

THE GENUS *BOSTRYCHIA* MONTAGNE, 1838 IN
SOUTHERN BRAZIL. TAXONOMIC AND
ECOLOGICAL DATA.

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THE GENUS *BOSTRYCHIA* MONTAGNE, 1838
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TAXONOMIC AND ECOLOGICAL DATA. (1)

AYLTHON B. JOLY

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INTRODUCTION

Though the genus *Bostrychia* was established by Montagne in 1838 (2) (cf. Montagne, C. "in" Ramon de la Sagra, *Histoire Physique, Politique et Naturelle de l'Ile de Cuba*. Botanique —

(1) Received for publication January 9, 1954.

(2) Conserved over *Amphibia* Stackhouse, 1809.

Plantes Cellulaires. Paris 1838-1842: I-X + 1-104 + Pl. I-V; p. 39), it was only in 1875 that it was first referred to the Brazilian coast by Martens (3). In that year, Martens on listing the plants collected by Glaziou near Rio de Janeiro, identified one as *Bostrychia sertularia* Montagne (as *B. sertularina* cf. 12, p. 147) = *B. binderi* Harvey (cf. 16, p. 10). One year later, Zeller reported on another species, *B. vieillardii* Kützing (cf. 28, p. 432) = *B. binderi* Harvey (cf. 16, p. 10) on the Brazilian coast. After that Möbius, in three successive papers (cf. 13, p. 339-340; 14, p. 1085; 15, p. 173-174) besides confirming the occurrence of the previously mentioned species, established a new record for *B. radicans* Montagne and described a new form of it (cf. 13) named forma *brasiliiana* Möbius (= *B. radicans* Montagne forma *moniliforme* Post). The next major contribution to the knowledge of Brazilian algae was the paper by Schmidt, who published a long list of species (cf. 19) collected by P. von Lützelburg at three different points on the Brazilian coast; no *Bostrychia* however was found among the material.

A few years later, Taylor mentioned *B. tenella* (Vahl) J. Ag. (cf. 21, p. 635 as *Amphibia tenella* (Vahl) Kuntze) = *B. binderi* Harvey (cf. 16, p. 29). On the following year, the same author (cf. 22) published a comprehensive list of all the previous records of Brazilian algae. It was then that an attempt was made to give modern names to the old records. Until that time there were only three species of *Bostrychia* referred to Brazil (cf. 22, p. 305-306). Five years after the appearance of Taylor's list, Post made a very complete revision of the genus *Bostrychia* (cf. 16). According to the last mentioned paper, the species referred to Brazil can be summarized as follows (4):

- 1) *Bostrychia sertularia* Montagne = *B. binderi* Harvey
- 2) " *vieillardii* Kützing = *B. binderi* Harvey
- 3) " *radicans* Montagne f. *brasiliiana* Möbius =
B. radicans (Mont.) Montagne f. *moniliforme* Post
- 4) " *tenella* (Vahl) J. Agardh = *B. binderi* Harvey (the Brazilian material prior to 1936 identified as *B. tenella*)

(3) A list assembling the majority of papers on Brazilian Algae appeared recently (See 9).

(4) The reference given by Lüderwaldt of *Bostrychia brasiliiana* (cf. 11, p. 133) must be considered as *nomen nudum* since there is no description or figures accompanying it.

From the above list one can see that until 1936 there were only two species unquestionably referred to Brazil. Later, Williams and Blomquist (5) reported, for the Northern part of Brazil, not only *B. binderi* Harvey, but also *B. tenella* (Vahl) J. Ag. and *B. sertularia* (Mont.) Howe (cf. 27, p. 385 and list on p. 397). As for the last mentioned species, the reader is referred to the list of synonymy given by Post (cf. 16, p. 10 and p. 28). It seems to the present author that the identity of *B. tenella*, as understood by Post, with the material assigned to that species in the paper quoted above, needs confirmation. The present writer recently (cf. 8) referred *B. radicans* and *B. binderi* as occurring on the coast of the State of Paraná, Southern Brazil.

Taxonomy of the Southern Brazilian representatives

The following key is intended to facilitate the identification of the Southern Brazilian plants. No attempt was made to include foreign species or varieties not found within the area surveyed.

- 1 — Plants always found growing on or nearby mangrove areas, usually on mangrove plants 2
- 1a — Plants restricted to shady caves and at the shady side of rocky cliffs to the landside of quiet bays or channels, usually growing high above the water level, not necessarily related to mangrove areas. Commonly saxicolous. Plants corticated except for the terminal portions of the last order branchlets which are monosiphonous *B. binderi* Harvey
- 2 — Small plants, forming dense tufts on mangrove roots or stems, or on rocks nearby mangrove areas, usually on rocks, at the landside of quiet bays, where mangrove or mangrove rivers end. Ultimate branchlets polysiphonous

(5) I am very much obliged to Prof. H. L. Blomquist, of the Department of Botany, Duke University, for his kindness in sending me samples of *B. sertularia* and *B. binderi* which are duplicates of the collection reported jointly by him and L. G. Williams in 1947 (see 27). This material arrived shortly after I had finished the typing of the present paper. Both samples belong to *B. binderi* Harvey. The one from Fernando Noronha Islands (March 9, 1945) is tetrasporic. The other from south of Recife, Pernambuco, is sterile (February 1945). In this material the short laterals are less developed than in the former, otherwise both are in accordance with Post's limitation of species in this genus.

- below (except the 5-23 terminal segments on forma *moniliforme*) ecorticated throughout *B. radicans* (Mont.) Montagne
- 2a — Plants stout, large, usually up to 5-6 cm high (~ 10 cm), always found within mangrove areas. With a parenchymatous cortex; the last segments of the lateral branchlets are nearly polysiphonous to the end *B. scorpioides* Montagne var. *montagnei* (Harv.) Post
- 2b — Large plants, but very delicate, collapsing completely during low tide; usually up to 5-6 cm high, always found within mangrove areas. With a cortex formed of hyphae. Mature plants with a delicate feather appearance *B. calliptera* (Mont.) Montagne

Bostrychia radicans (Montagne) Montagne

- References: Post 1936, p. 13-19; Kützing 1849, p. 839-840; J. Agardh 1863, p. 856-857; Falkenberg 1901, p. 513 T. 12 f. 4; De Toni 1903, p. 1156-1157; Tseng 1943, p. 168; Taylor 1945, p. 306.
Plate I, figures 1-10 (6)

Plants small growing in dense tufts, usually high above the high tide line especially if attached to rocks and then well protected from the sun. Commonly found within the influence of mangrove rivers, estuaries or in nearby mangrove areas, as in the large quiet, muddy bays, so common and characteristic of the Southern Brazilian shores. The plants have a maximum height of about 1,5 to 2,5 cm but sometimes they may reach several centimeters in length. It is very difficult to determine the exact length of the plants examined because of the growing habit and of the abundant formation of haptera which, being so effective as a means of fixation, prevents the collecting of entire plants. Another point difficult to ascertain because of this peculiar habit is the life-time of such plants. They behave like many rhizomatous land plants which, while growing at one end are dying at the other. They must be considered, at least within the area surveyed, as perennials. They keep on growing during all seasons and exhibiting reproductive structures throughout the year. The simple inspection of the list of material examined at the end of this page will serve to exemplify this condition. The

(6) All drawings were made from formalin preserved material.

thallus has a simple construction; it is formed of a single series of pericentrals which may range from 8 cells in older parts (Pl. I, fig. 4) to 4 in young ones when the thallus is examined in cross section. Each pericentral initial is divided in two, transversally, in such a way that each central is covered by two vertical series of pericentrals, when, in turn, we examine the longitudinal section (Pl. I, fig. 5). There is no formation of secondary cortex in any way; the thallus is ecorticated throughout. The formation of haptera from the secondary basal branchlets, (the "Ramiflucratae" of Post) (Pl. I, figs. 1, 3 and 6), though common, is not frequent and may lack completely in some plants. The branch formation is typically of the exogenous type, i. e. the lateral branch arises before the pericentrals are cut off. (Pl. I, figs. 9-10).

The plant has no distinct main axis in the sense that any lateral branchlet may eventually grow as a principal; this is not however the usual case; there is usually a difference between an axis of growth and laterals which give a somewhat feathery appearance to the fully grown plant (Pl. I, fig. 2). This marked difference is most evident in forma *moniliforme* which has long monosiphonous branchlets of last order (up to 23 cells in Brazilian plants).

The tetrasporangia born in stichidia (Pl. I, fig. 6) are, when mature, up to 58μ wide and are to be found in whorls of four to six. The size and shape of the stichidia are quite variable, sometimes just a few (1-3) whorls of tetrasporangia are formed and the stichidium is broader than long. The stichidia of the forma *moniliforme* (Pl. I, fig. 7) on the other hand, are quite uniform, being much longer than broad.

The carpoгония located near the tips, a few segments below the apex is of the usual type found in the genus, with a long and somewhat broad trichogyne. The mature cystocarps are nearly spherical and of a large size (Pl. I, fig. 8). It has a definite pore for the discharge of the carpospores which are not numerous.

Regeneration of the growing point is very common; any branch which has lost its terminal portion may start another one which causes a modification of the regular distribution of pericentrals. There is a pronounced difference in habit between plants growing upon the shady side of rocks, more or less away from mangrove proper, and high above the water, and plants which grow on stems, roots or pneumatophores of *Rhizophora mangle* Linn., *Avicennia tomentosa* Jacq. or *Laguncularia racemosa* (Linn.) Gaertn. f. which are periodically submerged. The

former, have been found to be frequently sterile and of smaller size with strongly incurved tips. On the other hand the plants from mangrove areas are invariably in reproduction and they are larger, more ramified and the tips are not so curved as in the former ecotype.

Material examined (7)

S. Paulo State: Prainha, Ubatuba, (Lat. S. 23° 26' 9"; Long. W. 45° 4' 10") 7-IX-1950 tetrasporic; Praia Perequê-Assú, Ubatuba, 4-VII-1953 sterile; Margem do Rio Claro, Ubatuba, 3-VII-1953 cystocarpic; Foz do Rio Claro, Ubatuba, 3-VII-1953 tetrasporic; Ponta das Galhetas, Caraguatatuba, 2-VII-1953 f. *moniliforme*, tetrasporic; Ilhabela, Ilha de S. Sebastião, 28-VII-1950 f. *moniliforme*, tetrasporic; Ilhabela, Ilha de S. Sebastião, 20-VIII-1948 f. *moniliforme*, tetrasporic; Fortaleza, Ilha de Santo Amaro, Santos, 16-III-1941 sterile; Canal N° 6, Santos, 13-IX-1950 tetrasporic; Guarujá, Ilha de Santo Amaro, 20-X-1950 sterile; São Vicente, 20-IV-1941 tetrasporic; Pedra do Monumento, S. Vicente, 16-V-1948 tetrasporic; Porto das Naus, S. Vicente, 23-IX-1948 f. *moniliforme* tetrasporic; Porto das Naus, S. Vicente, 21-IX-1953 tetrasporic; 25-X-1953 sterile; Praia de Parnapoan, S. Vicente, 21-IX-1953 tetrasporic; Praia de Parnapoan, S. Vicente 7-X-1953 tetrasporic; Prainha, Itanhaém, 2-I-1951 f. *moniliforme*, tetrasporic; Foz Rio Branco, Itanhaém, 25-X-1953 tetrasporic; Peruipe 22-VIII-1953 sterile; Praia do Guaraú, Peruipe, 3-I-1951 sterile; Mar de Cubatão, Cananéia, 5-V-1953 f. *moniliforme*, tetrasporic; 18-XII-1953, cystocarpic, tetrasporic; Ilha Comprida, Cananeia, 28-VII-1953 f. *moniliforme*, tetrasporic; Rio Nobrega, Ilha Comprida, Cananeia, 19-X-1953 f. *moniliforme*, sterile; 19-XII-1953, tetrasporic.

Paraná State: Caiobá, 4-XI-1950 cystocarpic; Caiobá, 10-II-1951 cystocarpic, tetrasporic.

Santa Catarina State: Neighborhood of Henrique Lage, (Lat. S. 28° 14' 24"; Long. W. 48° 39' 59") 4-XI-1952 sterile.

(7) The list of localities is arranged in such a way that it begins with the northernmost point of collecting and runs down to the southernmost locality where the plants have been found.

Bostrychia binderi Harvey

- References: Post 1936, p. 28-33; J. Agardh 1863, p. 873-874; Falkenberg 1901, p. 501; De Toni 1903, p. 1166-1167; Taylor 1930, p. 635 (as *Amphibia tenella*); Taylor 1942, p. 140; Tseng 1943, p. 177-180 Pl. 1 fig. 7-8; Taylor 1945, p. 306.
Plate II, figures 1-8

Plants up to 2-3 cm high; erect branches arising from a decumbent creeping rhizom. Plants usually growing in dense tufts in shady caves, or on the shady sides of rocky cliffs, well above the high-tide line; very common in any rocky shore, apparently not related to mangrove areas, though sometimes it may be found on mangrove, but not on mangrove plants. The plant has a determined difference between long and short shoots, (Pl. II, fig. 1) providing an easy means of identification "in situ". All branches, except the terminal segments of the last order branchlets (Pl. II, fig. 4) are covered by a parenchymatous cortex formed by the successive divisions of the pericentrals in the same way described by Falkenberg for *B. tenella* (cf. 4, p. 515-516 T. 12 f. 10; see also Pl. II, fig. 7 in this paper). The occurrence of monosiphonous branchlets are as pointed out by Tseng (26 p. 180) an ecological adaptation. Frequently the regeneration of the damaged short branches also occurs with formation of tufts of monosiphonous branchlets which are to be found mostly to the base of the long old shoots. The thallus shows in longitudinal section several rows of pericentrals between the cortex and the central siphon. The number of rows increases toward the base of the long shoots. On Pl. II, fig. 7 it is shown a longitudinal section taken well above the base and on fig. 8 a transverse section taken almost at the base. Though the plant is very common and has been collected almost throughout the year, no sexual plants were ever found. Apparently the tetrasporic plants are dominant in the first half of the year, whereas in the other half the collections are mainly of sterile plants. The stychidia are very variable in size and shape. Usually they are longer than broad (Pl. II, fig. 5, 6). The tetrasporangia are born in whorls of four to five.

Material examined (8)

S. Paulo State: Ubatuba, 7-IX-1950 sterile; Praia do Perequê-Assú, Ubatuba, 4-VII-1953 sterile; Foz do Rio Tabatinga, Caraguatatuba, 2-VII-1953 sterile; Ilhabela, Ilha de S. Sebastião, 6-IX-1948 sterile; 8-IV-1950 tetrasporic; 28-VII-1950 tetrasporic; 18-V-1951 tetrasporic; Praia da Fama, Ilha de S. Sebastião, 22-III-1951 tetrasporic; Praia da Serraria, Ilha de S. Sebastião, 24-III-1951 tetrasporic; Santos, 18-III-1941 tetrasporic; Porto das Naus, S. Vicente, 15-I-1953 tetrasporic; Itanhaén, 2-I-1951 tetrasporic; Praia do Guaraú, Peruibe, 3-I-1951 sterile.

Paraná State: Caiobá, 4-XI-1950 sterile; Caiobá 12-II-1951 tetrasporic; Ilha do Sai (Paraná-Santa Catarina States) 14-II-1951 tetrasporic.

Bostrychia scorpioides Montagne var. *montagnei* (Harvey) Post

References: Post 1936, p. 9; Harvey 1853, p. 55 Pl. 14 B (as *B. montagnei*); J. Agardh 1863, p. 871 (as *B. montagnei*); Falkenberg 1901, p. 517-518 T. 12 f. 5-9 (as *B. montagnei*); De Toni 1903, p. 1160 (as *B. montagnei*); Collins & Hervey, 1917, p. 129 (as *B. montagnei*); Howe 1918, p. 523 (as *B. montagnei*); Howe 1920, p. 572 (as *Amphibia montagnei*); Taylor 1928, p. 166 Pl. 24 figs. 14-15 (as *Amphibia montagnei*).

Plate III, figures 1-6.

This is the coarsest and largest species to be found in Southern Brazil. Until today it has been collected in mangrove areas only and usually growing on mangrove roots or stems. It is frequently found associated with *Caloglossa leprieurii* and *Bostrychia radicans*. Once it was found associated with *Cladophoropsis membranacea*, *Boodleopsis pusilla* and *Lophosiphonia* sp. (see Taylor et al. 1953 p. 98; incidentally reported as *B. Montagnei*). Though there is no determined difference between axis and lateral branches actually there is a pronounced development of a strong main shoot which supports distichously placed laterals. The apex of such shoots are invariably well curved, a feature so characteristic, and after which the genus has its name (see Pl. III, fig. 1 and the good figure of Harvey quoted above). All the branches with the exception of the terminal portions of the last-order

(8) See footnote on page 60

branchlets (Pl. III, fig. 3) are completely covered by a parenchymatous cortex (Pl. III, fig. 2, 4 and 5; see also the diagram of Falkenberg in the plate quoted above). This plant was never found with reproductive structures of any kind.

This is the first time that this plant is reported for Brazil.

Material examined ⁽⁹⁾

São Paulo State: São Vicente, 23-IX-1948; 30-IV-1950; 21-IX-1953; 25-X-1953; Mar de Cubatão, Cananéia, 5-V-1953; Ilha Comprida, Cananéia, 28-VII-1953.

Paraná State: Baía de Guaratuba, 12-II-1951.

Bostrychia calliptera (Montagne) Montagne

References: Post 1936, p. 24; Kützing 1849, p. 839; J. Agardh 1863, p. 872-873; Falkenberg 1901, p. 521-523, T. 11 f. 26-29; De Toni 1903, p. 1167-1168; Taylor 1945, p. 306.
Plate IV, figures 1-8.

Plants up to 6 cm high, of very delicate texture; main shoots somewhat irregularly branched but exhibiting here and there dichotomies. Each long branch has very regular alternate and distichously placed short laterals (Pl. IV, fig. 2). These are formed either on each or on every other segment short before the pericentrals are cut off. The resulting structure has a beautiful feather appearance somewhat resembling the habitus of *Pterosiphonia pennata* though it is more delicate (see Pl. IV, fig. 1 and the fig. 26 of Falkenberg quoted above). The haptera issuing at the point of branching are of the "Flagellifulcratae" type of Post. The plant has a cortex formed by hyphae in a very irregular pattern (Pl. IV, fig. 5). Old basal portions are completely covered by this cortex, which may lack on younger upper parts. The formation of hyphae is not restricted to the outer side of the pericentral cells. These as well as the axial cells may produce in and downward growing hyphae (see Pl. IV, fig. 8) which seek their way between the older cells. Each central cell is covered by two pericentrals. Young branches have invariably four pericentrals, older ones may have up to six (Pl. IV, fig. 7 see also fig. 29 of Falkenberg quoted above).

(9) See footnote on page 60

Old "short" laterals may have a later development which leads to a considerable increase in the length of these shoots. However the process of branch formation on these shoots does not follow the pattern so characteristic of the long shoots. These branches are few and irregularly placed, sometimes dichotomies are found (see Pl. IV, fig. 3). This is the only example known to me where certain predetermined short lateral branches are, by some unknown reason, capable of development, but incapable of reproducing the pattern of ramification exhibited by the long shoots, thus presenting strong evidence of the existence of correlations between long and lateral shoots.

The stichidia are formed on the upper laterals on both sides of the long branches. They are terminally placed and, when mature, much longer than broad (Pl. IV, fig. 4). Usually 3 to 4 tetrasporangia are born at each whorl.

This species has been found growing attached to mangrove plants only. It is commonly associated with *B. radicans* and more frequently with *B. scorpioides* var. *montagnei*.

This first record on the South Atlantic is of considerable phytogeographical interest. Besides being the only record on the Atlantic coast of South America below the Equator (cf. 16, p. 24; 24, p. 306), it also provides a more plausible understanding of Post's statement, when she says: "*B. calliptera* hat nach den bisherigen — (1936) — Kenntnissen ein disjunktives Areal." (Post l. c. p. 24). At that time the only records were limited to the French Guyana and the Indo-Pacific region.

Material examined (10)

São Paulo State: Porto das Naus, S. Vicente, 30-IV-1950 tetrasporic; 21-IX-1953 sterile. Neighborhood of Rio Nóbrega, Ilh Comprida, Cananéia, 28-VIII-1953 sterile.

SUMMARY

The author revises briefly the previous references of the genus *Bostrychia* in Southern Brazil. After discussing the bibliographical data, the first part ends with a tentative key for the identification of the species and varieties found within the area surveyed. (Lat. S. 23° 26' 9"; Long. W 45° 4' 10"; Lat. S. 28° 14' 24"; Long. W. 48° 39' 59"). The second part gives descriptions of the Brazilian plants. Ecological data are given

(10) See footnote on page 60

for each species considered. This part includes bibliographical references, list of material examined and the localities where the plants were collected. Four plates with numerous figures complete the text.

RESUMO

O autor relata brevemente, na Introdução, o histórico bibliográfico referente ao gênero *Bostrychia* no Brasil, terminando com uma lista das espécies até hoje encontradas no Brasil meridional. Apresenta em seguida uma chave para a identificação das espécies e variedades brasileiras. A terceira parte do trabalho trata da descrição detalhada de cada espécie e contém informações ecológicas gerais, relacionadas com este interessante grupo. Para cada espécie é dada uma lista de trabalhos de referência a mais completa possível, bem como uma relação detalhada de todo o material examinado. Aqui são incluídas informações sobre os lugares de coleta, época em que foram encontradas as plantas, e também os tipos de órgãos de reprodução observados. Uma lista das publicações referidas no texto e numerosas figuras originais completam o trabalho.

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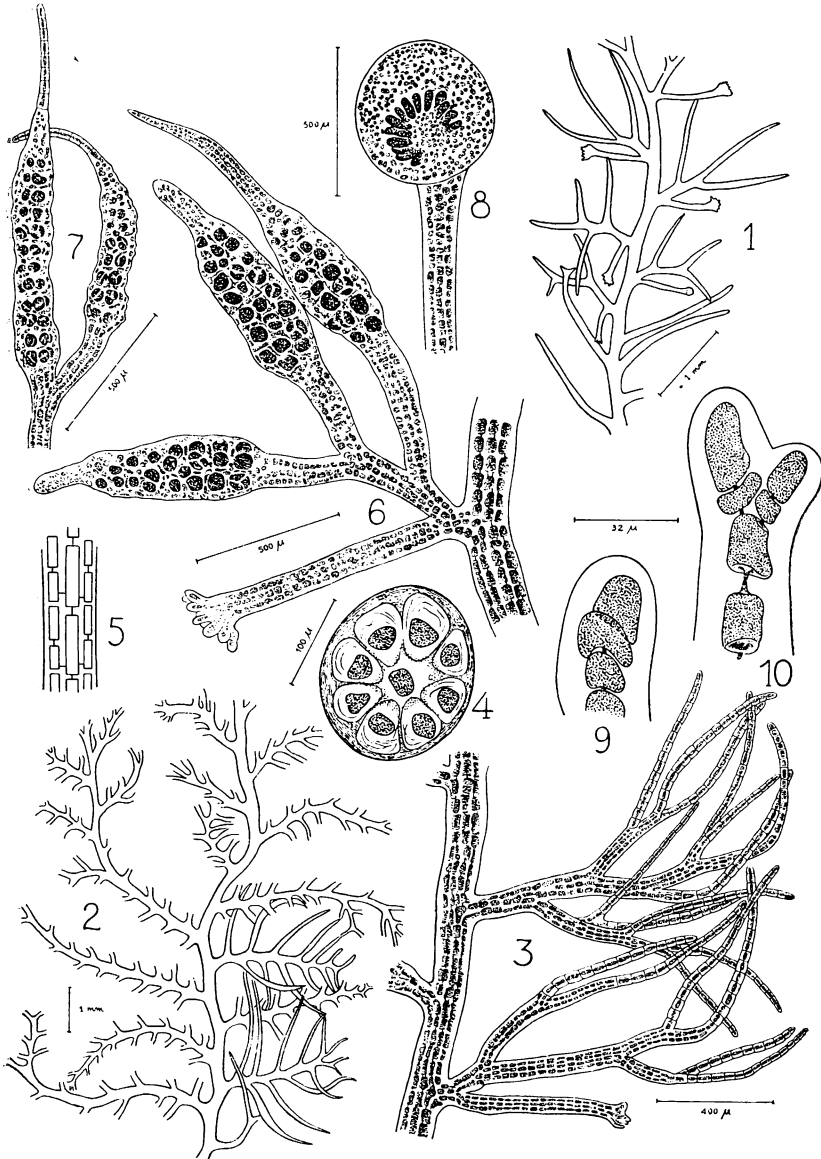


PLATE I

Bostrychia radicans

- 1 — Outline of part of a plant showing the relation of haptera with branching.
- 2 — Outline of part of a plant collected in mangrove.
- 3 — Portion of a plant of the forma *moniliforme* showing besides the hapteron also the characteristic monisiphonous branchlets.
- 4 — Transverse section of an old thallus.
- 5 — Diagram to illustrate the distribution of pericentrals and the lack of a cortex.
- 6 — Group of 3 stichidia belonging to a plant of the forma *typica*. Note the development of a hapteron at the same characteristic place.
- 7 — Stichidia from a plant of the forma *moniliforme*.
- 8 — A cystocarp.
- 9 and 10 — Tips of a growing apex to show young and two celled branches being cut off before the formation of pericentrals.

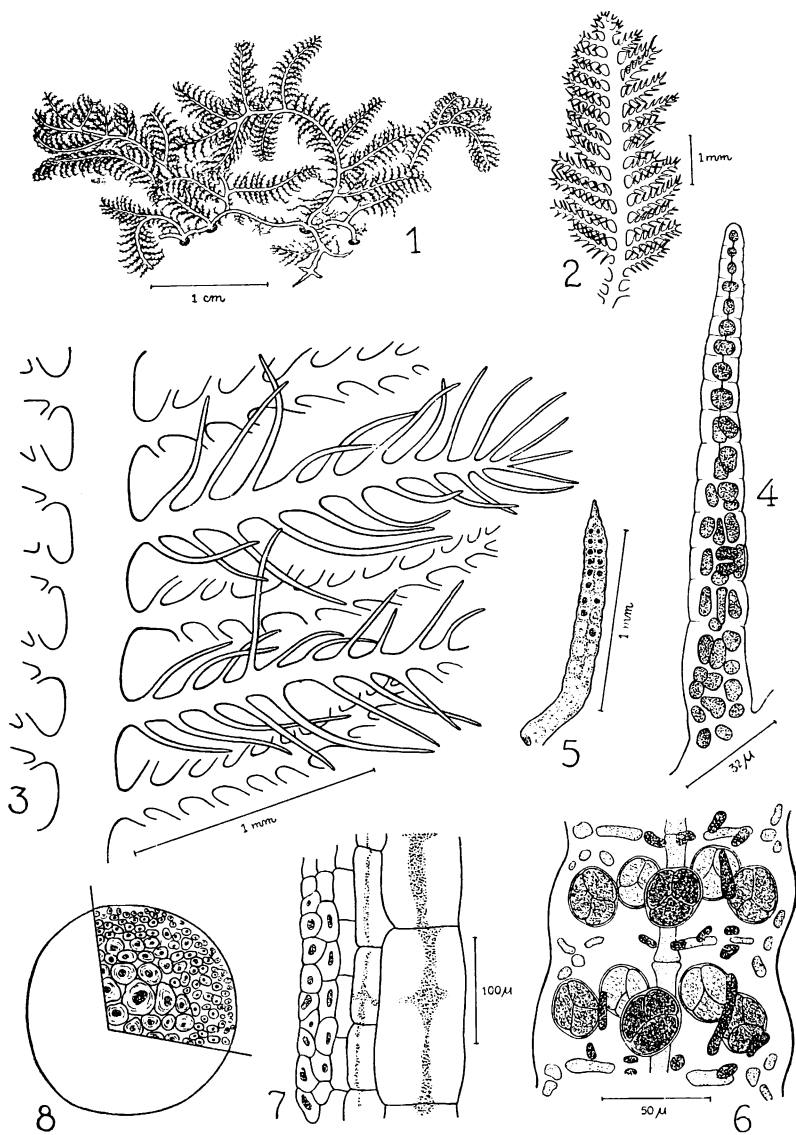


PLATE II

Bostrychia binderi

- 1 — Dissected portion of a tuft.
- 2 — Upper part of an erect shoot.
- 3 — Detail of an erect shoot.
- 4 — Branchlet of last order, with a few celled monosiphonous tips.
- 5 — Stichidium.
- 6 — Detail of a mature stichidium showing two whorls each of five tetrasporangia.
- 7 — Longitudinal section of the upper thallus, somewhat diagrammatic.
- 8 — Transverse section at the base of an old shoot.

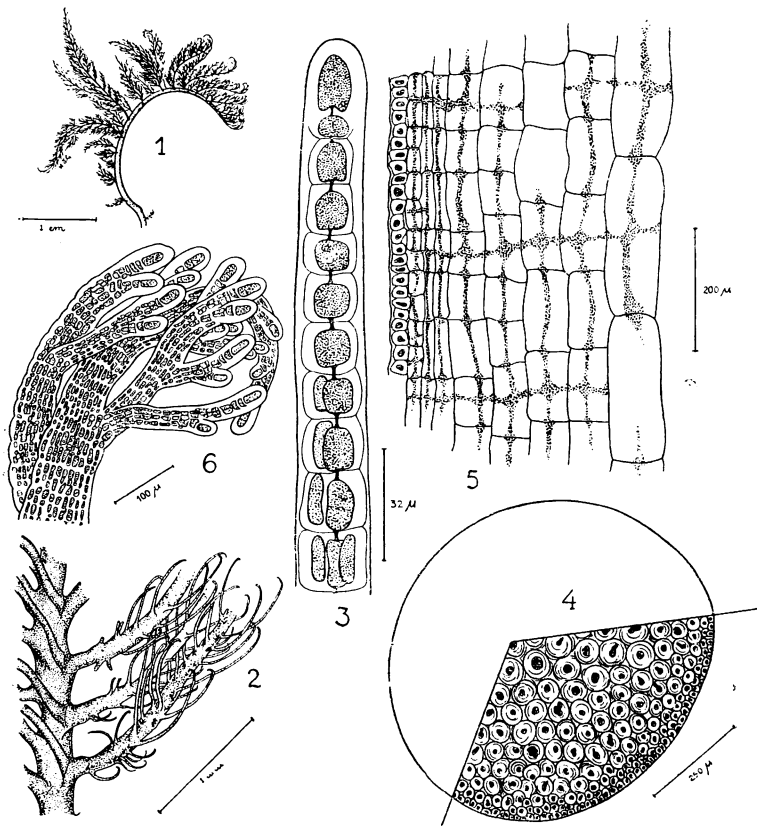


PLATE III

Bostrychia scorpioides var. *montagnei*

- 1 — Part of a plant to show its habitus.
- 2 — Details of cortication and of the complicated last orders branching (older and somewhat denuded portion).
- 3 — Tip of branchlet of last order, with monosiphonous apex (older portion).
- 4 — Cross section of an old stem.
- 5 — Longitudinal section of an old stem (slightly diagrammatic).
- 6 — Detail of a young tip showing the branching pattern and the beginning of cortication. Note the large apical cells and the polysiphonous ends of all young branches.