

## NEW REFERENCES OF BENTHIC MARINE ALGAE TO BRAZILIAN FLORA

### NOVAS REFERÊNCIAS DE ALGAS MARINHAS BENTÔNICAS PARA A FLORA BRASILEIRA

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#### R E S U M O

O trabalho descreve e ilustra vinte espécies de algas marinhas ainda não referidas para o litoral brasileiro. As novas referências estão assim distribuídas: 8 Clorofíceas, 3 Feofíceas e 9 Rodofíceas. Todo o material foi coletado em Fevereiro de 1972 no Atol das Rocas.

A grande maioria das espécies já era conhecida da região caraibica, o que vem demonstrar mais uma vez a extensão de sua flora na direção *S* e *E*, diminuindo ainda mais o número de espécies anteriormente consideradas endêmicas no Caribe.

#### S U M M A R Y

Twenty new references of benthic marine algae are ascribed to Brazil: 8 Chlorophyceae, 3 Phaeophyceae and 9 Rhodophyceae. All the material was collected at "Atol das Rocas" in February 1972.

The large majority of the species were already known from the Caribbean Sea, showing once more the extension of its flora towards *S* and *E* and restricting still more the number of endemic species in the area.

#### I N T R O D U C T I O N

"Atol das Rocas" is a small "island" located at about 147 miles to the NE off the Brazilmainland (3° 51'S — 33° 49'W).

The region consists of a calcareous rock ring, at about high tidal level, with two low and narrow sandy island and a central lagoon. All together it measures only about 1,5 kilometer in diameter. Though

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it resembles very much the South Pacific Atolls its atollian nature is considered doubtful (Vallaux, 1940). "Atol das Rocas" is bathed by the Southern branch of the South Equatorial Current at about the point where it divides to give rise to the Brazilian Current, flowing South, and the Antilles Current, flowing West.

The two strips that remain just uncovered by the high water, namely "Ilha do Cemitério" and "Ilha do Farol" are formed mainly by shell fragments mixed with quartz grains. The land flora is very scarce, presenting only 6 species of angiosperms (Gramineae, Cyperaceae, Portulacaceae). The region, apparently, is inhabited only by a few species of sea-birds, present in very dense populations, by one species of mouse and a few insects.

The marine fauna, except for fish, seems very poor, and several invertebrates, very common on the continent are not to be found.

Some aspects of the Geology of Rocas were published by Duarte (1938), Azeredo Rodrigues (1940), Vallaux (1940) and mainly by Andrade (1960). The best approach and a summary of all the geographical, geological and historical data for the region is given by Soares (1964). Concerning the biology of the island, Faria and Silva (1937) published a study of the fish and lobsters of Rocas.

The marine flora were completely unknown up to now, except by the reference of Azeredo Rodrigues (1940) on the occurrence of *Fucus* and that of Vallaux (1940) of *Dictyopteris delicatula*. A brief note on the biology and the flora of Rocas attol was published recently by Oliveira Filho 1972 and Oliveira Filho & Menezes 1972.

This paper describes only the species of benthic marine algae found in "Atol das Rocas" and not yet mentioned to the Brazilian littoral. The blue-green and encrusting red algae were not included. The complete list of species will be published elsewhere.

All the material was collected by Oliveira Filho in February 1972 and is deposited in the Phycological Herbarium of the Department of Botany, University of S. Paulo, Brazil (SPF).

#### DESCRIPTION OF THE SPECIES

##### *ENTEROMORPHA MULTIRAMOSA* Bliding

Bot. Not. 113(2):177. 1960

Figs. 9-13

Plants tufted; filaments measuring a few cm high, tubular throughout, 88-140  $\mu$  in diameter, ramified in the basal portion; unisseriate branchlets are frequent. The cells are mostly arranged in distinct longitudinal rows in older portions and often also in transverse rows in young ones; the cells are rectangular in surface view, measuring 23-30  $\mu$  broad and up to 42  $\mu$  long; discoid plastids with 3-4 pyrenoids.

This species has the characteristics of *clathrata* group of Bliding (1963) but does not agree with any one of the species referred to the Tropical Atlantic. Its features agree very well with the descriptions of *E. multiramosa*, given by Bliding (1960, 1963) for Mediterranean plants.

*ULOTHRIX* sp..

Figs. 19-20

Rare plants, epiphytic on *Polysiphonia subtilissima*. The plant is formed by a single unbranched filament, fixed by a basal cell, without rhizoids, measuring only 375  $\mu$  high and 4-5  $\mu$  in diameter; the cells measure 9-17  $\mu$  long. The chloroplast is cylindrical and has one pyrenoid.

These plants are different from the two other species referred for the Tropical and Subtropical coasts of the American Atlantic; it differs from *U. flacca* (Dill.) Thuret by the absence of rhizoids in the base and by the number of pyrenoids; from *U. subflaccida* Wille it differs mainly by its much reduced size.

*UROSPORA PENICILLIFORMIS* (Roth) Areschoug

*Hormiscia penicilliformis* Roth

Figs. 14-18

Plants filamentous, unbranched, growing epiphytically over *Lyngbia* sp. The filaments attach to the substratum by a differentiated basal cell, and, later on, also by rhizoids produced by the basal cells. The filaments measure 24-26  $\mu$  in diameter; with intercalary growth; cells, excepting the basal ones as long as wide. Fertile cells (akinetes) swollen in the middle.

Our plants agree with the description given by Taylor (1957) for *U. penicilliformis*. In the American Atlantic the species was referred to the North and Northeastern Coast of North America where it is to be found in the spring and summer months. (Taylor 1957). It is also referred to the Argentine Coast (Halperin and Baraso, 1971).

*PRINGSHEIMIELLA SCUTATA* (Reinke) Schmidt and Petrak

*Pringsheimia scutata* Reinke, Ber. d. deutsch bot. Ges. 6:241.1888.

Figs. 3-4

Plants with a monostromatic disk-like thallus, becoming irregular when well developed, growing epiphytically on *Struvea anastomosans*. Thallus measuring 120-150  $\mu$  in diameter; cells varying in size and shape, with 9-10  $\mu$  in diameter, being 1-3 times longer than broad;

the marginal ones are radially elongate; chloroplast plate-like, with a single pyrenoid; long, unbranched, colourless hairs are present in the marginal portion.

A widely distributed species. In the American Atlantic it has been referred to the northern part of the Caribbean region (Taylor 1960, Dias-Piferrer 1968).

*PHAEOPHYLA DENDROIDES* (Crouan) Batters

Cat. Brit. Mar. Alg., p. 13. 1902

*Ochlochaete dendroides* Crouan, Flor. Finist., p. 128. 1863.

Fig. 1

Plants epiphytic or partially endophytic on various algae. Filaments irregularly branched; cells 12-20  $\mu$  in diameter to 36-48  $\mu$  long, cylindrical to irregular; hairs swollen at the base, generally one on each cell, often somewhat spirally twisted, 2-4  $\mu$  in diameter and up to 768  $\mu$  long.

A widely distributed species. For the American Atlantic it was referred to several places in the Caribbean region (Taylor 1960).

*BLASTOPHYSA RHIZOPUS* Reinke

Der. d. deutsch bot. Ges., 6: 241. 1888.

Fig. 2

Plants growing epiphytically on *Stypopodium zonale*. Thallus bladder-like, minute, with oval or oval-acuminate coenocytic vesicles scattered or joined by slender colourless filaments, each cell bearing 1-3 long colourless unseptate hairs to 100  $\mu$  long, slightly enlarged at the base. Coenocytes 25-30  $\mu$  in diameter, with numerous rounded or angular chromatophores with single pyrenoids.

A widely distributed species. For the American Atlantic it was referred to the northeastern coast of North America (Taylor 1957) and to the northern part of the Caribbean region (Taylor 1960).

*PETROSIPHON ADHAERENS* Howe

Bull. Torrey Bot. Club 23:247. 1905.

Figs. 5-8

The thallus forms light-green disk-like crusts or cushions about 5 mm thick in the central portion and has a very firm texture. It is built up by irregularly divided coenocytic filaments laterally adhaerent, tardily septate, fixed to the substratum by the lowest filaments. The thallus is marginally monostromatic but gradually becomes pluristromatic towards the older portions. The filaments measure about 179-330  $\mu$  in diameter and present a very thick cell wall. The plastid is reticulate, each portion with a pyrenoid. Different stages of segregative division were found abundantly in the material.

A very common plant in the central lagoon of the atoll and in tide pools. It grows over Melobesioideae, just under the low water mark or a little deeper.

This is the first reference of the species to the Southern Atlantic, since it was known only from Florida to Bermuda (Taylor 1960).

*VALONIA OCELLATA* Howe

"In" Britton, The Bahama Flora: 603. 1920.

Plants growing as small cushions, 0,5-1,0 cm high, on calcareous substrate. The cushions are formed by small groups of cells, like individuals, laterally coalescent. In surface view the tips of the filaments or vesicles are very strongly packed together and measure about 1 mm in diameter. Frequently these groups of "cells" have a rhizoidal-like segment in its lower portion. The plants resemble very much young plants of *Dictyosphaeria* although there are no tenacular cells. The correct identification of the plants (if a *Valonia* or a *Dictyosphaeria*), would only be defined through culture studies. The similarities of this species with *Dictyosphaeria* was already pointed out by Howe (1920) and Taylor (1960). The plants found in Atol das Rocas present morphological features identical with the figures of Taylor (1960, pl. 9, figs. 6-7) for *V. ocellata*.

The species is known from various places in the Caribbean region (Taylor 1960).

*ECTOCARPUS ELACHISTAEFORMIS* Heydrich

Ber. d. deut. bot. Ges., 10:470. 1892.

Figs. 25-27

Plants minute, epiphytic, with a basal portion of wide spreading ramified filaments to 12  $\mu$  in diameter. The basal portion gives rise to erect, usually simple or rarely basal branched filaments with 3-5 cells and a long hyaline hair with a basal meristem. The plurilocular organs are cylindrical to slightly conical, borne near the base of the short erect filaments or arising directly from the prostrate branches, measuring about 15  $\mu$  in diameter and 34-40  $\mu$  long. The material were found growing on *Styopodium zonale*.

In the American Atlantic the species was referred to Florida (Taylor 1928), Virgin Islands (Boergesen 1913) and Bermuda (Collins and Hervey 1917).

*GIFFORDIA DUCHASSAIGNIANA* (Grunow) Taylor

Mar. Alg. Subtr. Coast Am., 207. 1960

*Ectocarpus duchassaigianus* Grunow. Alg. Reise der Ostr. Fregate Novara: 45. 1867.

Plants tufted, entangled, about 2 cm high; branching alternate to irregular on erect filaments; filaments ending in hairs with a trico-

thallic growth; erect branches measuring about 30  $\mu$  in diameter with cells 1-3 diameters long. Plurilocular organs sessile or with a single stalk cell, 36-42  $\mu$  in diameter to 240  $\mu$  long, cylindrical or fusiform, rounded at the apex, frequently with a few slight attenuations along the length.

The species was already known from Bermuda and several places in the Caribbean region (Taylor 1960).

*FELDMANNIA CAESPITULA* (J. Ag.) Knoepffler-Péguy  
Vie et Milieu, A 21(1):146

*Ectocarpus caespitulus* J. Ag. Alg. Maris Med. et Adr., 26. 1842.  
Figs. 21-24

Plants cushion-like, forming entangled tufts. Basal portion disk-like; erect filaments well ramified, to 0,5 cm high and about 30  $\mu$  in diameter, near the apex there is an intercalary meristem giving rise to attenuated and colourless hairs; plastids numerous and discoids. The plurilocular organs are cylindrical to globoid, sessile or with a short stalk, measuring about 30  $\mu$  in diameter and 60-100  $\mu$  long. The unilocular organs, also sessile or short stalked, measure 24-30  $\mu$  in diameter, and 60  $\mu$  long. Both are located on the adaxial side of the branches, being usually solitary.

This is the first reference of the genus *Feldmannia* to the Tropical and Subtropical coasts of the American Atlantic, however one should suppose that probably some of the species of *Ectocarpus* and *Giffordia* will probably be transferred to it in the near future.

*ACROCHAETIUM SERIATUM* Boergesen  
Mar. Alg. Dan. West Indies III (1):32. 1916  
Figs. 32-34

Base consisting of entangled filaments spreading on the host, more or less laterally united at the center, giving rise to erect filaments, 7-10  $\mu$  in diameter near the base, alternate or irregularly ramified, tapering toward the tips but without terminal hyaline hairs. Monosporangia occur mostly on the upper part of the plant, being mostly sessile, or sometimes on one celled stalk, oval, apiculate, borne usually on the upper side of branches in unilateral series or, occasionally, solitary, measuring 12  $\mu$  in diameter to 24-36  $\mu$  long. The plant were found growing on *Styopodium zonale*.

In the American Atlantic the species was referred only to the Virgin Islands, the type locality (Boergesen 1916).

*ACROCHAETIUM UNIPES* Boergesen  
Mar. Alg. Dan. West Indies III (1):35. 1916  
Figs. 28-31

The plant fixes itself through a single basal cell with a small cylindrical process that penetrates the host tissue; the basal cell,

corresponding to the original spores, is thick-walled and measures about  $17 \mu$  in diameter. Erect filaments, mostly 1 to 2 arise from the basal cell, about 1 mm high and  $12 \mu$  in diameter in the basal portion, tapering slightly towards the tips, but without terminal hairs. The branching is alternate and usually starts at some distance from the base. Monosporangia mostly sessile, about  $12 \mu$  in diameter and  $24 \mu$  long, on the upper side of the branches in unilateral series. The plants were found growing on *Dictyota dichotoma*.

In the American Atlantic the species was referred only to Hispaniola and Virgin Islands (Boergesen 1916). The original material was found growing epiphytically on *Dictyota linearis*, in deep water. The Brazilian material was also found on a *Dictyota* species (*D. dichotoma*) and collected below the tide mark.

*GALAXAURA SQUALIDA* Kjellman

Vet. Akad. Handl. 33:55. 1900

Fig. 39

Plants bushy, dichotomously branched, to about 7 cm tall, attached by a broad discoid holdfast; erect terete branches, pilose with segments 2 mm in diameter and 0,5-2,0 cm long; extended assimilatory filaments evenly distributed, measuring 150-190  $\mu$  long and about  $18 \mu$  in diameter; parenchymatous-like cortical tissue; cells of the innermost layer more or less globose, generally about  $35 \mu$  in diameter; cells of the epidermis closely arranged, of 2 kinds: with or without assimilatory filaments, both measuring 18-23  $\mu$  in diameter.

The species has been referred to several places in the Caribbean region and surroundings (Taylor 1960).

*GELIDIELLA SETACEA* (Feldmann) Feldmann et Hamel  
Rev. Gen. Bot. 46:533. 1934

*Echinocaulon setaceum* Feldmann. Trav. Crypt. dédiés a L. Mangin, 162. 1931.

Plants to 1-2 cm tall, forming entangled tufts. The basal portion is formed by well-developed prostrate branches; erect branches radial and irregularly branched; segments setaceous, 150-200  $\mu$  in diameter with acute tips. Cortical cells transversally and irregularly disposed. The plants were found abundantly growing on calcareous substrate.

In the American Atlantic the species was referred to Guadeloupe and French Guyana (Feldmann et Hamel 1934).

*DASYA RIGIDULA* (Kuetzing) Ardissonne

Florid. Ital. 2:140. 1878

*Eupogonium rigidulum* Kuetzing. Phyc. Gen.: 415. 1843

Figs. 36-38

Plants small to about 3 mm long, mostly repent, scarcely branched. Main axes 90-120  $\mu$  in diameter, equally long, with 5 pericentral cells, ecorticated. Branchlets dichotomously divided, spirally disposed, with a globoid basal cell, attenuated towards the tips, often with terminal hairs, about 750  $\mu$  long. The antheridia are cylindrical to conical, measuring 47  $\mu$  in diameter to 180  $\mu$  long. The material was found growing on *Stypopodium zonale*.

As was already remarked by Taylor (1960) this species is very similar to *Heterosiphonia wurdemanni*. The "Rocas" plants, though presenting the characteristics of *D. rigidula* are much smaller and have hairs at the tips of the branchlets, however the material was not abundant enough for more detailed studies, perhaps leading to the description of a new species. The species has been referred to several places in the Caribbean region.

*LAURENCIA PYGMAEA* Weber-Van Bosse  
Trans. Lin. Soc. Bot. 8:122. 1913

Figs. 40-41

Plants entangled forming cushion-like tufts to about 0,5 cm high; decumbent axes attached by numerous discoid holdfasts, giving rise to numerous, erect or suberect branches; erect axes mostly branched, branching alternate or secund often sparce; erect axes terete, 149-226  $\mu$  in diameter; final branchlets with about same diameter; surface cells not distinctly protruding, more or less square in cross-sections; pericentral cells with lenticular thickenings, sparse to very abundant; branchlets with frequent anastomosis. Our material agrees very well with the descriptions and figures of Cribb (1958) for the Australian specimens.

This species was known only from the Pacific (Yamada 1931, Cribb 1958).

*LOPHOSIPHONIA SUBADUNCA* (Kuetzing) Falkenberg  
Rhod. Golfes Neaple: 496. 1901

*Polysiphonia subadunca* Kuetzing. Tab. Phyc. 13:11. 1863

Plants with a prostrate axis, about 149-164  $\mu$  in diameter, with segments 60-75  $\mu$  long, attaching at intervals by well-developed rhizoids produced at the distal part of the cells and remaining in open connection with them; erect filaments arranged in two longitudinal rows on the dorsal side of the main prostrate axis, dichotomously branched, about 90  $\mu$  in diameter with segments measuring 60-75  $\mu$  long in the lower portion, attenuating toward the tips; upper portions with trichoblasts, or scars, spirally disposed; adventitious branches are often present. Tetrasporangia 1 per segment, irregularly and sparsely disposed in the upper branches.

In the American Atlantic the species is referred only to Texas and Bahamas (Taylor 1960).

*POLYSIPHONIA EXILIS* Harvey  
Nereis Bor. Amer. II:47. 1853



Basal filaments entangled, to about 120  $\mu$  in diameter with segments measuring 60-75  $\mu$  long; attached by unicellular rhizoids. The erect filaments measure 90-107  $\mu$  in diameter with segments measuring 60-85  $\mu$  long, ecorticated, with 8-9 pericentral cells in straight longitudinal rows. Trichoblasts inconspicuous on erect branches, one per segment, spirally disposed, mostly deciduous, leaving small scar cells. Adventitious branches abundant. Tetrasporangia in spiral sequence in the tips of the erect branches.

In the American Atlantic the material was referred to Bermuda, Florida and the Bahamas (Taylor 1960).

*POLYSIPHONIA SACCORHIZA* (Collins and Hervey) Hollenberg

Pacific Sc. 22(1):76. 1968

*Lophosiphonia saccorhiza* Collins and Hervey. Ann. Acad. Arts Sc., Proc. 53(1):123. 1917

Fig. 35

Plants entangled forming cushion-like tufts to about 0,5 cm high; in diameter, sometimes up to 105  $\mu$  thick, with segments 1-1,5 diameters long, attached by unicellular saccate rhizoids up to 150  $\mu$  in diameter and 600-750  $\mu$  long, deep pink. All the branches present 4 pericentral cells. Erect filaments few, short and dichotomously branched, bearing few trichoblasts on the upperparts, one per segment; these are soon shed, leaving scar-cells. Tetrasporangia measuring to about 50  $\mu$  in diameter disposed in short series in the erect branches. The plants were found growing on *Codium intertextum*.

The species was described based on material from Bermuda (Collins and Hervey 1917), being later found in several places in the Pacific Ocean (Hollenberg 1968, Cribb 1964). The saccate, pigmented rhizoids, characteristic of this species, occur also on other *Codium* epiphytes, as *Spermothamnion gorgoneum* (Mont.) Bornet (now *Tiffaniella* Doty and Meñez 1960), and is an adaptation to fixation on *Codium*.

#### ACKNOWLEDGEMENTS

We wish to offer our acknowledgements to the "Conselho Nacional de Pesquisas" (proc. 445-72 to Oliveira F.) for their support for travel expenses; to Prof. L. C. de U. Junqueira and C. F. de A. Rosa for the opportunity to participate in the "Rocas Expedition" and to Prof. A. B. Joly for the critical reading of the manuscript.

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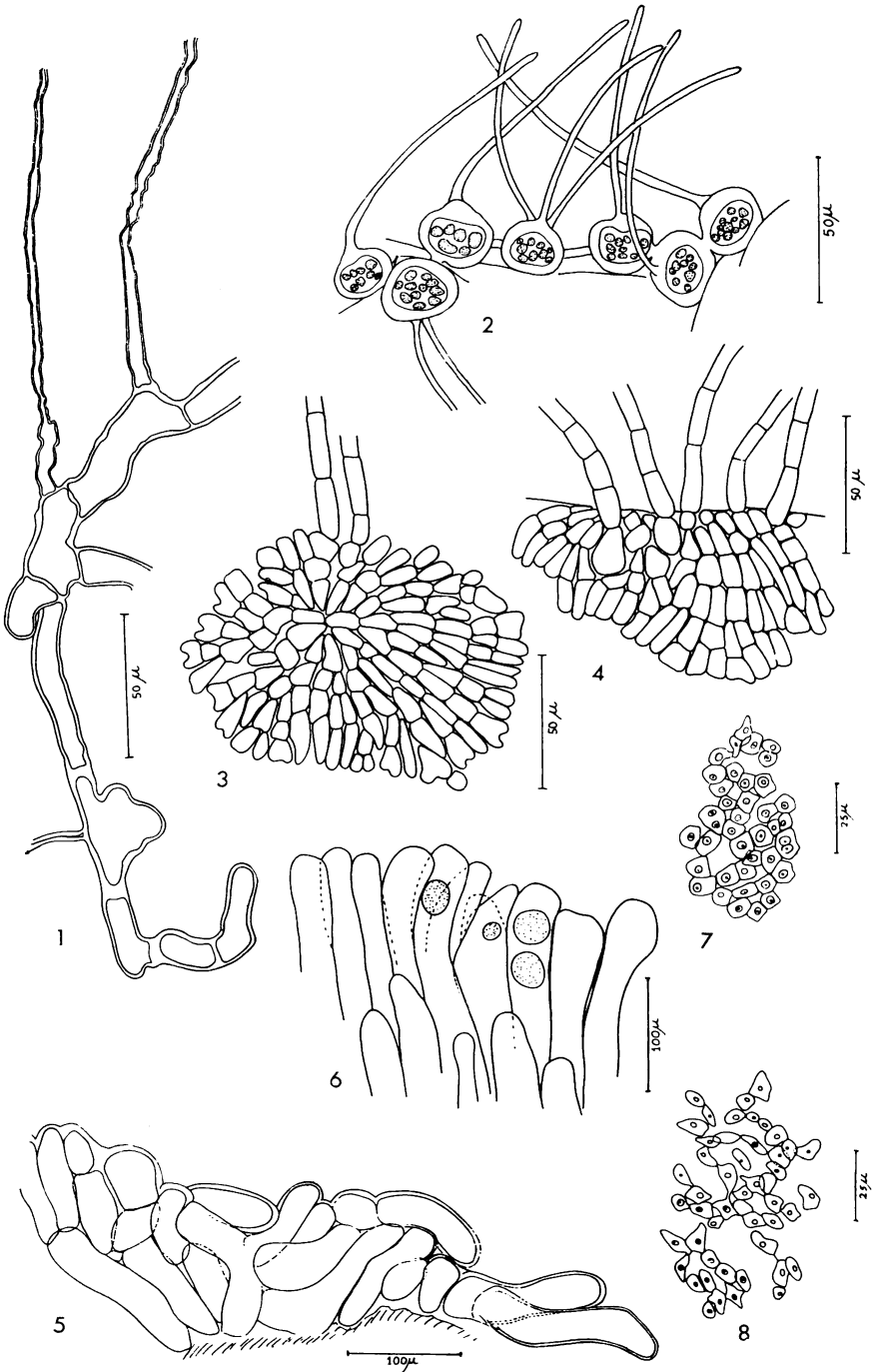
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### Figures

*Phaeophyla dendroides*: 1 — thallus view. *Blastophysa rhizopus*: 2 — view of the cells. *Pringsheimiella scutata*: 3-4 surface view. *Petrosiphon adhaerens*: 5 — marginal crosssections; 6 — surface view of the margin showing segregative division; 7 — plastids in young portions; 8 — plastids in old portions.

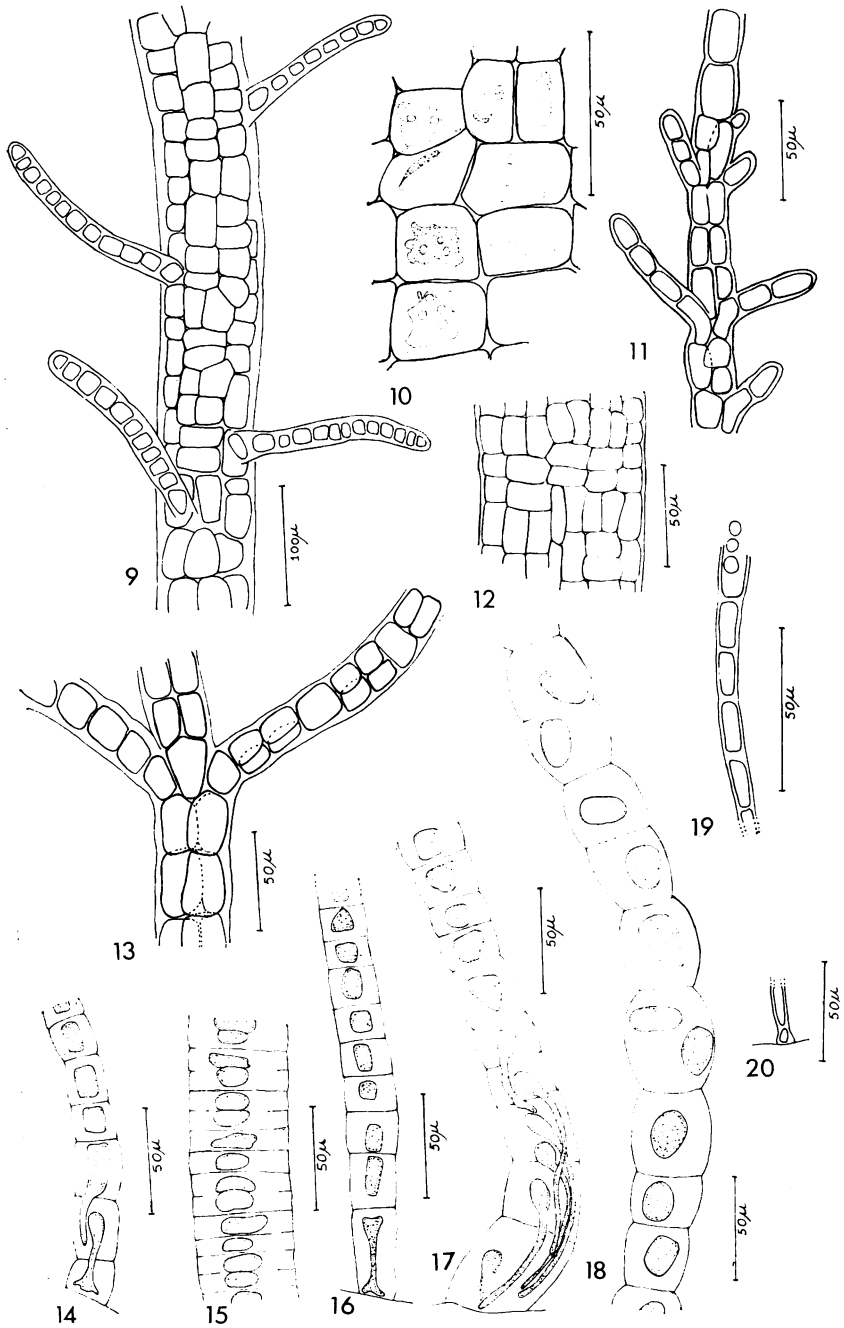
### Legenda das Figuras

*Phaeophyla dendroides*: 1 — vista do talo. *Blastophysa rhizopus*: 2 — vista do talo. *Pringsheimiella scutata*: 3-4 — vista superficial. *Petrosiphon adhaerens*: 5 — corte transversal à margem do talo; 6 — vista superficial da margem mostrando divisões segregativas; 7 — plastos em porções jovens; 8 — plastos em porções velhas.



*Enteromorpha multiramosa*: 9 — monosiphonous lateral branches; 10 — detail of the plastids and the pyrenoids; 11 — branching in young portions; 12 — cell arrangement; 13 — branching. *Urospora penicilliformis*: 14, 16 and 17 — basal portion with different stages in rhizoids development; 15 — cell division; 18 — akinetes. *Ulothrix* sp.: 19 — aplanospores; 20 — basal cell.

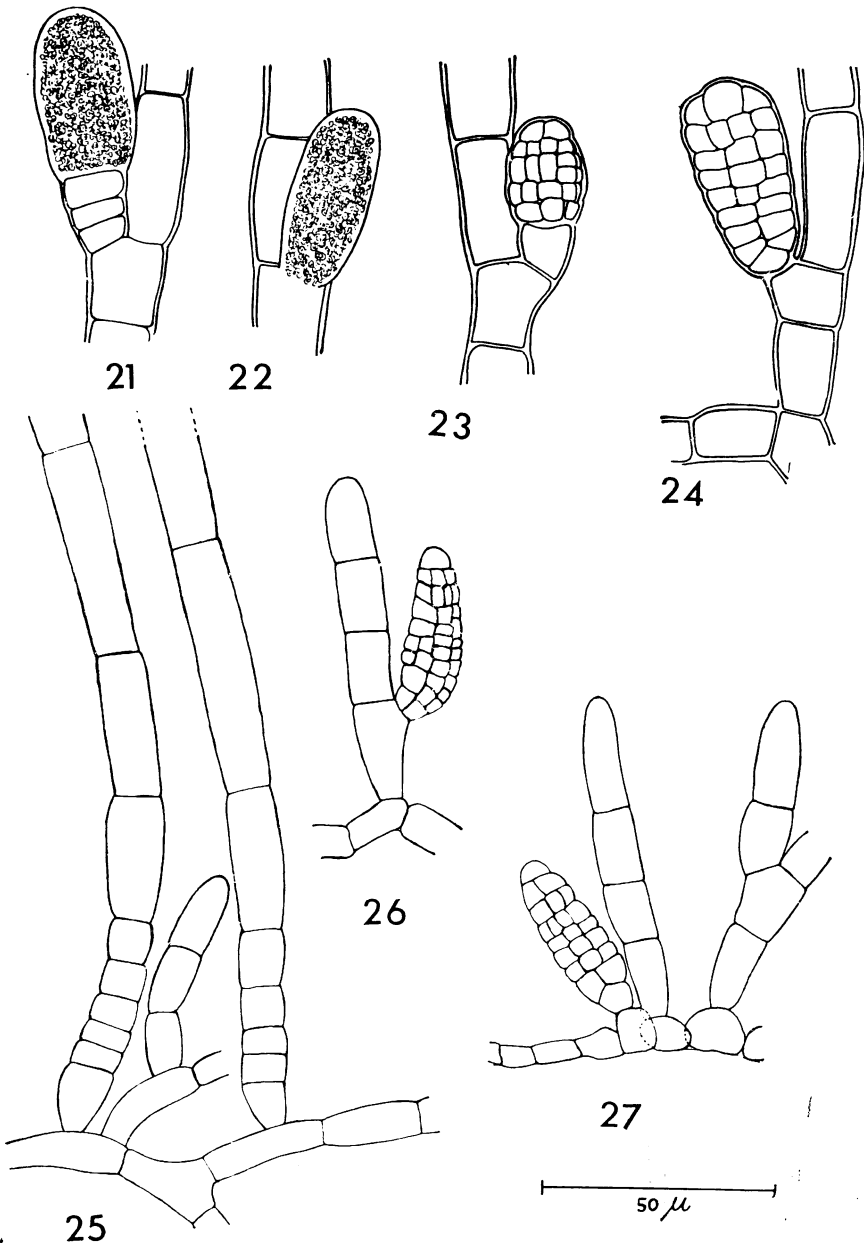
*Enteromorpha multiramosa*: 9 — ramos laterais unisseriados; 10 — detalhes dos plastos e pirenóides; 11 — ramificação em porções jovens; 12 — disposição das células; 13 — ramificação. *Urospora penicilliformis*: 14, 16 e 17 — porção basal mostrando diferentes estágios no desenvolvimento dos rizóides; 15 — divisão celular; 18 — acinetos. *Ulothrix* sp.: 19 — aplanosporos; 20 — célula basal.



*Feldmannia caespitula*: 21-22 — unilocular organs; 23-24 — plurilocular organs, both with and without stalk. *Ectocarpus elachistaeformis*: 25-27 — tricothallic growth and plurilocular organs.

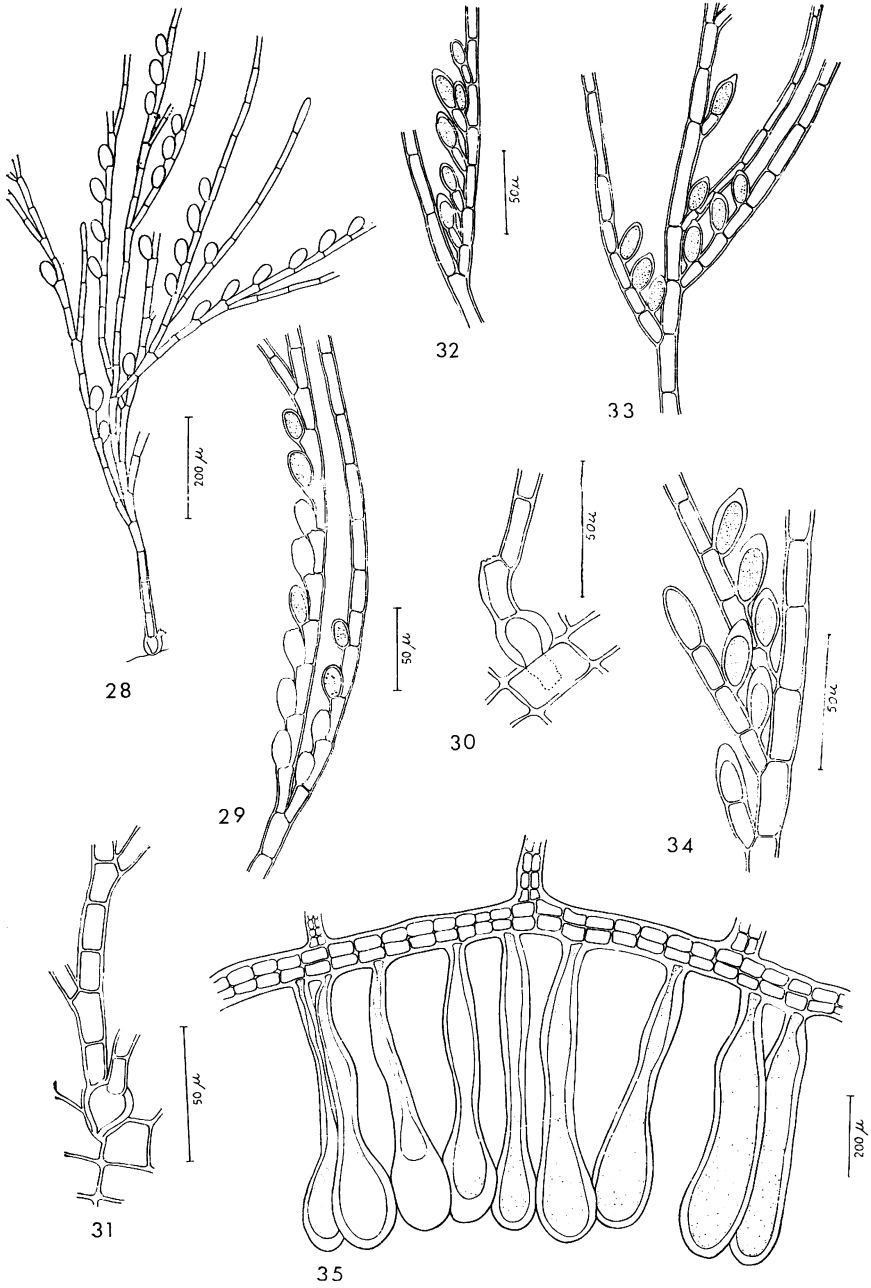
*Feldmannia caespitula*: 21-22 — órgãos uniloculares; 23-24 — órgãos pluriloculares, ambos com e sem pedúnculo. *Ectocarpus elachistaeformis*: 25-27 — crescimento tricotálico e órgãos pluriloculares,





*Acrochaetium unipes*: 28 — general aspect; 29 — detail of the monosporangia; 30-31 — basal portion. *Acrochaetium seriatum*: 32-34 — detail of the monosporangia form and arrangement. *Polysiphonia saccorhiza*: 35 — prostrate branches with typical rhizoids.

*Acrochaetium unipes*: 28 — aspeto geral; 29 — detalhe dos monosporângios; 30-31 — porção basal. *Acrochaetium seriatum*: 32-34 — detalhe mostrando a forma e arranjo dos monosporângios. *Polysiphonia saccorhiza*: 35 — ramo prostrado com os rizóides característicos.



*Dasya rigidula*: 36 — lateral axis with branchlets; 37 — detail of the terminal portion of a branchlet; 38 — antheridia. *Galaxaura squalida*: 39 — thallus structure in crosssection. *Laurencia pygmaea*: 40-41 — habitus.

*Dasya rigidula*: 36 — posição dos râmulos; 37 — detalhe da porção terminal de um râmulo; 38 — corpos anteridiais. *Galaxaura squalida*: 39 — corte transversal do talo. *Laurencia pygmaea*: 40-41 — forma do talo.

