

The genus *Glochidinium* gen. nov., with two species: *G. penardiforme* comb. nov. and *G. platygaster* sp. nov. (Peridiniaceae)

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Boltovskoy, A. 1999. The genus *Glochidinium* gen. nov., with two species: *G. penardiforme* comb. nov. and *G. platygaster* sp. nov. (Peridiniaceae). – Grana 38: 98–107. ISSN 0017-3134.

Glochidinium gen. nov., a new genus of Peridiniaceae based on *Peridinium penardiforme* Lindemann, is herewith erected. Its plate formula is: $Po + X + 4' + 6'' + 3C + 4S + 5''' + 2''''$. Main diagnostic characters of this new genus are the presence of only 3 cingular plates (it lacks the transitional one), the third cingular contacting the anterior sulcal plate, and an unusual sulcus holding a small triangular posterior sulcal plate. The thecal morphology and structure of two freshwater planktic species of the genus are described on the basis of LM and SEM observations. *G. penardiforme* comb. nov. is an infrequent species, albeit widely distributed world-wide. It has been recorded under the names of *Peridinium*, *Glenodinium* and *Peridiniopsis*. Peculiar features in the tabulation of the furrows and of the surface sculpture show that the species does not fit any of the known genera, for which reason the new genus *Glochidinium* is established. *G. platygaster* sp. nov., the second species included in the genus, differs from the former by its elongated body, the regular pentagonal shape of its large first apical plate, an equally large sulcal anterior plate, and well developed sculpture, chiefly on the antapical plates. *Glochidinium penardiforme* and *G. platygaster* were found in some reservoirs from central and northern Argentina. *G. penardiforme* was also found in several Argentine rivers and ponds.

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(Manuscript accepted 9 November 1999)

Widely accepted classification systems of the marine species of Peridinales (Graham 1942, Balech 1959, 1963, 1974, 1980; Fensome et al. 1993) confer special importance to the number of cingular plates, which are used diagnostically at the generic level. *Glochidinium* has only 3 plates in the cingulum, which sets it apart from *Peridiniopsis* Lemmermann and *Thompsodinium* Carty (6 cingulars), *Peridinium* Ehrenberg *Ensiculifera* Balech and *Durinskia* Carty & Cox (5 cingulars or 1 transitional plate + 4 cingulars), as well as from *Protoperidinium* Bergh and several marine genera of the *Diplopsalis* group (4 cingulars, or T+3C). The new genus *Glochidinium* is erected on the basis of its three plated cingulum, the unusual tabulation of the longitudinal furrow and exclusive surface sculpture. It includes two species: *Glochidinium penardiforme* comb. nov. and *Glochidinium platygaster* sp. nov. The first species was previously ascribed to 3 distinct genera.

MATERIALS AND METHODS

Thecal plate analyses with the aid of sodium hypochlorite (see Boltovskoy, 1995a, for detail of techniques employed) were carried out on the Peridinales collected in net plankton samples (27 µm mesh size) from several Argentine waterbodies, and preserved with formaldehyde solution. For scanning electron microscopy (SEM) specimens were isolated and freeze-dried as described in Boltovskoy (1995b). For basic plate designation Kofoid's (1909) system is adopted; the notation of the sulcal plates and apical pore complex platelets are used as by Balech (1974).

Sampling sites

Specimens of *Glochidinium penardiforme* were found in the following waterbodies (Fig. 1): Misiones province: Rolador stream, Jan. 1981 (Site 1); Tucumán province: El Cadillal reservoir, Oct. 1972 (Site 3); Córdoba province: Las Viñas reservoir, Jan. 1972 (Site 4); Río Tercero reservoir, Jan. 1985, Jan. 1986 (Site 5); Entre Ríos province: Uruguayan coast of the Uruguay river, Feb. 1996 (Site 7); delta of the Paraná river-Naranjo stream, Feb. 1996 (Site 9); Buenos Aires province: Río de la Plata, Dec. 1971, Oct. 1996 (Site 10); Núñez pools, Sep. 1973 (Site 11); Santiago river-Borzani stream, Oct. 1981 (Site 12); Chascomús pond, Mar. 1983 (Site 13); Quequén Grande river, Jan. 1969 (Site 14).

Glochidinium platygaster was recorded from the following waterbodies (Fig. 1): Corrientes province: Iberá pond, Feb. 1976 (Site 2); Tucumán province: El Cadillal reservoir, Oct. 1972 (Site 3); Córdoba province: Las Viñas reservoir, Jan. 1972 (Site 4); Río Tercero reservoir, Jan. 1980, Jan. 1981, Aug. 1984, Jan. 1985, Jan. 1987 (Site 5); San Luis province: La Florida reservoir, Mar. 1996 (Site 6); Santa Fé province: Submerged field along Route 8-km 307, Jun. 1980 (Site 7).

RESULTS

Glochidinium gen. nov.

Dinoflagellatae planctonici, cum tres cingulari laminae. Formula laminarum: $Po + X + 4' + 6'' + 5''' + 2'''' + 3C + 4S$; dispositione orthoperidinioidea. Habitus: in aquae dulcis.

Planktic freshwater dinoflagellate with 3 cingular plates. Tabular formula: $Po + X + 4'(3' + 1a$ for some authors)

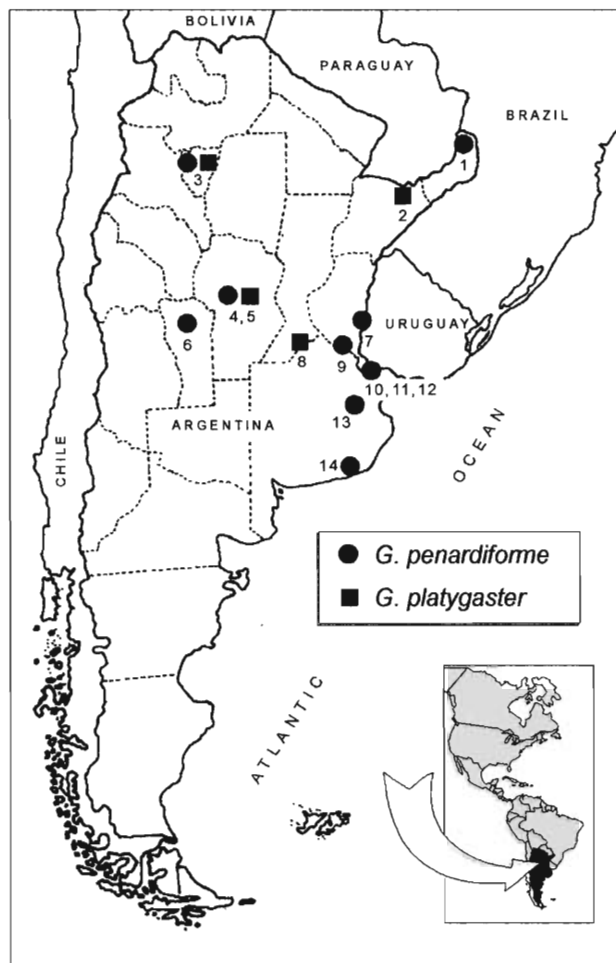


Fig. 1. Sampling sites.

+6''+5''' + 2''' + 3C + 4S. Type species: *Glochidinium penardiforme* (Lindemann) comb. nov. Basionym: *Peridinium penardiforme* Lindemann 1918, p. 126. (Archiv für Naturgeschichte A7: 121–194).

Mean lineal dimensions of species of this genus are slightly over half those for *Peridinium* sensu stricto. In contrast with other small freshwater genera, thick and refringent thecal walls. Thecal symmetry almost bilateral in plate arrangement, although not in its relative size. Asymmetry is particularly conspicuous in the dorsal side of the epitheca, where the precingular 3'' is half as large as 4'' (Figs. 7, 13). Plate overlapping patterns are the usual for Peridinales: the imbrication pattern is from dorsal to ventral and from the cingulum to the poles. Cingulum circular, profoundly excavated, formed by 3 plates. The first and the last ones (C1 and C3) short, vertically aligned with 1'' and 6'' on the epitheca, and with 1''' and 5''' on the hypotheca; the intermediate C2 very long and "C"-shaped, like in most *Protoperidinium*. Sulcus simple with only 4 plates. The anterior sulcal (Sa) plate penetrates slightly into the epitheca. The right sulcal (Sd) plate and the left sulcal (Ss) plate, longitudinally elongated, the former covering the latter partially. Posterior sulcal (Sp) plate small. Apical pore

complex formed by plates Po and X. Po and 3' are linked by means of a short apical sagittal suture (2'/4'). Inner margins of apicals 2' and 4' form two parallel brims bordering the apical pore complex. In ventral or dorsal view the former appear as two apical bumps. Surface sculptured with nodules of variable density and degree of development. The nodules may be linked by slightly lower broken cords, or may cover the surface of the theca almost entirely. The nodules on the antapical plates are the strongest and may develop into short spines. The pores are always located in small pits on the top of some of the nodules. The narrow cingular and sulcal lists are composed by strings of nodules, of which the left sulcal list is somewhat more developed. Growth bands constituted by regularly arranged rows of nodules.

***Glochidinium penardiforme* (Lindemann) comb. nov.**
(Figs. 2–7, 14–23)

Basionym: *Peridinium penardiforme* Lindemann 1918. Archiv für Naturgeschichte A7: 126, Figs. 10–15. Earlier uncertainties associated with the generic assignment of this species are reflected in the lack of agreement between different authors, who ascribed it to 3 distinct genera. The following are the references where the correct identification of the species is beyond doubt or where changes on generic assignment were made.

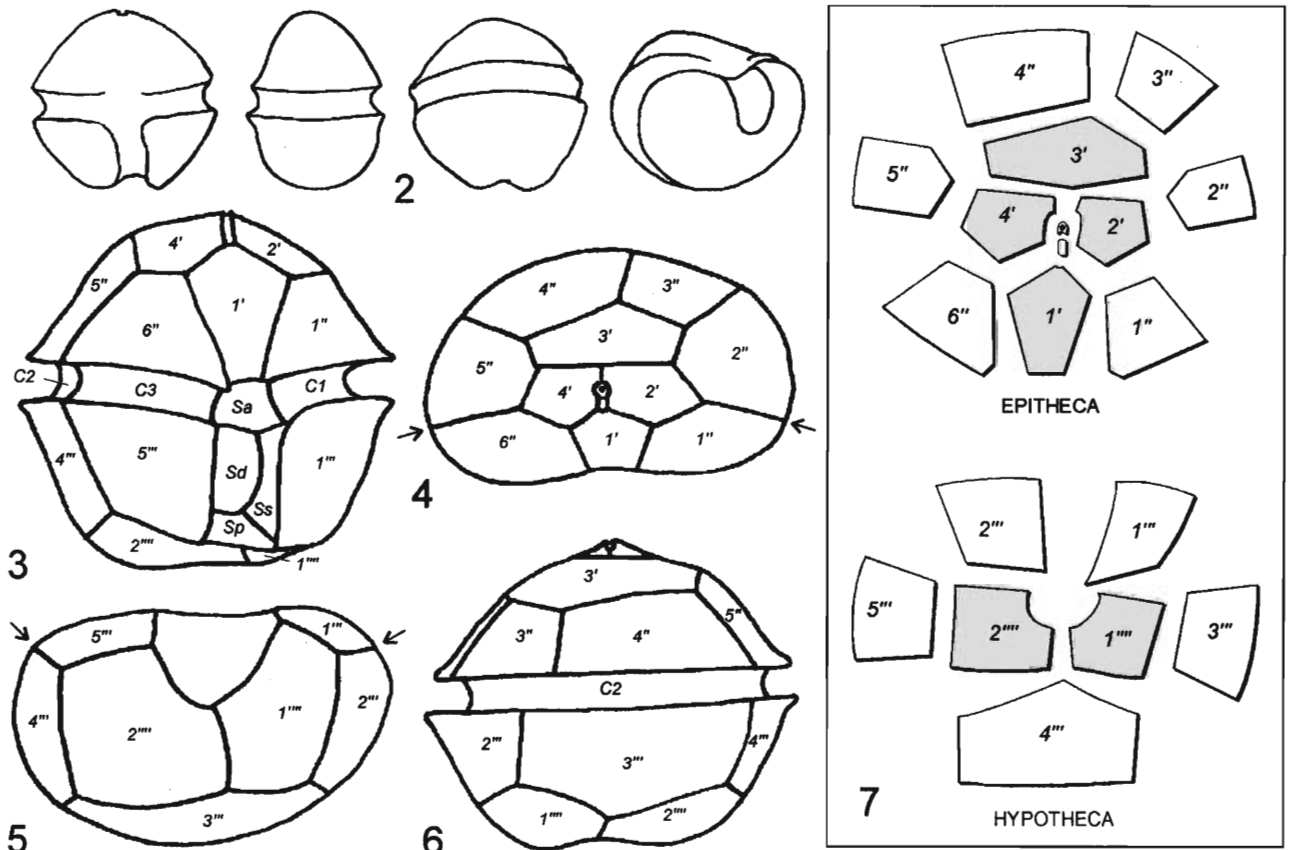
Peridinium penardiforme Lindemann 1918: 126, Figs. 10–15; Lindemann 1931: 703, Figs. 15–21; Lefèvre 1932: 162, Figs. 756–764; Huber-Pestalozzi 1950/68: 247, Fig. 270a–g; Imamura & Fukuyo 1990a: 133, Fig. 132 A–L. *Glenodinium penardiforme* Schiller 1937: 113, Fig. 110a–e; Kiselev 1950: 142, Fig. 231a–g; Thompson 1950: 295, Figs. 46–51. *Peridiniopsis penardiforme* Bourrelly 1968: 8; Popovský & Pfister 1990: 197, Fig. 214a–h; Pollinger & Hickel, 1991, Fig. 2d–f.

Dimensions

Materials from Argentina: length: 18–33 [mean: 27] µm; transdiameter: 11–26[21] µm; transdiameter is 61–96% of the length. Dorsoventral diameter around half the transdiameter. Cingular height: 3 to 3.5 µm. Dimensions of the species from the literature: length: 17–42; transdiameter: 17–30 µm.

Shape and general tabulation

Cells with spherical central nucleus, with or without chloroplasts. Outline ovoid in ventral view, with barely marked apex and middlemost antapical depression (Figs. 3, 6, 14, 15). Contour in lateral and apical views oval or bean-shaped (Figs. 4, 5, 16, 17). Ventral face of the theca slightly concave, dorsal convex. Cingulum circular, deeply excavated, divides the theca into two halves of similar height. Epitheca dome-shaped, hypotheca slightly wider, with bilobate antapical end in ventral view. The epithecal formula of *Glochidinium penardiforme* has been described in two different ways: as 3' + 1a + 6'' (Lefèvre 1932, Kiselev 1950), or as 4' + 6'' (Kiselev 1950, 1954). The inclusion in the apical series of a plate which do not contact the apical pore complex, although no in strictly Kofoidian way, is utilized



Figs. 2–7. The theca of *Glochidinium penardiforme* comb. nov. (2) Outline views. (3) Ventral view. (4) Apical view; the arrows mark the position of the intercingular sutures. (5) Antapical view; the arrows mark the position of the intercingular sutures. (6) Dorsal view. (7) Projection of main thecal plates; apical and antapical plates shaded.

to denote possible homologies with plates that do touch the apical pore complex in other taxa (Fensome et al. 1993: 16, 250). This seems to be a better choice for *Glochidinium*, and the dorso-median anterior epithecal plate is examined here as the 3rd apical (3') and not as an intercalary plate (1a), since it is presumably homologous with the 3' of some other *Peridinium* species where 3' does contact Po, or the 3' of those *Peridinium* species where the apical pore complex is lacking. On the other hand, being the apical pore a secondary character, its absence, presence or position should not influence the nomenclature of the plates surrounding the apex (Boltovskoy 1973, Abé 1981: 15).

Ecdysial openings in thecae of *G. penardiforme* are formed by the removal of the three dorsal epithecal plates 3' + 3'' + 4''. Their shape, position and relative size is similar to those of the hemiepithecal openings of most *Peridinium* s. s. species (Boltovskoy 1973, 1975) in which, however, seven dorsal plates are detached.

Cingulum and sulcus

Cingulum circular, profoundly excavated, without conspicuous cingular lists, formed by 3 plates (Figs. 3, 6, 14, 15, 22). Plates C1 and C3 short, intermediate C2, very long and "C"-shaped (Figs. 20, 34). The intercingular suture C1/C2 is colinear with the suture 1''/2'' and 1'''/2'''. Similarly the suture

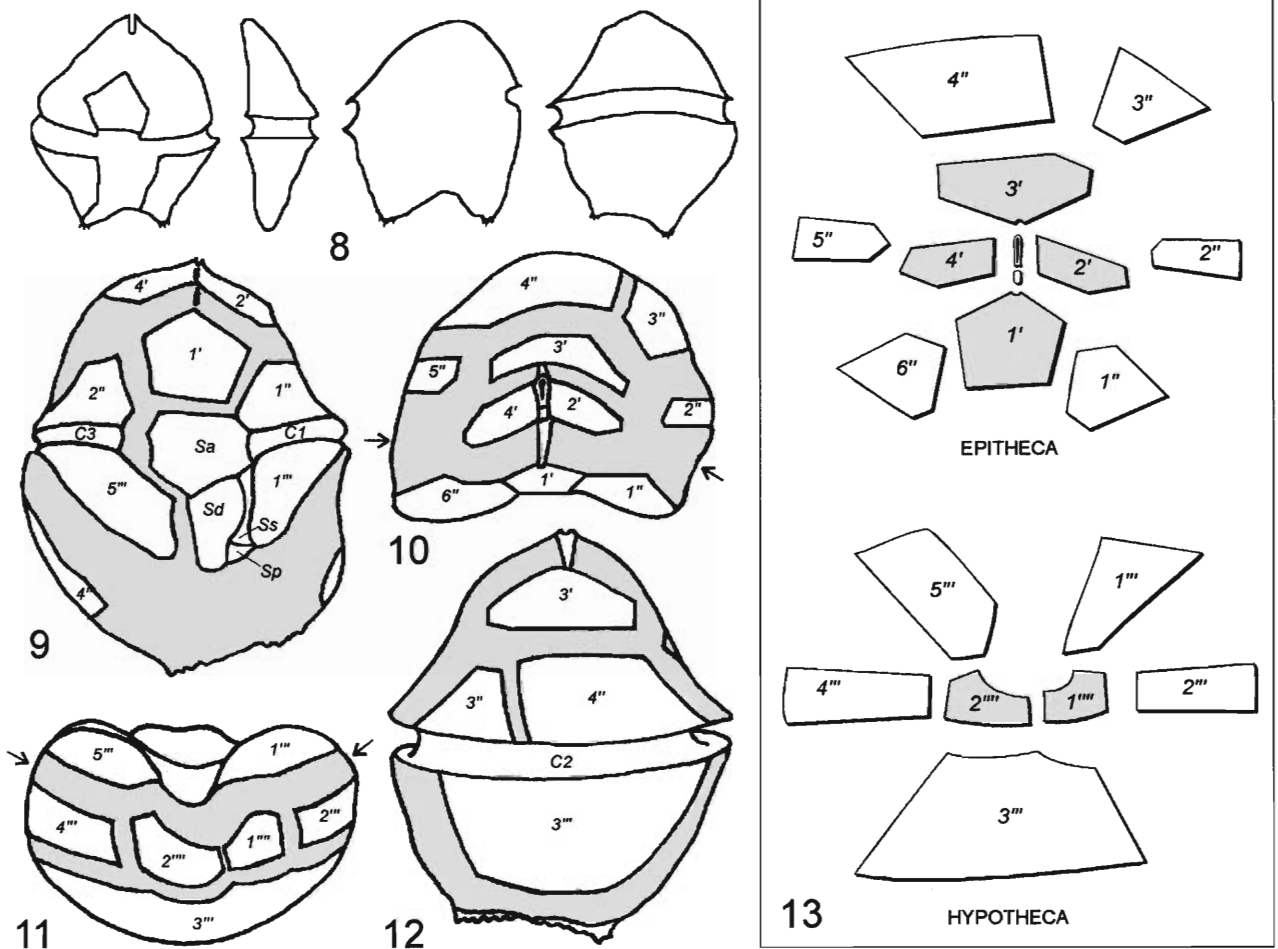
C2/C3 corresponds to 5''/6'' and 4'''/5'''. Sulcus with 4 plates (Figs. 20, 23, 34). The Sa plate penetrating slightly into the epitheca and contacting C3. The Sd plate, which anteriorly has a cingular contact too, and the Ss plate, are longitudinally elongated, the former covering the latter partially. Small triangular Sp plate displaced to the left half of the sulcus.

Apical pore complex

Pore complex formed by plates Po and X. Po does not contact 3', as a result of which plates 2' and 4' touch each other. The internal margins of these 2 plates form 2 parallel, smooth lips which surround the complex. In ventral and dorsal view these lips protrude apically.

Surface sculpture

Degree of development of the surface sculpture variable (Figs. 18, 19, 23). SEM micrographs show sparse rounded nodules, 0.3 µm in diameter, partially linked by slightly lower broken cords. The nodules on the antapical plates are the strongest (Fig. 17). Scattered pores, 0.02 µm in diameter, are located inside tiny pits on the top of larger irregular truncated nodules (0.7 µm), which may be interpreted as a cluster of three or four primary nodules. Along the cingular margins of the adcingular series there are rows of pores spaced about 2–2.5 µm. The almost smooth surface of the



Figs. 8–13. The theca of *Glochidinium platygaster* sp. nov. (8) Outline views. (9) Ventral view; growth bands shaded. (10) Apical view; the arrows mark the position of the intercingular sutures. (11) Antapical view; the arrows mark the position of the intercingular sutures. (12) Dorsal view. (13) Projection of main thecal plates; apical and antapical plates shaded.

cingular plates shows a similar arrangement of pores. The narrow cingular and sulcal lists are composed by strings of nodules, of which the left sulcal list is somewhat more developed (Figs. 14, 23). The structure of the marginal ridges is similar to that of the lists (Fig. 19). Growth bands usually narrow, with both longitudinal and transversal striae, the latter more conspicuous, with the appearance of strips of regularly arranged rows of nodules (Figs. 16, 22).

World-wide distribution

There are few records of *G. penardiforme* for Europe (Lefèvre 1932), Asia (Imamura & Fukuyo 1990a), Africa (Pollinger & Hickel 1991) and North America (Eddy 1930, Thompson 1950). In South America it was found in Brazil, Río Negro, in the Amazon basin (Uherkovich 1976, Uherkovich & Rai 1979).

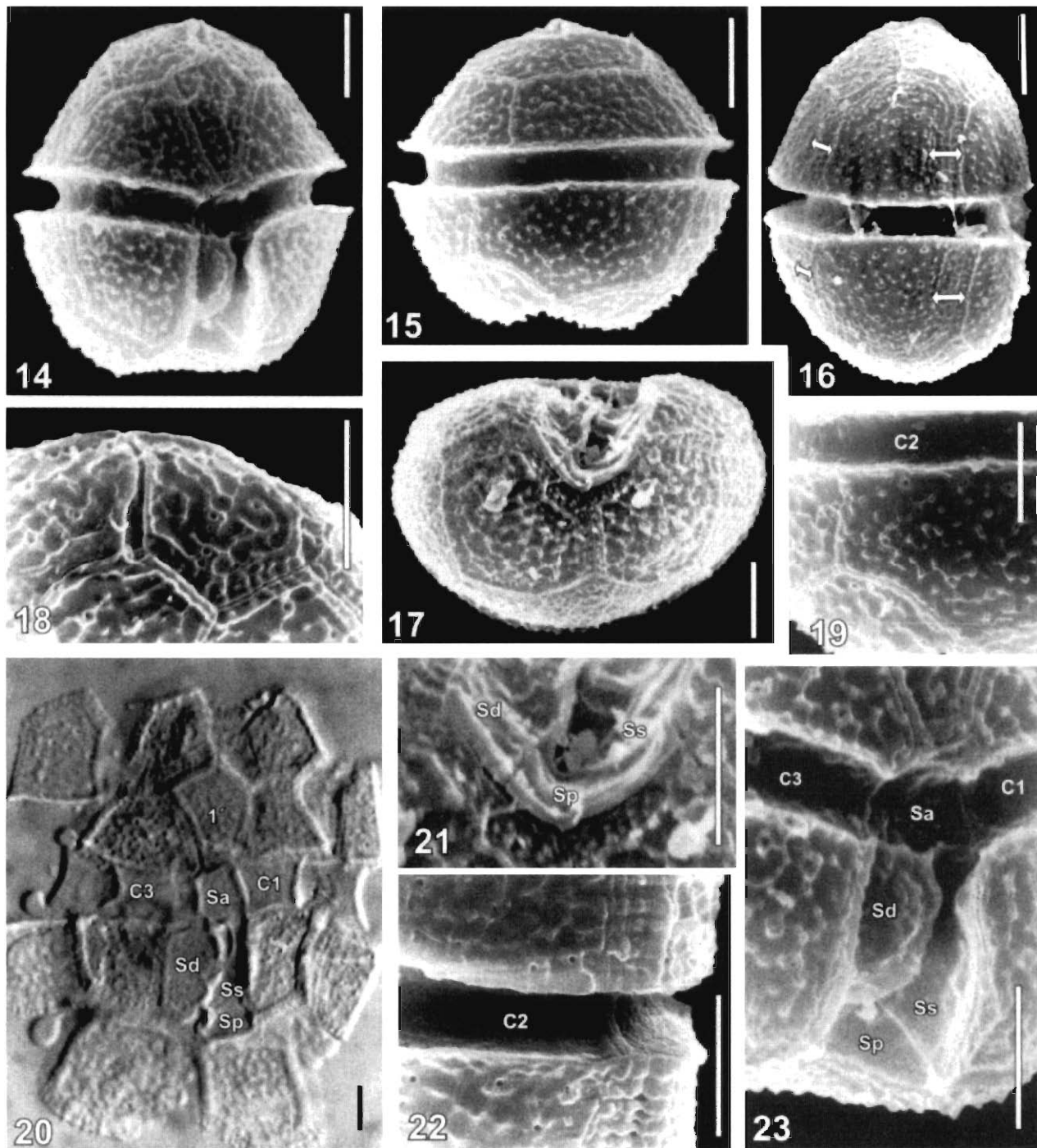
Distribution and environmental data from Argentina

Argentine records of *Glochidinium penardiforme* are from subtropical environments, including streams, rivers, ponds, pools and reservoirs from the central-northern part of the country (Fig. 1). Its confirmed latitudinal range stretches

between 25°50'45" S and 38°18'45" S, usually in small numbers. Its spring and summer records in the Río de la Plata, Río Quequén Grande, and Río Tercero reservoir are characterized by temperatures around 15–28° and pH values of 7–8. In the Río de la Plata mean conductivity values are 250 μ S/cm, but in Río Quequén Grande they can reach much higher levels (Guarrera 1950, Boltovskoy & Boltovskoy 1968, Boltovskoy & Foggetta 1985, Bonetto et al. 1987). In the reservoirs *Glochidinium penardiforme* is often found together with 2–3 much more abundant dinoflagellates: *Peridinium gatunense*, *P. willei*, *P. volzii* var. *botanicum*. Imamura & Fukuyo (1990a) and Pollinger & Hickel (1991) report findings in association with other species.

Glochidinium platygaster sp. nov. (Fig. 8–13, 24–33)

Dinoflagellatum planctonicum. Formula laminarum: Po+X+4'+6''+5''' +2''''+3C+4S. Lamina prima apicali (1') lata, forma pentagonalis aequilateralis. Laminae 1' et Sa facies et amplitudo similes. Laminae antapicali parvae et spinulatae. Habitus: in aquae dulcis. Holotypus: Figs. 24, 28. Locus typicus: Río Tercero reservoir, Córdoba, Argentina.

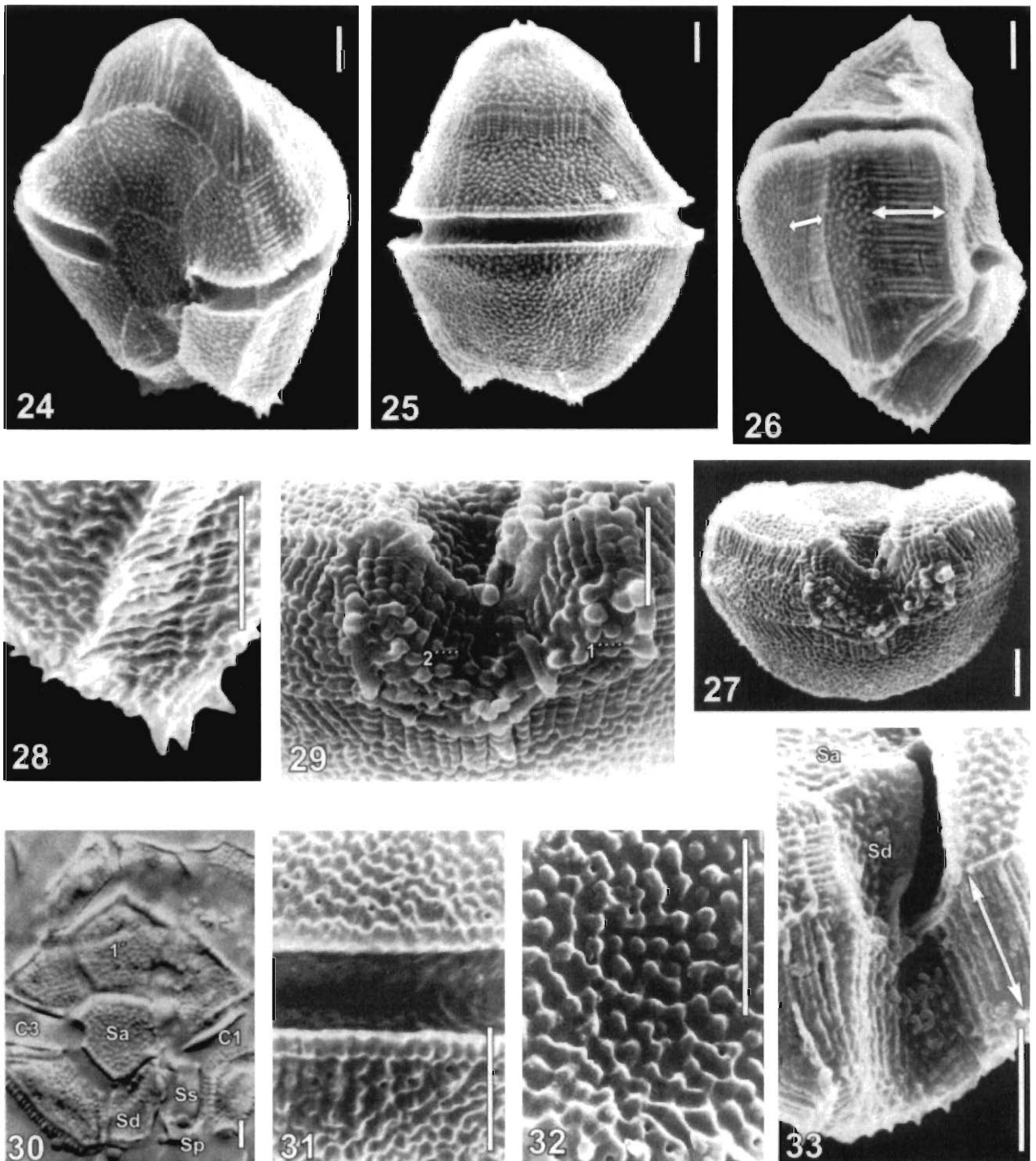


Figs. 14–23. Thecae of *Glochidinium penardiforme* comb. nov. (14) Ventral view. (15) Dorsal view. (16) Right lateral view. (17) Antapical view. (18) Apical area with partially hidden apical pore complex. (19) Detail of theca in dorsal view showing surface sculpture (sparse partially linked nodules), pores, sutures and cingular lists. (20) Theca treated with sodium hydrochlorite in ventral view. (21) Antapical end of the sulcus. (22) Detail of a theca in right lateral view showing the structure of growth bands. (23) Sulcal plates and ventral cingular plates, in situ. SEM micrographs, except figure 20 which is LM micrograph; the specimens are from sample site 3, excepting figures 14 and 23 which are from site 5. Double arrows mark growth bands. Scale bars = 5 μ m

Thecate freshwater dinoflagellate. Tabular formula $Po + X + 4' + 6'' + 5''' + 2'''' + 3C + 4S$. Plate 1' large, regularly pentagonal, similar to Sa in size and shape. Antapical plates small, studded with blunt spines.

Dimensions

Length: 45–55 [mean: 49] μ m; transdiameter: 30–36 [33] μ m; transdiameter 60–73 % of length. Dorsoventral



Figs. 24–33. Thecae of *Glochidinium platygaster* sp. nov. (24) Ventro-apical view. (25) Dorsal view. (26) Right latero-antapical view. (27) Antapical view. (28) Left antapical end with antapical spines. (29) Detail of theca in antapical view showing more developed surface sculpture on the antapical plates. (30) Theca treated with sodium hydrochlorite in ventral view. (31) Surface sculpture, pores and circular lists. (32) Surface sculpture: densely distributed nodules, some of them perforated. (33) Sulcus in oblique ventro-antapical view; SEM micrographs, except figure 30 which is LM micrograph; all the specimens figured are from sample site 5. Double arrows mark growth bands. Scale bars = 5 µm.

Shape and general tabulation

transdiameter about two thirds of the transdiameter. Cingular height: 3 to 3.5 µm.

Cells with or without chloroplasts. Central nucleus slightly compressed along the longitudinal axis. W. Outline sub-

pentagonal, longitudinally elongated in ventral view, with poorly defined apex and an antapical depression displaced to the left (Figs. 24, 25). Contour in apical and antapical views bean-shaped (Figs. 10, 11, 27). Ventral face of the theca slightly concave, dorsal face convex (Figs. 8, 26). Cingulum circular, deeply excavated (Figs. 25, 31), divides the theca into two parts of sub-equal height. Bell-shaped epitheca. Hypotheca somewhat wider, its antapical termination bilobulated in ventral view, the right lobe more expanded. The large "rhombic" plate is regular pentagonal (Figs. 9, 13, 24, 30), with an unusually lengthened suture 1'/Sa. Epithecals plates 2'', 2', 4' and 5'' arrayed as a transapical band. An arrangement of similar nature has been described for the epithecae of *Peridinium willei* Huitfeldt-Kaas and related species, and also for some marine species, including *Protoperidinium pentagonum* (Gran) Balech. This band-like disposal is generally associated with strong dorso-ventral flattening of the epitheca. In the hypotheca postcingulars 1''' y 5''' are longitudinally elongated (Figs. 9, 13). The two antapical plates are the smallest (Figs. 13, 27, 29).

Cingulum and sulcus

Cingulum circular, profoundly excavated and bordered by narrow cingular lists. It is composed by 3 plates: C1 and C3 short; intermediate C2 very long and "C"-shaped (Figs. 24–26, 31, 34). The position of the sutures between cingular plates matches those between the adcingular ones. Thus, two ventral longitudinal growth bands (i.e., 1''/2'', 1C/2C, 1'''/2''' and 2C/3C, 5''/6'', 4'''/5''') develop much more than the rest of the sutures between adcingular plates (Figs. 10, 11, 26, 27). This is in agreement with the correlation between the number of intercingular sutures (and hence, cingular plates), and the number of wide longitudinal growth bands in the adcingular series noted by Boltovskoy (1979) for *Peridinium* and *Protoperidinium*.

Sulcus with 4 plates (Figs. 30, 33, 34, 35). The very large, slightly concave Sa plate of *G. platygaster* is as large as its 1' plate (Figs. 9, 24, 30). The Sa plate penetrating slightly into the epitheca and contacting C3. Both Sd plates, which lack cingular contact, and Ss, are longitudinally elongated and somewhat displaced to the left with respect to the large 1'. The left margin of the Sd plate covers partially the Ss. Plate Sp small, triangular, displaced to the left half of the sulcus.

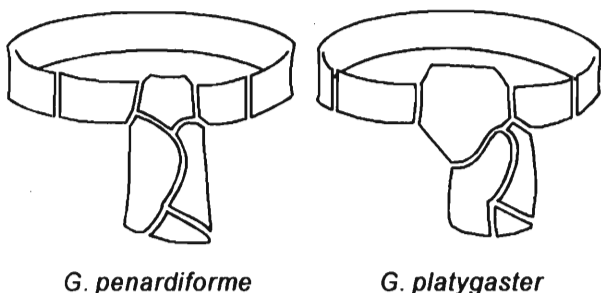


Fig. 34. Sulcal and cingular plate arrangement in the genus *Glochidinium*.

Apical pore complex

Po is dorso-ventrally extended and the "apical pore" is slot-like. The internal margins of the apicals 2' and 4' give rise to two parallel ridges bordering the apical pore complex (Fig. 24). In ventral and dorsal views these ridges appear as two apical bumps (Fig. 25).

Surface sculpture

Po does not contact 3', plates 2' and 4' touch each other, and the suture 2'/4' is very short. SEM micrographs show the surface of the plates densely covered by rounded nodules, 0.6 μm in diameter, partially connected by cords of lower relief. Dispersed pores, 0.02 μm in diameter are located inside tiny pits on the top of somewhat larger nodules (0.9 μm) (Figs. 31, 32, 36). Along the cingular margins of the adcingular series there are rows of pores spaced 2–2.5 μm . A similar arrangement of pores appears on the almost smooth surface of the cingular plates. The surface of the antapical plates is covered by 10 to 15 much stronger nodules which grow into antapical spines at the lateral plate margins (Figs. 28, 29). These spines are very characteristic for this species. The surface sculpture of the Sa and Sd plates is similar to those of the main thecal plates, but Ss, Sp and the cingular plates have an almost smooth surface (Figs. 30, 33). The narrow cingular and sulcal lists, somewhat more developed on the left sulcal list, are composed by strings of nodules, (Figs. 24, 31, 33). Most of the specimens of *Glochidinium platygaster* observed have very broad growth bands (Figs. 9–12, 24–27), with both longitudinal and transversal striae, the latter more conspicuous (Figs. 28, 33). In some cases the bands look like strips of regularly arranged rows of nodules.

Distribution in Argentina

Glochidinium platygaster was found chiefly in reservoirs, always in small numbers, jointly with *Peridinium gatunense* (dominant species), *P. willei* and *P. volzii* var. *botanicum*. In Rio Tercero reservoir, where bimonthly sampling where performed between 1980 and 1987, it was usually present during the summer at pH values of 7 or more, and temperatures up to 28°C. Its confirmed latitudinal distribution (24°19'30" S to 33°51'00" S; Fig. 1), and its thermic regime suggest subtropical affinities.

DISCUSSION AND CONCLUSIONS

Relationships of *Glochidinium* gen. nov. with other genera

Glochidinium penardiforme was originally included in the genus *Peridinium* (Lindemann 1918), which at the time also encompassed the marine species now considered as *Protoperidinium*. *Glochidinium penardiforme* differs from *Peridinium* and *Protoperidinium* by having 10 epithecal plates (instead of 13 or 14) and 3 cingular plates (instead of 4 or 5), by the shape and number of the sulcal ones and by the peculiar surface sculpture. Schiller (1937) transferred this species to the genus *Glenodinium*, and Bourrelly (1968) subsequently placed it in *Peridiniopsis*, together with a heterogeneous group of Schiller's *Glenodinium*. Both nomenclatural changes were made without major individual analysis of the species involved. Thus, *Peridiniopsis*, became a "pool genus" with nine different tabular formulae. Among

Table I. *Glochidinium* gen. nov. vs. other freshwater *Peridinales* with the same general tabulation: distinguishing traits.

	<i>Glochidinium</i> gen. nov.	<i>Peridiniopsis borgei</i>	<i>P. penardii</i>
GENERAL TABULATION	10 epithecal plates: 4' + 6" (or 3' + 1a + 6').	10 epithecal plates: 4' + 6" (or 3' + 1a + 6').	10 epithecal plates: 4' + 6".
CINGULUM AND SULCUS	4 sulcal plates. 3 cingular plates. Last cingular (3C) contacts Sa. Circular cingulum.	5 sulcal plates. 6 cingular plates. Last cingular (6C) does not contact Sa. Descendent cingulum.	6 sulcal plates. 4 cingular plates. Last cingular (4C) does not contact Sa. Descendent cingulum.
SURFACE SCULPTURE	Dispersed or densely distributed nodules, connected by means of an incomplete relief reticulum. The pores open on the top of the nodules.	From simple nodules to well developed reticulum. Pores located in the bottom of the alveoli.	Small nodules and independent pores.
PROJECTIONS	Narrow cingular and sulcal lists. Sometimes bunches of spinula on the antapical plates.	Cingular and sulcal lists, and apical and antapical crests with different degree of development. Never spines.	Cingular and sulcal lists poorly developed. No projections.
APICAL AREA	Apical suture 2'/4' very short: Po does not contact 3'.	Long apical suture 2'/4': Po does not contact 3'.	Without apical suture 2'/4': Po contacts 3'.
THECAL COMPOSITION	Plate composition apparently homogeneous, as in most <i>Peridinales</i> . Sodium hypochlorite aids plate detachment.	Plates and projections formed by two layers of different composition. Sodium hypochlorite dissolves the outer layer, including the surface sculpture.	Plate composition apparently homogeneous, as in most <i>Peridinales</i> . Sodium hypochlorite aids plate detachment.
HABITAT	Fresh waters.	Chiefly brackish waters.	Fresh waters.

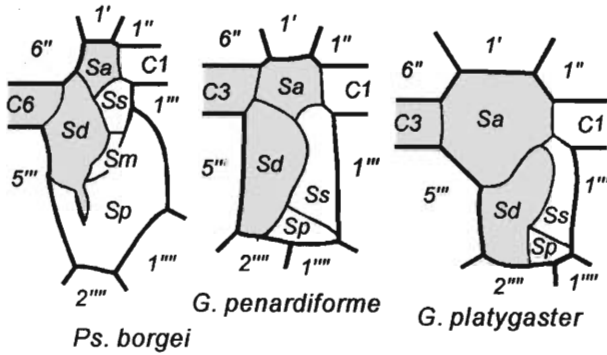


Fig. 35. Sulcal plate organization in *Peridiniopsis borgei* and the two species of *Glochidinium*, compared. Note the different relationships of the shaded plates.

the seven species of *Peridiniopsis* (sensu Bourrelly) with the same number of epithecal plates as *Glochidinium*, 3 have a different pattern: *P. kulczynskii* Woloszynska (Bourrelly), *P. edax* (Schilling) Bourrelly and *P. sphaeroideum* (Christen) Bourrelly, holding four sided 3' plate (instead of the large six sided one). These are poorly known species, with unknown cingular and sulcal tabulations, and the last two are of dubious validity because they are based on extremely deficient descriptions and illustrations. The remaining four species, having the same number and organisation of epithecal plates as *Glochidinium* are *Peridiniopsis borgei*

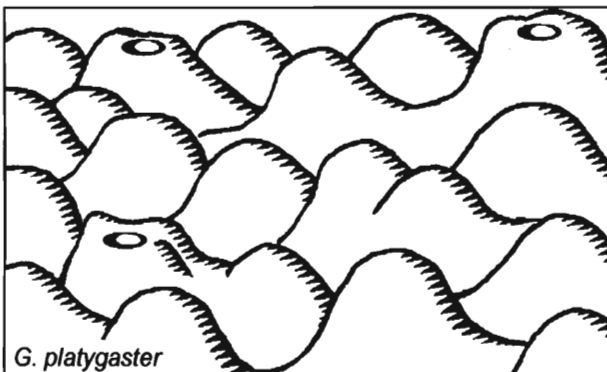
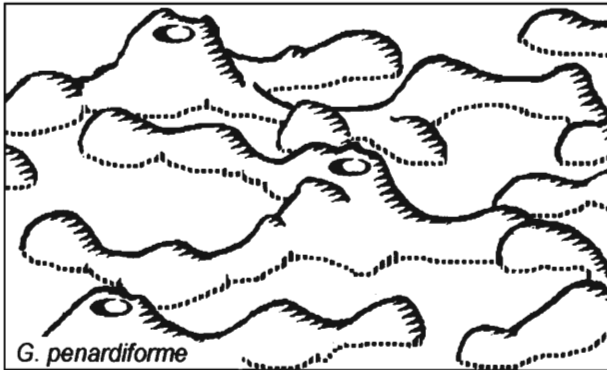


Fig. 36. Thecal surface sculpture in the species of the genus *Glochidinium*. Note that the differences are in the degree of development and density of the nodules, but the basic structure in both species is the same: connected nodules and pores on the top of some of them.

Lemmermann, *P. cristatum* (Balech) Ricard & Bourrelly, *P. penardii* (Lemmermann) Bourrelly, and the recently described *P. amazonica* Meyer (Meyer et al. 1997). *Glochidinium* differs from *Peridiniopsis borgei* (type species of *Peridiniopsis*), in the number of cingular plates, in its sulcal tabulation (Fig. 35), as well as in the surface sculpture and the physical and chemical nature of the theca (see Table I). The same is true for *P. cristatum* (see Balech 1961), a species closely related to *P. borgei* and for *P. amazonica*, although there are not remarks on the nature of the theca of the last species and some aspects of its sulcal tabulation remains obscure. Concerning *P. penardii*, this species has four cingular plates, six sulcal ones (Imamura & Fukuyo 1990b), and some other differences with the genus *Glochidinium* and *Peridiniopsis Borgei* (Table I). The epithecal arrangement of *Glochidinium* also agrees with that of the marine genus *Diplopsalis* Bergh, but *Diplopsalis* has only one antapical plate and a cingulum of the *Proto-peridinium* style. The above analysis may be summarised by the following Abé's assertion: "The plate formula [general tabulation is here implied] has been so highly estimated by some investigators as the most important character for generic distinction. In our opinion, however, two similar formulae do not necessarily indicate their close relationships" (Abé 1981: 19).

According to Lefèvre (1932) *Peridinium lindemanni* Lefèvre and *P. viguieri* Lefèvre are also species related to *G. penardiforme*. However, they have more plates in their epithecae (11 and 12, rather than 10). There are no details in the literature on their cingular and sulcal structure. *P. viguieri* (Lefèvre 1932, figure 907) shows two sutural lines dividing the cingulum dorsally, which, as opposed to *Glochidinium*, implies more than three cingular plates. Judging from the sulcal outline and the type of hypothecal spines, these two species may be closer to Lefèvre's (1932) *Elpatyewskii* group. Detailed studies are needed in order to define the taxonomic affinities of these species.

In the light of the above discussions, I feel that the establishment of a new genus for the specimens investigated is warranted.

Comparison between the species of *Glochidinium*

Similarities between *G. penardiforme* and *G. platygaster* are as follows: identical tabular formula, cingular plate C1 contacting the sulcus, since there are no transitional (T) plates, and C3 contacts Sa plate or Sa and Sd (Fig. 34). The sulcus of *Glochidinium* is atypical in that in most peridinioid species the distal cingular end contacts Sd only. This distinctive feature is only comparable with some species of *Proto-peridinium* of the subgenus *Archaeoperidinium* (Abé 1936, 1981: 84), as well as with some other rare cases, such as those of *Proto-peridinium roscoffiense* (Balech 1962), and *Proto-peridinium parthenopes* (Zingone & Montresor 1988) and the genus *Oblea* Balech. The basic surface structure in both species is the same: connected nodules with pores on the top of some of them.

Differences between the two species, aside the body outline, can be summarised as follows. *G. platygaster* develops much broader growth bands and a more conspicuous surface sculpture, including the development of antapical spines. *G.*

platygaster has much larger I' and Sa plates. In this respect, the expansion of the Sa plate of *G. platygaster*, compared with that of *G. penardiforme*, engenders changes in the plate relationships of the ventral area: C3 plate lacks the Sd contact, and 5''' attains contact with Sa (Figs. 34, 35).

Geographic distribution

G. penardiforme is not very common, but is present world-wide. The records of *G. penardiforme* and *G. platygaster* in plankton samples from Argentine reservoirs were always associated with other dinoflagellate species. *G. penardiforme* was also found in rivers, streams and ponds. Most records of *G. platygaster* were during the summer. Its distribution and thermal regime suggest that it is a subtropical species.

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