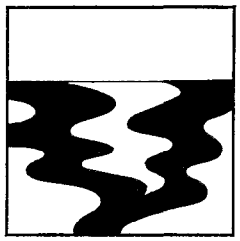

# *Study of the Euglenophyta from Camaleão Lake (Manaus, Brazil)*

## III. *Euglena* Ehr., *Lepocinclis* Perty, *Phacus* Duj.

Visitación Conforti (1)

Abstract

*A total of 85 taxa of Euglenophyta from Camaleão Lake (Marchantaria Island, near Manaus, Brazil) have been studied, 20 belonging to the genus* Euglena *Ehr., 18 to* Lepocinclis *Perty and 47 to* Phacus *Duj. On the basis of these observations we propose 5 new species:* L. americana, L. claviformes, P. pygmaeus, P. rodriguesiae, P. tropicalis; *9 new varieties:* L. globula *var.* major, L. claviformes *var.* ornata, L. salina *var.* caudata, P. acuminatus *var.* brasiliensis, P. balatonicus *var.* minor, P. horridus *var.* major, P. meson *var.* minor, P. segretii *var.* major, P. sesquitortus *var.* multiannulatus *and 3 new forma:* E. spirogyra *var.* fusiformis *fo.* minor, L. glabra *var.* raciborskii *fo.* gigas *and* L. salina *var.* vallicauda *fo.* minor. *Seventeen taxa have been examined by means of scanning electron microscopy.*

Keywords : Morphology — Taxonomy — Ultrastructure — *Euglena* — *Lepocinclis* — *Phacus* — Euglenophyta — Brazil.

Resumen

Estudio de las euglenofitas del lago Camaleão (Manaus, Brasil)
III. *Euglena* Ehr., *Lepocinclis* Perty y *Phacus* Duj.

*En este trabajo hemos estudiado un total de 85 taxones de la clase Euglenophyta, provenientes del lago Camaleão (Isla Marchantaria, próximo a Manaus, Brasil), pertenecientes 20 al género* Euglena *Ehr., 18 a* Lepocinclis *Perty y 47 a* Phacus *Duj. Como resultado de nuestras observaciones decidimos describir 5 especies* L. americana, L. claviformes, P. pygmaeus, P. rodriguesiae, P. tropicalis; *9 variedades* L. globula *var.* major, L. claviformes *var.* ornata, L. salina *var.* caudata, P. acuminatus *var.* brasiliensis, P. balatonicus *var.* minor, P. horridus *var.* major, P. meson *var.* minor, P. Segretii *var.* major, P. sesquitortus *var.* multiannulatus *y 3 formas* E. spirogyra *var.* fusiformis *fo.* minor, L. glabra *var.* raciborskii *fo.* gigas *y* L. salina *var.* vallicauda *fo.* minor *como nuevos taxones. Con la utilización del microscopio electrónico de barrido hemos examinado la ultraestructura de diecisiete taxones.*

Palabras claves : Morfología — Taxonomía — Ultraestructura — *Euglena* — *Lepocinclis* — *Phacus* — Euglenophyta — Brasil.

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RÉSUMÉ

LES EUGLÉNOPHYTES DU LAC CAMALEÃO (MANAUS, BRÉSIL)
III. *EUGLENA* EHR., *LEPOCINCLIS* PERTY ET *PHACUS* DUJ.

*Dans le présent travail, 85 taxons de la classe des Euglenophyta, qui proviennent du lac Camaleão (île Marchantaria, près de Manaus au Brésil), sont étudiés, 20 appartenant au genre* Euglena *Ehr., 18 au genre* Lepocinclis *Perty et 47 au genre* Phacus *Duj. Nous proposons 5 nouvelles espèces :* L. americana, L. claviformes, P. pygmaeus, P. rodriguesiae, P. tropicalis ; *9 nouvelles variétés :* L. globula *var.* major, L. claviformes *var.* ornata, L. salina *var.* caudata, P. acuminatus *var.* brasiliensis, P. balatonicus *var.* minor, P. horridus *var.* major, P. meson *var.* minor, P. segretii *var.* major, P. sesquitortus *var.* multiannulatus *et 3 nouvelles formes,* E. spirogyra *var.* fusiformis *fo.* minor, L. glabra *var.* raciborskii *fo.* gigas *et* L. salina *var.* vallicauda *fo.* minor. *Dix-sept des taxons cités ont été examinés au microscope électronique à balayage.*

MOTS CLÉS : Morphologie — Taxonomie — Ultrastructure — *Euglena* — *Lepocinclis* — *Phacus* — Euglenophytes — Brésil.

## INTRODUCTION

Due to the high diversity of the euglenophyta found in Camaleão Lake, Manaus, Brazil, we divided the publication of our results into three parts, the first one was dedicated to the genus *Trachelmonas* Ehr. (CONFORTI, 1993) and the second to the genus *Strombomonas* Defl. (CONFORTI, 1994). In the last paper of this series, we deal only with the naked genera *Euglena* Ehr., *Lepocinclis* Perty and *Phacus* Duj.

We have recorded 85 taxa, 47 belonging to genus *Phacus*, 20 to *Euglena* and 18 to *Lepocinclis*. We propose as new taxa *E. spirogyra* var. *fusiformis* fo. *minor*, *L. americana*, *L. claviformes*, *L. claviformes* var. *ornata*, *L. glabra* var. *raciborskii* fo. *gigas*, *L. globula* var. *major*, *L. salina* var. *caudata*, *L. salina* var. *vallicauda* fo. *minor*, *P. acuminatus* var. *brasiliensis*, *P. balatonicus* var. *minor*, *P. meson* var. *minor*, *P. pygmaeus*, *P. rodriguesiae*, *P. segretii* var. *major*, *P. sesquitortus* var. *multiannulatus* and *P. tropicalis*. In addition, data on the ultrastructure of the lorica of 6 taxa of *Euglena*, 4 of *Lepocinclis* and 7 of *Phacus* are included in this work.

## MATERIAL AND METHODS

The study area, the material and methods have been described in the first paper of this series (CONFORTI, 1993). We have recorded a total of 85 taxa belonging to naked genera of Euglenophyta, *Euglena*, *Lepocinclis* and *Phacus* (see Annexe). Only new taxa and those whose ultrastructure was observed are described in the text. In some cases, additional comments on relevant morphological or distribution characteristics are provided. For S.E.M. observations organisms were isolated under a dissecting microscope with the aid of micropipettes, dehydrated in gradually acetone and dried in a Critical Point Dryer (Balzers CPD 030). The specimens on coverslips were coated with gold paladium in a vacuum evaporator (ION Sputtering Balzers SCD 040). Samples were examined and photographed by means of a S.E.M. (Phillips 505) at the Electron Microscopy Service of CITEFA, Argentina.

## TAXONOMICAL DESCRIPTIONS
## FAMILY EUGLENACEAE

***Euglena* Ehr.**
***E. allorgei* Defl.** (pl. I, fig. 8)

The cells observed in our materials were shorter than those described by DEFLANDRE (1924), 93-94 µm long, 14-15 µm broad in Europe. In America : Argentina, Brazil.

***E. oxyuris* Schmarda** (pl. I, figs. 12a, b, pl. VI, figs. 4-6)

Cell 131-160 µm long, 16-18 µm broad, tail piece 16-18 µm long. The organisms occurring in our samples were morphologically similar to the taxon described by CONFORTI and TELL (1989). Widespread.

**var. *charkowiensis* (Swir.) Chu** (pl. I, fig. 13; pl. VI, figs. 1-3, 7)

Cell 111-134 µm long, 24-25 µm broad, tail piece 16-18 µm long. The ultrastructure of the specimens

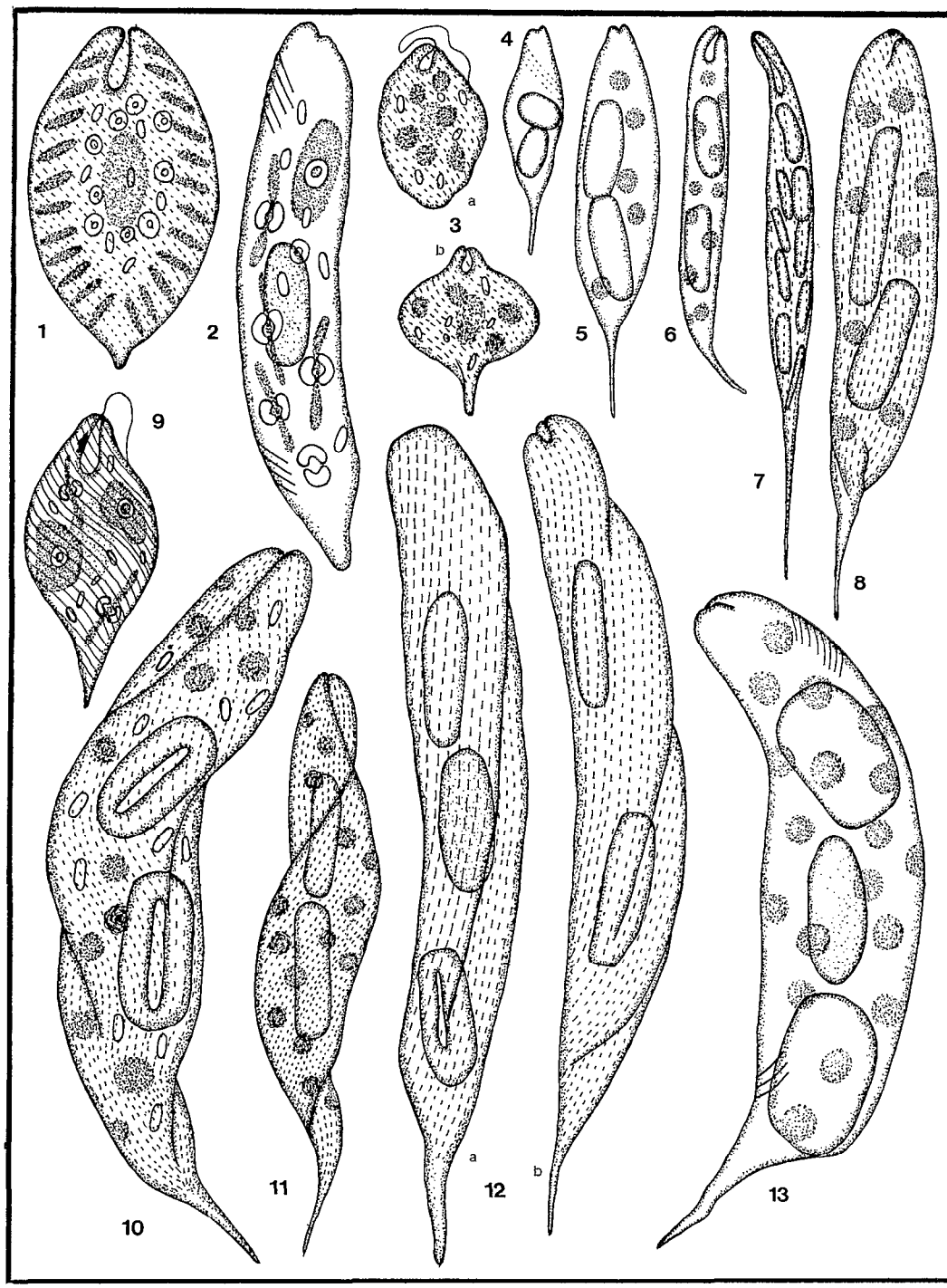


PLATE I

FIG. 1. — *E. oblonga*; 2. *E. communis*; 3 a, b. *E. variabilis*; 4. *E. limnophila* var. *minor*; 5. *E. limnophila*; 6. *E. intermedia* var. *brevis*; 7. *E. acus*; 8. *E. allorgei*; 9. *E. gracilis*; 10. *E. spiroides* var. *annulata*; 11. *E. tripteris*; 12 a, b. *E. oxyuris*; 13. *E. oxyuris* var. *charkowiensis*.

from Camaleão Lake was similar to the organisms described by CONFORTI and TELL (1989). Widespread.

***Euglena sp.*** (pl. VI, figs. 8-10)

We were unable to determine this taxon which was studied with S.E.M., since its morphology differs from those observed and determined under the optic microscope. We nevertheless consider interesting to show this material, because the disposition of the striae adopt during the metabolic movements can be observed. The body exhibits a torsion around its main axis and a shortening in length, a central discoid zone (13-14 μm diam.) and two conical ones, one anterior and another posterior, being differentiated (pl. VI, fig. 8). The cuticular bands which accompany this deformation show at certain places (pl. VI, fig. 10, arrow) a wider separation (0.7-1 μm), which is not maintained along the whole interband.

***E. spirogyra*** **Ehr.** (pl. II, fig. 8; pl. VI, fig. 17; pl. VIII, fig. 1)

Cell 70-100 μm long, 10-15 μm broad, tail piece 10-30 μm, ribbon-like, may present a torsion and helicoidal disposition of the striae (pl. VII, fig. 1). The organisms from the Camaleão Lake present more developed warts than those described by DAWSON *et al.* (1988), 1-1.8 μm high, 0.6-1 μm broad, constricted in the base and expanded to the free end. Widespread.

**var.** ***fusca*** **Klebs** (pl. II, fig. 3; pl. VI, figs. 13-16)

Cell 130-164 μm long, 21-24 μm broad, tail piece 20-28 μm, ribbon-like, the cellular body may present a torsion and a helicoidal disposition of the striae. The ultrastructure of this species has been described by BOURRELLY *et al.* (1976) and by CONFORTI and TELL (1989). Some specimens of the material from Camaleão Lake showed shorter warts (0.6-0.7 × 0.5-0.6 μm) and are formed by filaments arranged closer than those found in materials from Argentina or Europe. Widespread.

**var.** ***fusiformis*** **Defl. fo.** ***minor*** **n. fo.** (pl. II, fig. 7; pl. VI, figs. 11-12)

*Varietate a minoribus dimensionibus differt. Cellulae* 70-79 μm *long*, 18-20 μm *lat. In* Camaleão *lacu*, Manaus, Brasil, IX-X/88, X/87. *Holotypus tab. II, fig. 7.*

This new forma presented the same characteristics as the variety, the only difference being the smaller dimensions of the cell 70-79 μm long, 18-20 μm diam, tail piece 22-25 μm. The warts are very thin in the base (1-1.2 μm) and expanded to the free end (3-3.5 μm).

The variation of surface ornamentation in *E. spirogyra* and related organisms in account of environmental conditions has been recognized by LEFÈVRE (1934); SKUJA (1948); LEEDALE (1964); LEEDALE *et al.* (1965) and has recently been confirmed by DAWSON *et al.* (1988). Therefore it is interesting that, in the same sample, organisms belonging to same taxon present different development and morphology of the warts. Undoubtedly much is left to be known in this group of organisms and the causes which determine the presence of different types of cuticular ornamentation.

***Lepocinclis*** **Perty**

***L. americana*** **n. sp.** (pl. II, figs. 6 a-c; pl. VII, figs. 7-10)

*Cellulae* 49-58 μm *long.*, 23-30 μm *lat., ovoideae, ad polum anteriorem rotundatae; ad posteriorem, gradatim in caudam longam restrictae. Cuticula striata sinistrorsum, verrucis conicis ornata, quae in caudam dimensionibus minuunt. Duo magni annuli paramyli. Numerosi chloroplasti discoidei. In* Camaleão *lacu*, Manaus, Brasil. IX/87, XII/87-I/88, I-III/88. *Holotypus tab. II, fig. 6 b.*

Cell 49-58 μm long, 26-30 μm diam., ovoid, anterior end rounded, the posterior end gradually tapered to a long (13-16.5 μm) cauda. Pellicle striated to the left, ornamented by conical protuberances, which decrease in dimensions to the cauda. Two large lateral rings of paramylon. Numerous discoid chloroplasts. Stigma and flagellum were not observed.

This new species resembles *L. spirogyra* Korschik. in the ornamented pellicle but it differs mainly in the shape of its cells, specially in the anterior end.

***L. claviformes*** **n. sp.** (pl. II, fig. 12)

*Cellulae* 57-62 μm *long.*, 21-23 μm *lat., claviformes, in polum anteriorem planae, leviter in medio depressae, in polum posteriorem gradatim constrictae in conicam, longam caudam. Cuticula striata sinistrorsum. Duo annuli paramyli laterali. Chloroplasti multi discoidei. In* Camaleão *lacu*, Manaus, Brasil. XII/87-I/88. *Holotypus tab.* II, *fig.* 12.

Cell 57-62 μm long, 21-23 μm diam.; club-shaped, anterior end flattened, slightly depressed in the centre; posterior end gradually tapered to a conical long (13-15 μm) cauda. Pellicle spirally striated to the left. Two large lateral rings of paramylon. Numer-

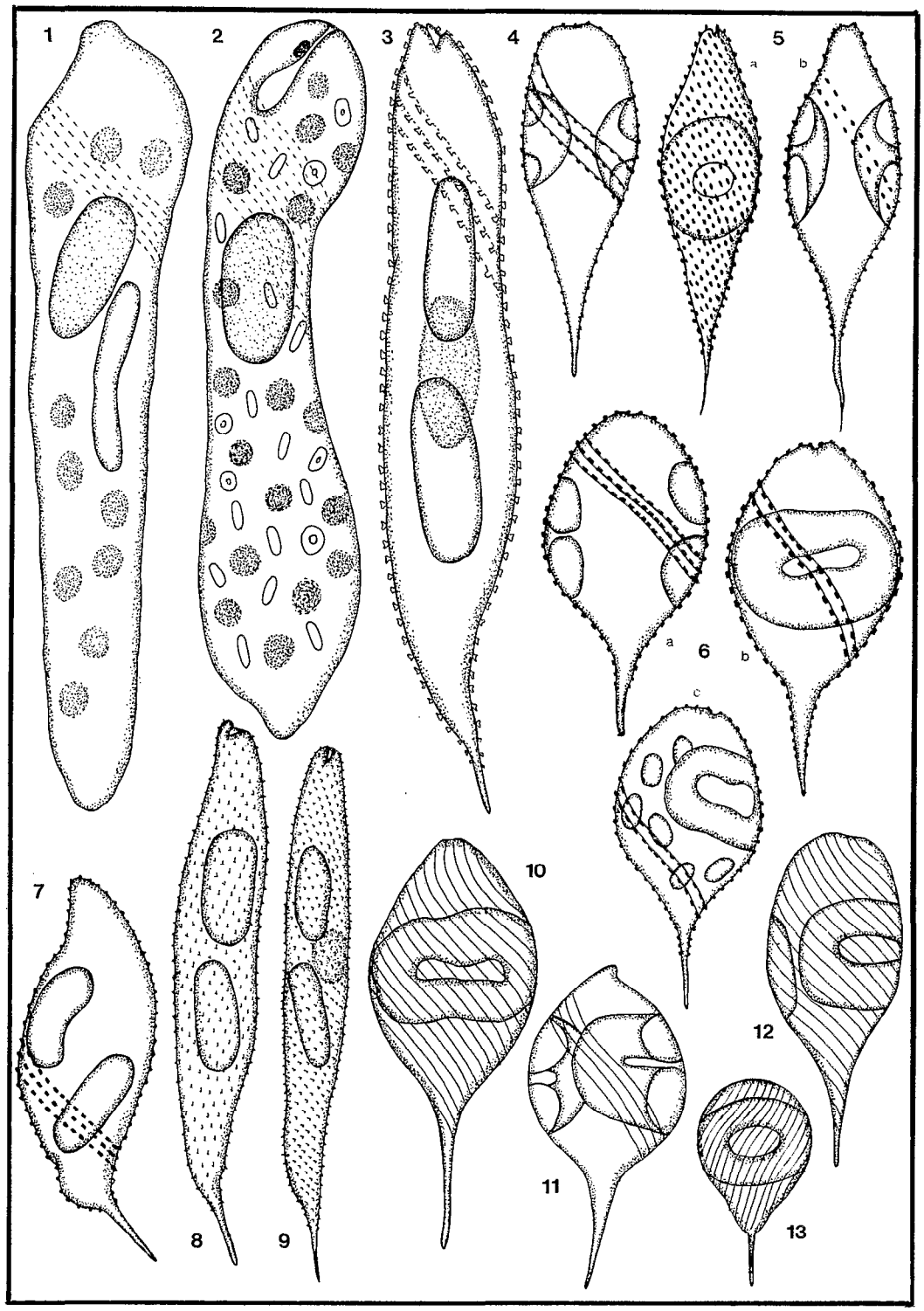


PLATE II

FIG. 1. — *E. ehrenbergii* var. *baculifera*; 2. *E. subehrenbergii*; 3. *E. spirogyra* var. *fusca*; 4. *L. claviformes* var. *ornata*; 5 a, b. *L. spirogyra*; 6 a-c. *L. americana*; 7. *E. spirogyra* var. *fusiformis* fo. *minor*; 8. *E. spirogyra*; 9. *E. spirogyra* var. *marchica*; 10. *L. caudata*; 11. *L. playfairiana* var. *striata*; 12. *L. claviformes*; 13. *L. piriformis*.

ous, discoid chloroplast. Stigma and flagellum were not observed.

We considered this organisms as a new species, because the shape of its cells does not resemble that of any other taxon.

**var. *ornata* n. var.** (pl. II, fig. 4)

*A specie differt cuticula ornata. Cellulae* 56-59 μm *long.*, 19-21 μm *lat. In* Camaleão *lacu*, Manaus, Brasil, IV/88. *Holotypus tab. II, fig. 4.*

This new variety presented the same characteristics as the species, the only difference being the pellicle distinctively ornamented with protuberances.

***L. fusiformis* (Carter) Lemm. *em.* Conr.** (pl. III, figs. 8 a, b)

Cell 30-35 μm long., 20-29 μm broad. Some specimens from Camaleão Lake presented four rings of paramylon instead of two (fig. 8 b). We do not consider this character sufficient to create a new taxon. Widespread.

***L. glabra* var. *raciborskii* Drez. fo. *gigas* n. fo.** (pl. III, fig. 15)

*A varietate majoribus dimensionibus differt. Cellulae* 30-37 μm *long.*, 26-32 μm *lat. In* Camaleão *lacu*, Manaus, Brasil, IX/87. *Holotypus tab. III, fig. 15.*

This new forma showed characteristics identical to the variety, the only difference being the larger dimensions of the cell 30-37 μm long, 26-32 μm diam.

***L. globula* Perty var. *major* n. var.** (pl. III, fig. 14)

*A specie majoribus dimensionibus differt. Cellulae* 30-33 μm *long.*, 31-33 μm *lat. In* Camaleão *lacu*, Manaus, Brasil, XII/87-I/88. *Holotypus tab. III, fig. 14.*

These organisms were considered as a variety of *L. globula* Perty because they presented the same morphological characters, they only differed from the type by the larger dimensions of the cell, 30-33 μm long, 31-33 μm diam.

***L. ovum* (Ehr.) Lemm. var. *ovum*** (pl. III, figs. 4 a, b; pl. VII, figs. 4-5)

Cell 25-36 μm long, 15-22 μm diam. Pellicle helicoidally striated to the left. The number of the striae decrease by undertucking process (Guttman and Ziegler, 1974), to the apical pore (pl. VII, fig. 4, arrow). Widespread.

**var. *butschlii* (Lemm.) Conr.** (pl. III, fig. 7 a, b; pl. VII, fig. 6)

Cell 35-40 μm long, 20-23 μm diam., caudus 4-7 μm long. Pellicle helicoidally striated to the left, with characteristics similar to those of the typical species. Widespread.

***L. playfairiana* var. *striata* Conf.** (pl. II, fig. 11)

The cells observed from the Camaleão Lake were longer than the specimens described by Conforti (1991), 50-55.5 μm long. This variety was originally reported in materials from Argentina, this is the only other record of it in the world.

***L. salina* Fritsch** (pl. III, fig. 1 ; pl. VII/2, 3)

The organisms recorded from Camaleão Lake were broader than those described by Fritsch (1914); 54-60 μm long, 49-51 μm broad. Our observations of the ultrastructure of this species (pl. VII, figs. 2, 3) were similar to those described by Conforti and Tell (1983). Widespread.

**var. *caudata* n. var.** (pl. III, fig. 3)

*A specie differt cellulis majoribus et polo posteriore rotundato cum cauda recta. Cellulae* 43-45 μm *long.*, 32-34 μm *lat. In* Camaleão *lacu*, Manaus, Brasil. XII/87-I/88. *Holotypus tab.* III, *fig.* 3.

This new variety presented the same characteristics as the specie, the difference being the large dimensions (43-45 × 32-34 μm) and the posterior end tapered to a short conical cauda (4-5 μm).

**var. *vallicauda* Conr. fo. *minor* n. fo.** (pl. III, fig. 2 a, b)

*A varietate minoribus dimensionibus differt. Cellulae* 43-45 μm *long.*, 22.5-28 μm *lat. In* Camaleão *lacu*, Manaus, Brasil. XII/87-I/88. *Holotypus tab.* III, *fig.* 2 a.

This forma presented the same characteristics as the variety, the only difference being the smaller dimensions of the cell, 43-45 μm long, 22.5-28 μm broad, cauda 5-6.5 μm long.

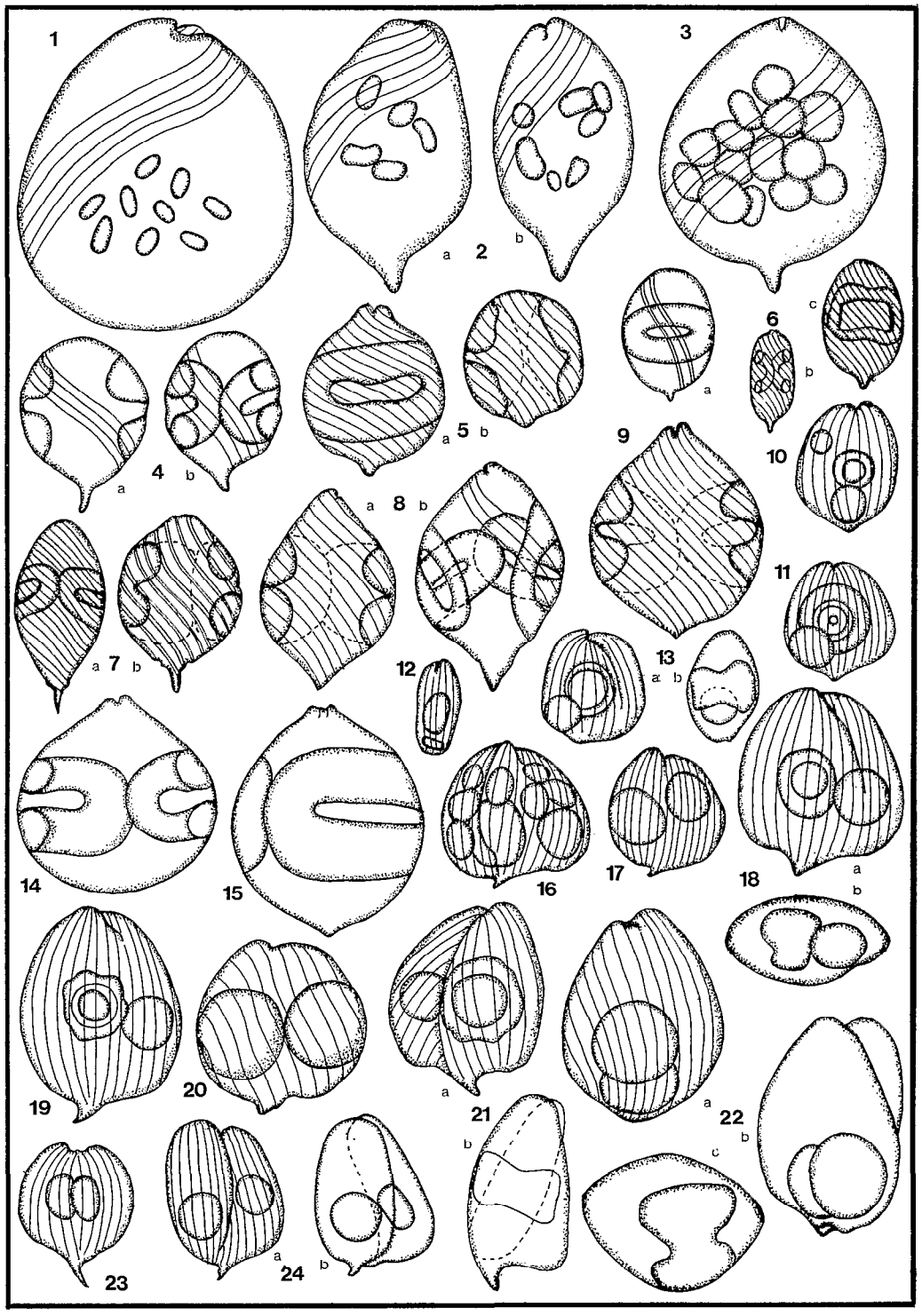


PLATE III

FIG. 1. — *L. salina*; 2 a, b. *L. salina* var. *vallicauda* fo. *minor*; 3. *L. salina* var. *caudata*; 4 a, b. *L. ovum*; 5 a, b. *L. ovum* var. *globula*; 6 a-c. *L. ovum* var. *dimidio-minor*; 7 a, b. *L. ovum* var. *butschlii*; 8 a, b. *L. fusiformis*; 9. *L. fusiformis* var. *amphirhynchus*; 10. *P. stokesii* fo. *minor*; 11. *P. acuminatus* var. *discifera*; 12. *P. granum*; 13 a, b. *P. balatonicus* var. *minor*; 14. *L. globula* var. *major*; 15. *L. glabra* var. *raciborskii* fo. *gigas*; 16. *P. incrassatus*; 17. *P. curvicauda* fo. *robusta*; 18 a, b. *P. viguieri*; 19. *P. brachykentron*; 20. *P. lextus*; 21 a, b. *P. curvicauda*; 22 a-c. *P. segretii* var. *major*; 23. *P. pygmaeus*; 24. *P. anomalus*.

***Phacus* Duj.**

***P. acuminatus* Stokes var. *brasiliensis* n. var.** (pl. IV, figs. 4 a, b)

*A typo differt magno paramylo bacilliformi, circumdato aliis minoribus. Cellulae* 29-31 µm *long.*, 23-25 µm *lat. In* Camaleão *lacu*, Manaus, Brasil. XII/87-I/88, IX-X/88. *Holotypus tab.* IV, *figs.* 4 b.

Cell 29-31 µm long, 23-24 µm broad. This variety presents one very large rod shaped paramylon body, surrounded by smaller scattered oval to round plates. The other characters are identical to those of the typical species.

**var. *discifera* (Pochm.) Hub.-Pest.** (pl. III, fig. 11)

Cell 19-20 µm long, 17-19 µm broad. This variety was only found in materials from France. It is here first record for America.

***P. angulatus* Pochm.** (pl. IV, fig. 6)

Cell 31-33 µm long, 23-25 µm broad. This species was seldom found: India, Argentina, Brazil.

***P. balatonicus* Hort. var. *minor* n. var.** (pl. III, figs. 13 a, b)

*A specie minoribus dimensionibus differt. Cellulae* 19-20 µm *long.*, 16-17 µm *lat. In* Camaleão *lacu*, Manaus, Brasil. X/87. *Holotypus tab.* III, *fig.* 13, a, b.

This variety presented the same characteristics as the typical species, the only difference being the smaller dimensions of the cell; 19-21 µm long, 16-17 µm broad.

***P. contortus* Bourr.** (pl. IV, figs. 1 a, b)

Cell 41-42 µm long, 33-38 µm broad. This species was only found in tropical and warm temperate areas; Argentina, Brazil and Guadeloupe.

***P. curvicauda* var. *robusta* All. et Lef.** (pl. III, fig. 17)

Cell 20.5-30 µm long, 18.5-26 µm broad. This variety was only found in Europe, this is the first time that it is recorded in America.

***P. ephippion* Pochm.** (pl. V, fig. 11)

Cell 60-63 µm long, 30-33 µm broad. The identification of this species was based on the shape and the dimensions of the cell; the greater number of paramylon bodies could be due to an extraordinary amount of organic matter in the water. This taxon was found only in South Africa and South America: Argentina, Brazil.

***P. heimii* Lef.** (pl. IV, fig. 2)

Cell 31-43 µm long, 27-34 µm broad. This species was only recorded from Indochina and South America: Argentina, Brazil.

***P. horridus* Pochm.** (pl. V, fig. 14; pl. IX, figs. 7-9)

Cell 29-30 µm long, 19-20 µm broad, widely ovate to ovate, symmetrical, moderately flattened, ovate to elliptic in polar view. Anterior end obtuse with a prominent, papillate collar surrounding the flagellar pore. Posterior end broadly rounded, with a well-developed, straight bluntly-pointed cauda, torsioned at its base, 6-8 µm long. Pellicle longitudinally striate. In frontal view 9 strips ornamented with conspicuous spines curved downwards (1-1.5 µm long), alternating with smooth bands. The distance between two spines ranges from 0.8-1 µm. The width of the strips is 1.7-2 µm. The spines are not present in the cauda. Europe, Argentina, Brazil.

**var. *major* n. var.** (pl. V, fig. 13, 17)

*A specie majoribus dimensionibus differt*, 38-60 µm *long.*, 22-37 µm *lat. In* Camaleão *lacu*, Manaus, Brasil. IV/88. *Holotypus tab.* V, *fig.* 17.

This variety presented the same characteristics as the type, the only difference being the bigger dimensions of the cell, 38-60 µm long, 22-37 µm broad.

We consider that the specimens of *P. horridus* described by Tell and Zalocar (1985) from materials of Argentina, should be included in this new variety. They also showed larger dimensions than the type, 47-57 × 30-36 µm.

***P. incrassatus* (Defl.) Pochm.** (pl. III, fig. 16)

Cell 19-24 µm long, 21-25 µm broad. This species was only found in materials from South America : Argentina, Brazil, Venezuela.

***P. longicauda* (Ehr.) Duj. var. *longicauda*** (pl. VII, fig. 10; pl. IX, figs. 1-2)

Cell 78-110 µm long, 24-39 µm broad, flattened with a median longitudinal swelling. Anterior end broadly rounded, symmetrical, strongly overlapped. Lateral margins entire. Posterior end tapering into a straight or curved, very long (30-40 µm) pointed

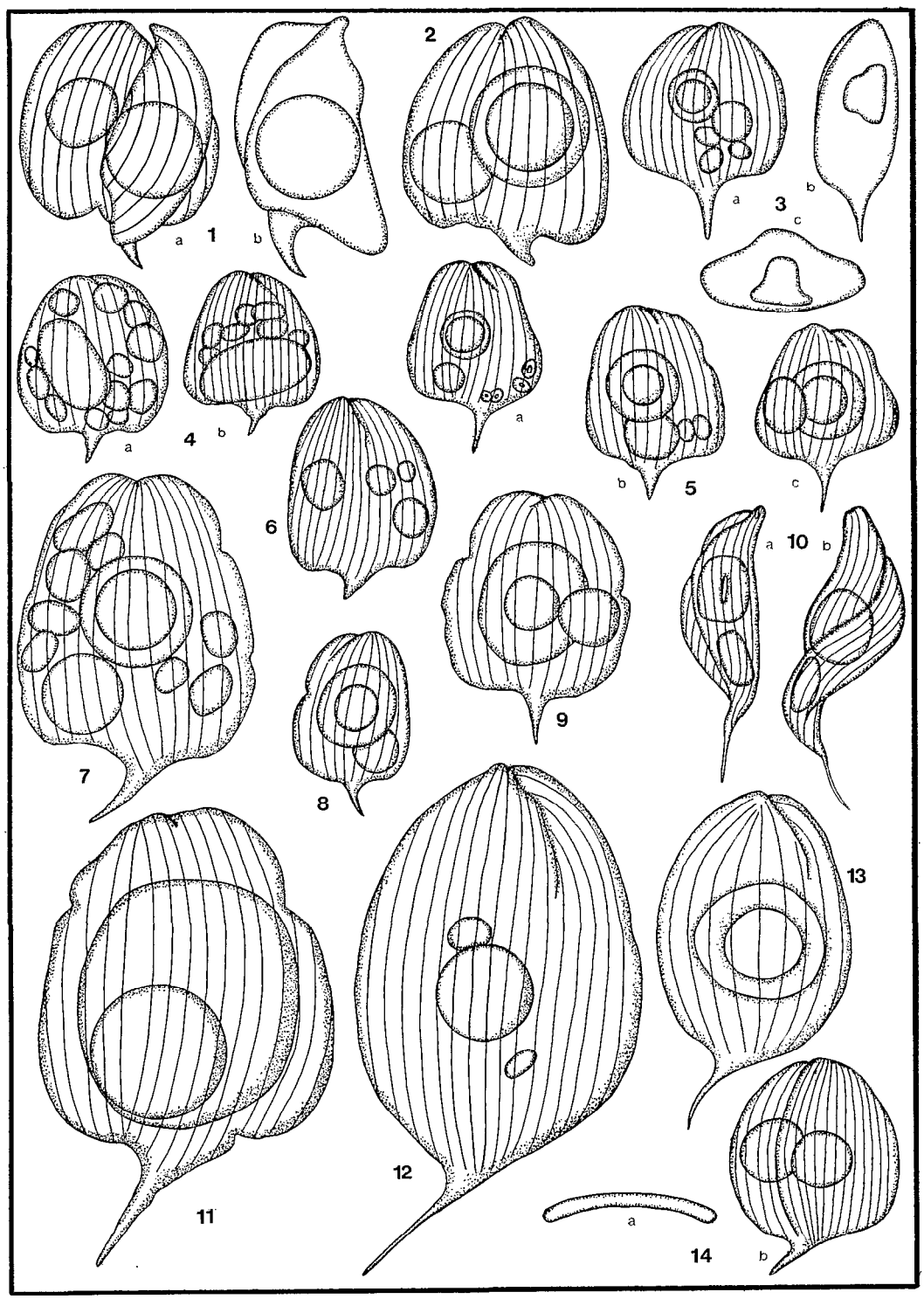


PLATE IV

FIG. 1a, b. — *P. contortus*; 2. *P. heimii*; 3a-c. *P. tropicalis*; 4a, b. *P. acuminatus* var. *brasiliensis*; 5a-c, *P. rodriguesiae*; 6. *P. angulatus*; 7. *P. undulatus*; 8. *P. unguis*; 9. *P. indicus*; 10a, b. *P. raciborskii* var. *longus*; 11. *P. orbicularis*; 12. *P. orbicularis* fo. *gigas*; 13. *P. hamatus*; 14a, b. *P. pleuronectes*.

cauda. In frontal view the pellicle shows 14 longitudinal striae. One central disc of paramylon. Widespread.

**var. *insecta* Kocz.** (pl. V, fig. 6; pl. IX, figs. 5, 6)

Cell 130-157 µm long, 35-45 µm broad, widely ovate with a dorsal swelling that extends the full length of the cell, anterior end broadly rounded, posterior end tapering into a straight or slightly curved, very long cauda (50-70 µm long). Lateral margins irregular, each bearing one or more conspicuous notches (pl. IX, fig. 6). Pellicle longitudinally striated (3-4 in 10 µm). The striae run along the cell from the apex to the posterior end where they reduce their number in the cauda. Widespread.

**var. *major* fo. *insecta* Hub.-Pest.** (pl. V, fig. 12)

The specimens observed from Latin America were bigger than those described by HUBBER-PESTALOZZI (1955) from Hungary : for Argentina (CONFORTI, 1991) 193-198 µm long, 49-55 µm broad, cauda 101-105 µm long; for Camaleão Lake 215-220 µm long, 68-70 µm broad, cauda 130-135 µm long.

**var. *rotunda* Hub.-Pest.** (pl. V, fig. 7)

Cell 120-126 µm long, 41-48 µm broad, cauda 54-60 µm long. This variety was only found in tropical and warm temperate areas: Argentina, Brazil, Java.

***P. margaritatus* Pochm.** (pl. V, fig. 16)

Cell 30-34 µm long, 21-22 µm broad. This species was only found in France and South America: Argentina, Brazil.

***P. meson* Pochm. var. *minor* n. var.** (pl. IX, figs. 3, 4)

*A specie minoribus dimensionibus differt. Cellulae* 74-75 µm *long.*, 21-23 µm *lat. In* Camaleão *lacu*, Manaus, Brasil. I-III/88. *Holotypus tab.* IX, *fig.* 3.

Cell ovate-elliptic, weakly asymmetrical with a prominent dorsal keel that reaches the posterior end of the cell. The dorsal face convex and the ventral face flat. Anterior end broadly rounded, slightly emarginate. Posterior end tapering into a well developed, straight, sharply-pointed cauda, 22-25 µm long. The lateral margins undulated, each bearing one or more conspicuous notches (pl. IX, fig. 4). The cell is furrowed by prominent longitudinal striae (6 in 10 µm). They run along the cell from the apex to the posterior end where they reduce their number in the cauda. The organisms recorded from Camaleão Lake were smaller than those described by POCHMANN (1942), 74-75 µm long, 21-23 µm broad.

***P. orbicularis* Hübn.** (pl. IV, fig. 11; pl. VIII, figs. 1-3)

Cell 71-110 µm long, 40-60 µm diam., orbicular to globose, asymmetrical, with a central keel running longitudinally along the cellular body determining a triangular shape in polar view. Anterior end asymmetrically rounded, each lateral margin bearing one or more conspicuous notches (pl. VIII, fig. 3). The cell is furrowed by longitudinal striae (5-6 in 10 µm), they run along the cell from the apex to the posterior end where they reduce their number in the cauda, by undertucking process (GUTTMAN and ZIEGLER, 1974). The pellicle also shows very fine transversal striae very close to each other and forming a straight angle with the longitudinal striae (13-20 in 10 µm). Widespread.

***P. pseudonordstedtii* var. *minuscula* Hub.-Pest.** (pl. V, fig. 8)

Cell 20-24 µm long, 10-12 µm broad, cauda 8-10 µm long. This variety was described by HUBER-PESTALOZZI (1955) in materials from Sunda Island of Sumbarva. This is the first time that it is recorded in America.

***P. pygmaeus* n. sp.** (pl. III, fig. 23)

*Cellulae* 22-24 µm *long.*, 19-20 µm *lat., late ovoideae, symmetricae, leviter compressae. Polus posterior, in cauda curva, acuta attenuatus. Cuticula longitudinaliter striata. Duo disci paramyli centrales. Numerosi chloroplasti discoidei. In* Camaleão *lacu*, Manaus, Brasil. IV/88. *Holotypus tab.* III, *fig.* 23.

Cell 22-24 µm long, 19-20 µm broad; widely ovate, symmetrical, moderately flattened, ovate to elliptic in polar view. Anterior end rounded with a central depression. Posterior end tapered to a curved, acute cauda (4.5-5 µm long). Pellicle longitudinally striate. Two paramylon discs lying in the centre of the cell. Numerous discoid chloroplasts.

This newly established species resembles in its body shape some species of *Phacus* with ornamented pellicle like *P. suecicus* Lemm. or *P. monilatus* Stokes, but its differs on account of the anterior end with its conspicuously central depression.

***P. raciborskii* var. *longus* Conf.** (pl. IV, figs. 10 a, b)

The organisms observed in the samples of Camaleão Lake were longer than those described by CON-

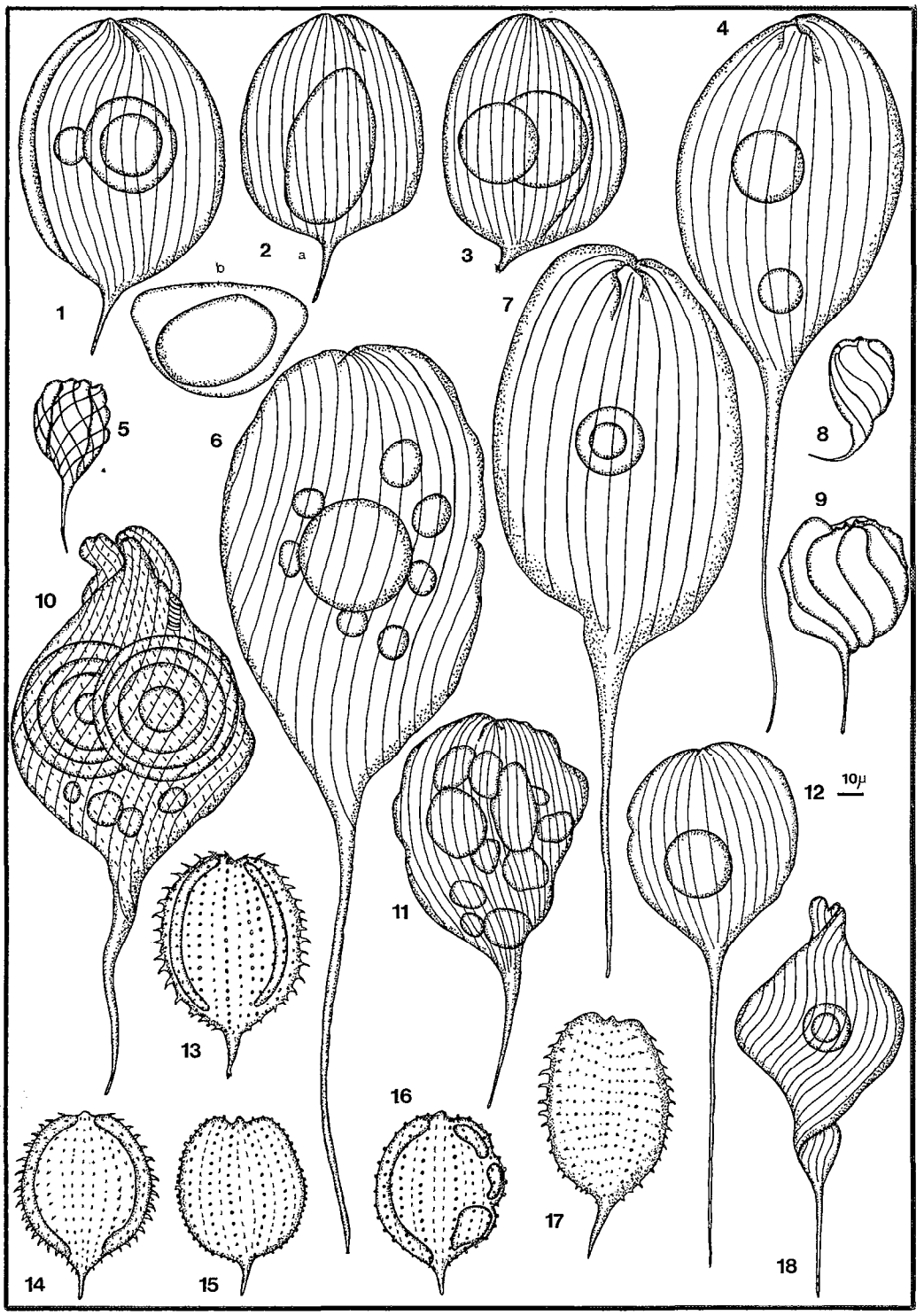


PLATE V

FIG. 1. — *P. platalea*; 2 a, b. *P. platalea* var. *liszae*; 3 a, b. *P. triqueter*; 4. *P. lismorensis*; 5. *P. rudicula*; 6. *P. longicauda* var. *insecta*; 7. *P. longicauda* var. *rotunda*; 8. *P. pseudonordstedtii* var. *minuscula*; 9. *P. pseudonordstedtii*; 10. *P. sesquitortus* var. *multiannulatus*; 11. *P. ephippion*; 12. *P. longicauda* var. *major* fo. *insecta*; 13 & 17. *P. horridus* var. *major*; 14. *P. horridus*; 15. *P. suecicus*; 16. *P. margaritatus*; 18. *P. sesquitortus*.

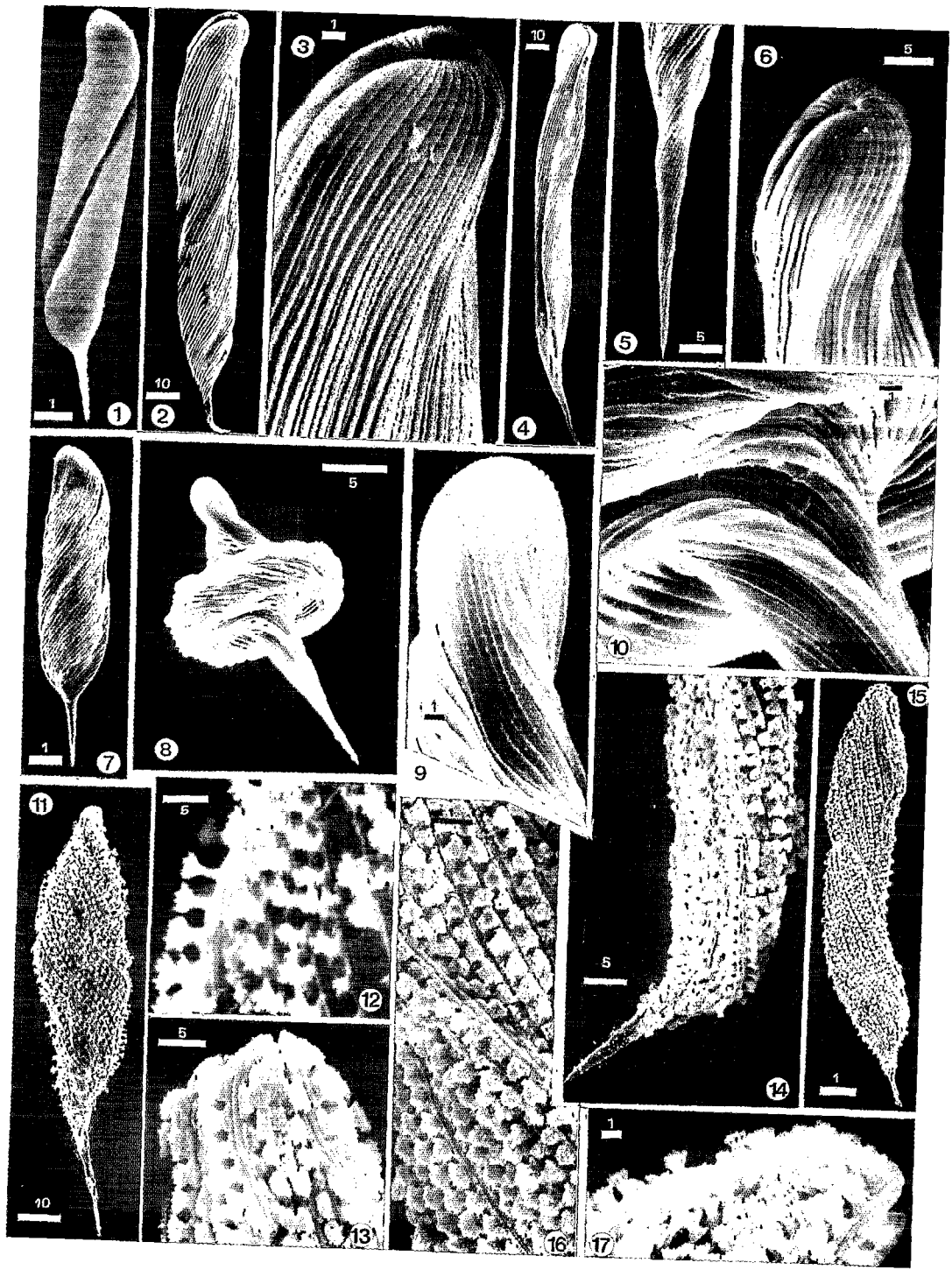

PLATE VI

FIG. 1, 2, 3, 7. — *E. oxyuris* var. *charkowiensis*; 4-6. *E. oxyuris*; 8-10. *Euglena sp.*; 11-12. *E. spirogyra* var. *fusiformis* fo. *minor*; 13-16. *E. spirogyra* var. *fusca*; 17. *E. spirogyra*.

FORTI (1989) in materials from Argentina; 47-53 μm long, 12-15 μm broad.

***P. rodriguesiae* n. sp.** (pl. IV, fig. 5 a-c)

*Cellulae* 32-34 μm *long.*, 22-24 μm *lat., fere quadrangulare, asymmetricae. Polus anterior late rotundatus, sulco apicale breve. Margines, unus integrus, alter incisus vel uterque cum levi concavitate centrali. Polus posterior gradatim restrictus in cauda recta, acuta. Cellulae fusiformes a latere visae. Cuticula longitudinaliter striata. Granum paramyli, unum trochleare, unum disciforme, circundatum alteribus minoribus annularibusque. Chloroplasti numerosi, discoidei. In* Camaleão *lacu*, Manaus, Brasil. XI/87, IV/88, IX-X/88, XI-XII/88. *Holotypus tab.* IV, *fig.* 5 a.

Cell 32-34 μm long, 22-24 μm broad, trapezoidal, asymmetrical. Anterior end broadly rounded, strongly overlapped, with a short apical furrow. Lateral margins, one entire and the other with a notch or both with a slight central concavity. Posterior end tapered with a straight and acute cauda (7-10 μm long). Cell fusiform in lateral view. Periplast longitudinally striated. One bobbin-like paramylon body, and one discoid surrounded by smaller plates or link-shaped. Numerous, discoid chloroplasts.

We considered that the organisms described as *P. acuminatus* var. *acuticauda* Pochm. by ALVES DA SILVA *et al.* (1991 : 817-818, fig. 9) were erroneously named. They showed the same characters as this new species, therefore they should be determined as *P. rodriguesiae.*

***P. segreti* var. *major* n. var.** (pl. III, figs. 22 a-c)

*A varietate dimensionibus majoribus paramyloque trochleari differt. Cellulae* 34-35 μm *long.*, 25-26 μm *lat. In* Camaleão *lacu*, Manaus, Brasil, X/87. *Holotypus tab.* III, *figs.* 22 a-c.

This variety showed the same characters as the typical species, the differences being the bigger dimensions of the cell, 34-35 μm long, 25-26 μm broad, and the bobbin-like paramylon body.

***P. sesquitortus* Pochm.** (pl. V, fig. 18; pl. VIII, figs. 4-7)

Cell 69-78 μm long, 34-40 μm broad, cauda 24-25 μm long. The structure of this species is the same as that observed in *P. tortus* (Lemm.) Skv. except that it shows a double torsion of the body, instead of a single twisting. There are 14 main striae on each face (6-7 in 10 μm), mounted on a elevation of the pellicle which follows the cell's torsion. Thinner transversal striae extend between those above mentioned (29-30 in 10 μm). The torsion originates in the apical end, extends along the whole cell and produces two helicoidal rotations. The cellular edge is strengthened by a broad rounded fringe of 1-15 μm in width. The ultrastructure of the organisms from Camaleão Lake was similar to that described by CONFORTI and TELL (1989) in specimens from Argentina. Australia, Argentina, Brazil.

**var. *multiannulatus* n. var.** (pl. V., fig. 10)

*Cellulae* 85-90 μm *long.*, 38-40 μm *lat. Varietas differens praesentia duorum corporum paramyli lateralium, per quattuor vel quinque annulos superpositos compositorum. In* Camaleão *lacu*, Manaus, Brasil. IX/87. *Holotypus tab.* V, *fig.* 10.

Cell 85-90 μm long, 38-40 μm broad, cauda 36-37 μm long. This variety is identical in all respects to *P. sesquitortus* Pochm. differing only in the presence of two lateral paramylon body, each composed by 4 or 5 superposed rings.

***P. tortus* (Lemm.) Skv.** (pl. VIII, fig. 8-9)

Cell 66-75 μm long, 26-32 μm broad, cauda 15-20 μm long, flat, broadly ovate to broadly elliptic. The cellular body presents only one torsion. On each face there are 14 to 16 longitudinal striae (5-6 in 10 μm) which follow the cell's torsion. Thinner transversal striae extend between those above mentioned (20-22 in 10 μm). The ultrastructure of the specimens from Camaleão Lake was similar to those observed by CONFORTI and TELL (1989) in materials from Argentina. Widespread.

***P. tropicalis* n. sp.** (pl. IV, figs. 3 a-c)

*Cellulae* 36-38 μm *long.*, 25-27 μm *lat., orbiculae vel late ovoide, symmetricae longitudinale amplificatae in medio. Polus anterior inaequaliter, rotundatus, cum sulco apicale breve. Polus posterior obtuse rotundatus, cum cauda recta, acuta. Cuticula longitudinaliter striata. Granum paramyli unum trochlaeiforme, magnum centrale; alter disciforme, uterque circumdata aliis minoribus discis. In* Camaleão *lacu*, Manaus, Brasil. XI-XII/88. *Holotypus tab.* IV, *figs.* 3 a-c.

Cell 36-38 μm long, 25-27 μm broad, orbicular to widely ovate, symmetrical with a median, longitudinal swelling. Anterior end asymmetrically rounded with a short apical furrow. Posterior end obtusely rounded, with an obliquely-angled, straight, sharply pointed cauda, 9-10 μm long. Pellicle longitudinally striate. One large, central, bobbin-like disc paramylon body, and other scattered smaller discs. Numerous, discoid chloroplasts.

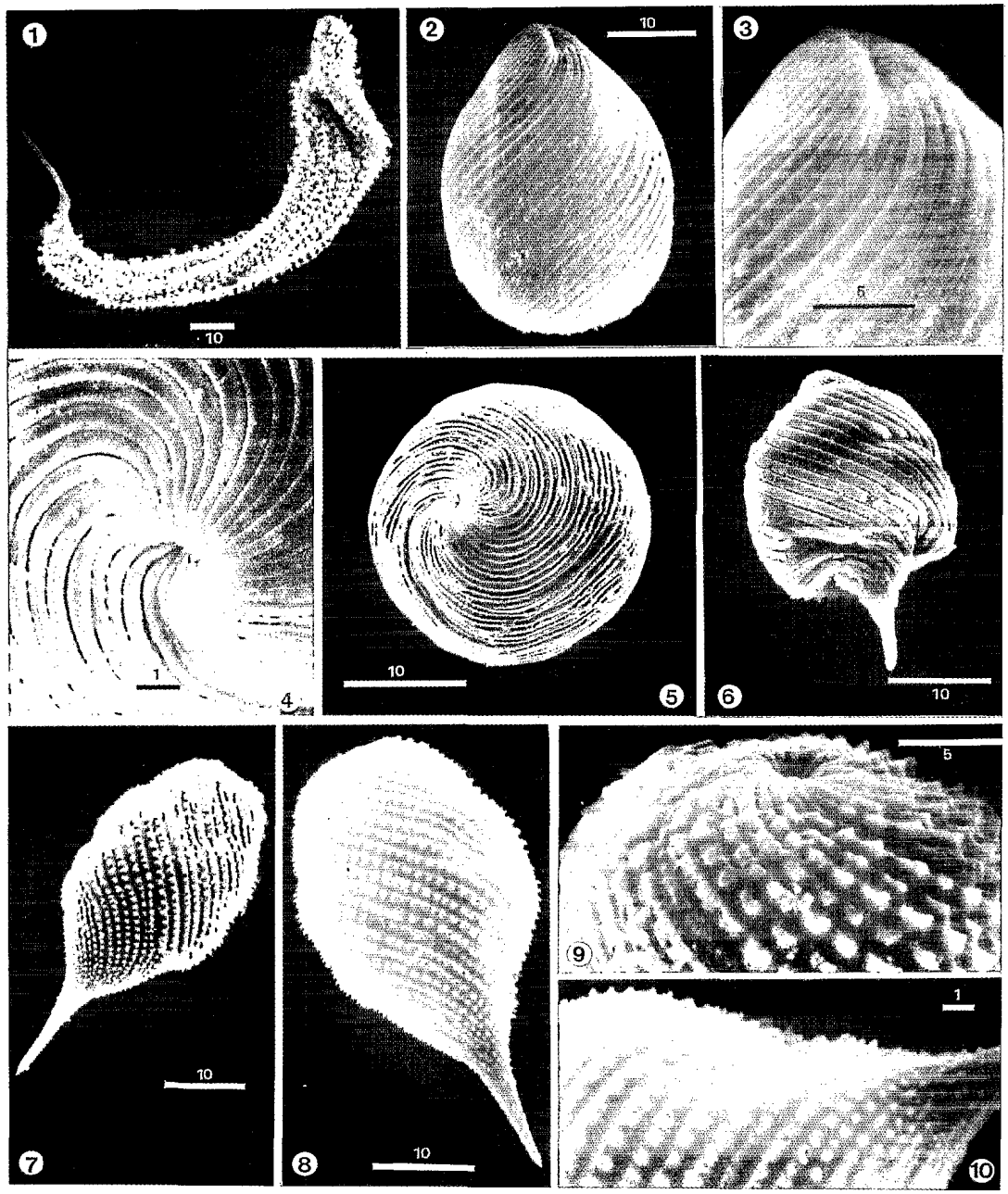


PLATE VII

FIG. 1. — *E. spirogyra*; 2-3. *L. salina*; 4-5. *L. ovum*; 6. *L. ovum* var. *butschlii*; 7-10. *L. americana*.

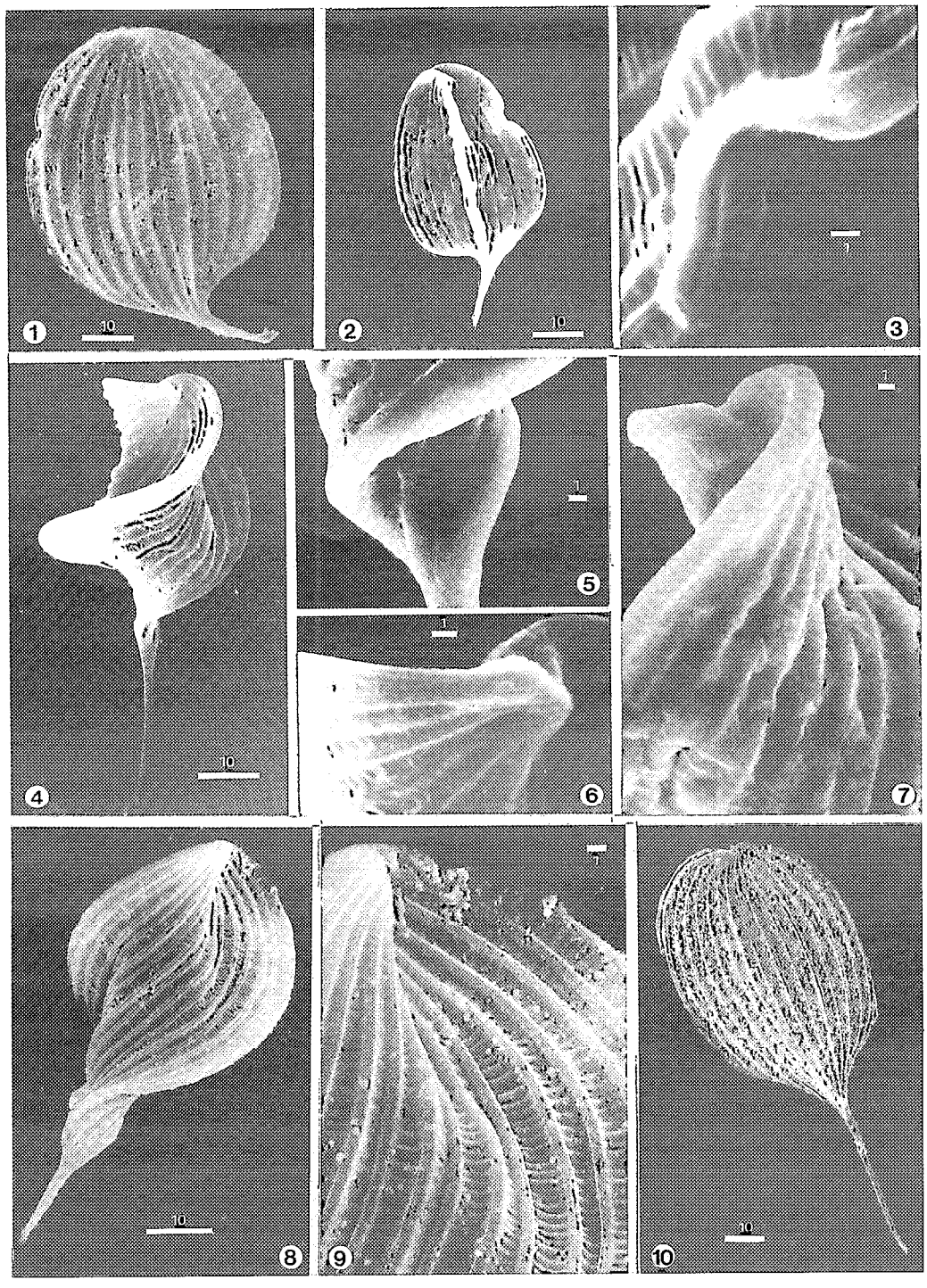


PLATE VIII

FIG. 1-3. — *P. orbicularis*; 4-7. *P. sesquitortus*; 8-9. *P. tortus*; 10. *P. longicauda*.

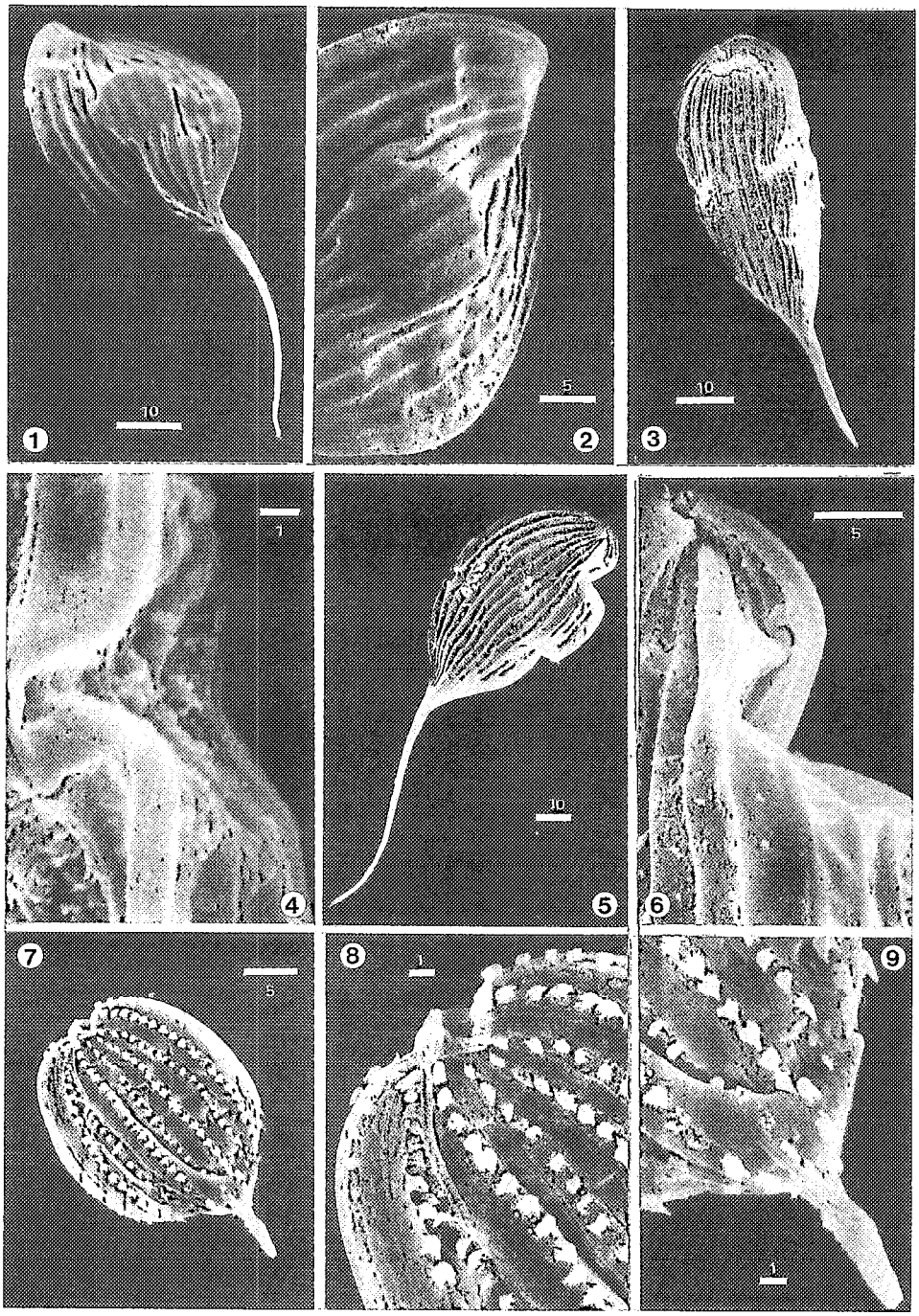


PLATE IX

FIG. 1-2. — *P. longicauda*; 3-4. *P. meson* var. *minor*; 5-6. *P. longicauda* var. *insecta*; 7-9. *P. horridus*.

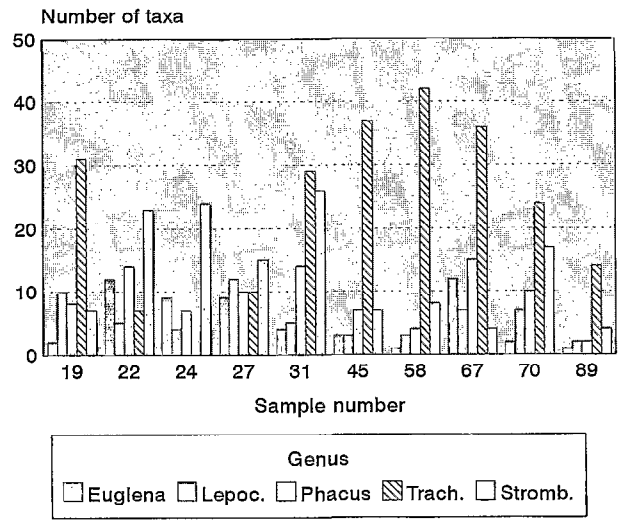


PLATE X

Number of taxa of each genus present in the different samples.
*Nombre d'espèces dans chacun des genres identifiés dans les échantillons.*

*P. tropicalis* tends to resemble *P. pulcher* Roll, but differs through its median longitudinal swelling instead a keel and the presence of its bobbin-like paramylon body.

***P. viguieri* All. et Lef.** (pl. III, fig. 18)

Cell 29-31 µm long, 26-28 µm broad. This species was seldom founded, France, Argentina and Brazil.

## CONCLUSIONS

Among the 85 taxa described in this paper, 17 were considered as new taxa: *E. spirogyra* var. *fusiformis* fo. *minor*, *L. americana*, *L. glabra* var. *raciborskii* fo. *gigas*, *L. globula* var. *major*, *L. claviformes*, *L. claviformes* var. *ornata*, *L. salina* var. *caudata*, *L. salina* var. *vallicauda* fo. *minor*, *P. acuminatus* var. *brasiliensis*, *P. balatonicus* var. *minor*, *P. horridus* var. *major*, *P. meson* var. *minor*, *P. pygmaeus*, *P. rodriguesiae*, *P. segretii* var. *major*, *P. sesquitortus* var. *multiannulatus* and *P. tropicalis*.

Seven taxa were only recorded for America: *E. comunis*, *E. spiroides* var. *annulata*, *L. piriformis*, *L. playfairiana* var. *striata*, *P. contortus*, *P. incrassatus* and *P. raciborskii* var. *longus*.

Five were only found in tropical and warm temperate regions: *L. caudata*, *P. contortus*, *P. longicauda* var. *rotunda*, *P. pseudonordstedtii* var. *minusculus* and *P. raciborskii* var. *longus*.

Three were recorded for the first time for South America: *E. spirogyra* var. *marchica*, *P. acuminatus* var. *discifera*, and *P. curvicauda* fo. *robusta*.

Forty three presented a widespread or cosmopolitan distribution.

Six were examined and photographed by means of a S.E.M. for the first time: *E. spirogyra* var. *fusiformis* fo. *minor*, *L. americana*, *L. ovum*, *L. ovum* var. *butschlii*, *P. meson* var. *minor* and *P. longicauda* var. *insecta*. The highest numbers of *Euglena* taxa were found in the samples number 22 and 67, presenting each 12 taxa. Sample 27 contained 12 *Lepocinclis* taxa and 15 taxa of the genus *Phacus* were found in sample 67 (pl. X). These three samples 22, 27 and 67 were collected during the low water period, presented high concentrations of dissolved oxygen (10.2 g/l) and dissolved solids (105 mg/l), high conductivity (762 S/cm), low transparency (0.10 m) and were slightly basic pH (7.6).

Samples number 89 and 58 were the least diverse, presenting 5 and 8 taxa respectively.

Considering the 220 euglenophyta taxa recorded from the Camaleão Lake and described in parts I, II and III of this work (pl. X), 90 belong to the genus

*Trachelomonas*, 47 to *Phacus* 45 to *Strombomonas*, 20 to *Euglena* and 18 to *Lepocinclis*.

Samples 19, 45 and 58 were very rich in *Trachelomonas* and very poor in other genera. In sample 24, where the genus *Trachelomonas* was absent, *Strombomonas* was the most diverse. These results may be indicating that the low water period of the lake would be unfavorable to the presence of *Trachelomonas*, while the other genera increase their development.

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## ANNEXE

List of *Euglena, Lepocinclis* and *Phacus* taxa from the Camaleão Lake (Manaus, Brazil).
Bold figures indicate sample number,
and the reference to the illustration is given by plate and illustration number.

*Liste des espèces collectées dans le lac de Camaleão (Manaus, Brésil) des genres* Euglena, Lepocinclis *et* Phacus.
*Les nombres en gras indiquent le numéro des échantillons; l'illustration correspondante est donnée par le numéro de la planche et de la figure dans la planche.*

*Euglena* Ehr
*E. acus* Ehr., **24-27-45-58-67**, I/7
*E. allorgei* Delf., **27-67**, I/8
*E. communis* Gojdics, **22-24-67**, I/2
*E. ehrenbergii* var. *baculifera*, **24**, II/1
*E. gracilis* Klebs, **22-67-89**, I/9
*E. intermedia* var. *brevis* Fritsch & Rich, **31**, I/6
*E. limnophila* Lemm. var. *limnophila*, **22-27-67-70**, I/5
var. *minor* Drez. **24-27-31-67**, I/4
*E. oblonga* Schmitz, **31**, I/1
*E. oxyuris* Schmarda, **22-24-27-31-45-67**, I/12 a, b; VI/4-6
var. *charkowiensis* (Swir.) Chu, **19-22-24-67**, I/13; VI/1-3, 7
*E. sp.*, —, VI/8-10
*E. spirogyra* Ehr., **22-24-70**, II/8; VII/1; VI/17
var. *fusca* Klebs, **19-22-67**, II/3; VI/13-16
var. *fusiformis* fo. *minor* n. fo., **22-27-67**, II/7; VI/11-12
var. *marchica* Lemm., **24-27-67**, II/9
*E. spiroides* var. *annulata* Gojdics, **22**, I/10
*E. subehrenbergii* Skuja, **22-24-27-67**, II/2
*E. tripteris* (Duj.) Klebs, **22-24-27-45**, I/11
*E. variabilis* Klebs, **22**, I/3 a, b
*Lepocinclis* Perty
*L. americana* n. sp., **19-27-31**, II/6 a-c; VII/7-10
*L. caudata* Da Cunha, **67-70**, II/10
*L. claviformes* n. sp., **27**, II/12
var. *ornata* n. var., **45**, II/4
*L. fusiformis* (Carter) Lemm. *em.* Conr., **19-22-24-27-31-67-70**, III/8 a, b
var. *amphirhynchus* Nygaard, **19-27**, III/9
*L. glabra* var. *raciborskii* fo. *gigas* n. fo., **27**, III/15
*L. globula* var. *major* n. var., **27**, III/14
*L. ovum* (Ehr.) Lemm., **58-67**, III/4 a, b; VII/4-5
var. *butschlii* (Lemm.) Conr., **19-22-24-27-67-70**, III/7 a, b; VII/6
var. *dimidio-minor* Da Cunha, **19-22-27-31-45-58-70-89**, II/6
var. *globula* (Perty) Lemm., **19-45-70**, III/5 a, b
*L. piriformis* Da Cuhna, **19**, II/13
*L. playfairiana* var. *striata* Conf., **19**, II/11
*L. salina* Fritsch, **19-22-24-27-31-58-67-89**, III/1; VII/2-3
var. *caudata* n. var., **27**, III/3
var. *vallicauda* fo. *minor* n. fo., **27-31-67-70**, III/2 a, b
*L. spirogyra* Korsh., **19-22-24-27-67-70**, II/5 a, b
*Phacus* Duj.
*P. acuminatus* var. *brasiliensis* n. var., **67**, IV/5 a, b
var. *discifera* (Pochm.) Hub.-Pest., **19**, III/11
*P. angulatus* Pochm., **67**, IV/6
*P. anomalus* Fritsch & Rich, **22-24-70**, III/24 a, b
*P. balatonicus* var. *minor* n. var., **22**, III/13 a, b
*P. brachykentron* Pochm., **22**, III/19
*P. contortus* Bourr., **22-31-58-70**, IV/1 a, b
*P. curvicauda* Swir., **19-22-24-27-31-67-70**, III/21 a, b
fo. *robusta* All. & Lef., **19-27**, III/17
*P. ephippion* Pochm., **27-45**, V/11
*P. granum* Drez., **22**, III/12
*P. hamatus* Pochm., **22**, IV/13
*P. heimii* Lef., **19-22-24**, IV/2
*P. horridus* Pochm., **31-45-58-67-70-89**, V/14, IX/7-9
var. *major* n. var., **45**, V/13, 17
*P. incrassatus* (Defl.) Pochm., **67**, III/16
*P. indicus* Skv., **67**, IV/9
*P. lismorensis* Playf., **19-31**, V/4
*P. longicauda* (Ehr.) Duj., **24-31-58**, VIII/10; IX/1-2
var. *insecta* Kocz., **45-67-89**, V/6; IX/5, 6
var. *major* fo. *insecta* Hub.-Pest., **45**, V/12
var. *rotunda* Hub.-Pest., **19-27**, V/7
*P. margaritatus* Pochm., **31**, V/16
*P. meson* var. *minor* n. var., **31**, IX/3, 4
*P. orbicularis* Hübn., **19-22-27-67-70**, IV/11, VIII/1, 3
fo. *gigas* (Da Cunha) Popova, **67**, IV/12
*P. platalea* Drez., **22**, V/1
var. *tiszae* Hort., **70**, IV/1
*P. pleuronectes* (Müll.), **27**, IV/14 a, b
*P. pseudonordstedtii* Pochm., **67**, V/9
var. *minuscula* (Conr.) Hub.-Pest., **70**, V/8
*P. pygmaeus* n. sp., **45**, III/23
*P. raciborskii* var. *longus* Conf., **67**, IV/10 a, b
*P. rodriguesiae* n. sp., **31-45**, IV/5 a-c
*P. rudicula* (Playf.) Pochm., **27**, V/5
*P. segretii* var. *major* n. var., **22**, III/22 a-c
*P. sesquilortus* Pochm., **31**, V/18; VIII/4-7
var. *multiannulatus* n. var., **19**, V/10
*P. stokesii* fo. *minor* Conr., **22-31**, III/10
*P. suecicus* Lemm., **31-70**, V/15
*P. textus* Pochm., **19**, III/20
*P. tortus* (Lemm.) Skv., **24-27-31-58-67-70**, VIII/8-9
*P. triqueter* (Ehr.) Duj., **22-24-70**, V/3 a, b
*P. tropicalis* n. sp., **67**, IV/3 a-c
*P. undulatus* (Skv.) Pochm., **27-67**, IV/7
*P. unguis* Pochm., **24-27-31-67**, IV/8
*P. viguieri* All. et Lef., **22**, III/18 a, b