginal furrow narrow and shallow, curved forward in the axial area, touching the posteroaxis. Marginal border simple and narrow, maximum width at the axial area with two small posterolateral spines.

Size: The largest cephalon is 2.5 mm (sag.) long and 2.4 mm (tr.) wide. The largest pygidium is 2.5 mm (sag.) long and 3 mm (tr.) wide. The smallest pygidium is 0.7 mm (sag.) long and 1 mm (tr.) wide.

Ontogeny: The pit and scrobicules are present even in the junior specimen. All the inmature pygidia have a more rectangular shape than the adult ones. A junior specimen represented in Pl. I, Fig. 13 has a double preglabellar median furrow on the internal mold.

Discussion: *Clavagnostus canotensis* resembles to *Aspidagnostus stictus* Öpik, 1967 by its similar ornamentation, but differs in its generic characters. According to the new material studied here, *Clavagnostus? rawlingi* is considered as a junior synonymous of *C. canotensis.*

Occurrence and age: Levels 1 to 3 of Solitario Formation, Canota, Mendoza. Late Middle Cambrian, *Lejopyge laevigata* Zone.

Family **Diplagnostidae** Whitehouse, 1936

Genus *Baltagnostus* Lochman, 1944

Type species: *Proagnostus? centerensis*, Resser, 1938.

Baltagnostus? sp.

Pl. I, Fig. 15

Material: Internal and external cast of one pygidium (PIUNSJ 624-625).

Description: Pygidium subquadrangular, convex and smooth, wider than long; acrolobe unconstricted. Border possessing a pair of short and broad posterolateral spines; border furrow shallow and wide; axis wide and extended to the border furrow, rounded posteriorly, slightly constricted in the middle and with effaced segmentation. Median node large and placed in the anterior half of the axis, with a small secondary node on the tip of the axis.

Remarks: The only pygidium found is provisionally assigned to *Baltagnostus* due to the expansion of the marginal border between the spines. Our pygidium resembles *B. eurypyx* Robison, 1964 in its general outline, the posterior border and the spines, but differs in the position of median node that is placed at the mid-point of the axis in the North American species. *Ammagnostus beltensis* (Lochman in Lochman & Duncan, 1944) is similar to *Baltagnostus?* with regard to the pyriform shape of the axis and the position of the median and terminal nodes, but the North American specimens have a subcircular outline and the border is uniform in width.

Occurrence and age: Level 1a of Los Sombreros Formation, Ojos de Agua gulch, San Juan. It is placed within the *Lejopyge laevigata* Zone, late Middle Cambrian.

Genus *Oedorhachis* Resser, 1938

Type species: *Oedorhachis typicalis* Resser, 1938.

Oedorhachis australis Poulsen, 1960

Pl. I, Figs. 16-18

1960 *Oedorhachis australis* Poulsen, 13, Pl. 1, Fig. 8.

Material: One cephalon and two pygidia preserved as calcitic exoskeletons (PIUNSJ 626-628).

Description: Cephalon subquadrangulate, non-scrobiculate, moderately convex; border rounded and narrow; border furrow wide (deliquiate) and shallow. Glabella bilobate, slightly expanded forward, anteroglabella semicircular and wider than posteroglabella, transglabellar furrow straight and well defined, median node small in the middle posteroglabella; glabellar rear rounded; basal lobes simple and large. Pygidium semicircular, zonate border (collar) between the posterolateral spines, border furrow deliquiate and shallow, axial furrows faint, axis long and wide touching the posterior border furrow, slightly ogival; posteroaxis expanded, subsequently ending in a rounded point; axial node long occupying the anterior third.

Size: Cephalon 3.5 mm (sag.) long and 3.5 mm (tr.) wide. Pygidium 3.2 mm (sag.) long and 3.6 mm (tr.) wide.

Discussion: Poulsen (1960) created this species with only one pygidium that seems to be very closely related to *Oedorhachis typicalis* Resser, 1938; however *O. australis* differs by its less abruptly expanding posteroglabella and its less expanded posterior border that is divided by a longer transverse depression extending between the posterolateral spines. Nevertheless Robison (1988) did not consider those differences to be sufficient for a new species and therefore synonymized the two species.

The new material examined allowed a careful comparison between the cephalon and pygidium, and the following diffe-

---

Plate II

1-3 *Kormagnostus seclusus* (Walcott). 1. Damaged exoskeleton of cephalon. PIUNSJ 630, × 7.8. 2. Fractured exoskeleton of pygidium. PIUNSJ 631, × 10. 3a. Partially exfoliated exoskeleton of pygidium. PIUNSJ 632, × 8.5. 3b. Lateral view of 3a. × 9.

4-6 *Peronopsis tenuis* (Illing). 4. Incomplete partially exfoliated exoskeleton of cephalon. PIUNSJ 633, × 11. 5. Exoskeleton of incomplete pygidium. PIUNSJ 634, × 10. 6a. Exoskeleton of pygidium. PIUNSJ 635, × 8.5. 6b. Lateral view of 6a. × 10.

7-9 *Ptychagnostus aculeatus* (Angelin). 7. Internal mold of pygidium. PIUNSJ 637, × 4.9. 8. Internal mold of pygidium. PIUNSJ 638, × 5.1. 9. Detail of granules in latex cast of pygidium. PIUNSJ 639, × 16.

10-18 *Tomagnostella exsculpta* (Angelin). 10. Exoskeleton of a small cephalon. PIUNSJ 640, × 15.7. 11. Exoskeleton of a large cephalon. PIUNSJ 641, × 7.6. 12. Internal mold of cephalon. PIUNSJ 642, × 9.3. 13. Internal mold of cephalon. PIUNSJ 643, × 8. 14. Internal mold of cephalon. PIUNSJ 644, × 10. 15. Internal mold of cephalon. PIUNSJ 645, × 10. 16. Internal mold of cephalon. PIUNSJ 646, × 11.9. 17. Internal mold of a small pygidium. PIUNSJ 647, × 16.4. 18. Internal mold of a large pygidium. PIUNSJ 648, × 10.

Plate II

1

2

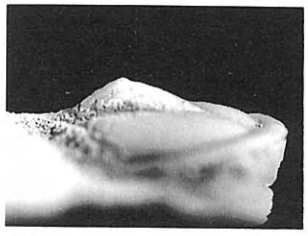
3a

3b

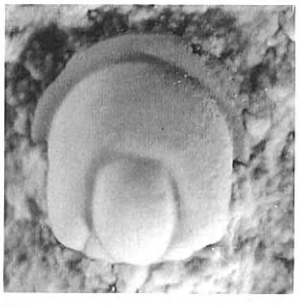
4

5

6a



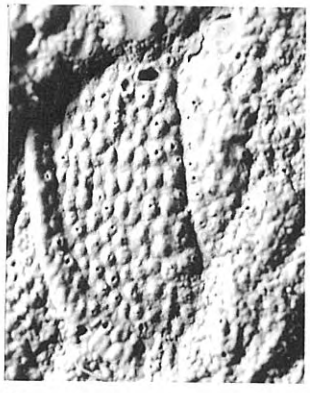
6b



10

7

8



9

11

12

13

14

15

16

17

18

rences are apparent: the cephalon of *O. typicalis* has a median pointed anterior margin, a more forwardly expanded glabella, a wider anteroglabella and a scrobiculate genae, characters that are not present in *O. australis*; the pygidium of *O. typicalis* has a posterior border more expanded in axial line and an increasing axial gap between the collar and the posterior border. *O. australis* has a gap and uniform posterior border. Also the posteroglabella is more expanded and round in *O. typicalis*.

Therefore we consider *O. australis* a valid species as it is here revised.

Occurrence and age: Level 1, Solitario Formation, Canota, Mendoza. Late Middle Cambrian age. It is presently restricted to *Lejopyge laevigata* Zone.

Family **Peronopsidae** Westergård, 1946
Genus *Ammagnostus* Öpik, 1967

Type species: *Ammagnostus psammius* Öpik, 1967.

Ammagnostus sp.
Pl. I, Fig. 19

Material: Only one cephalon, preserved as a calcitic exoskeleton (PIUNSJ 629).

Remarks: This single cephalon is similar those identified by Poulsen (1960) in Solitario Hill as *Baltagnostus hospitus* and *Baltagnostus mendozensis* which were attributed by Robison (1988) to *Ammagnostus beltensis*, a species also recorded in the upper Middle Cambrian from North Greenland (cf. Robison, op. cit.). But due to the presence in our cephalon of a bulky glabella, the more cautious approach is to leave it under open nomeclature.

Occurrence and age: Level 1 of the Solitario Formation, Canota, Mendoza, *Lejopyge laevigata* Zone.

Genus *Kormagnostus* Resser, 1938

Type species: *Kormagnostus simplex* Resser, 1938.

Kormagnostus seclusus (Walcott, 1884)
Pl. II, Figs. 1-3

1988 *Kormagnostus seclusus* (Walcott); Robison, 45, Pl. 11, Figs. 5-15 (with previous synonymy).

Material: One cephalon and two pygidia preserved as calcite exoskeletons (PIUNSJ 630-632).

Remarks: As was noted by Robison (1988), *K. seclusus* populations, exhibit exceptional variation in outline and convexity of the pygidial axis and morphological changes also occurred during ontogeny. In our large specimens the axis is well expanded and voluminous rearward, the posterior axial furrow is effaced, the pygidial border is wide and slightly convex; while in specimens of intermediate size the pygidial axis has parallel sides and is less tumid; the pygidial border is wider and flatter.

Occurrence and age: Levels 1a and 1b of Los Sombreros Formation, Ojos de Agua gulch, San Juan. Our specimens were found in the *Lejopyge laevigata* Zone.

Genus *Peronopsis* Hawle & Corda, 1847

Type species: *Battus integer* Beyrich, 1845.

Peronopsis tenuis (Illing, 1916)
Pl. II, Figs. 4-6

1988 *Peronopsis tenuis* (Illing); Robison, 47, Pl. 10. Figs. 7, 8, 10-12 (with previous synonymy).

Material: One cephalon and three pygidia preserved as calcite exoskeletons (PIUNSJ 633-636).

Remarks: The posteroaxis is sharply pointed and the back is depressed with a pronounced down sloping profile; the median node is located a little forward to the middle of the axis and a secondary median node is present near the tip of the posteroaxis. In the Argentine material, the anterior glabellar furrow is straighter and deeper than in the Greenland specimens.

Occurrence and age: Level 1a of the Los Sombreros Formation, Ojos de Agua gulch, San Juan. The material found belongs to the *Lejopyge laevigata* Zone.

Family **Ptychagnostidae** Kobayashi, 1939
Genus *Ptychagnostus* Jaekel, 1909

Type species: *Agnostus punctuosus* Angelin, 1851.

Ptychagnostus aculeatus (Angelin, 1851)
Pl. II, Figs. 7-9

1984 *Ptychagnostus aculeatus* (Angelin); Robison, 14, Pl. 8 (with previouys synonymy).

Material: Three pygidia preserved as internal and external casts (PIUNSJ 637-639).

Remarks: The pygidium is covered with prominent granules of uneven size that are widespread both on pleural field and on the axis. The exoskeleton is mostly flattened and deformed. This typical morphology is characteristic of *P. aculeatus* and this is the first reference in Argentina.

Occurrence and age: Level 1, Solitario Formation. Canota, Mendoza. *Lejopyge laevigata* Zone.

Genus *Tomagnostella* Kobayashi, 1939

Type species: *Agnostus exsculptus* Angelin, 1851.

Tomagnostella exsculpta (Angelin, 1851)
Pl. II, Figs. 10-18

1988 *Tomagnostella exsculpta* (Angelin); Robison, 51, Pl. 12, Figs. 8-12 (with previous synonymy).

Material: Twenty nine cephala and eleven pygidia preserved as external and internal casts (PIUNSJ 640-650).

Remarks: The cephalic and pygidial characters of the Argentine material agree well with the species *T. exsculpta* as was described by Robison (1988). The only observed difference is the steepness of the marginal cephalic border attributed here to a degree of crushing. Some of our specimens have the anterior transglabellar furrow deeper and straighter, although in other specimens the furrow is effaced and curved, similar to the specimen from Greenland. The specimens of Pl. II, Figs. 12 and 14 have the anterior axial furrow less effaced, with an obsolescent anterior lobe.

Occurrence and age: Levels 1 to 3 of Solitario Formation, Canota, Mendoza. In Argentina it occurs in the *Lejopyge laevigata* Zone, upper Middle Cambrian.

AGE OF THE FAUNA

The trilobites from San Juan are found within an olistostrome of the Los Sombreros Formation where we have distinguished two fossiliferous levels (Fig. 3).

The agnostid horizon 1a contains an assemblage of *P. tenuis, K. seclusus* and *Baltagnostus?* sp. The first mentioned species has a stratigraphic range from the

Ptychagnostus gibbus Zone (mid Middle Cambrian) to the *Lejopyge laevigata* Zone (upper Middle Cambrian), while *K. seclusus* has an observed stratigraphic range (Robison, 1988) from at least the lower *Lejopyge laevigata* Zone to the *Glyptagnostus stolidotus* Zone (Late Cambrian). Therefore this assemblage belongs to the *Lejopyge laevigata* Zone. This may be corroborated by the presence of *Baltagnostus?*, a genus that is a useful index for the late Middle Cambrian (Robison, 1964). The level 1b only has *K. seclusus*. Its stratigraphical proximity to the last level suggests a similar upper Middle Cambrian age for it.

The studied fauna from Mendoza comes from three stratigraphic levels distributed within the Solitario Formation (Fig. 3).

Level 1 contains *P. aculeatus, T. exsculpta, Ammagnostus* sp., *C. canotensis* and *O. australis*. The first mentioned species is reported from the upper two-thirds of the *L. laevigata* Zone; however, most occurrences seem to be correlated with the upper half of the lower subzone (Robison, 1984). Therefore a *L. laevigata* Zone is also proposed for this assemblage. The stratigraphical range of *T. exsculpta* (*Ptychagnostus punctuosus-Lejopyge laevigata* zones) and *Ammagnostus* (*L. laevigata-Glyptagnostus stolidotus* zones) are not inconsistent with this proposed age. Consequently, the local species *O. australis*, only recorded in this level, may be from the *L. laevigata* Zone.

Level 3 contains *A. exsulatus, C. canotensis, T. exsculpta* and *Agnostus?* sp. The first agnostoid species is known only from the upper *L. laevigata* Subzone in North Greenland but additional findings are probably necessary before *A. exsulatus* can be used as a biostratigraphical index. However, the presence of *T. exsculpta* suggests a *L. laevigata* Zone. Therefore, the local species *S. canotensis*, present in the three levels, may be a representative agnostoid of the *L. levigata* Zone from Argentina.

Although the material from both the localities belongs to the same zone, it is impossible to achieve a more detailed correlation due to the absence of common taxa, as well as to the provenance from allochthonous blocks of the San Juan agnostoids.

ACKNOWLEDGMENTS

We are grateful to Prof. Robison from the University of Kansas, Drs. Grant (Uppsala University), Rabano (CSIC, Madrid), Shergold (AGSO, Canberra), and Arbizu and Martínez Chacón (Oviedo University), for the revision and commentaries to the original manuscript. Thanks to Antonio Plou for help us with the photos and Martina Acena for the english text. This work has been carried out during a sabbatic stay of Osvaldo Bordonaro in the University of Zaragoza with the permission of CONICET-CRICYT (Argentina), and was supported by the Spanish "Dirección General de Investigación Científica y Técnica" (DGICYT. SAB 92-0084).

BIBLIOGRAPHY

Angelin, N. P. 1851. *Palaeontologia Suecica*, pars 1, *crustaceorum formationis transitionis*. Stockholm, 1-24.

Baldis, B. y Bordonaro, O. 1985. Variaciones de facies en la cuenca cámbrica de la Precordillera Argentina, y su relación con la génesis del borde continental. *Sexto Congreso Latino-Americano de Geología,* **1**, 149-161. Bogotá, Colombia.

Benedetto, J. L., Vaccari, N. E. y Herrera, Z. 1986. El hallazgo de rocas cámbricas fosilíferas al oeste de Jáchal, provincia de San Juan. *Actas IV Congreso Argentino de Paleontología y Bioestratigrafía,* **1**, 29-30.

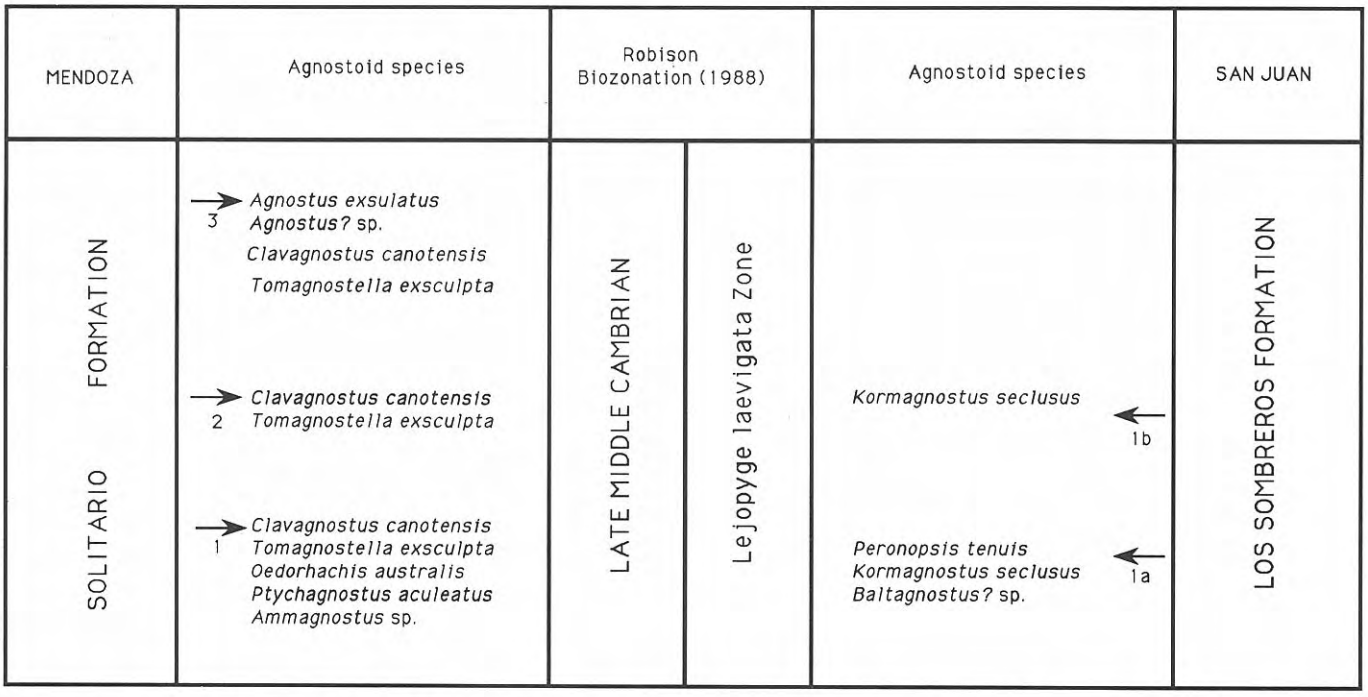


Figure 3. Bio and chnostratigraphical scheme of the agnostoid assemblages studied here. The San Juan fossils are from the same allocthonous block.

Beyrich, E. 1845. *Über einige böhmischer Trilobiten*, 47 p., 1 pl. Berlin.

Bordonaro, O. 1992. El Cámbrico de Sudamérica. In: *Paleozoico inferior de Ibero-América* (Eds. J. C. Gutiérrez-Marco, J. Saavedra y I. Rábano). Madrid, 69-84.

Bordonaro, O. y Banchig, A. 1990. Nuevos trilobites del Cámbrico medio en la Quebrada Ojos de Agua, Sierra de Tontal, San Juan, Argentina. *Actas V Congreso Argentino de Paleontología y Bioestratigrafía, Correlación Geológica,* **7**, 31-38.

Brogniart, A. et Desmarest, A. G. 1822. *Histoire naturelle des crustacés fossiles, sous les rapports zoologiques et géologiques. Savoir: Les Trilobites.* F. G. Levrault, Paris, 154 p., 11 pls.

Cuerda, A., Cingolani, C. y Varela, R. 1983. Las graptofaunas de la Formación Los Sombreros, Ordovícico inferior de la vertiente oriental de la Sierra del Tontal, Precordillera de San Juan. *Ameghiniana,* **30** (3-4), 239-260.

Cuerda, A., Cingolani, C., Varela, R. y Schauer, O. 1986a. Cámbrico y Ordovícico en la Precordillera de San Juan: Formación Los Sombreros. Ampliación de su conocimiento bioestratigráfico. *Actas IV Congreso Argentino de Paleontología y Bioestratigrafía,* **1**, 5-17.

Cuerda, A., Cingolani, C., Varela, R. y Schauer, O. 1986b. Bioestratigrafía del Ordovícico (Llanvirniano-Llandeiliano) de la Sierra del Tontal, Precordillera de San Juan. Descripción de su fauna graptolítica. *Ameghiniana,* **23**, 3-33.

Harrington, H. J., Moore, R. C. and Stubblefield, C. J. 1959. Morphological terms applied to trilobita. In: *Treatise on Invertebrate Palaeontology* (Ed. R. C. Moore). O. The University of Kansas Press and the Geological Society of America, 117-126.

Hawle, I. und Corda, A. J. C. 1847. Prodrom einer Monographie der bohmischen Trilobiten. *Abhandlungen der Konigliche Bohmischen Gesellschaft Wissenschaften,* **5**, 121-292, pls. 1-7.

Holm, G. und Jaekel, O. 1909. Über die Agnostiden. *Zeitschrift der Deutschen Geologischen Gesellschaft,* **61** (4), 380-400.

Holm, G. and Westergård, A. H. 1930. A Middle Cambrian fauna from Bennett Island. *Zapiski Akademii Nauk Soyuza SSR, po Otdeleniyu Fiziko-Matematicheskikh Nauk,* **21** (8), 1-25, pls. 1-4.

Howell, B. F. 1937. Cambrian Centropleura vermontensis fauna of northwestern Vermont. *Geological Society of America Bulletin,* **48**, 1147-1210.

Illing, V. C. 1916. Paradoxidian fauna of the Stockingford Shales. *Quarterly Journal of the Geological Society London,* **71**, 386-450.

Jaekel, O. 1909. Über die Agnostiden. *Zeitschrift der Deutschen Geologischen Gesellschaft,* **61** (4), 380-400.

Jago, J. B. and Daily, B. 1974. The trilobite *Clavagnostus* Howell from the Cambrian of Tasmania. *Palaeontology,* **17** (1), 95-109.

Kobayashi, T. 1939. On the Agnostids (Part I). *Journal of the Faculty of Science, Imperial University of Tokyo, Section II,* **5** (5), 69-198.

Lochman, C. and Duncan, D. 1944. Early Upper Cambrian faunas of central Montana. *Special Papers of Geological Society of America,* **54**, 1-181.

M'Coy, F. 1849. On the classification of some British fossil Crustacea with notices of some new forms in the University collection at Cambridge. *Annals and Magazine of Natural History, Series 2,* **4**, 161-179, 330-335, 392-414.

Öpik, A. A. 1967. The Mindyallan fauna of North Western Queensland. *Bureau of Mineral Resources, Geology and Geophysics. Bulletin,* **74** (1-2), vol. 1, 1-404, vol. 2, 1-167.

Poulsen, C. 1960. Fossils from the late Middle Cambrian Bolaspidella Zone of Mendoza, Argentina. *Matematisk-fysiske Meddelelser Det Kongelige Danske Videnskabernes Selskab,* **32**, 1-42.

Pratt, B. R. 1992. Trilobites of the Marjuman and Steptoean Stages (Upper Cambrian), Rabbitkettle Formation, southern Mackenzie Mountains, northwest Canada. *Palaeontographica Canadiana,* **9**, 1-179.

Resser, C. E. 1938. Cambrian System (restricted) of the southern Appalachians. *Geological Society of America, Special Paper,* **15**, 140 p.

Robison, R. A. 1964. Late Middle Cambrian faunas from western Utah. *Journal of Paleontology,* **38** (3), 510-566.

Robison, R. A. 1982. Some Middle Cambrian agnostoid trilobites from Western North America. *Journal of Paleontology,* **56** (1), 132-160.

Robison, R. A. 1984. Cambrian Agnostida of North America and Greenland. Part 1, Ptychagnostidae. *The University of Kansas Paleontological Contributions,* **109**, 1-59.

Robison, R. A. 1988. Trilobites of the Holm Dal Formation (late Middle Cambrian), central North Greenland. In Stratigraphy and Palaeontology of the Holm Dal Formation (late Middle Cambrian) central North Greenland (Ed. J. S. Peel). *Meddelelser om gronland, Geosciences,* **20**, 23-103.

Rusconi, C. 1950a. Trilobitas y otros organismos del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza,* **4**, 71-84.

Rusconi, C. 1950b. Nuevas trilobitas y otros organismos del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza,* **4**, 85-94.

Rusconi, C. 1951. Más trilobitas cámbricas de San Isidro, Cerro Pelado y Canota. *Revista del Museo de Historia Natural de Mendoza,* **5**, 3-30.

Rusconi, C. 1952. Varias especies de trilobitas del Cámbrico de Canota. *Revista del Museo de Historia Natural de Mendoza,* **6**, 5-17.

Salter, J. W. 1864. A monograph of the British trilobites from the Cambrian, Silurian and Devonian formations. *Monograph of the Palaeontographical Society*, 1-80, pls. 1-6.

Shergold, J., Laurie, J. R. and Sun Xiaowen. 1990. Classification and review of the trilobite order Agnostida Salter, 1864: an Australian perspective. *Bureau of Mineral Resources of Australia*, Report, **296**, 1-92.

Vaccari, N. E. y Bordonaro, O. (en prensa). Trilobites en los olistolitos cámbricos de la Formación Los Sombreros (Ordovícico), Precordillera de San Juan, Argentina. *Ameghiniana.*

Walcott, C. D. 1884. The Paleontology of the Eureka district, Nevada. *Monograph of the U.S. Geological Survey,* **30**, 1-369.

Wahlenberg, G. 1818. Petrificata Telluris Svecanae. *Nova Acta Regiae Societatis Scientiatum Upsaliensis,* **8**, 1-116, pls. 1-4.

Westergård, A. H. 1946. Agnostidea of the Middle Cambrian of Sweden. *Sveriges Geologiska Undersökning*, Ser. C, **477**, 1-141.

Whitehouse, F. W. 1936. The Cambrian faunas of northeastern Australia. Parts 1 and 2. Memoirs of the Queensland Museum, **11** (1), 59-112, pls. 8-10.

Manuscrito recibido: 8 de octubre, 1992
Manuscrito aceptado: 15 de junio, 1993