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Studies on the marine algal flora of Venezuela. IV. *Botryocladia papenfussiana* sp. nov. (Rhodophyceae, Rhodymeniales)[1,2]

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A new sublittoral species of *Botryocladia, B. papenfussiana* is described based on collections trawled from depths of 10–15 meters near the Institute of Oceanography, Cumaná, Venezuela. Thallus morphology and structure, tetrasporic, male and female plants are figured in detail. The Venezuelan plants are characterized and also distinguished from related species by the shape, size, and structure of the vesicles.

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Introduction

The genus *Botryocladia* Kylin (Rhodymeniales, Rhodophyta) is mainly a tropical and subtropical deep water marine alga. The thallus is differentiated into a simple or branched, solid axis which bears one to many hollow, grape-like branchlets called vesicles or bladders. While studying the marine benthic vegetation of eastern Venezuela, a *Botryocladia* sp. was trawled several times in September 1969 from sublittoral waters near the Institute of Oceanography, Cumaná, Venezuela. These plants were strikingly different in many respects from the three known species of the Caribbean Sea, *viz., B. occidentalis* (Børgesen) Kylin, *B. pyriformis* (Børgesen) Kylin, (Taylor, 1960), and *B. shanksii* Dawson (1962). Of these, only *B. occidentalis* is recorded from Venezuela (Rodriguez, 1959, as *Chrysymenia uvaria* (L.) J. Ag.; Hammer and Gessner, 1967). After studying a paper by G. Feldmann and Bodard (1965) which contained a key to the 21 known species of *Botryocladia,* we decided that the plants we had represented a new species.

Botryocladia papenfussiana Ganesan et Lemus sp. nov.

Plantae 10–40 mm altae, epiphyticae vel epizoicae adhaesae a parvo disco basale 1–3 mm diam., erecti axes 1–4, exiles, rotundati, simplices vel irregulariter ramosi saepe, 1–10 mm longi, 220–300 μm crassi, vesiculae elongatae, terminaliter rotundatae, 1–16 per plantam, 8–37 mm longae atque 2–5 mm latae; paries vesiculae generaliter cum 2 stratis cellularum, super continuum interiorem stratum magnarum cellularum, 25–170 μm longarum, 20–70 μm latarum, polygonalium in visu superficiei, exterius stratum minorum cellularum 10–20 μm latarum, instructarum more reticulato super laterales parietes magnarum cellularum interiorum; tertius ordo parvarum cellularum 4–10 μm latarum, ovatarum vel rotundarum, sparsarum, potest aut non potest esse praesens super unum vel ambo latera secundi strati; glandicellulae binae ad octonas super cellulas non modificatas; sphaericae vel ovatae, 17–45 μm longae atque 12–35 μm latae; tetrasporangia sphaerica ad ovatam ellipticam, 20–33 μm diam. maximae; cystocarpi sparsi, sphaerici, moderate vel prominenter protuberantes 500–660 μm diam., carposporangia subsphaerica, 12–24 μm diam., spermatangia 2–3 (4) μm diam.

Habitat in parvis conchis gastropodorum, tubis polichaetorum atque *Ulva lactuca* in altitudine 10–15 m in Peñoncito, Cumaná, Venezuela.

HOLOTYPUS: E. K. Ganesan atque A. J. Lemus *790* (20.i.71) in Ficoteca Venezolana, Instituto Oceanográfico, Universidad de Oriente, Cumaná, Venezuela depositus.

Botryocladia papenfussiana[3] grows on a variety of objects such as small Gastropod shells (*Engoniophos* sp., *Conus* sp., and *Chicoreus margaritensis*), Polychaete tubes, and *Ulva lactuca* at a depth of 10–15 metres. The plants were first trawled at Peñoncito, which is about 3 km west of the Institute of Oceanography and also subsequently at Playa Manzanillo and Playa Naiguata, which are near Peñoncito. On the basis of material obtained in the trawl, the bottom in all these places appears to be sandy or muddy.

[1]Paper presented during the XX Annual Convention of AsoVAC held at Caracas, Venezuela, May 19–23, 1970.

[2]Supported by two grants given to the senior author by Comisión de Desarrollo y Coordinación Científica, Universidad de Oriente, Cumaná, Venezuela (Proyectos DCC/87/70/EM–02 and DCC–105/71/BM–01).

[3]The specific name honours Prof. G. F. Papenfuss for the invaluable help he has given to our study of Venezuelan marine benthic algae. This paper is also dedicated to him on the occasion of his retirement from academic service.

A total number of 85 plants were found and measured. The plants are 10–40 mm high. Each plant is attached by a small basal disc which is 1–3 mm broad. From this disc arise 1–4 very slender, terete, erect axes, which are 1–10 mm long and 220–300 μm broad. Each axis may be simple, or more commonly it is branched irregularly many times (Fig. 1, 2). Structurally the axis is made up of large, angular or oval cells in the centre which grade into smaller cells towards the periphery (Fig. 7). Each axis gradually expands above into a simple, hollow, elongate, terminally blunt vesicle. The vesicles are 8–32 mm long and 2–5 mm broad. Exceptionally, the vesicle may be up to 37 mm long. The axes of the vesicles may

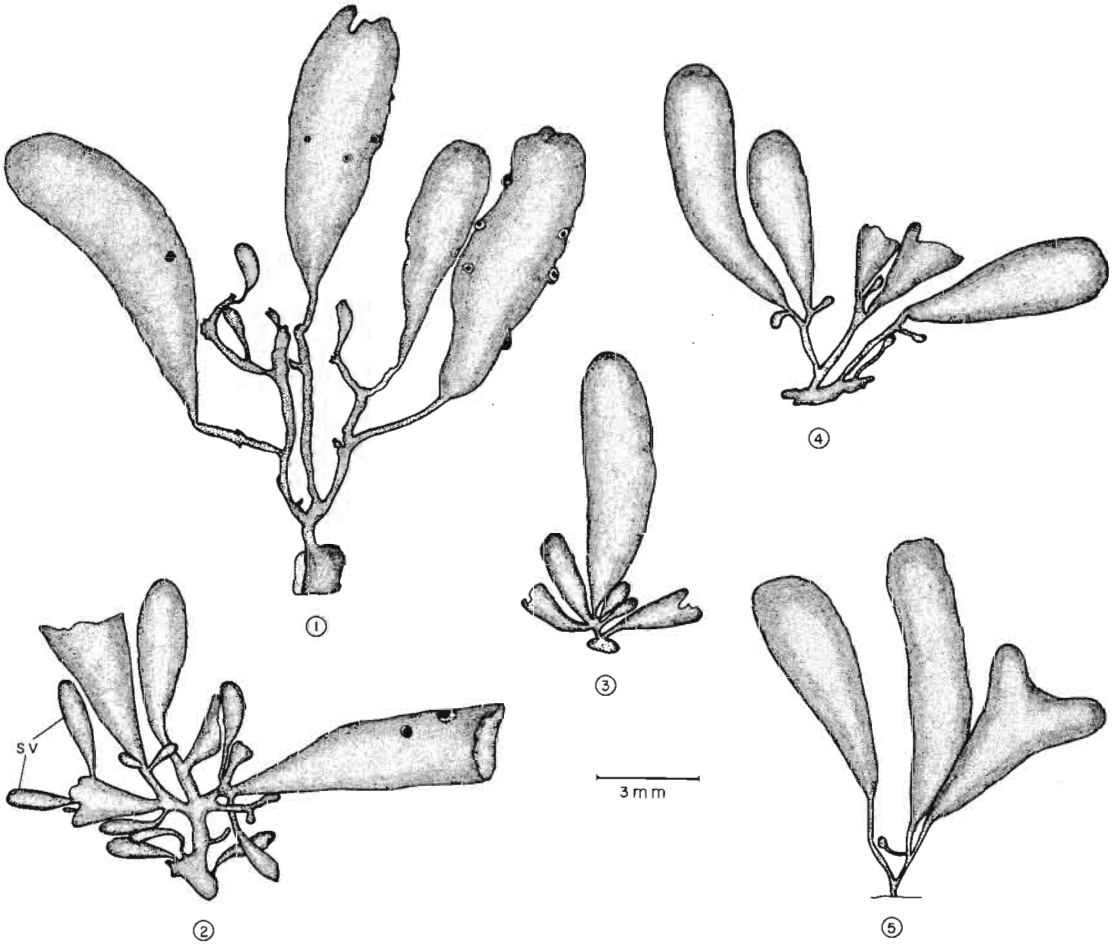
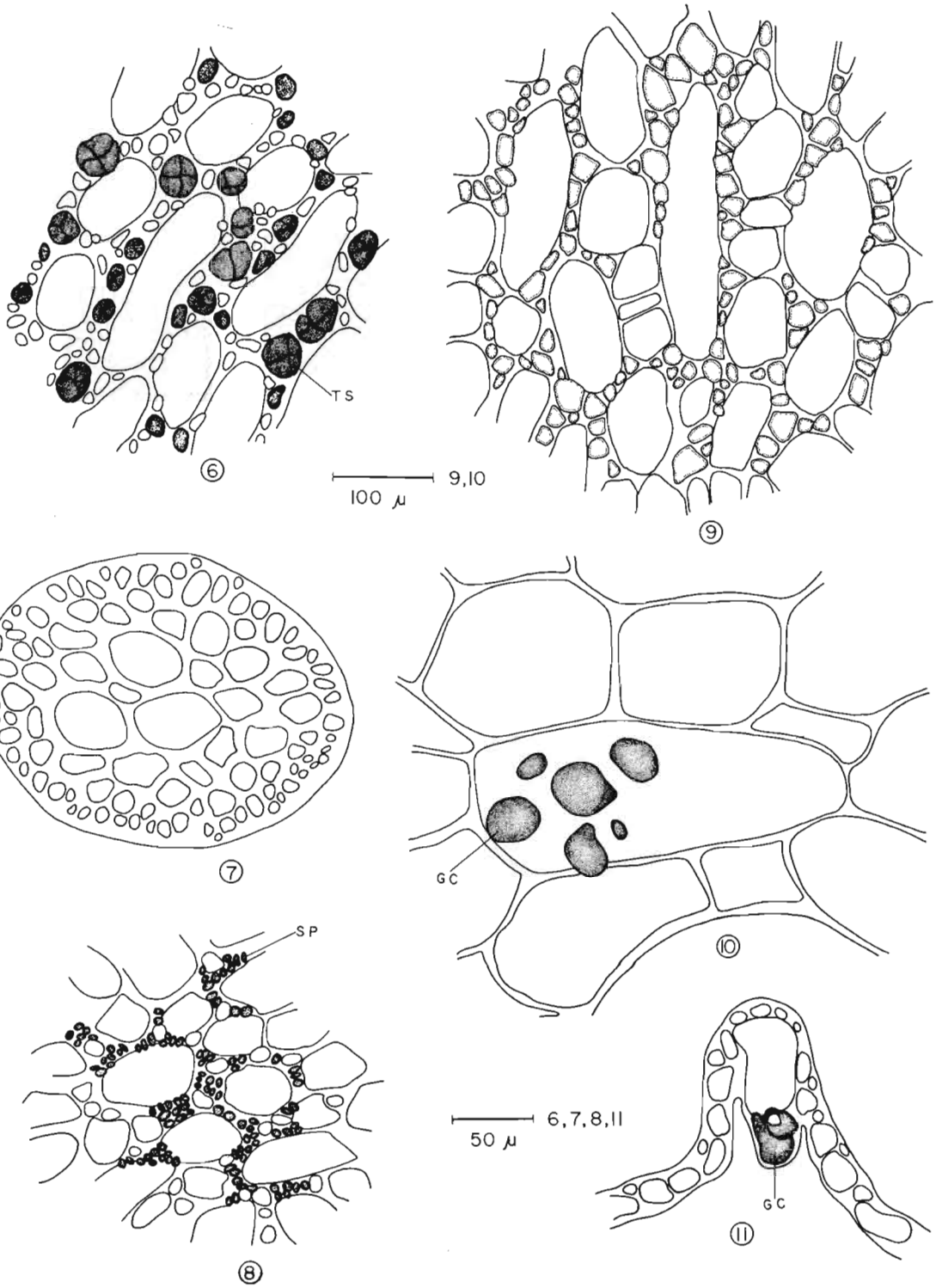


FIG. 1–5. *Botryocladia papenfussiana* sp. nov. FIG. 1. Habit of a female plant (HOLOTYPE), drawn from living material. FIG. 2. Habit of another female plant showing the irregular branching of the axis and formation of secondary vesicles (*SV*) from the torn margins. FIG. 3. Habit of a tetrasporic plant with a much reduced axis. FIG. 4. Habit of a male plant. FIG. 5. Habit of a plant (sex not identified) with a bilobed vesicle.

FIG. 6–11. *Botryocladia papenfussiana* sp. nov. FIG. 6. Surface view of a portion of the vesicle wall of a tetrasporic plant showing tetrasporangia (*TS*). FIG. 7. Transverse section of an axis. FIG. 8. Surface view of a portion of the vesicle wall of a male plant showing spermatangia (*SP*). FIG. 9. Surface view of a portion of a sterile plant showing cell arrangements of the wall of the vesicle. FIG. 10. A group of gland cells (*GC*) on the inner large cells facing the cavity. FIG. 11. Transverse section of a portion of the wall of the vesicle with 2 gland cells (*GC*); the vesicle is so very delicate that it is difficult to get a perfect, rather rounded section, and hence the odd shape and the "creased" appearance.


TS
⑥
100 μ
9,10
⑨
⑦
GC
⑩
SP
⑧
50 μ
6,7,8,11
GC
⑪

be prominent (Fig. 1, 2) or much reduced (Fig. 3). Rarely a vesicle may be bilobed terminally (Fig. 5). From the torn ends of vesicles secondary vesicles may proliferate (Fig. 2, *SV*). The number of vesicles per plant usually varies from 1–10 (Fig. 12, 13, 14). However, in a single instance, 18 vesicles of different ages were found on a 20 mm high tetrasporic plant.

Structurally, the wall of the vesicle consists of 2–3 layers of cells. The innermost layer is continuous and is composed of large, thick-walled cells which line the cavity. These cells are generally much elongated in surface view (Fig. 9, 15, 18), up to 170 μm long and 70 μm broad at the base of the vesicle and becoming small, 15–25 μm long and broad towards the apex. The second layer consists of small, densely-staining cells of different shapes. These cells are 10–20 μm broad, do not completely cover the inner layer and are arranged regularly over the lateral walls of the large inner cells. A third layer of oval or rounded cells 4–10 μm in diameter may or may not be present on one or both sides of the second layer (Fig. 15, top right). In other words, the outer region, made up of 1–3 rows, is arranged in a net-like manner leaving the greater portion of the large inner cells uncovered (Fig. 15, 18).

Gland cells, which occur in several members of the Rhodymeniales, are frequent and are borne on unmodified cells on the side of the large cells facing the cavity (Fig. 10). Sometimes, the cell which bears the gland cells projects into the cavity of the vesicle (Fig. 11). Gland cells usually occur in groups of 2–8 (Fig. 18), but rarely occur singly. Individual gland cells are 17–45 μm long and 12–35 μm broad.

Tetrasporangia are formed abundantly mainly on the external surface of the middle region of the vesicle and are differentiated among the outer net-like layer of cells, generally beneath an opening (Fig. 6, 17). Mature tetrasporangia are spherical to ovoid elliptical, cruciate to irregularly divided, and 20–33 μm in maximum diameter.

Sexual plants are dioecious. Cystocarps are scattered sparsely, and project moderately or prominently from the vesicle surface (Fig. 1, 12, left). Mature cystocarps are spherical and 500–660 μm broad. Carposporangia are subspherical and 12–24 μm broad. Spermatangia are formed in great abundance on the external surface a little below the distal end of the vesicle. These occur in groups and are formed by the transverse and vertical division of the outer net-like layer of cells (Fig. 8, 16). Spermatangia are 2–3 (4) μm diameter.

HABITAT AND TYPE LOCALITY: On small Gastropod shells, Polychaete tubes and *Ulva lactuca* at a depth of 10–15 meters, Peñoncito, Cumaná, Venezuela.

HOLOTYPE: E. K. Ganesan and A. J. Lemus *790* (20.i.71) cystocarpic specimen deposited in the Herbarium, Instituto Oceanográfico, Universidad de Oriente, Cumaná, Venezuela. Additional material deposited in the same Herbarium: *E.K.G. and A.J.L. 709,* 4.ix.69; *E.K.G. and A.J.L. 769,* 17.vi.70, Peñoncito, from depths of 10–15 meters; *E.K.G. and A.J.L. 770, 771, 773, 774,* 17.vi.70, Playa Manzanillo, from depths of 12 meters; *E.K.G. and A.J.L. 785, 786,* 18.vi.70, Playa Naiguata, from depths of 10 meters.

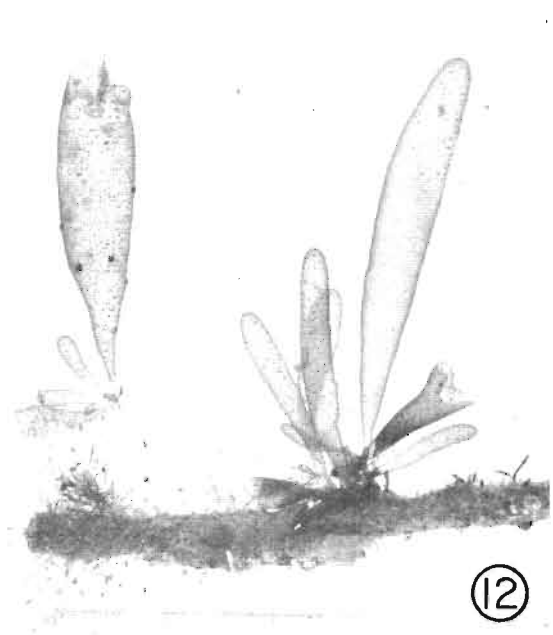
Duplicates are also deposited in the Herbarium, University of California (*UC*), Berkeley, and the Phycology Herbarium, University of British Columbia (*UBC*), Vancouver, Canada.

Discussion

G. Feldmann and Bodard (1965) recognize 21 species and provide a key to the known species of *Botryocladia*. According to this key, the plants we trawled from Venezuela seem to fall near a group of plants which includes *B. senegalensis* G. Feldmann *et* Bodard, *B. hancockii* Dawson, *B. fernandeziana* Levring, and *B. beaudettei* Dawson. This group is characterized by plants with a relatively short axis (sometimes very much reduced) and with one or a few, elongate, cylindrical or fusiform vesicles, which are more than 2 diameters long. The external cortical layer of the vesicles is discontinuous in all these species. On the basis of several differences that are mentioned below, we consider our plants as a new species of *Botryocladia* and describe them as *B. papenfussiana* Ganesan *et* Lemus sp. nov.

In *B. senegalensis* (G. Feldmann and Bodard, 1965), the axes are very short (1–2 mm

FIG. 12–15. *Botryocladia papenfussiana* sp. nov. FIG. 12–14. Habit of several plants growing on Polychaete tubes and small Gastropod shells (photographed from living material). FIG. 15. Surface view of the wall of the vesicle of a sterile plant; ×340.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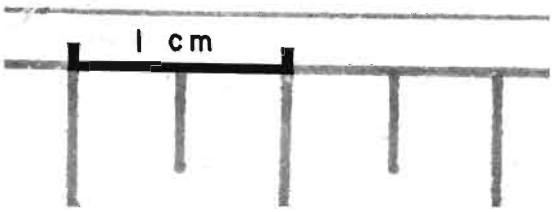
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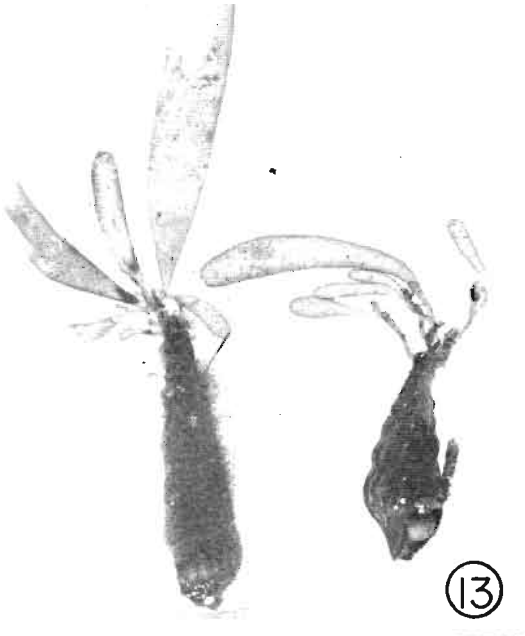
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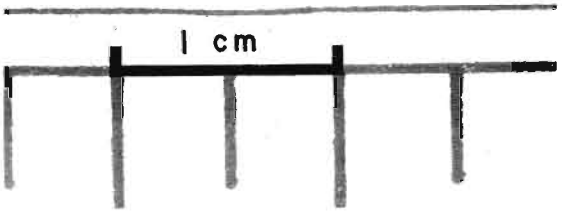
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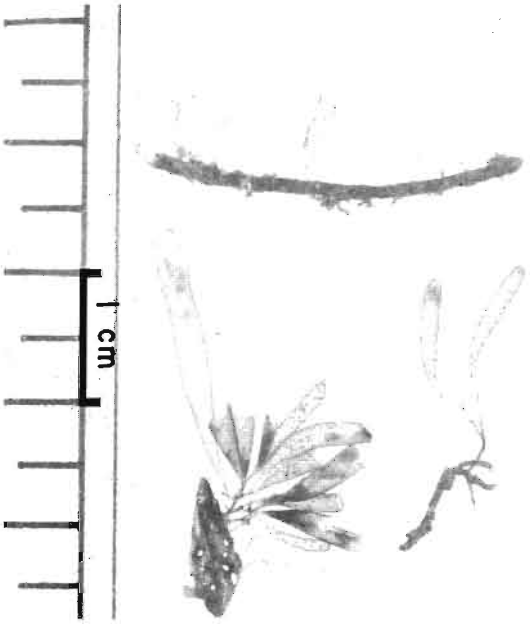
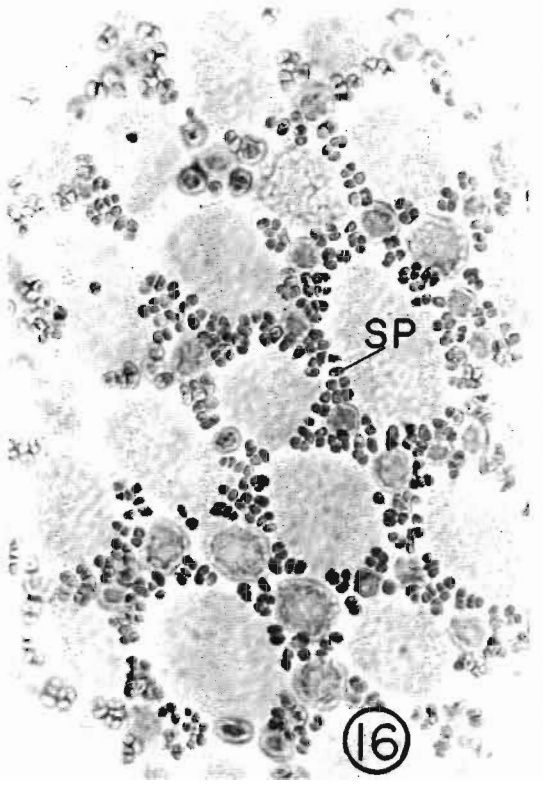
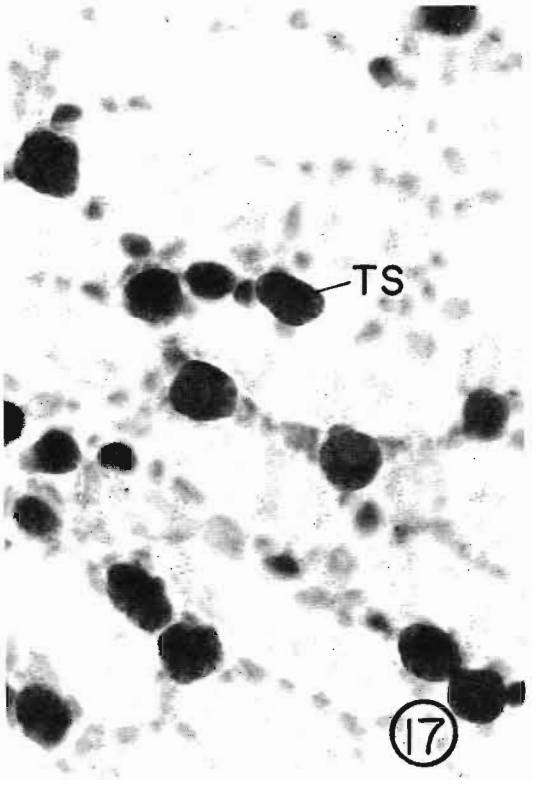
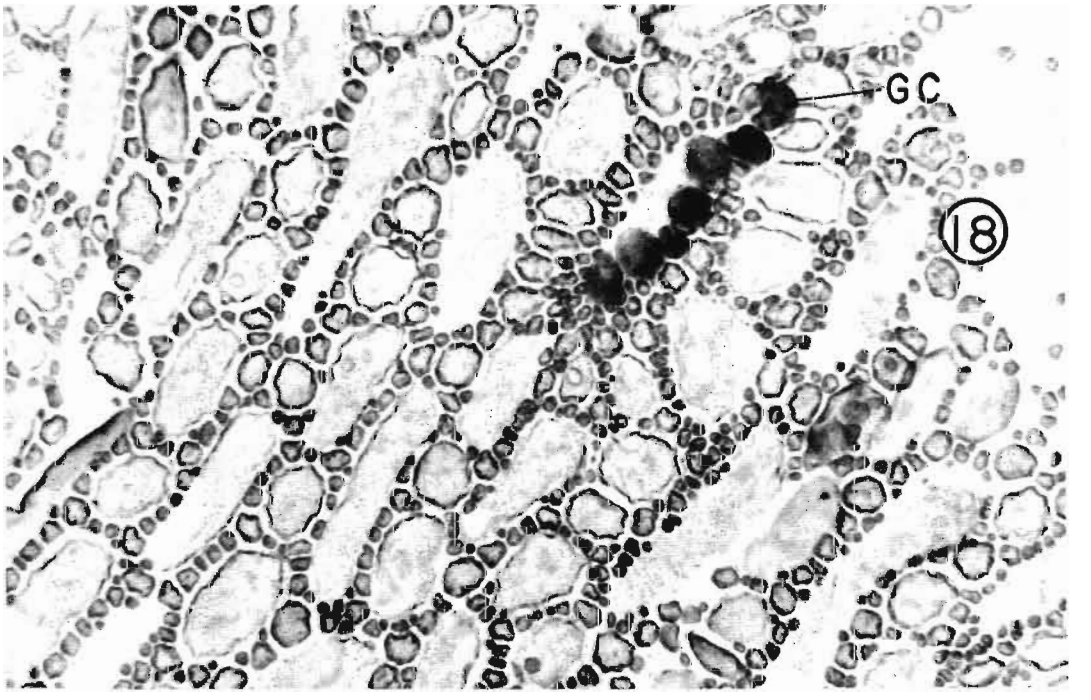

1 cm
14


15


SP
16


TS
17


GC
18

long) and the vesicles are ovoid-oblong sacs 40–60 mm long and 15–20 mm broad. Cystocarps are numerous, each about 100 μm in diameter. In *B. papenfussiana* also, the axes may be very short. However, in *B. papenfussiana* the vesicles are elongate, 8–32 mm long and 2–5 mm broad, cystocarps are scattered sparsely and each cystocarp is 500–660 μm in diameter.

In *B. hancockii* (Dawson, 1944, 1963), the primary elongate vesicle has several secondary vesicles, which in turn bear tertiary protuberances. Secondary and tertiary vesicles are not present in the Venezuelan material.

In *B. fernandeziana* (Dawson, 1963), the vesicles are about 10 mm long, 3.5 mm in mid diameter, elongate-elliptic and narrowed terminally. *B. papenfussiana* has elongate, terminally blunt vesicles, which are up to 32 mm long and 5 mm broad.

In *B. beaudettei* (Dawson, 1960), gland cells occur consistently in groups of three, which hang from one of the smaller cells of the inner layer, this cell sometimes projecting downward and bearing several arachnoid lateral wall processes. In *B. papenfussiana,* gland cells occur usually in groups of 2–8 on unmodified cells, which lack the arachnoid lateral wall processes.

Our Venezuelan plants are also different from the above four species in regard to the wall structure of the vesicles. In *B. senegalensis* (G. Feldmann and Bodard, 1965, p. 4, fig. 2), *B. hancockii* (Dawson, 1944, p. 389, pl. 45, fig. 4), *B. fernandeziana* (Dawson, 1963, p. 450), and *B. beaudettei* (Dawson, 1960, p. 46, fig. 6 *C*), the wall of the vesicle has three well developed layers of cells. In *B. papenfussiana* the third layer of cells is generally very poorly developed being represented only by scattered cells.

Acknowledgements

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Resumen

Se describe una nueva especie sublittoral de *Botryocladia, B. papenfussiana* (Rhodymeniaceae, Rhodophyta), obtenida en colecciones por arrastre a profundidades de 10–15 metros, cerca del Instituto Oceanográfico, Universidad de Oriente, Cumaná, Venezuela. Se dan detalles sobre morfologiá, estructura del talo, de plantas tetrasporicas, masculinas y femeninas. Las plantas venezolanas están caracterizadas y se distinguen de las especies relaciondas por la forma, tamaño y estructura de las vejigas.

References

DAWSON, E. Y. 1944. The marine algae of the Gulf of California. *Allan Hancock Pacific Exped.,* 3(10): 189–453, 77 pl.

——— 1960. New records of marine algae from Pacific Mexico and Central America. *Pac. Nat.,* 1(19–20): 31–52, 7 fig.

——— 1962. Additions to the marine flora of Costa Rica and Nicaragua. *Ibid.,* 3(13): 375–395, 5 pl.

——— 1963. Marine red algae of Pacific Mexico. Pt. 6, Rhodymeniales. *Nova Hedwigia,* 5: 437–476, 19 pl.

FELDMANN, G., AND BODARD, M. 1965. Une nouvelle espèce de *Botryocladia* des côtes du Sénégal. *Bull. Inst. Oceanogr. Monaco,* 65 (1342): 1–14, 5 fig.

HAMMER, L., AND GESSNER, F. 1967. La taxonomiá de la vegetación marina en la costa oriental de Venezuela. *Bol. Inst. Oceanogr. Cumaná,* 6(2): 186–265, 30 pl.

RODRIGUEZ, G. 1959. The marine communities of Margarita Island, Venezuela. *Bull mar. Sci. Gulf Caribb.,* 9(3): 237–280, 26 fig.

TAYLOR, W. R. 1960. *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas.* Univ. Michigan Press, Ann Arbor, 870 p., 80 pl.

FIG. 16–18. *Botryocladia papenfussiana* sp. nov. FIG. 16. Surface view of a portion of the vesicle wall of a male plant showing spermatangia (*SP*); ×564. FIG. 17. Surface view of a portion of the vesicle wall of a tetrasporic plant showing tetrasporangia (*TS*); ×339. FIG. 18. Surface view of a portion of a sterile plant showing a group of 7 gland cells (*GC*); these gland cells occur on the side of the large cells facing the cavity; ×251.