INTRODUCTION

During the Silurian, in the Central Andean Basin (Fig. 1.1), that extends from Peru to North-western Argentina (Benedetto et al., 1992), a thick and fossiliferous, siliciclastic succession was deposited, which appears nowadays deformed and dismembered due to the Andean tectonics. In North-western Argentina, the most important outcrops of this succession are those from the Zapla and Santa Barbara ranges, especially the ones from the Subandean Range, especially the ones from the Zapla and Santa Barbara ranges, in Jujuy and Salta provinces.

In the Zapla range (Fig. 1.2), the main lithostratigraphic units are Zapla Formation (Schlagintweit, 1943) and Lipeón Formation (Turner, 1960) while at Santa Barbara range, the correlative lithostratigraphic units are...
Cachipunco Formation (Padula et al., 1967) and Arroyo Colorado (Andrey et al., 1982).

Zapla Formation is composed mainly by argillaceous sandstones, which present disperse quartz clasts; sandstones and diamictits. It may reach up to 100 m in thickness and it was originally referred to the Llandoverian, based on stratigraphic correlation (Antelo, 1973; Cuerda & Antelo, 1973). Notwithstanding, more recent works (Monaldi & Boso, 1987; Astini et al., 2004; Rubinstein, 2005; de La Puente & Rubinstein, 2007; Rubinstein et al., 2007) reassigned it to the Ordovician due to the finding of Dalmatina at the top of the unit. Lipeón Formation comprises a monotonous succession, between 600 and 1,600 metres in thickness, of siltstones and fossiliferous sandstones. According to Andreis et al. (1982), it formed in an extern marine platform, beneath the wave base level. Benedetto et al. (1992) gave this formation a Llandovery-Pridolian age, but Rubinstein & Toro (2006) assigned it to the Llandovery-Ludlow based on the palynomorphs and graptolites content.

The stratigraphy of Silurian-Devonian rocks in the Santa Bárbara range has been described in several publications (e.g., Padula et al., 1967; Mingramm & Russo, 1972; Antelo, 1978; Mingramm et al., 1979; Moreno Espeleta et al., 1981; Pezzi & Mozetic, 1990; Vistalli, 1990; Starck, 1995; Aceñolaza et al., 2000; Astini et al., 2004).

In outline, Cachipunco Formation comprises a succession of laminated black shales, rich in fossils and pyrite, interstratified with quartzitic sandstones. It is partially equivalent to Lipeon Formation, with a greater participation of sandstones. According to Mingramm et al. (1979) it would have been deposited in a sublitoral marine environment. This unit was proposed by Padula et al. (1967) grouping the “piso Z1” of Hagerman (1933) and Bellmann’s “Gotlandico” (1962).

The fossil content of these rocks, mainly invertebrates and palynomorphs, has been extensively studied (Baldis, 1972; Antelo, 1978; Bultynck & Martin, 1982; Sánchez, 1990; Rubinstein, 1997, 2003; Grahn & Gutiérrez, 2001; Rubinstein & Toro, 2006).

The aim of the present paper is to discuss the palynological content (acritarchs, prasinophyceae and spores), from the Cachipunco Formation, in the Santa Bárbara range (South-eastern Jujuy Province; Fig. 1.2).

Fig. 1. 1, Map showing the location of the Silurian Central Andean Basin in South America (Modified from Benedetto et al., 1992). 2, Geological Map of Santa Barbara Range.
GEOLOGICAL SETTING AND BIOSTRATIGRAPHY

The palynological samples were collected from two different sections both corresponding to the Cachipunco Formation: Angosto Los Pereyras and Cumbre Los Pereyras (Fig. 1.2). The area is located approximately 150 km to the Southeast of San Salvador de Jujuy, Jujuy Province.

Angosto Los Pereyras

Angosto Los Pereyras is located to the North of the Arroyo Colorado and to the East of Santa Clara City. At this location, Cachipunco Formation comprises 273 meters of micaceous, dark-grey to yellow siltstones without visible base or top (Fig. 2.1). These siltstones, which are bioturbated, are intercalated with thin beds of light-grey, micaceous, argillaceous fine sandstones.

Cumbre Los Pereyras

This section is located near 8 kilometers to the north of Angosto Los Pereyras. It comprises 135 meters of siltstones and sandstones, of similar characteristics of those from Angosto Los Pereyras, but with a larger proportion of sandstones than in the latter (Fig. 2.2).

Biostratigraphy

Cachipunco Formation was originally referred to the Early Devonian due to the presence of macrofloristic remains (see Padula et al., 1967, Mingramm et al., 1979). Subsequently, was transferred to the Middle-Late Silurian (Baldis, 1972; Antelo, 1978; Vistalli, 1990), and more recently, Grahn & Gutiérrez (2001), assigned it a Late Llandoverian Early Pridolian age, based on the analysis of the chitinozoa content of the unit.

MATERIALS AND METHODS

Forty palynological samples were collected from the Cachipunco Formation, 30 of which were found to be productive. Samples were processed using palynological HCl-HF-HCl acid maceration techniques (see Wood et al., 1996). Slides were examined using light microscopy and scanning electronic microscopy.

Light photomicrographs were taken on an Olympus BX-51 microscope using an Olympus C-5000 digital camera, while the scanning micrographs were taken on Philips XL-30 at 20 kV. All figured material is housed in the collection of the MACN (Museo Argentino de Ciencias Naturales “B. Rivadavia”) under the prefixes BA Pal (Buenos Aires, Palynology). The specimen locations are referred using England Finder coordinates.

The preservation state of the material is quite bad, being the majority of specimens fragmented, often impregnated with pyrite and most of them showing signs of corrosion. Such situation made difficult the assignment of same palynomorphs.

For identification purposes, different measures were taken, as referred on the systematic section. Abbreviations of such measures are as follows: V∅ = Diameter of the vesicle; VW = Width of the vesicle; VL = Length of the vesicle; VT = Total length of the vesicle (including processes); PL = Length of the processes; PN = Number of processes; PØ = Diameter of the processes; P∅B = Diameter of the bases of the processes; P∅D = Diameter of the distal end of the processes; PL/V∅ = Length of the processes/vesicle diameter ratio; VW/VL = Vesicle width/vesicle length ratio; VW/VT = Vesicle width/vesicle total length ratio; ∅ = Diameter (for spores); Cw = Cingule width; Zw = Zone width. Such measures are presented in the format N1 (N2) N3, where N1 and N3 represent the minimum and the maximum value measured respectively, and N2 the mean for all the specimens evaluated. The number of specimens measured appears between brackets. In the Synonym and Distribution sections it is included primarily the material described for Argentina. For the graphic showing vertical and percentage distributions (Figs. 3 and 4) there where counted between 200 and 300 palynomorphs per slide.

SYSTEMATICS

Group ACRITARCHA Evitt 1963

Genus Ammonidium Lister 1970

Type species: Ammonidium microcladum (Downie) Lister 1970.

Ammonidium ludloviense (Lister) Dorning 1981 (Fig. 3.1)

1987 Ammonidium rigidum (aff.) var. ludloviense Lister; Pöthe de Baldis: 90, pl. I, fig. 1.

1993 Ammonidium rigidum var. ludloviense Lister; Rubinstein: 70.

1998 Ammonidium waldronense (Tappan & Loeblich) Dorning; Pöthe de Baldis: 6, pl. I, figs. 7-8.

Dimensions. V∅ = 20(25)/30 µm, PL = 4(5)/6 µm, P∅B = 2 µm, P∅D = 1 µm, PL/V∅ = 0.2, Eylima, 0.5 µm (2 specimens measured).
Remarks. *Ammonidium rigidum* (Deunff) var. *ludloviense* Lister as described and illustrated by Pöthe de Baldis (1987) it corresponds to the species described here due to the length and shape of its processes and the vesicle diameter. The specimen described by Pöthe de Baldis (1998) as *A. waldronense* (Tappan & Loeblich) Dorning is here reassigned to *A. ludloviense* owing to the length of its processes (3.5 µm). According to Tappan & Loeblich (1971) the length for *A. waldronensis* processes is between 5-10 µm.

Ammonidium sp. cf. *A. waldronense* (Tappan & Loeblich) Dorning 1981 (Fig. 3.2)

1987 *Caiacorymbifer* cf. *waldronis* Tappan & Loeblich; Pöthe de Baldis: pl. 1, fig. 8.

Description. Vesicle spherical, hollow, single-walled. Eylima thin (0.5 mm). Numerous processes (near 30 visible), hollow and freely communicated with the vesicle interior. Processes
tapered into distally equifurcate terminations. No excystment method observed.

**Dimensions.** $V\varnothing = 22(24.5)27$ $\mu$m, $PL = 8(9)10$ $\mu$m, $P\varnothing B = 1.5-2$ $\mu$m, $P\varnothing D = 1$ $\mu$m, $PL/V\varnothing = 0.3(0.37)0.4$ (5 specimens measured).

**Remarks.** These specimens are assigned to Ammonidium cf. waldronense (Tappan & Loeblich) Dorning since the number of processes is not as high as it is in the holotype (more than 40; Tappan & Loeblich, 1971) and no assessment of the vesicle ornamentation can be made due to the bad preservation state of the material. The material illustrated by Pöthe de Baldis (1987) as Caiacorymbifer cf. waldronis (sic) might be considered to be co-specific with the one described here, based on the processes characteristics and the relationship processes length/vesicle diameter (0.37 in Pöthe de Baldis 1987).

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**Ammonidium sp. A**

(Fig. 3.3)

**Description.** Vesicle spherical, hollow, with few (between 3-7), hollow, open-to-vesicle-interior, slightly tapering processes. Processes equifurcate distally into 3-5 spines. No excystment method observed.

**Dimensions.** $V\varnothing = 22(24)26$ $\mu$m, $PL = 12(16)20$ $\mu$m, $P\varnothing B = 2$ $\mu$m (2 specimens measured).

**Remarks.** Owing to the ramification pattern that presents this specimen, we assigned it to the genus Ammonidium. A more accurate assignment could not be made due to the bad preservation of the material.

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**Genus Barathrisphaeridium** Wicander 1974

**Type species:** Barathrisphaeridium chagrinense Wicander 1974.

**Barathrisphaeridium? sp. A**

(Fig. 3.4)

**Description.** Vesicle spherical in outline, evenly covered with numerous (near 25) slender, flexible, relatively short, homomorphic, and acuminate processes. Processes are solid and do not communicate with vesicle interior. Excystment by rupture of the vesicle wall.

**Dimensions.** $V\varnothing = 25(28.3)33$ $\mu$m, $PL = 7(9.6)13$ $\mu$m, $P\varnothing B = 1(1.2)2$ $\mu$m, $P\varnothing D = 0.5$ $\mu$m (7 specimens measured).

**Remarks.** The bad state of preservation of the material does not allow the nature of the wall structure to be observed; therefore the species are doubly assigned to this genus. The specimens described by Rubinstein for Los Espejos Formation (Rubinstein, 1992b) as Barathrisphaeridium? sp. have significantly shorter processes.

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**Genus Barbestiastra** Sarjeant & Stancliff 1994

**Type species:** Barbestiastra barbata (Downie) Sarjeant & Stancliffe 1994.

**Barbestiastra barbata** (Downie) Sarjeant & Stancliffe 1994

(Figs. 3.5, 7.5)

1971 Estiastra cf. barbata Downie; Pöthe de Baldis: 286, pl. 1, fig. 7.
1975a Estiastra aff. barbata Downie; Pöthe de Baldis: 494, pl. V, figs. 2, 5.

**Dimensions.** $T = 77(87.25)94$ $\mu$m, $PL = 20(25)31$ $\mu$m; 8 to 10 conical processes (4 specimens measured).

**Remarks.** The material described by Pöthe de Baldis (1971, 1975a) and doubtfully assigned to Estiastra barbata Downie is considered to be co-specific with the specimens characterized here because both of them display similar features, in shape and ornamentation patterns.

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**Genus Cymbosphaeridium** Lister 1970

**Type species:** Cymbosphaeridium bikidum Lister 1970.

**Cymbosphaeridium sp. A**

(Fig. 3.7)

**Description.** Vesicle roughly spherical, dark-coloured, probably double-walled, with 10 transparent, hollow, columnar, flexible processes. Distal ends are open and present aculeate tips. No excystment method observed.

**Dimensions.** $V\varnothing = 47$ $\mu$m, $P\varnothing = 4-6$ $\mu$m, $PL = 17$ $\mu$m, $PN = 7$ (1 specimen measured).

**Remarks.** Cymbosphaeridium pilar (Cramer) Lister (1970) has a granulate vesicle and cauliflorate branching at the tips.

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**Genus Diexallophasis** Loeblich emend. Sarjeant & Vavrdová 1997

**Type species:** Diexallophasis remota (Deunff) Playford 1977.
**Diexallophasis denticulata** (Stockmans & Willière) Loeblich 1970
(Fig. 3.118)

1997a *Diexallophasis cf. remota* (Deunff) Playford; Pöthe de Baldis: 41, pl. II, fig. 5.

1997b *Diexallophasis remota* (Deunff) Playford; Pöthe de Baldis: 468, pl. I, fig. 15.

**Dimensions.** V∅ = 21(29.1)35 µm, PL = 18(25.7)32 µm, P∅B = 4(4.6)6 µm, P∅D = 1(1.4)2 µm (26 specimens measured).

**Remarks.** Specimens observed here present different degrees of deformation due to folds in its wall. *Diexallophasis denticulata* and *D. remota* (Deunff) Playford (1977) have been considered by several authors (Playford, 1977; Sarjeant & Vavrdova, 1997) to be synonyms. Mullins (2002) maintained them as separated species, hinged on the characteristics of the processes, being broader-based and more robust in *D. remota*, and the ornamentation of the vesicle, which is micropunctate to foveolate in *D. denticulata*. Additionally to this, we consider *D. remota* to have a distinct sub polygonal vesicle, and more processes than *D. denticulata*. Therefore, we consider them to be different species.

The specimens described as *D. cf. remota* (Deunff) Playford by Pöthe de Baldis (1997a), clearly presents all the distinct characteristics of *D. denticulata*, a globular vesicle with few processes arising from it, so we reassign them herein. In the same way, the material illustrated by Pöthe de Baldis (1997b), depict similar characteristics to those of *D. denticulata*, a spherical vesicle, with 4-5 long processes, and therefore is reassigned to that species. Probably, the material described by Rubinstein (1997) as *Evitia denticulata denticulata* (Cramer) Le Héréssé, also corresponds to *D. denticulata*, since both present similar vesicle and processes characteristics.

**Diexallophasis remota** (Deunff) Playford 1977
(Fig. 3.8)

**Dimensions.** V∅ = 22(28.2)36 µm, PL = 20(27.7)37 µm, P∅B = 3(3.9)5 µm, P∅D = 0.5-1.5 µm; 7-13 processes (20 specimens measured).


**Diexallophasis sp. A** (Figs. 3.9, 7.1)

2000 *Exochoderma?* sp. aff. *E. arca* Wicander & Wood; Pöthe de Baldis: 332, pl. 3, fig. H.

**Description.** Vesicle quadrangular in outline, with straight sides. Eylima single-layered, laevigate to slightly granulate. One process developed at each corner, and one arising from the centre face of vesicle. Processes (4-6 in total) are hollow and communicate freely with the vesicle interior. They are ornamented with grana or small spines, and very lightly costate. Distally ended in a simple, closed, pointed tip. Some processes are truncated. Excystment method not observed.

**Dimensions.** V∅ = 24(28.3)31 µm, PL = 16(26)34 µm, PN = 5-7, P∅B = 5(5.3)7 µm, P∅D = 1(1.4)2 µm (16 specimens measured).

**Remarks.** The material described by Pöthe de Baldis (2000: *Exochoderma* sp. aff. *E. arca* Wicander & Wood) for Los Espejos Formation is considered to be co-specific with *Diexallophasis* sp. A since both have the same characteristics (similar vesicle length, equal number of processes and similar processes length). Both are differentiated from *Exochoderma arca* Wicander & Wood (1981), as the latter is larger and has most process bifurcated. *Diexallophasis* sp A is differentiated from *D. denticulata* due to the vesicle shape (being in the former much more polygonal than in the latter), to the presence of ridges in the base of the processes and the fact that distal ends in this species are acuminated and do not show any type of bifurcation. *Diexallophasis remota* is separated from *D. sp A* based on this species has a quadrangular vesicle, with lesser processes (up to 6) than *D. remota*.

*Diexallophasis mucronata* (Stockmans & Willière) Pribewalder has a smaller vesicle and its processes present a distinct pattern of branching (Stockmans & Willière, 1963; Pribewalder, 1987). It differs from *D. downtongorgensis* Mullins (2004) in having a larger vesicle, more notorious ornamentation and the same wall thickness in both, vesicle and processes.

**Genus Domasia** Downie emend. Hill 1974

**Type species:** *Domasia trispinosa* Downie emend. Hill 1974.
**Domasia quadrispinosa** Hill 1974  
(Fig. 3.10)

**Dimensions.** **VØ** = 17(20.5)22 µm, **PL** = 17(21.7)30 µm (4 specimens measured).

**Remarks.** We differentiate this species from *Dorsennidium europaeum* (Stockmans & Willière) Sarjeant & Stancliffe due to the nature of its vesicle (Stockmans & Willière, 1960; Sarjeant & Stancliffe, 1994). In *D. quadrispinosa* Hill, the vesicle is elongated and inflated, while in *D. europeaum* the vesicle is triangular and flattened.

Genus *Dorsennidium* Wicander emend.  
Sarjeant & Stancliffe 1994

**Type species:** *Dorsennidium patulum* Wicander 1974.

**Dorsennidium europaeum** (Stockmans & Willière) Sarjeant & Stancliffe 1994  
(Fig. 3.6)

**Dimensions.** **VØ** = 12 µm, **PL** = 20 µm, **PØB** = 2 µm (1 specimen measured).

Genus *Eupoikilofusa* Cramer 1970a

**Type species:** *Leiofusa striatifera* (Cramer) Cramer 1970.

**Remarks.** The validity of the name *Eupoikilofusa*, as discussed on Dorning (1994), is accepted here.

**Eupoikilofusa filifera** (Downie) Dorning emend. Mullins 2001  
(Fig. 3.12)

1987 *Leiofusa argentina* Pöthe de Baldis; Priewalder: 87.
1990 *Leiofusa* cf. *striata* Brito & Santos; Rubinstein: 91, pl. II, fig. 11.
1992a *Leiofusa* cf. *striata* Brito & Santos; Rubinstein: 244-245.
1997 *Dactylofusa striatifera* (Cramer) Fensome et al.; Rubinstein: 164, pl. I, fig. 5.

1975a *Leiofusa aff. striatifera* Cramer; Pöthe de Baldis: 494, pl. III, fig. 9.
1997b *Dactylofusa striatifera* (Cramer) Fensome et al.; Pöthe de Baldis: 468, pl. IV, fig. 11.

**Dimensions.** **VW** = 20(23.5)28 µm, **VT** = 128(141.7)150 µm (10 specimens measured).

**Remarks.** Almost all specimens are incomplete. According to Fensome et al. (1990) *Eupoikilofusa filifera* is an invalid combination and it must be referred to *Dactylofusa filifera* (Downie) Fensome et al. (1990), however Dorning (1994) made a revision of these genera maintaining as a valid genera *Eupoikilofusa*. The differentiation between *E. striatifera* and *E. filifera* is based on the number and general characteristics of their striae. In the first one, striae appear in a large number, being them thin and discontinuous, while in the second one, the striae are thick, continuous and there are only between 2 to 5 of them in each individual.

In conformity with this, *Leiofusa argentina* Pöthe de Baldis (1971) is a junior synonym of *E. filifera* not of *E. striatifera* as stated by Priewalder (1987). The material described by Rubinstein (1990), and classified as *L. cf. striata* Britos & Santos, could be reubicated as *E. filifera* due to the number (2-4) and characteristics of the striaes seen on the illustration of that specimen. The material from La Horqueta Formation categorized as *Dactylofusa striatifera* (Cramer) Fensome et al. (Rubinstein, 1997) seem to be *E. filifera* (Downie) Dorning, due to the number of the striaes (4) that can be seen in the illustration.

**Eupoikilofusa striatifera** (Cramer) Cramer 1970  
(Fig. 4.1)

1997b *Dactylofusa striatifera* (Cramer) Fensome et al.; Pöthe de Baldis: 468, pl. IV, fig. 11.

**Dimensions.** **VW** = 20(23.5)28 µm, **VT** = 128(141.7)150 µm (10 specimens measured).

**Remarks.** *Eupoikilofusa striatifera* (Cramer) Cramer 1970 differs from *E. filifera* (1959) in the number of striae they have. The latter has between 2 and 5, while the former has 8 or more. *Leiofusa estrecha* Cramer (1964a) is similar in size to *E. striatifera* but the former has a psilated eylima.

**Eupoikilofusa sp. cf. E. tenuistriata** (Pöthe de Baldis) Pöthe de Baldis 1981  
(Fig. 4.2)

**Description.** Vesicle hollow, fusiform with one side convex and the other side straight to slightly

Type species: Leiofusa fusiformis (Eisenack) Eisenack 1938.

Leiofusa bernesgae Cramer 1964a (Figs. 4.5, 7.6)

Dimensions. VL = 24(26.3)30 µm, VW = 12(16.8)20 µm, VT = 69(106)144 µm, PL = 24(40.1)62 µm, VW/VL = 0.57(0.69)0.87 (6 specimens measured).

Remarks. Leiofusa bispinosoides Brito & Santos (1965) is considered to be a junior synonym of L. bernesgae by Moreau-Benoit (1974). The differences in size of the material described by Pöthe de Baldis (1975a) and Rubinstein (1990) are not enough criteria to separate these materials from L. bernesgae, as stated also by Rubinstein (1992b). Leiofusa “banderilla” Cramer, described by Pöthe de Baldis (1971), showed all the distinctive characteristics (shape and size of the vesicle, length of the processes) of L. bernesgae, consequently it becomes reassigned here. Leiofusa banderillae Cramer (Pöthe de Baldis, 1987) has the appearance of being a specimen of L. bernesgae, but both processes are broken, making such designation impossible. The original material of L. banderillae Cramer (1964a) has longer processes (between 100-150 µm).

Leiofusa estrecha Cramer 1964a (Fig. 4.4)

Dimensions. VT = 120(158.3)225 µm, VW = 25(26)35 µm, VW/VT = 0.11(0.17)0.28 (8 specimens measured).
Remarks. All specimens are incomplete. *Leiofusa fusiformis* Eisenack (1934) presents a pliomle and a different shape of the processes; *L. parvitatis* Loeblich (1970) is smaller (the overall length varies from 50 to 93 µm). *Eupoikilofusa filifera* (Downie) Dorning (1981) and *E. striatifer* (Cramer) Cramer (1970a) are similar in size, but both present striations (or folds) on their surface. *Eupoikilofusa tenuistrata* (Pöthe de Baldis) Pöthe de Baldis (1981) presents subtle striations on its wall and has a different vesicle shape.

**Leiofusa exilata** Dorning 1981

(Fig. 4.6)

Dimensions. VW = 13(14.7)18 µm, VT = 100(184.3)263 µm, VW/VT = 0.05(0.10)0.18 (3 specimens measured).

Remarks. Despite the fact that *Leiofusa exilata* Dorning (1981) is smaller in width than the specimens described here, we assigned it to this species based on the similarities both share in length, general shape and relation: vesicle width/total length.

*Leiofusa exilata* is also similar in size to *L. estrecha* Cramer (1964a), differing from it the overall shape and the width/total length relationship.

**Leiofusa parvitatis** Loeblich 1970

(Fig. 4.11)

Dimensions. VL = 19(21)24 µm, VW = 9(9.8)12 µm, PL = 18(29.3)40 µm, VT = 57(79.5)104 µm, VW/VL = 0.4-0.5 (4 specimens measured).

Remarks. *Leiofusa estrecha* Cramer (1964a) is larger (overall length varies between 120-400 µm) and has a different vesicle shape. *Eupoikilofusa tenuistrata* (Pöthe de Baldis) Pöthe de Baldis (1981) presents subtle striations on its wall and has a different vesicle shape.

**Leiofusa tumida** Downie 1959

(Fig. 4.7)

1990 *Leiofusa* cf. *tumida* Downie; Rubinstein: 91, pl. II, fig. 9.

Dimensions. VL = 20(23)25 µm, VW = 14(16.2)20 µm, PL = 34(40)50 µm, VT = 95(103)125 µm, VW/ VL = 0.7-0.8 (3 specimens measured).

Remarks. *Leiofusa* cf. *tumida* Downie as described by Rubinstein (1990) is smaller (total length is 60 µm), but the difference in size is not enough criterions to substantiate its separation.

**Leiofusa sp. A**

(Fig. 4.8)


1981 *Leiofusa banderillae* Cramer, Pöthe de Baldis: 244, pl. V, fig. 8.

1990 *Leiofusa* sp. A Rubinstein: 91, pl. I, fig. 15.

1997a *Leiofusa tumida* Downie; Pöthe de Baldis: 46, pl. I, fig. 17.

1998 *Leiofusa bernesgae* Cramer; Pöthe de Baldis: 10, pl. 3, fig. 7.

Description. Vesicle slightly rectangular, elongated with a process at each pole. Processes are solid and the contact process-vesicle is indistinct. Eylima thin and laevigated. No excystment method observed.

Dimensions. VL = 30(33)36 µm, VW = 7 µm, VW/VL = 0.23-0.19 (2 specimens measured).

Remarks. In all the observed individuals processes were broken, making a more accurate asssignation impossible. The specimens illustrated by Pöthe de Baldis (1975a, 1981, 1997a, 1998) as *Leiofusa* aff. *estrecha*, *L. benderillae*, *L. tumida*, and *L. bernesgae* respectively, display all the characteristics of the species described here. *Leiofusa* sp. A differs from *L. bernesgae* Cramer (1964a) and *L. tumida* Downie (1959) in the shape of the vesicle (which is cylindrical to rectangular in the former) and the nature of its processes (which are solid). It can be distinguished from *L. estrecha* based on its size (being the latter much larger, with overall lenghts that varies from 120 to 400 µm) and from *L. benderillae* Cramer (1964a) contrasting the length (around 100-150 µm) and nature of the processes, as well as the shape of the vesicle.

Genus *Micrhystridium* Deflandre emend.

Sarjeant & Stancliffe 1994

**Micrhystridium sp. cf. M. stellatum**

Deflandre 1935.

Type species: *Micrhystridium inconspicuum* Deflandre 1935.

**Micrhystridium sp. cf. M. stellatum**

Deflandre 1945

(Fig. 4.10)

Description. Vesicle originally spherical, but polyhedral in shape, bearing numerous (12-20) simple spines. Spines are slender, hollow and communicate freely with the vesicle cavity. Distal tips are simple and closed. Processes bases are wide, which gives the polyhedral shape in compression. Eylima laevigate and thin. No excyst-
ment structure observed.

**Dimensions.** $V \phi = 13(13.5)14 \mu m$, $PL = 5(6)7 \mu m$ (2 specimens measured).

**Remarks.** The assignment of these specimens to *Micrhystridium stellatum* Deflandre (1945) is doubtfully since we only have two individuals, in which not all the determinant characteristics of the species could be seen.

Genus *Multiplicisphaeridium* Staplin emend. Lister 1970

**Type species:** *Multiplicisphaeridium rami-ispinosum* Staplin 1961.

*Multiplicisphaeridium arbusculum*

Dorning 1981

(Fig. 4.9)

1974 *Multiplicisphaeridium ramosculum* Deflandre; Pöthe de Baldis: 318, pl. IV, fig. 5.

**Dimensions.** $V \phi = 20(25)30 \mu m$, $PL = 23(27.3)31 \mu m$, $P/D = 2 \mu m$, $PN = 6-11$ (3 specimens measured).

**Remarks.** The material described as *Multiplicisphaeridium ramosculum* Deflandre by Pöthe de Baldis (1974) display wide variations in the branching pattern. According to the characteristics depict by Fig. 5 -the presence of processes both acuminated and bifurcated and the fact that such bifurcations take place at half of the processes’ length- we consider proper to reassign such material to *M. arbusculum*. *Multiplicisphaeridium ramosculum* Lister (1970) processes bifur cate only distally.

*Multiplicisphaeridium baldissi* sp. nov.

(Figs. 5.1-3, 7.9)

1974 *Multiplicisphaeridium ramosculum* Deflandre; Pöthe de Baldis: 318, pl. IV, fig. 3.

2000 *Evittia? escobaides* Cramer emend. Sarjeant & Vavrdová; Pöthe de Baldis: 332, pl. 3, fig. D.

**Occurrence.** Cachipunco Formation, Angosto Los Pereyras Section, BA Pal 5988-5992; Los Pereyras Section, BA Pal 6004, 6006.

**Type location.** Angosto los Pereyras, Jujuy Province, Argentina.

**Stratotype.** Cachipunco Formation.

**Diagnosis.** Vesicle spherical, hollow, with heteromorphic processes. Eylima thick, scabrate to laevigate. Up to 13 processes, short, conical to tubiform, hollow and freely communicated with vesicle interior. Processes show different branching patterns: distally bifurcated of one bifurcation at 2/3rds of the processes length and a second one at their distal ends.

**Holotype.** BA Pal 5988 (1) O71/1 (Fig. 5A).

**Name derivation.** It is named in honor to Elba Diana Pöthe de Baldis, Argentinian palynologist.

**Description.** Vesicle spherical, hollow, with evenly distributed, slightly heteromorphic processes. Eylima thick (1 mm), scabrate to laevigate, and in some specimens slightly costate at processes bases. 6-13 sub conical to tubiform, hollow, freely communicated with vesicle interior, short (ca. $\frac{1}{2}$ vesicle diameter) processes, with laevigate to slightly granulate walls. Processes show different branching patterns, some bifurcate distally, while others show a first bifurcation at 2/3rds of the processes length and a second one at their distal ends. An excystment structure is not observed.

**Dimensions.** $VD = 24(28.8)33 \mu m$, $PL = 11(14.6)19 \mu m$, $PDB = 3(4.1)5 \mu m$ (25 specimens measured).

**Remarks.** This species is characterized by the shape and width of its processes, the variations in the ramification patterns and the lack of conspicuous ornamentation. The characteristics exhibit by the material described as *Multiplicisphaeridium ramosculum* Deflandre by Pöthe de Baldis (1974) -wide processes and a conspicuous ramification pattern—allow their reinterpretation as *M. baldissi* sp. nov. *Multiplicisphaeridium ramosculum* has longer and slender processes than *M. baldissi*. Pöthe de Baldis (2000) assigned individuals similar to *M. baldissi* to the species *Evittia escobaides* (Cramer 1964b), but the latter has a polygonal vesicle and presents only one order of branching, characteristics that clearly distinguish both species.

*Multiplicisphaeridium picorricum* (Cramer) Lister has a larger number of processes (around 15-20), which are thinner than those of *M. baldissi* (Cramer, 1964b). *Multiplicisphaeridium robertinum* (Cramer, 1964b; Lister, 1970) in having more narrow processes, and a thinner eylima than *M. baldissi*.

*Multiplicisphaeridium baldissi* is differentiated from *M. sp. A*, as described on this work, based on the length, shape and number of the processes. It differs from *M. sp B* in the pattern of ramification of the processes. It is separated of *M. sp C* due to the shape of the processes, being in the latter mucho wider at the base, and presenting high-angled bifurcations. Also, *M. sp C* has distally solid pinnulas.
**Multiplicisphaeridium eoplanctonicum** (Eisenack) Lister 1970 (Fig. 5.4)

1998 *Oppilatala eoplanctonica* (Eisenack) Dorning; Pöthe de Baldis: 14, pl. IV, figs. 10-11.

**Dimensions.** VØ = 38 µm, PL = 43 µm, PN = 7 (1 specimen measured).

**Remarks.** Dorning (1981) transferred *Multiplicisphaeridium eoplanctonicum* (Eisenack) Lister to *Oppilatala* Loeblich & Wicander emend. Sarjeant & Vavrdová (1997). The main characteristic to differentiate both genera is the nature of their processes. In *Oppilatala*, processes do no communicate freely with the vesicle interior since their bases have a basal plug, while in *Multiplicisphaeridium* are open to the vesicle cavity. So, if the original holotype of *M. eoplanctonicum* has their processes in free communication with the vesicle interior, as it is described, the assignment of this specie to the genus *Oppilatala* would be erroneous. Consequently, the assignment of this specie to the genus *Multiplicisphaeridium* is based on the fact that the processes are open to the vesicle interior. *Multiplicisphaeridium eoplanctonicum* differs from *M. arbusculum* Dorning (1981) in having a distinct branching pattern, in *tonicum* *M. arbusculum* differs from *Dorning* cle interior. Sarjeant & Vavrdová (1997) is based on the similarity in number and character of the processes, and in a similar relationship length of the processes/vesicle diameter. Owing to the bad state of preservation of the material is impossible to make a more exact assignment. *Oppilatala ramusculosa* (Deflandre) Dorning (1981) is quite similar to our specimen, but the former its processes do not communicate with the vesicle interior. *Multiplicisphaeridium* sp. cf. *M. jarillense* Pöthe de Baldis (1997b) is based on the similarity in number and character of the processes, and some of them are simple. The polygonal vesicle distinguishes *M. variabile* from the other species of *Multiplicisphaeridium*.

**Multiplicisphaeridium sp. cf. M. jarillense** Pöthe de Baldis 1997b (Fig. 5.5)

**Description.** Vesicle spherical, hollow, laevigate, with a thin wall. 9-17 hollow, open to vesicle cavity, laevigate processes. Processes are relatively long (around 50% of the vesicle diameter), slender and flexuous. Distally they multifurcate in an irregular fashion. No excystment method observed.

**Dimensions.** VØ = 16(17.6)19 µm, PL = 4(7)12 µm (10 specimens measured).

**Remarks.** The assignment of these specimens to *Multiplicisphaeridium jarillense* Pöthe de Baldis (1997b) is based on the similarity in number and character of the processes, and in a similar relationship length of the processes/vesicle diameter. Owing to the bad state of preservation of the material is impossible to make a more exact assignment. *Oppilatala ramusculosa* (Deflandre) Dorning (1981) is quite similar to our specimen, but the former its processes do not communicate with the vesicle interior. *Multiplicisphaeridium* sp. cf. *M. jarillense* Pöthe de Baldis differs of *M. eoplanctonicum* (Eisenack) Lister (1970) in having more processes and a smaller relationship length of the process/vesicle diameter (being the processes of the latter almost twice as large as the vesicle). *Multiplicisphaeridium cladus* (Downie) Eisenack (1969) has a similar size and number of processes, but the branching pattern is different (wide bifurcation angle, and it may present processes distally trifurcated). *Multiplicisphaeridium paraguferum* (Cramer) Lister (1970) has more processes (more than 20). *Multiplicisphaeridium intonsurans* (Lister) Sarjeant & Stancliffe (1994) differs in the branching pattern (processes are barbate) and in the shape of the vesicle which is slightly polygonal. *Multiplicisphaeridium variopinnum* Cramer (1966) display processes which are simple or monofurcate. It differs from *M. forquiferum* (Cramer & Diez) Eisenack et al. (1973) in having a distinct differentiation between the processes and the vesicle.

**Multiplicisphaeridium variabile** (Lister) Dorning 1981 (Fig. 5.7)

**Dimensions.** VØ = 22(26.3)29 µm, PL = 21(22.3)23 µm, PØB = 3 µm, PN = 10(11)12; 10-11 processes (3 specimen measured).

**Remarks.** *Multiplicisphaeridium osgoodense* (Cramer & Diez) Eisenack et al. (1973) also has a polygonal vesicle, but it is larger (25-50 µm) and has fewer processes (around 6). *Multiplicisphaeridium pentagonale* (Stockmans & Williérie) Mullins (2002) has fewer processes and some of them are simple. The polygonal vesicle is similar to *M. jarillense*. *Multiplicisphaeridium variabile* (Lister) Sarjeant & Stancliffe (1994) differs from the other species of *Multiplicisphaeridium*.
Multiplicisphaeridium ramispinosum (Staplin) Sarjeant & Vavrdová (1997) processes bifurcate dichotomously, has a slightly larger vesicle, and longer processes.

**Multiplicisphaeridium sp. A**

(Fig. 5.8)

**Description.** Vesicle spherical, to slightly ellipsoidal in shape, laevigate, single-layered, with 4-6 hollow, long, psilated processes. Processes communicate freely with vesicle interior. Branching occurs 1/2 to 2/3rds of the processes length. Branches ramified up to the third order. No excystment method observed.

**Dimensions.** \( VØ = 24(27.3):34 \) \( \mu \)m, \( PL = 22(24.1):35 \) \( \mu \)m, \( PØB = 3(4.2):5 \) \( \mu \)m, \( PN = 4-6 \) (7 specimens measured).

**Remarks.** It differs from *Multiplicisphaeridium arbusculum* Dorning (1981) in having fewer processes; *M. ramusculosum* Lister (1970) has a distinct branching pattern.

**Multiplicisphaeridium sp. B**

(Fig. 5.9)

**Description.** Vesicle spherical to subspherical, hollow, thin-walled and covered with 12-20, evenly distributed, rather columnar processes. Processes bifurcate distally only once, are open to vesicle cavity, and are hollow though distally they are solid. Excystment by unornamented rupture of vesicle wall.

**Dimensions.** \( VØ = 20(25.3):35 \) \( \mu \)m, \( PL = 5(8):13 \) \( \mu \)m, \( PN = 11(15):20 \) (3 specimens measured).

**Remarks.** We assigned these specimens to the genus *Multiplicisphaeridium* Staplin emend. Lister because its processes present a single bifurcation distally, while in *Ammonidium* Lister processes equifurcate, being into two or more distally and flexible spines. It is differentiate from the other species of *Multiplicisphaeridium* described here due to the nature of its ramification pattern.

Genus Neoverhyachium Cramer emend. Sarjeant & Stancliffe 1994

**Type species:** Neoverhyachium carminae (Cramer) Cramer 1970.

Neoverhyachium carminae Cramer 1970

(Figs. 5.10-11)

1998 Neoverhyachium? sp. Póthe de Baldis: 12, pl. IV, fig. 7.

1998 Veryhachium valiente Cramer; Póthe de Baldis: 17, pl. V, figs. 8, 18.

**Dimensions.** \( VL = 16(19.9):24 \) \( \mu \)m, \( VW = 11(14.7):18 \) \( \mu \)m, \( PL = 10(16.6):30 \) \( \mu \)m, \( PØB = 1.5(2.0):3 \) \( \mu \)m (23 specimens measured).

**Remarks.** Neoverhyachium mayhillensis Dorning (1981) is larger than *N. carminae* Cramer. According to Mullins (2001) *N. carminae* has also a more complex pattern of folds. Due to a preservation bias, not all the individuals observed here show the pattern of folds. The specimens described by Póthe de Baldis as *N.?* sp. (Póthe de Baldis, 1998) and *Veryhachium valiente* Cramer (Póthe de Baldis, 1998) are very similar to the specimens assigned here to *N. carminae*. It has similar dimension of vesicle and processes. The absence of the characteristic fold of *Neoverhyachium* may be due to a preservation bias.
Genus **Onondagaella** Cramer emend. Playford 1977

**Type species:** *Veryhachium asymmetricum* Deunff 1954 (a *nomen nudum* until validated by Deunff, 1961).

*Onondagaella asymmetrica* (Deunff) Cramer 1966  
(Figs. 6.1, 7.4)

**Dimensions.** VL = 40(59.7)82 µm, PL = 10(21.6)30 µm (50 specimens measured).

**Remarks.** The vesicle length was measured from the broader process to the opposite size. Processes length is measured in the two identical processes.

Genus **Ozotobrachion** Loeblich & Drugg 1968

**Type species:** *Ozotobrachion dactylos* Loeblich & Drugg 1968.

*Ozotobrachion* sp. A (Fig. 6.6)

**Description.** Vesicle triangular in outline, cushion-like, with convex sides and three processes, one arising from each corner of the vesicle. Processes tubiform, flexible, hollow, not communicated with vesicle interior, with blunt or stub distal ends. No encystment structure observed.

**Dimensions.** VØ = 17(21.5)26 µm, PL = 12(18)25 µm, PØ = 2(3)4 µm (5 specimens measured).

**Remarks.** *Triangulina* Cramer (1964b) and *Ozotobrachion* Loeblich & Drugg (1968) are the two genera that posses a triangular vesicle and a double-layered wall. *Ozotobrachion* has processes with bifurcated distal ends, while in *Triangulina* processes have rounded distal ends. In the individuals recorded in Angosto Los Pereyras Section, distal ends are broken; therefore a more accurate assignment could not be made. Despite of that, and owing to the fact that *Ozotobrachion* has usually longer processes than *Triangulina*, we decided to assign these specimens to the former genus, instead of the latter.

Genus **Salopidium** Dorning 1981

**Type species:** *Baltisphaeridium brevispinosum* var. *granuliferum* Downie 1959.

*Salopidium* sp. cf. *S. granuliferum*  
(Downie) Dorning 1981  
(Fig. 6.7)

**Description.** Vesicle spherical, hollow, with a thick, foveolate wall. Processes are numerous (ca., 25), relatively short (1/3 of the vesicle diameter), slenderly columnar, tapering into simple, unbranched tips. Excystment not observed.

**Dimensions.** VØ = 25-27 µm, PL = 7-8 µm, PØB = 2-3 µm (2 specimens measured).

**Remarks.** Since the small number of specimens present, we uncertainly assigned this species based on the width of its processes, since they are much shorter and broader than in the holotype as described by Mullins (2001).

Genus **Tylotopalla** Loeblich emend. Sarjeant & Vavdrová 1997

**Type species:** *Tylotopalla digitifera* Loeblich 1970.

*Tylotopalla maraca* Diez & Cramer 1976  
(Fig. 6.8)

**Dimensions.** VØ = 25 µm, PL = 10 µm (1 specimen measured).

**Remarks.** The transfer of *Tylotopalla maraca* Diez & Cramer (1976) to the genus *Dorsennidum* Wicander (1974) proposed by Sarjeant & Vavdrová (1997) is not accepted herein since *Dorsennidum* includes forms with polygonal vesicles determined by the acuminated and hollow processes, which range in number between 4-10 (Sarjeant & Stancliffe, 1994). While this species has a spherical vesicle, with 10-30 processes. *Salopidium granuliferum* (Downie, 1959) has a foveolate wall and more and shorter processes. *Ammonidium waldronense* (Tappan & Loeblich, 1971) has small rosette like spines at the processes tips.

*Tylotopalla robustispinosa* (Downie)  
Eisenack et al. 1973  
(Fig. 6.3)

**Dimensions.** VØ = 13 µm, PL = 5 µm (1 specimen measured).

Genus **Veryhachium** Deunff emend. Sarjeant & Stancliffe 1994

**Type species:** *Veryhachium trisulcum* (Deunff) Deunff 1954, subsequent designation by Downie (1959) (see Loeblich & Tappan, 1976).
**Veryhachium trisphaeridium** Downie 1963  
(Fig. 6.2)

**Dimensions.** \( V_\varnothing = 17(18.3)21 \) \( \mu m \), \( PL = 15(23.1)35 \) \( \mu m \), \( P_\varnothing B = 1(1.8)/2 \) \( \mu m \) (16 specimens measured).

**Remarks.** *Veryhachium trisphaeridium* Downie is very similar to *Dorsennidium europaeum* (Downie) Sarjeant & Stancliffe (1994), although the latter has a fourth process arising perpendicular to the plane of the vesicle.

**Veryhachium trispinosum** (Eisenack) Stockman & Willière 1962  
(Figs. 6.4, 7.3)

**Dimensions.** \( V_\varnothing = 14(19.8)25 \) \( \mu m \), \( PL = 11(26.4)42 \) \( \mu m \) (38 specimens measured).

**Remarks.** *Veryhachium trispinosum* (Eisenack) Stockman & Willière (1962) is differentiated from *V. trisphaeridium* Downie (1963) due to the thickness of its wall and the nature of its processes.

**Genus Visbysphaera** Lister emend. Kiryanov 1978

**Type species:** *Visbysphaera dilatispinosa* (Downie) Lister 1970.

**Cf. Visbysphaera sp. A**  
(Figs. 6.4, 7.10)

**Description.** Vesicle spherical, with rather numerous (ca., 14), short, clavate to capitate processes. Excystment structure not observed.

**Dimensions.** \( V_\varnothing = 20-31 \) \( \mu m \), \( PN = 6-14 \), \( PL = 6-7 \) \( \mu m \) (2 specimens measured).

**Remarks.** The genus *Visbysphaera* Lister emend. Kiryanov is characterized by its columnar to club shaped processes and the ornamentation of the vesicle (Lister, 1970). Since in our specimens, this last characteristic is impossible to see due to the state of preservation of the material, we assigned them doubtfully to this genus.

**Genus Vogtlandia** Burmann 1970

**Type species:** *Vogtlandia ramificata* Burmann 1970.

**Vogtlandia sp. A**  
(Fig. 6.11)

**Description.** Vesicle thin, single-walled, scabrate, quadrangular shaped, with straight to slightly convex or concave sides. 5 conical, hollow, open to vesicle interior, multifurcate (at half of the processes length) up to the fourth order processes. Such processes have very broad bases, and modify vesicle shape. No excystment method observed.

**Dimensions.** \( V_\varnothing = 22-28 \) \( \mu m \), \( PL = 15-19 \) \( \mu m \), \( P_\varnothing B = 6-8 \) \( \mu m \) (2 specimens measured).

**Remarks.** These specimens are included in the genus *Vogtlandia* Burmann since the shape of the vesicle, number of processes and ramification pattern (Burmann, 1970). A more accurate designation is impossible to be made due to the state of preservation in which the scarce material is found.

**ACRITARCA INCERTAE SEDIS**

**Acritarca type A**  
(Fig. 6.9)

**Description.** Vesicle polygonal in outline, formed by the coalescence of 7 to 9 conical processes. The broad-based processes are bifurcated up to three times. The first bifurcation develops at half of the process’s length. Vesicle and processes evenly covered with grana and/or spines. No excystment method observed.

**Dimensions.** \( V_\varnothing = 24-31 \) \( \mu m \), \( PL = 22-24 \) \( \mu m \), \( P_\varnothing B = 9-10 \) \( \mu m \), \( PN = 7-9 \) (2 specimens measured).

**Remarks.** This species is differentiated from *Barbestiastra* Downie emend. Sarjeant & Stancliffe (1994) due to the fact that *Barbestiastra* has acuminate processes while this species present distal ramifications.

**Class PRASINOPHYCEAE Christensen 1962**

**Genus Duvernaysphaera** Staplin emend. Deunff 1964

**Type species:** *Duvernaysphaera tenuicingulata* Staplin 1961.

**Duvernaysphaera aranaiides** (Cramer) Cramer & Díez 1972  
(Fig. 6.10)

1971 *Helios aranaiides* Cramer; Pöthe de Baldis: 289, pl. II, fig. 8.
1974 *Duvernaysphaera jelinii* Pöthe de Baldis; Pöthe de Baldis: 326, pl. I, fig. 3.
1975a *Duvernaysphaera jelinii* Pöthe de Baldis: 495, pl. IV, fig. 1-2, 4-5.
1975b *Helios aranaiides* Cramer; Pöthe de Baldis: 510, pl. III, fig. 6.

1981 *Helios aranaides* Cramer; Pöthe de Baldis: 243, pl. IV, figs. 10-12.

1987 *Duvernaysphaera gothica* Martín; Pöthe de Baldis: 92, pl. I, fig. 21.

1991 *Helios aranaides* Cramer; Rubinstein: 97, pl. I, figs. 2-3, 6-7.

1991 *Duvernaysphaera gothica* Martín; Pöthe de Baldis: 92, pl. I, fig. 21.

1993 *Helios aranaides* Cramer; Rubinstein: 97, pl. I, figs. 2-3, 6-7.

1993 *Duvernaysphaera gothica* Martín; Rubinstein: 70.

1993 *Helios aranaides* Cramer; Rubinstein: 70.

**Dimensions.** $T = 36(36.7)49 \mu m$, $\varnothing C = 17(20)28 \mu m$, $PL = 5(8.5)11 \mu m$, $PN = 10(14)19$, $P\varnothing B = 1(1.6)2$ (8 specimens measured).

**Remarks.** We do accept that *Helios* Cramer (1964b) is a junior synonym of *Duvernaysphaera* Staplin (1961), as discussed by Cramer & Díez (1972), Playford (1977), Mullins (2001), among others. *Duvernaysphaera jelinii* Pöthe de Baldis (1974) is considered to be a junior synonym of *D. gothica* Martin (1968) by Pöthe de Baldis (1981). On the other hand, *D. gothica* is considered a junior synonym of *D. aranides* (Cramer) by Cramer & Díez (1972). This latter criterion is accepted in this work.

**Genus Leiosphaeridia** Eisenack emend. Downie & Sarjeant 1963

**Type species:** *Leiosphaeridia baltica* Eisenack 1958a.

*Leiosphaeridia wenlockia* Downie 1959

(Figs. 6.12, 7.2)

**Dimensions.** $V\varnothing = 25(27.8)32 \mu m$ (13 specimens measured).

*Leiosphaeridia sp. A* (Figs. 6.14, 7.7)

**Description.** Vesicle spherical, thin walled (0.5 \mu m), scabrated to slightly punctuated. Foldings are not distinct. Vesicle diameter varies from.

**Dimensions.** $V\varnothing = 38(44.9)55 \mu m$ (9 specimens measured).

**Remarks.** *Leiosphaeridia tenuissima* Eisenack (1958b) differs only in size from the specimens described here, being the former much bigger; *L. wenlockia* Downie (1959) differs from *L. sp. A in its size and the characteristics of its wall, being thicker and with foldings in the latter.

**Anteturma SPORITES Potonié 1893**

**Turma TRILETES Reinsch 1881**

**Subturma ZONOTRILETES Waltz 1935 in Luber & Waltz 1938**

**Infraturma CRASSITI Bharadwaj & Venkatachala 1961**

**Genus Ambitisporites** Hoffmeister 1959

**Type species:** *Ambitisporites avitus* Hoffmeister 1959.

*Ambitisporites avitus* Hoffmeister 1959

(Fig. 6.13)

**Dimensions.** $\varnothing = 36(39.7)45 \mu m$, $Cw = 3(3.3)4 \mu m$ (9 specimens measured).

**Spore Type A** (Fig. 7.11)

**Description.** Miospore trilete, radial, zonate with subcircular amb. Laesura distinct, simple, with straight sides and extending to the zone borders. Exine laevigated.

**Dimensions.** $\varnothing = 65 \mu m$, $Zw = 15 \mu m$ (1 specimen measured).

**ALGAE INCERTAE SEDIS**

**Genus Proteolobus** Wood 1997

**Type species:** *Proteolobus walli* Wood 1997.

*Proteolobus cylindrus* Al-Ruwaili 2000

(Fig. 7.8)

**Dimensions.** $PL = 35-40 \mu m$, $T = 75-80 \mu m$, $P\varnothing = 10 \mu m$ (1 specimen measured).

**MICROPLANKTON CHARACTERISTICS**

**Angosto de Los Pereyras Section** (Fig. 8)

The analyzed associations present a great diversity of species between the 10 and 140 meters, being identified more than 22 species in each level. On the other hand, in the base and the superior section of the stratigraphic column the specific diversity is much lower (between 8-17 species per level).

At a generic level, associations are clearly dominated by the Leiosphaeridia genera, with minor participation of Onondogaella, Multiplicisphaeridium, Diezallophasis, Verhyachium, Neovarhyachium, and Leiofusa.
Inunciaga & Gutiérrez: Silurian microplankton from the Cachipunco Formation

In according to this, at specific level, a conspicuous predominance of *Onondogaella asymmetricta*, *Gorgonisphaeridium succinum*, *Multiplicisphaeridium arbusculum*, *M. ramusculosum*, *Diexallophasis denticulata*, *Verhyachium trisphaeridium*, *Ambitisporites avitus*, *Neoverhyachium carminae*, *Duvernaysphaera aranaides*, and *Leiofusa bernesgae*, among others could be observed.

A Wenlockian-Ludlovian age is inferred for this association based on the stratigraphic range of the most important species identified for it (Fig. 5).

The age for this section, as stated by Grahn & Gutiérrez (2001) based on the chitinozoarian content, is slightly younger (Wenlokiano-Pridoliano)
than the age obtained from the acritarchs (Ludlovian-Wenlockian).

**Cumbre de Los Pereyras Section** (Fig. 9)

The inferior sector of this section (30 meters) comprises only one palynological association (BA Pal 6003). In that section only *Leiosphaeridia* and some specimens of *Gorgonisphaeridium* were identified. Between the 40 and 120 meters, the studied associations (7 in total) display a moderate to low diversity (between 3-20 species per level).

In concordance with Angosto Los Pereyras, in the associations recovered for Cumbre Los Pereyras, prevail the genus *Leiosphaeridia*. Notwithstanding, this genus coexist mainly with specimens of the genera *Verhyachium*, *Ammonidium*, *Dorsenidium*, *Multiplicisphaeridium*, *Tylotopalla*, and *Leiufusa*.

The more prominent species for this section are: *Gorgonisphaeridium succinum*, *Tylotopalla maraca*, *Ammonidium ludoviciense*, *A. waldronense*, *Dorsenidium europaeum*, *Neoveryhachium carminae*, *Leiufusa bernesgae*, *Salopidium* sp. *S. granuliferum* y *Multiplicisphaeridium arbusculum*, among others.

Comparing these findings with those obtained for Angosto Los Pereyras, and the stratigraphic ranges of the species identified (Fig. 10), we are able to constrain the age of this section to a Wenlockian-Ludlovian period.

Taking into account the previous distribution in other Argentinian formations of the identified taxones from Cachipunco Formation (Fig. 11) it is possible to notice a remarkable affinity with the palynoflore from Los Espejos Formation.
Though the palynological association from that litostratigraphic unit is one of the better known of Argentina (see Rubinstein, 1993, 1995), it is important to mention the fact that 27 species over a total of 36, have been identified for both formations.

There are described for the first time for the Argentinean Silurian: *Domasia quadrispinosa*, *Leiofusa exilata*, *L. parvitatis*, *Proteolobus cylindricus* y *Tylotopalala maraca*, for the first time for the Silurian of Argentina. A new species, *Multiplicisphaeridium baldisii*, is here proposed.

Finally, based on the palynological content of the Cachipunco Formation, a Wenlock-Ludlow age is assigned to this litostratigraphic unit. Such age, slightly differs from the one obtained by Grahn & Gutiérrez (Wenlock-Pridoli, 2001), from the chitinozoarian content of this formation.

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