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ULTRASTRUCTURAL STUDY OF *STROMBOMONAS* (EUGLENOPHYTA) FROM THE PROVINCE OF CHACO (ARGENTINA)[1]

VISITACION CONFORTI[2] and YOLANDA ZALOCAR DE DOMITROVIC[3]

Summary: Nine taxa of *Strombomonas* Deflandre (Euglenophyta) from the province of Chaco (Argentina) have been examined with scanning electron microscopy (SEM). Details of the lorica ultrastructure are described and illustrated, five of them for the first time with SEM: *Strombomonas confortii* Zalocar de Domitrovic, *S. eurystoma* (Stein) Popova, *S. longicauda* (Swirenko) Deflandre, *S. pizarroi* Zalocar de Domitrovic and *S. urceolata* (Stokes) Deflandre. For the other taxa (*S. tellii* Zalocar de Domitrovic, *S. scabra* var. *hiperintermedia* Conforti, *S. diptera* Zalocar & Tell and *S. tetraptera* Balech & Dastugue) additional comments on relevant morphological characteristics are furnished.

Key words: taxonomy, ultrastructure, Euglenophyta, *Strombomonas*, Chaco, Argentina.

Resumen: Estudio ultraestructural de *Strombomonas* (Euglenophyta) de la provincia de Chaco (Argentina). En este trabajo se examinaron con microscopio electrónico de barrido (MEB) nueve taxones del genero *Strombomonas* Deflandre (Euglenophyta), colectados en cuerpos de agua de la provincia del Chaco (Argentina). Se describe e ilustra la ultraestructura de sus lórigas, de las cuales cinco son analizadas por primera vez con esta técnica: *Strombomonas confortii* Zalocar de Domitrovic, *S. eurystoma* (Stein) Popova, *S. longicauda* (Swirenko) Deflandre, *S. pizarroi* Zalocar de Domitrovic y *S. urceolata* (Stokes) Deflandre. Para los taxa restantes (*S. tellii* Zalocar de Domitrovic, *S. scabra* var. *hiperintermedia* Conforti, *S. diptera* Zalocar & Tell y *S. tetraptera* Balech & Dastugue), se amplia su descripción y se detacan algunas diferencias con observaciones previas.

Palabras clave: taxonomía, ultraestructura, Euglenophyta, *Strombomonas*, Chaco, Argentina.

INTRODUCTION

The Argentine northeastern region is very rich in vegetated water bodies (specially in the Paraná River floodplain) which presents favorable conditions for the development of euglenoids. Numerous taxa have been reported for this area (Tell, 1980, 1998; Bonetto *et al.*, 1984; Tell & Conforti, 1985; Tell & Zalocar de Domitrovic, 1985; Zalocar de Domitrovic *et al.*, 1986; Zalocar de Domitrovic, 1991, 1993, 1999, in press; Conforti, 1998, 1999). Among these, a high number of species belonging to the genus *Strombomonas* Deflandre were described. Initially, several taxa of this genus, were classified as species of *Trachelomonas* Ehrenberg. Due to the differences in lorica morphology, specially for its sac – shape, members of the *Trachelomonas* subgroup "Saccatae" of *Trachelomonas* were elevated to the generic level by Deflandre (1930) and renamed *Strombomonas*. This author based the separation of the two genera on rather poorly and doubtfully defined morphological characters of the envelope. Consequently some researches have discussed the adoption of Deflandre's classification (Balech, 1944; Dunlap *et al.*, 1986; Tell & Conforti, 1988; Conforti & Nudelman, 1997). This controversial group has been scarcely studied around the world. In Argentina they were also rarely found and the highest number of reports correspond to our study area (Tell, 1998; Tell & Zalocar de Domitrovic, 1985; Zalocar de Domitrovic, 1991). Some of these specimens showed such an original and different morphology that the authors considered them as new taxa. Although in previous papers (Hager, 1979; Tell & Conforti, 1984, 1985, 1988; Dunlap *et al.*, 1986; Conforti, 1993; Conforti *et al.*, 1994; Couté & Thérézien, 1994; Conforti & Pérez, 2000) some species have been described with scanning electron microscopy (SEM), there are still very few taxa studied at this level. The present investigation attempts to improve this situation.

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Material and Methods

The materials analyzed in this work were obtained from different water bodies of the province of Chaco, northeastern region of Argentina (27° 27' S; 58° 49' W), which were shallow and vegetated with macrophytes. They were collected from the following places: El Puente Lake, Cuatro Diablos Lake, "A" and "B" Lakes in Presidencia Roque Sáenz Peña, Cochereck Lake and Felman Lake (see map of the study area in Zalocar de Domitrovic, 1991). Water was sieved through a 25 µm mesh plankton net and fixed with 4% formaldehyde. For SEM observations, organisms were isolated under a dissecting microscope with the aid of micropipettes, dehydrated in a series of ethanol solutions (50 to 100 %), air dried on aluminum foil and coated with gold / palladium. Specimens were examined and photographed with a Phillips 505 SEM at the Electron Microscopy Service of CITEFA. Samples were deposited in the Phycologycal Collection of the Centro de Ecología Aplicada del Litoral (CONICET), Corrientes.

Taxonomical Descriptions

Strombomonas confortii Zalocar de Domitrovic, *Cryptogamie, Algol.* 12 (4): 273-274, fig.1 a-d, 1991.
Figs. 1, A-D

Lorica 36-38 µm long, 28-30 µm wide, bell - shaped. Anterior end narrowed into a cylindrical neck (4-4.5 x 6.5-7 µm), oblique or irregular at the tip. Posterior end flattened surrounded by a wing - shaped expansion (3-4 µm long), irregular in the free edge (Fig. 1 A-B, arrowheads). The cauda is conical, straight or slightly oblique (13-15 x 7-8.5 µm). Wall totally covered with agglutinated exogenous particles. The dimensions of the lorica examined in this study were smaller than those analyzed in the original description, 47-48 x 38-38.5 µm. This species has only been found in materials from Chaco, Argentina (Zalocar de Domitrovic, 1991).

Material: ARGENTINA: Chaco, Lake "A" in Presidente R. S. Peña, 23 Dec.1989, Zalocar de Domitrovic, C-3507.

Strombomonas longicauda (Swirenko) Deflandre, *Arch. Protkde.* 60 (3): 599-560, figs. 108-109, 1930.
Figs. 1, E-F

Lorica 50-60 µm long, 23-26 µm wide, rhomboidal. Middle region circular in apical view. Anterior end narrowed into a long cylindrical neck (10-14 µm long), widened, oblique and irregular towards the tip (6-7 µm wide). Posterior end abruptly narrowed down to a conical, straight, very long cauda, 20-22 µm. Wall yellowish, thick, rough, with numerous adhered particles on its surface. Europe (Huber- Pestalozzi, 1955). In South America: Argentina, Buenos Aires (Conforti, 1981), it is recorded in Chaco for the first time.

Material: ARGENTINA: Chaco, Lake Felman, 5 Nov. 1978, Zalocar de Domitrovic, C-855.

Strombomonas pizarroi Zalocar de Domitrovic, *Cryptogamie, Algol.* 12(4): 274-276, fig.2 a-b, 1991.
Figs. 2, A-C

Lorica 48-55 µm long, 28-31 µm wide, pear - shaped. Pore surrounded by a short neck (3-3.5 µm long), widened, oblique and irregular at the distal end (5-6 µm wide). Posterior end abruptly narrowed down to a conical, straight or oblique, long cauda (18-20 µm long). Wall thick, coarse, with very irregular contour, totally covered with agglutinated exogenous materials. Among these particles, it is possible to distinguish some with large dimensions. This observation is opposite to the original description of this species, where the author said that the lorica surface is smooth. This species was has only been recorded in materials from Chaco, Argentina (Zalocar de Domitrovic, 1991).

Materials: ARGENTINA: Chaco, Lakes "A", 23 Dec. 1989 and Lake "B" in Presidente R. Saenz Peña, 24 Set. 1990, Zalocar de Domitrovic, C-3507, C-3561.

Strombomonas tellii Zalocar de Domitrovic, *Cryptogamie, Algol.* 12 (4): 276, fig. 3 a-c, 1991.
Fig. 2, D

Lorica 49-51 µm long, 31-33 µm wide, rhomboidal, with an equatorial fold; broadly elliptic in apical view. Anterior end prolonged into a short collar (3-4 µm long), widened, oblique or irregular at the distal end (7-8.5 µm wide). Posterior end narrowed into a straight conical cauda (10-11 µm long), straight and symmetrical or oblique and asymmetrical in lateral view. Wall very thick, coarse, yellowish to light brown, shows exogenous particles coating its surface. Argentina (Chaco, Zalocar de Domitrovic, 1991) and Brazil (Conforti, 1993).

Material: ARGENTINA: Chaco, Lake "A" in

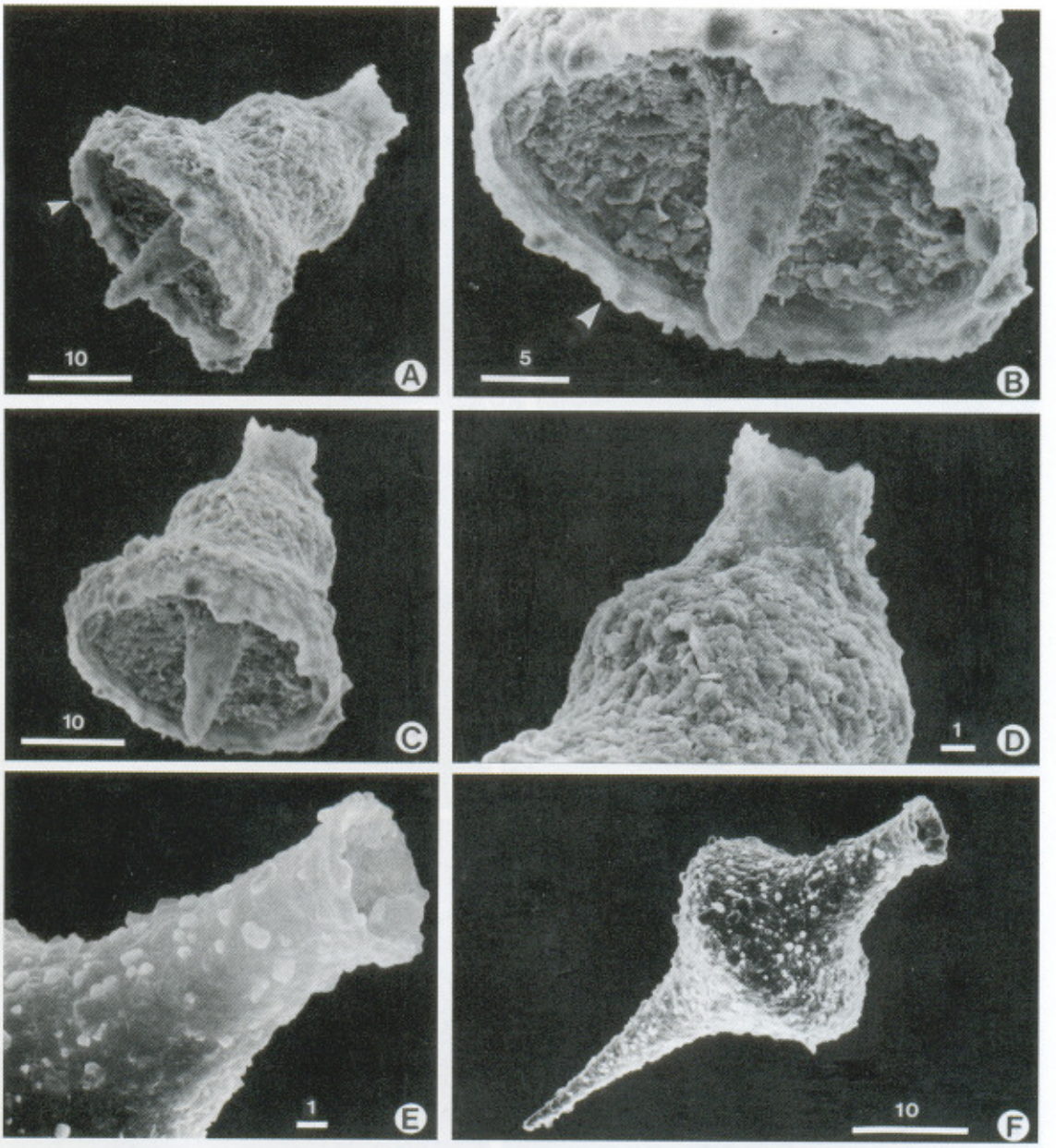

Fig. 1. **A-D**: *Strombomonas confortii*, **A**, **C**: general views; **B**: detail of the posterior end showing a detail of the wing - shaped expansion (arrowhead); **D**: detail of the neck and lorica surface; **E-F**: *Strombomonas longicauda*, **E**. detail of the collar and lorica surface; **F**: general view. Scale bar values are given in µm directly on the micrographs.

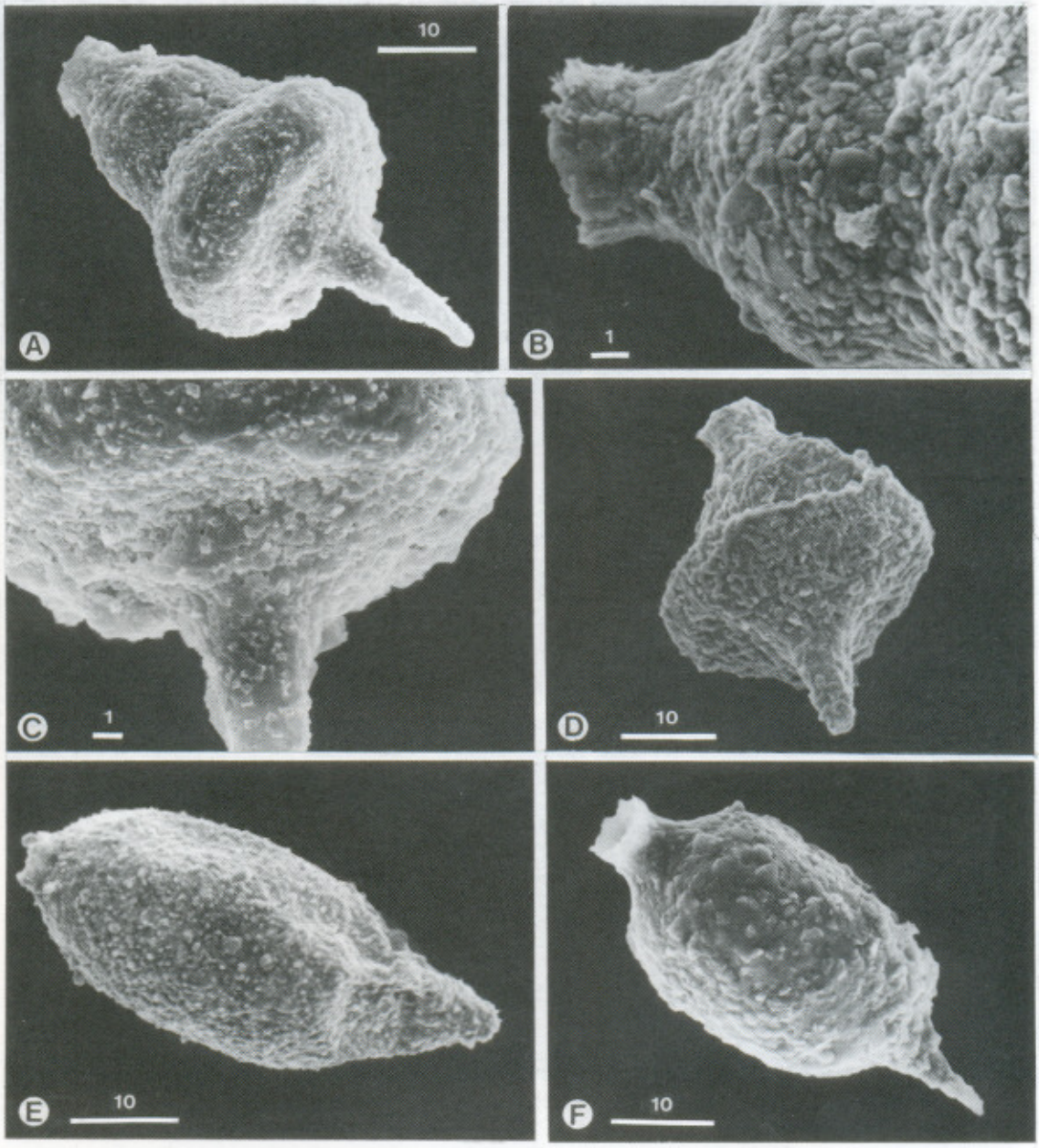

Fig. 2. **A-C**: *Strombomonas pizarroi*, **A**. general view; **B**. detail of the neck and lorica surface; **C**. detail of the posterior end; **D**:*Strombomonas tellii*, general view; **E**. *Strombomonas eurystoma*, general view; **F**: *Strombomonas urceolata*, general view. Scale bar values are given in µm directly on the micrographs.

Presidente R. S. Peña., 23 Dec. 1989, Zalocar de Domitrovic, C-3507.

Strombomonas eurystoma (Stein) Popova, *Flora – sporovych rastenij SSSR,* 8, pg. : 206, Pl. XX, figs. 1-11, 13. 1966.
Fig. 2, E

Lorica 43-47.5 µm long, 20-24 µm wide, irregularly ellipsoid, compressed in lateral view. Pore surrounded by a short neck (2-2.5 x 5-5.5 µm), undulated at the free end. Posterior end narrowed into a conical cauda (7.5 - 9.5 µm long), rounded at the tip. Wall yellowish, thick, totally covered with agglutinated exogenous materials. Widespread (Huber - Pestalozzi, 1955). In South America: Argentina, Corrientes (Tell, 1980), recorded in Chaco for the first time and Brazil (Conforti, 1993).

Material: ARGENTINA: Chaco, Lake El Puente, 5 Dec. 1985, Zalocar de Domitrovic, C-312.

Strombomonas urceolata (Stokes) Deflandre, *Arch. Protkde.* 60(3): 586-587, figs. 70, 71, 73. 1930.
Fig. 2, F

Lorica 38-55 µm long, 20-26 µm wide, urceolate, slightly flattened in lateral view. Sides straight, converging to the anterior end like a cylindrical short collar (4-4.5 x 5-5.5 µm), widened, oblique or straight at the distal end. Posterior end abruptly tapering to a conical cauda (8-9 µm long). Wall totally covered with exogenous agglutinated particles. Widespread (Huber-Pestalozzi, 1955). In Argentina, Corrientes (Tell, 1980) and Chaco (Tell & Zalocar de Domitrovic, 1985).

Material: ARGENTINA: Chaco, Lake Cuatro Diablos, 24 April 1980, Zalocar de Domitrovic, C-333.

Strombomonas scabra var. **hiperintermedia** Conforti, *Cryptogamie, Algol.* 10(1): 74-75, figs. 14 a-c. 1989.
Figs. 3, A-D

Lorica 55-65 µm long,19.5-33 µm wide, ellipsoid. Neck cylindrical, long (10-13 µm), denticulate at the distal end and surrounded at the proximal end by a well developed annular external thickening (2-3.5 x 9-13 µm), which shows irregular contour (Fig. 3 C, arrowhead). Posterior end gradually tapering to a long conical cauda, that is either long (11-13 µm, Fig. 3 A) or short (5-6 µm, Figs. 3 B, D). Wall brown to reddish brown, totally covered by exogenous adhered particles. This taxon has been already described with SEM by Tell & Conforti (1988), but they only have reported specimens like those shown in Fig. 3 B. *Strombomonas scabra* var. *hiperintermedia* was only recorded in materials from Argentina, Buenos Aires (Conforti, 1989) and Chaco (Zalocar de Domitrovic, 1991).

Materials: ARGENTINA: Chaco, Lakes Cochereck , 9 May 1979, and "B" in Presidente R. S. Peña, 24 Set. 1990, Zalocar de Domitrovic, C-1092, C-3561.

Strombomonas diptera Zalocar & Tell, *Bull. Mus. Hist. Nat., Paris* 1: 42, lam. VIII, fig. 10. 1980.
Figs. 3, E-F

This species is characterized by the presence of two helycoidal helicoidal wings 2-3 µm long (Figs. 3 E-F, arrowhead), that surround the body from the collar to the cauda. The studied specimens presented some differences than with those described with SEM by Couté & Thérézien (1994). The dimensions are smaller; lorica 30.5-42 µm long, 19.5-21 µm wide, neck 4-7 µm long, 3.5-4 µm diam., cauda 3-4 µm. The envelope showed very irregular contour. It is extremely thick, coarse, with numerous exogenous particles adhered on it its surface which increase the thickness of the wings thickness. This species was only recorded in materials from South America; Argentina, Corrientes (Tell, 1980), Chaco (Tell & Zalocar de Domitrovic, 1985) and Bolivia (Couté & Thérézien, 1994).

Material: ARGENTINA: Chaco, Lake Felman, 5 Nov. 1978, Zalocar de Domitrovic, C-855.

Strombomonas tetraptera Balech & Dastugue, *Physis* 12: 355. 1938.
Figs. 3, G-H

Lorica fusiform, quadrangular with concave sides in apical view. This species is characterized by the presence of four helicoidal wings that surround the body from the collar to the posterior end. Neck short, wide and irregular at the tip. Posterior end gradually narrowed into a conical short cauda (Fig. 3H). The wall is totally covered by agglutinated exogenous granules, which produce a very irregular envelope surface. The specimens studied in this work showed smaller dimensions than those described by Tell & Conforti (1988). These authors reported lorica 43-66 x 25-33 µm, collar 2-3 x 10-12 µm, cauda 4-5 x 10 µm,

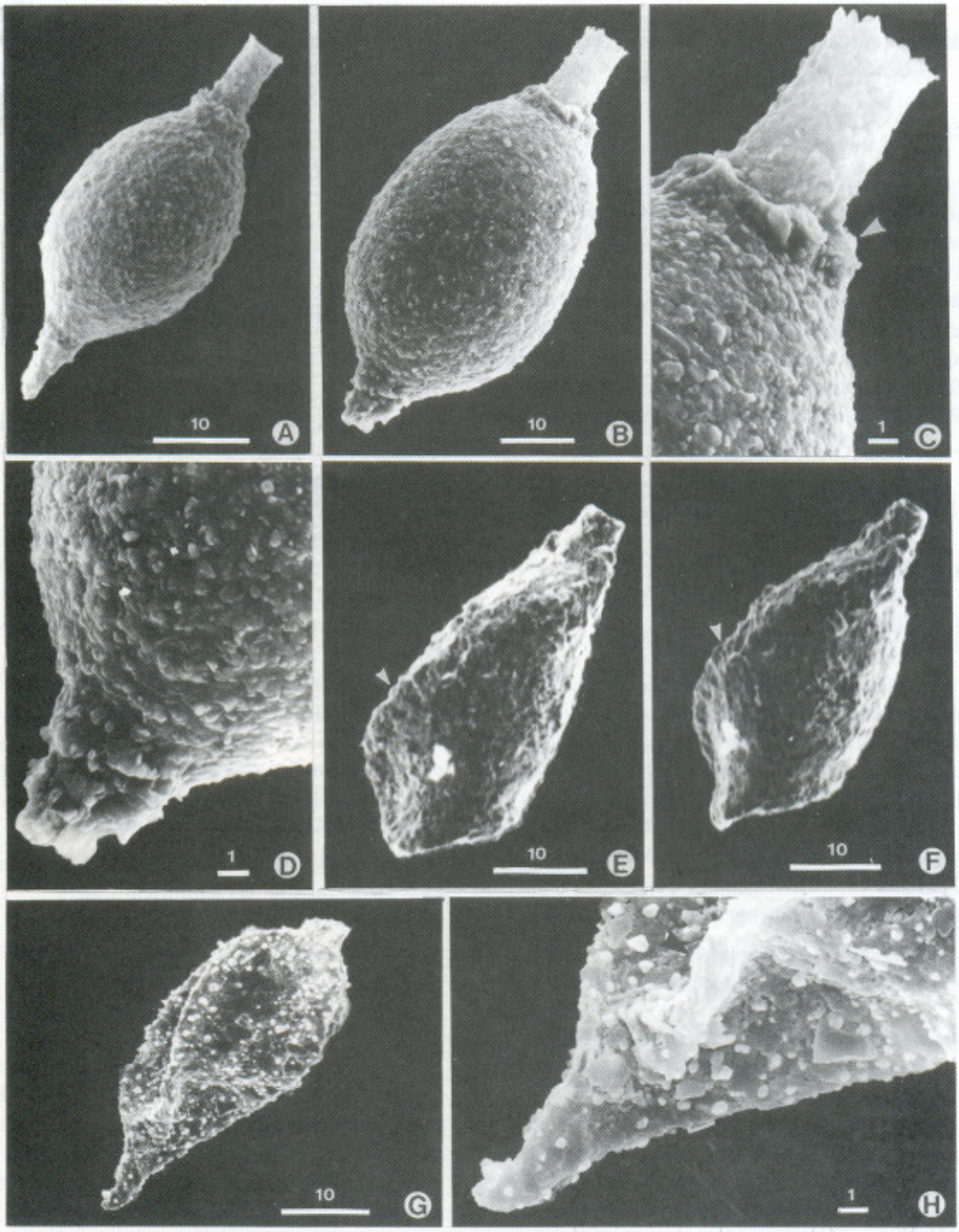

Fig. 3. **A-D**: *Strombomonas scabra* var. *hiperintermedia*, **A-B**. general views; **C**. detail of the neck showing annular thickening (arrowhead) and lorica surface; **D**. detail of the posterior end; **E-F**: *Strombomonas diptera*, general views showing the lateral wing (arrowheads); **G-H**: *Strombomonas tetraptera*, **G**. general view, **H**. detail of the posterior end showing the helicoidal wing (arrowhead) and lorica surface. Scale bar values are given in µm directly on the micrographs.

whereas we observed lorica 44-47 x 18.5-26 µm, collar 3-3.5 x 5-5.5 µm, with a longer cauda, 7.5-8 x 6-6.5 µm and wings with different thickness, 4-5 µm in the first group and 1.5-2 µm in the latter. In spite of the observed morphological differences, we do not estimate that there is enough evidence enough to consider these organisms as two separate taxa. Size variations are probably produced by to different amounts of agglutinated exogenous material. On the other hand, the observed organisms do not coincide either with those described as *Strombomonas tetraptera* var. *gallica* (Bourrelly & Couté, 1978) which do not present wings. This species has exclusively been found in South America: Argentina, Buenos Aires (Balech & Dastugue, 1938), Chaco (Tell & Zalocar de Domitrovic, 1985), Brazil (Conforti, 1993) and Uruguay (Conforti & Pérez, 2000).

Materials: ARGENTINA: Chaco, Lake Felman, 5 Nov. 1978 and "B" in Presidente R. S. Peña, 24 Set. 1990, Zalocar de Domitrovic, C-855, C- 3561.

Conclusions

Among the studied taxa, *S. eurystoma* and *S. longicauda* are new records for the province of Chaco. *S. confortii, S. eurystoma, S. longicauda, S. pizarroi* and *S. urceolata* are described with SEM for the first time. In spite of the fact that *S. diptera, S. scabra* var. *hiperintermedia* and *S. tetraptera* have been already described with SEM in previous works, we include our observations because they showed morphological differences with those materials.

On the other hand, our SEM observations confirm that the characteristic loricae coarse, irregular and granulate in this group are caused by the presence of agglutinated exogenous particles on its wall. All the studied taxa have shown different materials adhered on its their surface. Tell & Conforti (1988) reported that this condition could be used as a good valid taxonomic character to separate *Strombomonas* Deflandre and *Trachelomonas* Ehrenberg, but posteriorly Conforti & Nudelman (1997) reported one species of this latter genus with adhered material.

Among the nine taxa studied, six have only been found in South America (*S. confortii, S. diptera, S. pizarroi, S. scabra* var. *hiperintermedia, S. tellii* and *S. tetraptera*), three of which have only been reported for Argentina (*S. confortii, S. diptera, S. pizarroi* and *S. scabra* var. *hiperintermedia*). Other authors (Uherkovich & Schmidt 1974; Yacubson 1980; Tell & Zalocar de Domitrovic 1985; Thérézien 1989; Zalocar de Domitrovic 1991; Conforti 1993; Couté & Thérézien 1994; Menezes 1996; Tell 1998) who studied euglenoids from different places in South America, have described several species of *Strombomonas* exclusively found in this continent. These reports could indicate the presence of endemic taxa or probably they could be the result of the few studies on this genus in other places of the world. Further analysis of samples from other localities should enhance our understanding not only on their distribution but ultimately on the different characteristics of this poorly known group of euglenoids.

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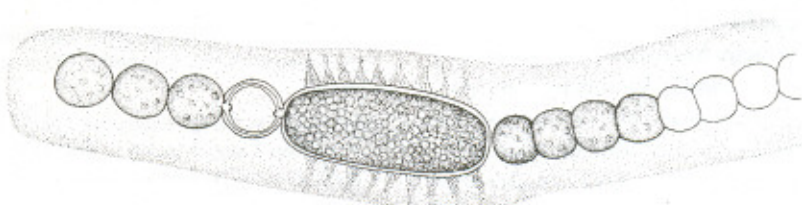

Anabaena echinospora var. *yamano* Guarrera & Echenique