The Marine Benthic Algae of the Caroline Islands, II. Phaeophyta and Rhodophyta[1]

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PHAEOPHYTA

ECTOCARPUS Lyngbye 1819

Key to species:

1. Plurilocular sporangia both laterally and terminally borne on branches ..... *E. columellaris*
1. Plurilocular sporangia only laterally borne on the branches..... 2
2. Plurilocular sporangia subspherical, borne at right angle to the branch; tips of some branches hooked..... *E. breviarticulatus*
2. Plurilocular sporangia oblong or elongate, borne at acute angle to the branch; hooked tips of branches absent..... 3
3. Plurilocular sporangia oblong with blunt tips, not laterally borne in short series on the adaxial side of a branch..... *E. indicus*
3. Plurilocular sporangia elongate with pointed tips, solitary or generally borne in a short series of three to four on the adaxial side of a branch ..... *E. irregularis*

1. *Ectocarpus breviarticulatus* J. Agardh 1847:7; Dawson 1954b:398, fig. 14a, b; Setchell 1924:171, fig. 37.

Filaments forming contorted tufts about 1 to 1.5 cm tall. The filaments attached to each other by hooked tips of the branches, forming rope-like strands. The plurilocular sporangia are almost spherical in shape and are borne at right angles to the branch. These distinctive characters are in agreement with those noted by the above authors for this species. Seen only once growing on rocks.

Type: from Pacific southern Mexico found epiphytic on *Chnoospora pacifica*; presumably in Agardh Herbarium in Lund.

Materials examined: 15272, on reef at Tafansak Village, Kusiae Is., VII–16–60.

2. *Ectocarpus indicus* Sonder, *In* Zollinger 1854:3; Dawson 1956:43, fig. 32; Dawson 1957:110; Weber van Bosse 1913:129, fig. 34; Boergesen 1941:16, figs. 6–7; Taylor 1950:95.

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Ectocarpus duchassaignianus Grunow 1867:45, pl. 4, figs. a, b, c.
Pl. 1, figs. 1–2

Filaments were found epiphytic on *Sargassum* sp. forming soft tufts growing mixed with *Sphacelaria furcigera* and *Acrochaetium robustum*, about 1 mm high. The erect filaments are 15 to 18 μ in diameter arising from a prostrate system. The sporangia are laterally borne, 25–28 μ in diameter and 55–88 μ long, cylindrical clavate to oblong. Intercalary growth zones are present. The erect system is laxly branched and the branches taper slightly towards the apices.

Type: from Bima, Indonesia; present whereabouts of the specimen not known to the writer.

Materials examined: 23086a. 2, on *Sargassum* growing on reef flat at Fefan Is., Truk Group, VII–28–60.

3. *Ectocarpus columellaris* Boergesen 1936: 71, fig. 4 a–f.
Pl. 1, figs. 3–5

Filaments forming soft tufts on old fronds of *Padina* growing together with other small specimens. The filaments consist of a prostrate system made up of irregularly shaped cells which give off rhizoids at certain points. The prostrate system gives rise to the erect filaments which bear the plurilocular sporangia. The erect filaments are commonly unbranched, or very sparsely branched. The cells are 14 to 20 μ in diameter and twice to four times longer than broad although shorter cells are also present.

The lateral and terminal plurilocular sporangia are oblong-cylindrical in shape and are always borne on erect filaments. The lateral sporangia are always sessile. The sporangia are slightly but distinctly tapered to the apex.

Marked growing zones are present and are found generally above the point of attachment of the lateral sporangia. Growing zones are absent from the short erect filaments bearing the terminal sporangia.

My materials differ from *E. columellaris* described by Boergesen (1936) from Ceylon by the larger diameter of the erect filaments which are branched and the presence of the marked growing zones in the erect filaments bearing the lateral plurilocular sporangia.

Type: Boergesen 6020, on old blades of *Padina tetrastromatica* from Galle, Ceylon, presumably in the Herbarium at Copenhagen.

Materials examined: 23629.2, 23084a.2, on *Padina* sp. growing on reef at Fefan Is., Truk Group, VII–28–60.

4. *Ectocarpus irregularis* Kütz. 1845:234; Boergesen 1941:23, figs. 8:11; Dawson 1954b:398, fig. 14 e, f.

Filaments forming soft tufts, irregularly branched; branches distinctly finer towards the apices, 25–30 μ at their largest diameter. Plurilocular sporangia sessile, laterally placed along the erect branches, or in short rows of 2–3, sometimes 4, on the upper adaxial side of the lateral branches. Sporangia elongate with acute tips, about 50–85 μ long and 25–35 μ in diameter.

The materials agree perfectly well with the descriptions and figures of Boergesen (1941) and Dawson (1954b) for this species.

Type: from the Adriatic Sea; present whereabouts not known to the writer.

Materials examined: 21029, on reef at Falas Is., Truk Group, VII–30–60.

SPHACELARIA Lyngbye 1819

Key to species:

1. Propagula with two, short, stout horns; borne singly, or in a short series at the abaxial side of the branch; main erect axes 4 cells thick, not less than 30 μ in diameter ..... *S. rigida*
1. Propagula with 2–3 long horns; main erect axes 2–3 cells thick, not more than 30 μ in diameter 2
2. Horns 2, very slender and slightly tapered toward their apices .... *S. furcigera*
2. Horns 2–3, more or less stout and distinctly tapered from their broader bases to the apices ..... *Sphacelaria* sp.

1. *Sphacelaria rigida* (Hering) Kütz. 1849:465; Boergesen 1941:42, fig. 19.

Pl. 1, figs. 7–8

Tufts about 1 cm tall. The erect filaments arise from a compacted mass of basal cells. The branches are abundant and irregularly disposed, alternate. The apical cells slightly enlarged at the distal end, a little larger than the diameter of the segment below them. The diameter of the main axis varies from 32 to 36 μ, slightly tapering to 25 to 30 μ towards the tips of the branches. The segments are almost as long as wide.

The propagulae abundant, provided with long stalks composed of up to 9 cells borne singly or in series at the abaxial side of a branch. Horns two, generally composed of three to four cells (sometimes up to 8) slightly tapering from a slightly enlarged base to the blunt tips. The propagulae are about 125 to 145 μ tall, from the base of the stalk to the small knob-like cell at the summit; about 105 to 125 μ from the tip of one horn to the other. Unilocular sporangia spherical, borne on a 1-celled stalk.

The type of the propagulum approaches those of *S. taitensis, S. tribuloides* and *S. rigida*. It, however, seems to be more like those of *S. rigida* than those of the former two species, especially in the shape and arrangement of the propagula. Besides, the filaments are noticeably rigid; the diameter of the filaments, as well as the hairs, is smaller. Compared with *S. taitensis* Setchell (1926), my specimens have very much more slender filaments and does not form extended patches of hemispherical tufts like those of the former, and the propagula are very much smaller in size. Unlike those of *S. tribuloides*, as noted by Boergesen (1941), the propagula of my specimens were never seen placed opposite each other, or opposite a branch. Also, the branching is never opposite and the propagula are commonly disposed in short series on one side of a branch.

Type: from Port Natal; present whereabouts not known to the writer.

Materials examined: 15007.1, on *Hypnea* collected on reef flat on the eastern side

of Peipalap Peak, Ponape Is., VI–17–60.

2. *Sphacelaria* sp.

Pl. 1, figs. 9–10

Filaments were found growing epiphytic on *Turbinaria* together with *Jania* and *Ectocarpus*, forming a soft cushion. The tufts are light brown in color and about 1 to 1.5 mm tall. The erect filaments are about 20 to 26 μ in diameter, 2 to 3-celled thick (commonly 2), arising from the prostrate, densely matted filaments. The segments of the erect filaments are about 1.2 to 1.5 diameters long.

The propagulae abundant, commonly bearing two, or occasionally 3, straight horns. The stalk of the propagulum is about 140 to 170 μ as long as the horns (or shorter in younger ones) and distinctly tapering towards the base. The filaments are commonly simple to once branched except for the presence of the propagulae and are almost uniform in diameter throughout. Apical hairs present. (No sporangia were seen.)

Materials examined: 21947.1, epiphytic on *Turbinaria ornata*, collected by E. G. Meñez on reef near Tafansak Village, Kusaie Island, July 16, 1960; in M.S. Doty Herbarium, Department of Botany, University of Hawaii, Honolulu, Hawaii.

3. *Sphacelaria furcigera* Kütz. 1855, Tab. Phyc. 5, pl. 90, fig. 2; Boergesen 1941: 46, fig. 21; Dawson 1954b: 400, fig. 14th.

Pl. 1, fig. 6

Specimens were found epiphytic on *Sargassum* sp. The erect branches were seen arising from a basal disc of cells. Germinating propagula were seen and in several cases, one end of a propagulum was seen attached to the host by means of a circular disc made up of one layer of cells. The segments are 1.5 to 1.8 diameters long.

Type: from Kurak Island, Persian Gulf; present whereabouts not known to the writer.

Materials examined: 23629.1, 23086a, on *Sargassum*, on reef at Fefan Is., Truk Group, VII–28–60.

4. *Sphacelaria* spp.

The materials noted here were all sterile and therefore determination of the species was not attempted. Specimens no. 23754.1a and 23752.1 were found epiphytic on *Laurencia, Microdictyon* and other smaller algae and attached to the host by means of a disc-like structure made up of irregularly shaped cells. The erect filaments form small dark brown tufts and are much branched, about 60–75 μ in diameter, the cells shorter than the width of the filaments. Specimen no. 23225.1 was also sterile. The filaments were 30 to 50 μ thick. This particular specimen is sparsely branched and with abundant hairs. The filaments are 3 to 4 cells wide.

Materials examined: 23754.1a, 23752.1, epiphytic on larger algae, on reef at Quoi Is., Truk Group, VIII–2–60; 23225.1, on lagoon side of Ifaluk Is., VIII–10–60.

RALFSIA Berkeley 1831

Ralfsia expansa J. Agardh 1847: 7; Boergesen 1914: 33, figs. 146–148; Weber van Bosse 1913: 146, fig. 45.

Pl. 3, figs. 7–10

Seen only once. Growing on dead corals, forming dark brown, patches about 1–2 cm in diameter, irregular in shape, closely appressed but easily removed from the surface of the coral and attached to it by means of rhizoids.

The thallus bilaterally asymmetrical, the lower layer almost half as thick as the upper radiating filaments although it is bilaterally symmetrical in some portions. The crust is about 330–385 μ thick, including the erect filaments.

The erect filaments are distinctly clavate, about 140–145 μ tall. Unilocular sporangia terminal, solitary, in pairs or sometimes in threes; elliptical to clavate in shape and quite variable in size, 15–25 μ at thier thickest portion, 80–85 μ long. Young sporangia were seen in the old empty sporangial wall.

Type: from Vera Cruz, Mexico, collected by Liebmann; now in the Botanical Museum, Copenhagen.

Materials examined: 23216.3, on dead coral on reef at Dublon Is., Truk Group, VII–31–60.

DICTYOTA Lamouroux 1809

Key to species:

1. Fronds small, thin, to about 3 cm long, forming decumbent clumps or frequently mixed with other algae; tips of branches round in outline.... ..... *D. friabilis*
1. Frond forming large erect clumps, 4 cm or more tall; tips of branches obtuse, acute or mucronate 2
2. Segments linear, variable in width; angles at the dichotomies acute; branch apices obtuse or acute ..... *D. divaricata*
2. Segments cuneate, broadest below the dichotomies tapering toward a narrow base; angles formed by the dichotomies somewhat semicircular.... ..... *D. apiculata*

1. *Dictyota friabilis* Setchell 1926:91, pl. 13, figs. 4–7; pl. 20, fig. 1; Dawson 1954b:401, fig. 16 a, b.

The materials studied were found generally mixed, or growing among other algae. The specimens are usually small and incomplete although good clumps of this species were also encountered. The thin fronds which are easily broken, the presence of the rhizoids scattered over the frond, and, the presence of tetrasporangia without any arrangement all over the frond are in good agreement with the characteristics of *D. friabilis* as described by Setchell (1926).

Type: Setchell's specimen no. 5014a, from reef at Arue Point, Tahiti; presumably at the herbarium, University of California, Berkeley.

Materials examined: 15261, on reef at Kusaie Is., VII–15–60; 15295, 21582, on

reef around Utwa Village, Kusaie Is., VII–17–60; 23572, on reef at Yap Is., VIII–18–60; 23669, on reef at Falas Is., Truk Group, VII–30–60; 21881, on reef at Falas Is., Truk Group, VII–30–60; 21430, 21986, 15819, on reef at Yap Is., VIII–19–60.

2. *Dictyota divaricata* Lamouroux 1809:331; Dawson 1957:110, fig. 14; Taylor 1928:120, pl. 16, figs. 6–9; Okamura, Icones 3:32.

Thalli about 4 to 6 cm tall. The branching generally dichotomous, sometimes appearing alternate in the young portions of the fronds. The fronds show a marked tapering in width from the base to the apices of a branch as well as a marked difference in the width of the branches in the same plant. The dichotomous branching at the basal portion of the fronds is obscured by the production of proliferations at at the margins, or on both surfaces of the fronds. The apices obtuse or acute and generally forked. On rocks or epiphytic on other larger algae and eel grass.

Type: from the Mediterranean coast of France; present whereabouts not known to the writer.

Materials examined: 15843, on reef at Kusaie Is., VII–15–60; 23582, on reef at Dublon Is., Truk Group, VII–31–60; 23086, on reef at Fefan Is., Truk Group, VII–28–60; 23698, on reef near the north end of airport runway at Moen Is., Truk Group, VII–29–60; 21610, 23360, 21505, 21995, 23778, on reef at Yap Is., VIII–18–60; 21849, 21659, on reef near the boat pier at Ponape Is., VII–29–60.

3. *Dictyota apiculata* J. Agardh 1894:67; Weber van Bosse 1916:183, pl. 3, fig. 6.

Thalli about 4–6 cm tall. Branching dichotomous with few, small teeth at the margin of the branches. Marginal proliferations are only found in the older portion of the frond. The angles of the dichotomies wide, about 45 to 90°.

These materials are characterized by having a narrow basal portion which becomes broader toward the distal portion of the thallus. Also, the portions of the segments below the dichotomies are very much broader than the basal portion forming cuneate segments. The apices of the branches are broadly rounded or imarginate.

Patches of rhizoids were found at the older portion of the frond although these were also found at the margins of some of the younger branches.

Specimen number 15591 is generally the same as characterized above except that the apices, although broad, are not generally rounded, but instead these are provided with two or commonly four short mucronate tips. The same materials, however, bear a branch with broad rounded apices. One thallus was fertile and the tetrasporangia were scattered all over the frond on both surfaces.

The materials remind one of *D. patens* which was reported by Okamura (1915) from Japan. However, my specimens differ substantially by the broader apices of the branches instead of being narrowed, and fewer marginal teeth than in *D. patens*.

Although there are some minor differences between my specimens and those reported by Weber van Bosse (1916), i.e., presence of fewer small teeth along the margin, the reduced mucronate apices among specimens no. 15651, 15550, 15558,

yet the habit and the form of the segments and the type of branching all show close resemblance to *D. apiculata.*

Type: from Novae Hollande; present whereabouts not known to the writer.

Materials examined: 15591, 15651, 15550, 15558, on reef at Koror Is., Palau Group, IX–5–60.

HYDROCLATHRUS Bory 1826

Hydroclathrus clathratus (Ag.) Howe 1920:590; Dawson 1954b:403, fig. 18b; Taylor 1950:96; Taylor 1960:261, pl. 36, fig. 5; Setchell 1926:89.

Encoelium clathratum C. Agardh 1822:412.

Most of the materials examined consist of small portions of the thalli found with other algae.

Type: from Belle Isle, France; present whereabouts not known to the writer.'

Materials examined: 23668, on reef at Falas Is., Truk Group, VII–30–60; 21662, 23557, 21188, 21148, 21172, 21202, 21526, 21239, on reef flat with sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 21435, 21845, 21699, on reef near boat pier at Ponape Is., VII–20–60; 21484, on reef at northern portion of Yap Is., VIII–19–60; 21970, 21786, 21805, 15595, 15018, 23009, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21965, on outer reef flat facing Mantapeitak Is., Ponape Group, VI–20–60; 23217, 23584, on reef at Dublon Is., Truk Group, VII–31–60.

DICTYOPTERIS Lamouroux 1809

Dictyopteris repens (Okamura) Boergesen 1924:265, fig. 13; Dawson 1956:44, fig. 34.

Haliseris repens Okamura 1916: 8, pl. 1, fig. 7–18.

The fronds were found entangled with *Actinotrichia fragilis* and *Jania* sp. Tufts of rhizoids arise from the readily recognizable midrib although these are also found at the margins of the blades. Some were found attached on dead corals and on the base of the stipe of *Sargassum*. On rocks or attached or mixed with other algae.

Type: from Truk Island, Caroline Islands, epiphytic on *Gelidiopsis variabilis*, collected by K. Miyake, May 7, 29, 1915; presumably in Okamura's herbarium in Japan.

Materials examined: 15107, 21192, 21081, 21052.1, 23556, on reef flat with sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60. Specimen no. 23556 possesses a broad frond which is about 4 mm wide and much coarser than those from the Marshall Islands reported by E. Y. Dawson (1956).

STYPOPODIUM Kütz. 1843

Stypopodium lobatum Kütz. Tab. Phyc. IX:63; J. Agardh 1894:20.

Zonaria lobata C. Agardh 1824:265 (Syst. Alg.)

Zonaria lobata J. Agardh 1848:109 (Sp. et. Ord. Alg.)

Pl. 3, fig. 11; pl. 7, fig. 8

The thallus large, reaching a height of 20 cm. Structurally, as seen in cross and longitudinal sections, the blade shows a medulla composed of 2 to 4 layers of large cells which are irregularly arranged. The upper and lower epidermis do not seem to show significant differences in either the size and form. The blade is about 180 to 200 μ thick. The materials somewhat resemble *Zonaria stipitata* Tanaka and Mozawa (1962) but search for the stipe and veins among the materials did not reveal these structures. The specimens possess tufts of long cylindrical rhizoids at the basal portion of the blades. Specimens were sent to Dr. T. Tanaka in Japan, and he is of the opinion that the plants are probably *Stypopodium lobatum*. *Type*: from the Atlantic Ocean; present whereabouts not known to the writer. *Materials examined*: 15705a, 21133a, 21098, 21090, 15976, 15112, 21470, 21071, 23562, 21069, 21496, 21525, 23479, 21685, 23548, 21210, 21163, 21269, 15755, 23480, 21160, 21700. All materials included here were collected on reef flat with sandy-rocky substratum at Iwayama Bay, Palau Is., VIII–22–60.

Pocockiella Papenfuss 1943

Pocockiella variegata (Lamouroux) Papenfuss 1943:463–468, figs. 1–8, 9–14.

Dictyota variegata Lamouroux, Nouv. Bull. Sci. Soc. Philom., I:331, 1809.

Zonaria variegata (Lamx.) C. Agardh, Syn. Scand. 20, 1817.

Gymnosorus variegatus (Lamx.) J. Agardh 1894:11 (see Papenfuss, 1943, for synonyms).

Pl. 2, figs. 3–5

Thalli growing closely adherent on stones or dead corals, except for the peripheral portion of the blade which is loosely attached, entire to lobed. In cross section the blade is composed of one layer of large squarish to rectangular medullary cells which are taller than wide, 36–42 μ tall and 25–36 μ wide; a layer or two of cortical cells; and a single layer of epidermal cells. The cortical cells are as broad as the medullary cell but very much thinner. The upper and lower epidermal cells are distinctly different in size and shape, the latter are approximately the same size as that of the cortical cells as seen in cross section; the cells of the upper epidermis are somewhat rectangular in shape, about 7–10 μ wide and 14–18 μ tall, generally 2 to 3 cells correspond to the width of a medullary cell in cross section. The cylindrical or moniliform rhizoids are found on the lower surface of the blade in contact with the substratum, and thus not limited to the basal portion only, except for the free portion of the blade near the margin where these are wanting. The tips of the rhizoids are modified into holdfast cells, the distal portions of which are modified into small, branched, crooked finger-like structures which fasten the plant to the substratum. Papenfuss (1943) and Taylor (1950) did not mention these modified holdfast cells at the tips of the rhizoids in their papers, and this is the first occasion in which these structures have been reported in *Pocockiella*.

The blade is about 125–150 μ thick, entire during its younger stage but later becoming lobed, the lobes frequently overlapping.

In one collection number 15809 (Pl. 2, figs. 1–2), consisting of several dried

materials, the specimens possess a very thick and hard blade on drying and crustose in habit. Patches of reddish rhizoids were found on the lower surface of the blades. The upper surface of the blade was greenish in color, the lower surface brownish. The rhizoids are very long, branched, composed of generally moniliform cells about 45 μ thick.

The blade is about 230 to 260 μ thick with 7 to 9 layers of cortical cells. The thick blade and the long, branched rhizoids are the distinctive characters of this collection. Unfortunately the materials are all sterile. Growing on dead corals, shells, coralline algae, and stones.

Type: from Antilles; present whereabouts not known to the writer.

Materials examined: 23221, 23605a, 23646, 23587, 23253, on reef at Dublon Is., Truk Group, VII–31–60; 21553, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 15292, on reef around Utwa Village, Kusaie Is., VII–17–60; 23755, on reef between Moen and Falo Is., Truk Group, VII–29–60; 23517, on reef at Falas Is., Truk Group, VII–30–60; 15705, 21133, on reef at Iwayama Bay, Palau Is., VIII–22–60; 15809, on reef at eastern side of Ulul Is., VIII–6–60; 23734, on reef at eastern side of Pulo Anna Is., IX–3–60.

Notes on *Pocockiella* and *Stypopodium*

While making slides of *Pocockiella* and *Stypopodium* from dried specimens I noticed that the former regained its natural texture and the collapsed cells expanded to its original size and form when soaked in water. Sections made from soaked materials show beautifully the natural arrangement of the cells comparable to that of fresh or pickled materials. Those of *Stypopodium* never regain their natural texture. The cells were collapsed and the shape and arrangement of the cells can not be exactly determined. The reason for this difference seems to be due to the thickness and the ability of the wall material to imbibe water and expand to its natural state. The walls of *Pocockiella* are much thicker than those of *Stypopodium*.

Padina Adanson 1763

Superficial examination of the numerous dried and pickled specimens of *Padina* from the Caroline Islands has revealed a wide variation in form, size, degree of calcification, color, thickness of the blade, and distribution of the reproductive structures. The range in the variation of the characters was observed to be so overwhelmingly overlapping that it was difficult to separate one species from another. A part of the difficulty was due to the confused state of the terminology used in the literature to characterize the different species, i.e., the use of the terms "fertile" and "sterile" for zones on the "upper" and "lower" surfaces. These have been used in different senses by different authors so that they are confusing in many instances. Thus the terms used in this paper will be defined.

The expanded blade or frond of the genus *Padina* has two surfaces, namely, one associated with the concave surface of the inrolled margin, and the other associated with the convex surface. The latter, called here the lower surface, is composed of cells which are generally smaller than those found in the other, the

upper surface. The inrolled tip is usually incurled away from the substratum and so is up towards the light as a rule. It is thus that I have come to associate it with the upper surface.

Thivy (1945, unpublished) in her exhaustive monograph on the genus *Padina*, as far as this writer interprets it, used the terms "upper" and "lower" surface of the blade in the opposite sense from that being used here. From actual observation of *P. japonica* in nature, I found that the upper surface, which corresponds to her "lower" surface, is more calcified than the lower surface, and that the cells of the upper layer are always larger (thickness and length) than those of the lower. The latter is always associated with the reproductive structures when these are only found on one surface. Longitudinal sections of the blade including the margin show these morphological differences.

The blade may be fertile or sterile, the former condition being characterized by the presence of sporangia or gametangia. The reproductive structures appear in concentric lines or groups (sori) and together with the concentric lines of hairs produce the characteristic zonate appearance of the blade. The reproductive structures are generally borne on the lower surface but may also be found on the upper surface. The concentric lines of hairs are also found on both surfaces or they may be less developed on the upper surface. As seen in a longitudinal section of the blade the hair lines may be alternate, or opposite. The latter was observed to have hair lines well developed on the lower surface with occasional presence of hairs on the upper surface opposite or sub-opposite those of the lower, the hair lines being equidistant from each other. In those showing alternate pattern, the distance from any hair line on the lower surface to the next hair line on the upper surface towards the margin is always shorter than the distance from any hair line on the upper surface to the next hair line on the lower. Such blades show, as a rule, alternating bands of narrow and wider areas when seen on the surface view.

The terms "fertile" and "sterile" glabrous zones is used here to denote that portion of the blade between any two consecutive concentric lines of hairs (i.e., on both surfaces); the portion of the blade with concentric lines of hairs is called piliferous zones. It has also been observed that any portion of the blade between the concentric lines of hairs has the potential of becoming fertile. This observation is based on the fact that the so called "sterile" zones of the blade in some species also produce reproductive structures, especially on the older portions. In such a case, the terms fertile and sterile glabrous zones are restricted to the portion of the blade near the inrolled margin where these zones are distinct.

Longitudinal sections of the blades of fertile materials from each collection were prepared. The sections were made from a portion of the blade which included the margin and three to four concentric lines of reproductive structures. The sections were stained with aniline blue and mounted in 25% "karo." These were studied under the microscope, and the pattern and distribution of the hairs and reproductive structures were plotted on the previously made diagram of the longitudinal section of the blade. The relative distance of the hair lines and the repro-

ductive structures in relation to each other was plotted on the diagram and checked against the observations made on the same blade under the dissecting microscope. Several sections were plotted until the pattern of the arrangement of the hairs and the reproductive structures was clearly indicated. The same was done for each collection without attempting at this point to identify the species.

The accumulated diagrams of all the collections were studied and sorted out according to the following major criteria: a) number of cell layers, b) the distributional pattern of the hair lines and the reproductive structures, c) the presence or absence of the indusium, d) the size of the cells of the upper and lower layers, form of the holdfast, and the diameter of the reproductive structures. It was felt that these criteria are the most constant among the characters important in separating the numerous collection of *Padina* into species. Although the hairs fall off after a certain period yet their exact location may be indicated by small scar cells with remnants of the walls of the hairs clearly visible. Other pertinent but minor characters of the individual specimen were recorded so as to have an idea of the degree of the variability in the species, i.e., color of the blade, degree of calcification, size, thickness of the blade and others.

Key to species:

1. Blades divided into alternating wide and narrow glabrous zones by the distinct and well-developed hair lines on both surfaces; tetrasporangial sori forming concentric lines on every other glabrous zone..... 2
1. Blades divided into glabrous zones of more or less uniform width by well-developed concentric hair line on the lower surface; the hair line on the upper surface of the blades rudimentary; tetrasporangial sori forming concentric lines above every hair line of the lower surface of the blade.... .....*P. minor*
2. Tetrasporangial sori indusiate, forming concentric lines in the middle of the narrow glabrous zones; blades heavily calcified on the upper surface.... .....*P. japonica*
2. Tetrasporangial sori non-indusiate, forming concentric lines in the middle of the narrow glabrous zones; blades slightly calcified.....*P. australis*

1. *Padina australis* Hauck 1887:44; Weber van Bosse 1913:179, fig. 52; Okamura 1932:88; pl. 295, figs. 1–4; Yamada 1925:251; Yamada 1931a:70, fig. 2 a–c; pl. 18.

Pl. 3, figs. 5–6

Thalli large, up to 15 cm tall. The blade is divided into several large, flabellate lobes up to 15 cm broad; two-celled throughout and about 70–90 μ thick. The blade is divided into wide and narrow glabrous zones by distinct concentric hair lines or piliferous zones, those on the lower surface alternating with those on the upper surface. The narrow glabrous zones on the lower surface of the blade bear the reproductive structures, or sori, which are non-indusiate. The sori are located just distal to the hair lines on the lower surface, thus when viewed from either surface,

the sori appear to be located on the middle portion of the narrow fertile glabrous zones. The fertile glabrous zones are about 2 mm wide while the sterile glabrous zones are from 2.5 to 5 mm, especially broader near the margin.

Gametophyte bisexual; oogonia about 115μ in diameter, antheridia squarish, about 26 μ tall in longitudinal section. Sporangia about 80–115 μ in diameter.

Type: from Cape York, Australia, presumably from Dunk Is.,; now in the herbarium of the New York Botanical Gardens.

Materials examined: 23010, 21783, 21791, 21779, 21808, 15665, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21703, on reef at Kusaie Is., VII–15–60; 21693, 15756, 15981, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 23581, 23270, on reef at Falas Is., Truk Group, VII–30–60; 21223, 21493, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, IV–25–60; 15586, 15548, on reef at Koror Is., Palau Group, IX–5–60; 15972, on reef near north end of airport runway at Moen Is., Truk Group, VII–29–60; 21833, on *Sargassum* sp., on reef flat at Fefan Is., Truk Group, VII–28–60; 23077, 23197, on reef at Fefan Is., Truk Group, VII–28–60; 23250a, on reef at Dublon Is., Truk Group, VII–31–60.

2. *Padina japonica* Yamada 1931a:69, pl. 19, fig. 2; Thivy mss. (unpublished):133, pl. 8, fig. 1; pl. 2, figs. 1–6; pl. 3, figs. 3–5; pl. 6, fig. 3; pl. 22, fig. 2.

Thalli ashy-brown in color, about 4–6 cm tall. The blade is provided with a short stipe, and is divided into several flabellate lobes on maturity. Both surfaces of the blade calcified, more heavily on the upper. Hair lines on both surfaces distinct, the upper alternating with those of the lower, dividing the blade into wide and narrow glabrous zones. The blade are 2-celled throughout, about 85 μ thick.

Reproductive sori are produced on every other fertile, glabrous zone of the lower surface, the sori nearer the hair line immediately below it. The sori indusiate, the indusium visible with the naked eye or under low magnification. Mature reproductive structure about 100 μ in diameter.

Type: from Japan, the exact locality not indicated although several places were cited; present whereabouts not known to the writer.

Materials examined: 23295, on reef at western side of Quoi Is., Truk Group, VIII–2–60; 15785, 23697, on reef near north end of airport runway at Moen Is., Truk Group, VII–29–60; 23250, on reef at Dublon Is., Truk Group, VII–31–60.

3. *Padina minor* Yamada 1925:251; Yamada 1931a:68; Yamada 1944:38; Okamura, Icones 6:56: pl. 279, figs. 6–9.

Pl. 3, figs. 1–4

Thalli 5–8 cm tall, very slightly calcified on both surface. Blades thin, 2-celled thick throughout, 70–80 μ thick, generally with entire margins although these may be sometimes cut into smaller lobes. Concentric hair lines on the upper surface not well developed; those of the lower surface generally equidistant from each other.

Reproductive sori are in concentric lines immediately above every hair line

on the lower surface; non-indusiate; sporangia 75–85 μ in diameter.

Blades were observed associated with "Vaughaniella" stage.

My materials fit the descriptions and figures of the above authors except for the absence of the indusium in the reproductive sori which Okamura (1931) shows in his Figure 9 for this species. Like Yamada (1944), I also have not seen this structure among the materials I included under this species.

Type: from Garanbi, Formosa; present whereabouts not known to the present writer.

Materials examined: 21666, on reef near boat pier, Ponape Is., VII–20–60; 23270, on reef at Dublon Is., Truk Group, VII–31–60; 21067, on reef at southwestern side of Puluwat Is., VIII–7–60; 15343, on reef at Helen Is., IX–29–60; 21011, 15706, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 21735, on outer reef facing Mantapeitak Is., Ponape Group, VII–20–60.

Turbinaria Lamouroux 1828

Key to species:

1. Longitudinal ridges very prominent, toothed; apical aspect of the blade triangular; marginal blade finely toothed ..... *T. decurrens*
1. Longitudinal ridges ill-defined, not toothed; apical aspect of the blade irregular; marginal blade toothed 2
2. Intra-marginal crown of teeth commonly present; marginal blades coarsely toothed ..... *T. ornata*
2. Intra-marginal teeth absent; marginal blades very prominent and finely toothed; vesicles prominent ..... *T. conoides* var. *conoides* f. *retoflexa*

1. *Turbinaria ornata* (Turner) J. Agardh 1848:266; Reinbold 1901:350; Dawson 1954b:405, fig. 21; Dawson 1956:44; Taylor 1964:483, pl. 3, figs. 1–6; figs. 7–9. *Fucus turbinatus* var. *ornatus* Turner 1808:50, pl. 24, figs. c, d.

This species is one of the most frequently collected algae from the Caroline Islands. Most of the materials studied were small and not well developed. Their size ranges from 3 to 15 cm tall. The leaves are small in most of the specimens compared to the measurements of Taylor (1964) due to the poor growth of the plants. I do not have any doubts in assigning these specimens to this species. Among the materials studied several plants representing fa. *ecoronata* are recognizable.

Type: type locality unknown; present whereabouts of the type not known to the writer.

Materials examined: 15127, 15439, 15490, 15172, 15685, 15273, on reef at Tafansak Village, Kusaie Is., VII–16–60; 15502, 15002, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 15099, 21273, 21200, 21187, 15711, 15983, 21692, 21157, 15754, on reef flat with sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 21363a, 15231, 15138, 21123, on reef flat at Epwelkapw, Ponape Is., VI–20–60; 15892, 15833, 15920, 15914, on reef at Quoi Is., Truk Group, VIII–2–60; 15322, 15398a, on south eastern portion of Helen Reef, VII–28–60; 21114, on lagoon side of reef flat at northwest tip of Mokil Is., Mokil Group, VI–10–60;

21598, 23686, 15938, on reef at Quoi Is., Truk Group, VIII–2–60; 21737, 21733, 21326, 21682, 15872, 15621, 15717, 15635, 15601, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 23304, 21253, 21255, on reef at Quoi Is., Truk Group, VIII–2–60; 23159, on western side of Quoi Is., Truk Group, VIII–2–60; 21373, 15771, on reef at Yap Is., VIII–18–60; 15786, 15955, 23740, on reef between Moen and Falo Is., Truk Group, VII–29–60; 15810, 15806, 15959, near northern end of airport runway at Moen Is., Truk Group, VII–29–60; 15536, 15520, 15474, 15522, 15474, 15543, 15528, 15506, on reef near Helen Is., Helen Reef, VIII–30–60; 15481, on reef with sandy to rocky substratum with plenty of animal corals at western end of Helen Is., Helen Reef, VIII–28–60; 23694, on reef near south end of Moen Is., Truk Group, VIII–1–60.

2. *Turbinaria decurrens* Bory 1827:119; Weber van Bosse 1913:149; Taylor 1964: 477, pl. 1, figs. 22–28.

This species was seen only twice, but it agrees well with Taylor's (1964) description and figures for this species. The specimens are small, to about 12 cm tall and the longitudinal ridges extend from the terminal portion of the blade to almost the stipe thus obscuring the short terete stalk.

Type: Durville's specimens from Society Is. and New Guinea; present whereabouts not known to the writer.

Materials examined: 15605, 15527, growing on rocks on reef at Pulo Anna Is., IX–3–60.

3. *Turbinaria conoides* var. *conoides* f. *retroflexa* Taylor 1964:481.

Only two specimens found in one collection were studied. These fit very well the new *forma* of this species described by Taylor (1964) rather than the typical variety. The thalli are about 30 cm tall with several branches. The leaves are small, about 6 to 9 mm long and 5 to 8 mm broad. The vesicles are very distinct and the marginal blade appears companulate.

Type: E. Y. Dawson and J. Domantay No. 11519; now in the University of California Herbarium (Berkeley) as No. M-098556.

Materials examined: 15603, on reef at Pulo Anna Is., IX–3–60.

Sargassum C. Agardh 1820

The following key and notes on the species of *Sargassum* are primarily based on the morphological characters of the specimens recognizeable to the writer. As such, they are purely artificial groupings based on the writer's own taxonomic opinion of the specimens.

Being aware of the extreme variability of the specific characters in the genus as well as the complications that may arise later if specific epithets are supplied, the writer deems it necessary to leave these entities without specific epithets for the present.

Key to species:

1. Secondary branches terete 2

1. Secondary branches flattened or compressed ..... *Sargassum* sp. 6
2. Vesicles present 3
2. Vesicles absent ..... *Sargassum* sp. 2
3. Vesicles with costae or appendages 4
3. Vesicles without costae or appendages..... *Sargassum* sp. 1
4. Midribs of the leaves prominent up to apices 5
4. Midribs of the leaves fading below the apices..... 6
5. Leaves up to 5 cm long, about 10 times or more longer than wide; linear-lanceolate becoming linear at the upper portions of the branches; vesicles small about 2 mm long..... *Sargassum* sp. 4
5. Leaves to about 3 cm long, about 5 times longer than wide; linear-laceolate; vesicles about 3 cm long; presence of branches with undifferentiated leaves ..... *Sargassum* sp. 7
6. Vesicles large, more than 2.5 mm long, numerous with very well developed costae and linear or expanded appendages at their apices..... *Sargassum* sp. 3
6. Vesicles smaller, 2.5 mm or less long, costae not well developed; linear outgrowths present at their apices..... *Sargassum* sp. 5

1. *Sargassum* sp. 1

Thalli to about 15 cm tall, attached to the substratum by means of thickened disc-like holdfasts. The primary branch short, about 1 cm long, mottled in appearance and thicker than the terete secondary branches. The secondary branches with small, short, spine-like outgrowths.

The leaves are distichously arranged, alternate, sub-sessile with very short petioles. The blade linear-oblong to lanceolate in shape, not more than four times longer than wide; the midrib prominent just below the apex of the leaves; apices of the leaves obtuse to acute; the base slightly asymmetrical; margin very finely dentate; cryptostomata scattered on both surfaces of the blade.

The vesicles ovate or spherical with short cylindrical stalks about 1 mm long, simple without any ornamentation except for a few cryptostomata, or thickened areas on the surface. The stalk shorter than the length of the vesicle.

The secondary branches somewhat crowded from the primary branch so that the specimens exhibit a somewhat bushy growth. Growing on rocks.
Materials examined: 23558, 21070, 21052, 21081, on reef at Iwayama Bay, Palau Is., VIII–22–60.

2. *Sargassum* sp. 2

Thalli to about 40 cm tall, attached to the substratum by means of a small disc-like basal holdfast. The primary branch very short, from which arise long, thin and sparsely branched secondary branches giving the plant a very lax habit. The branches cylindrical in cross section, with many small reduced spinose outgrowths.

The leaves are smaller near the base of the branches, bigger towards upper portion, up to about 2.5 cm long including the short petioles, not more than 5 times

longer than wide; linear-oblong to lanceolate in outline, the base distinctly asymmetrical, the midrib distinct more than midway, or a little below the apices which are obtuse to acute; the margin finely and irregularly toothed; crypostomata scattered on both surfaces of the blade.

The vesicles not seen. The basal portion of the slender secondary branches devoid of leaves but remnants of leaf stalks and bases of the smaller branches give the stipe a rough appearance. On rocks.

Materials examined: 21491, 21118, 21356, on reef flat near bridge between Kolonia and Jokaj Is., Ponape, VI–25–60; 15661, 21324, 15593, 15661, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60.

3. *Sargassum* sp. 3

Thalli up to about 60 cm tall, laxly branched, primary branch short, arising from a disc-like holdfast. The branches terete with numerous thin but well developed outgrowths giving them a rough appearance.

Leaves large, up to 4.5 cm long, variable in outline, linear lanceolate to oblong lanceolate, in some cases becoming ovate; the petioles short but distinct; margin variable, from finely dentate to shallowly and irregularly cut, the lobes provided with fine teeth, or the teeth extended into prominent extensions. The midrib prominent up to or just below the apices of the leaves which are obtuse to bluntly rounded; base of the leaves slightly asymmetrical; cryptostomata scattered on both surfaces.

Vesicles numerous, large, racemose, obovate, with prominent costae modified into flattened wings on the side or with linear or expanded outgrowth at the tips. The stalk of the vesicles short, about 1–2 mm long, cylindrical. Growing on rocks.

Materials examined: 15996, on reef at Dublon Is., Truk Group, VII–31–60; 15609, 15679, 15656, 15569, 15546, 15679, 15546, on reef at Koror Is., Palau Group, IX–5–60; 15985, 21156, 21201, on reef at Iwayama Bay, Palau, VIII–20–60.

4. *Sargassum* sp. 4

Thalli bushy to about 20(30) cm tall, attached by means of a thickened disc-like holdfast; the primary branches terete, very short to about 1 cm long but commonly 5 mm; the secondary branches crowded from the primary branch which gives the plants a bushy appearance, the branches with numerous and well developed, flattened, simple, or lobed outgrowths which are about 0.5–0.8 mm long, giving the branches a spiny appearance.

Leaves up to 5 cm long, narrow, about 10 times or more longer than wide; leaves larger at the basal portion of the branches, linear lanceolate in outline and becoming smaller and linear towards the upper portion of the branches, very much reduced when the upper portion of the branch bears vesicles. The midribs prominent up to the apex of the leaves.

Vesicles small, about 2 mm long, obovate with a very short stalk less than a millimeter long. Mature vesicles simple with few prominent knobs on the surface, young ones with deciduous outgrowth at tips. About 4 to 5 vesicles, or less, are

borne on a short raceme.

One distinctive character of this species is that the vesicles are borne on an elongated secondary branch much taller than those bearing leaves only and the leaves among the vesicles are very much reduced, linear, the margins irregularly serrated. On rocks.

Materials examined: 23333, on reef at Fefan Is., Truk Group, VII–28–60; 21624, 21846, 21624, 21668, 21475, 21654, on reef near boat pier, Ponape Is., VII–20–60.

5. *Sargassum* sp. 5

This collection is represented by an incomplete specimen. The leaves are oblong to ovate in shape with short, distinct petioles, the blade up to about 2 cm long, about 3 times longer than wide. The midribs are prominent but fade starting at about 3/4 from the base of the blades. The margin is irregularly incised and the lobes provided with smaller teeth or the teeth are extended into narrow linear outgrowths. The cryptostomata are scattered on both surfaces of the blade.

The vesicles are about 2.5 mm long, obovate, with short stalk, about 1 mm long. The apical portions of the vesicles are provided with outgrowths (appendages); cryptostomata are also found on the surface.

Holdfast was not seen. The branches are cylindrical in cross section.

Materials examined: 15690, on reef at Tafansak Village, Kusaie Is., VII–16–60.

6. *Sargassum* sp. 6

Thalli bushy, up to 12 cm tall, attached to the substratum by means of a thickened disc. The primary branch is very short, about 2 to 4 mm long, about 1 to 1.5 mm thick. The erect secondary branches are compressed to flattened at their basal portion, much branched, spreading.

The leaves to about 1.5 cm long, about 2.5 times longer than wide, oblong-obovate in outline, the bases tapered towards the flattened petiole; the apex obtuse to bluntly rounded; margins coarsely dentate; cryptostomata few, scattered irregularly on the blade; midribs hardly discernible in the basal half or less of the blade; or seem to be entirely absent.

Vesicles not seen.

Specimens are fertile, the receptacles paniculate, dense, cylindrical and verrucose to somewhat spinose and elongated. On rocks.

Materials examined: 15890, 15949, on reef near north end of airport runway at Moen Is., Truk Group, VII–29–60.

7. *Sargassum* sp. 7

Thalli up to 15 cm tall attached to the substratum by means of a thickened disc-like holdfast. Branches terete, the primary branch short up to about 1 cm long, verrucose. The secondary branches coarse, about 1 to 1.5 mm thick and generally much branched at the upper portion, provided with numerous short, branched outgrowth giving them a very rough appearance.

Leaves at the basal portion linear-lanceolate to about 3 cm long, about 5 times as long as wide, tapered to a blunt or acute apex; base of the blades slightly

asymmetrical; margins irregularly dentate, sometimes the teeth very much reduced; crytostomata prominent, scattered on both surfaces of the blade; midrib very prominent up to the apex of the blade; leaves found on the upper portion of the branches bearing vesicles are smaller in size, short about 1 cm or less, about 3 times as long as wide, the margins very irregularly toothed; or sometimes very small, about 5 mm long and with irregular shape, and usually crowded at the tip of the branch.

One striking character of this species is the presence of branches arising from the primary branch bearing undifferentiated leaves. These forms of leaves were also seen in the upper portion of the branches bearing the normal leaves.

The vesicles are few, obovate, about 3 mm long with an outgrowth at the apex; with few cryptostomata. The stalk is shorter than the length of the vesicle. *Materials examined*: 23087, on reef at Fefan Is., Truk Group, VII–28–60; 15969, 15958, 15795, 21030, 15975, on reef near north end of airport runway at Moen Is., Truk Group, VII–29–60; 21654a, on reef near boat pier at Ponape Is., VII–20–60; 21630, on reef flat at Iwayama Bay, Palau Is., IX–22–60; 23206, on reef at Dublon Is., Truk Group, VII–31–60.

RHODOPHYTA

ERYTHROTRICHIA Areschoug 1850

Key to species:

1. Chromatophores parietal with 4–5 pyrenoids.....*E. parietalis*
1. Chromatophores stellate with central pyrenoid.....*E. carnea*

1. *Erythrotrichia parietalis* Tanaka 1952:18, fig. 10a–e; Dawson 1954b:412, fig. 23d–e.

Filaments epiphytic on *Centroceras clavulatum*. Their parietal chromatophores with 4–5 pyrenoids and the penetrating basal cells are distinctive of this species. The filaments are about 15–18 μ in diameter.

Type: holotype is Tanaka's specimen growing on *Grateloupia filicina* from Hyuga Province, Japan; present whereabouts not known to the writer.

Materials examined: 21718.3, on reef at Pulo Anna Is., IX–3–60.

2. *Erythrotrichia carnea* (Dillwyn) J. Agardh f. *tenuis* Tanaka 1944:92, fig. 13; Tanaka 1952:16, fig. 7.

Filaments are epiphytic on *Ceramium* sp. which is in turn epiphytic on *Chaetomorpha* sp. The stellate chromatophore with a central pyrenoid, and the basal cell with short, branched rhizoids are distinctive. The materials are, however, sterile.

Type: holotype not designated. No specific locality indicated, but was reported by Tanaka from several Japanese provinces; present whereabouts not known to the writer.

Materials examined: 21315a.1, epiphytic on other algae, on eastern seaward reef flat of Pingelap Is., VII–1–60; 15563.7, on reef at Koror Is., Palau Group, IX–5–60.

Acrochaetium Nägeli 1861

Acrochaetium robustum Boergesen 1915:40, fig. 38–40; Boergesen 1920:449, fig. 418; Tseng 1945:158, pl. 1, figs. 2–4; Abbott 1947:203, fig. 4; Dawson 1954b: 414, fig. 25j–k.

Pl. 4, figs. 1–4

Epiphytic on *Ectocarpus* sp. and *Sphacelaria* sp. which are in turn epiphytic on *Sargassum*, the thalli are minute, about a millimeter tall, attached to the host by means of a single basal cell which shallowly penetrates the host tissue.

The filaments are 3–5 μ in diameter. Monospores are borne on short stalks which may be alternate, or in a series of 2 to 4 on one side of the main axes.

My materials are much smaller than those described by Boergesen (1915–20) from the Danish West Indies. I have not observed the erect filaments growing from a pluricellular basal disc, and the basal cells are smaller, only about 13 μ long, oblong ovate in shape and not shallowly constricted at the median portion. The cells at the basal portion of the erect filaments are more or less the same as those above, except for some which are about 2 diameters long like those described by Boergesen from the Danish West Indies. The size and the shape of the monosporangia are however identical with those of Boergesen's materials.

I have, however, seen and examined much coarser specimens in which the erect filaments measure 7–8 μ in diameter and which possess shorter cells near the base and up to 6 diameters long near the upper portion. They also show basal cells which are identical with Figure 38 of Boergesen (1915–20) as well as Dawson's (1954b) Figure 25k for *A. robustum*. The size and the shape of the monospores are also identical with those of the type from the Danish West Indies. Dawson's (1954b) figure 25j shows that materials from Viet Nam are quite different in that the branchlets bearing the monospores are disposed almost at right angles to the main axes. Dawson's figure thus differs from Boergesen's Figure 40 for this species and also from my specimens.

Type: growing on *Sargassum vulgare*, St. Thomas Harbor, Danish West Indies; present whereabouts not known to the writer.

Materials examined: 23629.3, on *Sargassum* sp., 23086a.3, on *Sphacelaria furcigera* and *Ectocarpus* sp. 23094a.3, on *Padina*, on reef at Fefan Is., Truk Group, VII–28–60; 21094.8, on *Jania*, on reef at Iwayama Bay, Palau Is., VIII–22–60.

Asparagopsis Montagne 1840

Asparagopsis taxiformis (Delile) Collins and Hervey 1917:117; Dawson 1957:112, fig. 20; Boergesen 1915–20:352, figs. 347–351.

Fucus taxiformis Delile 1813:295, pl. 57, fig. 2.

Thalli are about 4 cm tall, composed of creeping stolons from which erect axes arise. Both the prostrate and erect axes are terete.

The erect shoots consist of a percurrent axis giving rise to minor lateral branches which bear in turn fine determinate branchlets in all directions. The branchlets are curved towards the axes, giving the whole erect shoot a feathery appearnce.

My only specimen is vegetative but fits very well the description of Boergesen (1915–20) and figure 20 of Dawson (1957) for this species. The cell arrangement of the determinate branchlets is very distinct in this species. It consists of three rows of cells without a central filament, the cells being alternately arranged.

On rocks on exposed portion of reef.

Type: from Alexandria, Egypt, holotype not designated; present whereabouts not known to the writer.

Materials examined: 21506, on reef at Yap Is., VIII–18–60.

LIAGORA Lamouroux 1812

Liagora farinosa Lamouroux 1816; Abbott 1945:149, fig. 2a–d; Abbott 1961:4.

Pl. 8, fig. 3

Several dried specimens were available for study. These were about 6 cm tall with densely paniculate branching; the branches become short and fragile on drying and are heavily calcified.

The assimilatory filaments are about 4–5 times dichotomous, the cells near the central filaments cylindrical and becoming moniliform towards the tips. The central filament is irregular in shape, generally cylindrical and swollen in the middle and slightly tapering towards both ends, about 55 μ at the thickest portion and about 200 μ long.

The carpogonial branches are lateral, four-celled and slightly curved; the trichogyne is about 55 μ long.

The materials resemble *L. kahukuana* described by Abbott (1945) from Hawaii in gross morphology and also in the form of the central filaments and carpogonial branches. They differ, however, from this species in the absence of the involucre made up of very slender cells which surrounds the cystocarps. At least this structure was not seen by the writer in fertile specimens.

One interesting feature found in the specimens is the presence of disc-like structures like those noted by Howe (1920) which he regarded as "organs belonging to the *Liagora*" which he calls monosporangium-bearing discs. Boergesen (1942) assumed them to be a facultative endophyte which he observed in *L. mauritiana*. I noticed, in the course of the examination of the slides prepared from dried materials, that the bases of the stalks of these disc-like structures were not at all connected to the wall of the assimilatory filaments. Whether this is only due to the dried condition of the specimens, I was not able to ascertain. The question whether these structures are endophytes (Boergesen, 1942) or monosporangium bearing discs (Howe, 1920) can only be resolved by cultural studies. However, I am inclined to believe that these structures are endophytes as noted above, i.e., the base of the stalks of those discs were not at all connected to the assimilatory filaments of *Liagora*. Dr. I. A. Abbott, from her unpublished studies of these structures, also believes that these are endophytes. She observed that the chromatophores of these structures are not identical with those of *Liagora*.

The specimens seem to be identical in their anatomical features with *L. farinosa*.

They differ, however, from the specimen reported by Dawson (1954b) from Nha Trang by being heavily calcified and with densely arranged lateral branches. Specimens were sent to Dr. I. A. Abbott for verification. (See Abbott, 1945, for synonymy)

Type: from the Red Sea, near Suez; now in herbarium of the University of California.

Materials examined: 15998, 21601, 15875, on reef at Quoi Is., Truk Group, VIII–2–60.

ACTINOTRICHIA Decaisne 1842

Actinotrichia fragilis (Forsk.) Boergesen 1932:6, pl. 1, fig. 4; Tseng 1941:97, fig. 8a–e; Dawson 1954b:416, fig. 28b.

Fucus fragilis Forskål 1775:190; *A. rigida* (Lamx.) Decaisne 1842:118; *A. rigida* (Lamx.) Decaisne, *In* Okamura, List of marine algae collected in Caroline Islands and Australia, 1904.

Thalli form a caespitose mass made up of cylindrical dichotomously branched thalli, rigid and stiff on drying, the clumps reaching to about 6 cm tall. The regularly placed bands of extended assimilatory filaments along the smooth unconstricted branches are distinctive. This is one of the most frequently encountered species in the Caroline Islands.

Type: from the Red Sea; now in Forskål Herbarium, Botanical Museum, Copenhagen.

Materials examined: 23251, 23377, 15997, 23278, 23580, on reef at Dublon Is., Truk Group, VII–31–60; 21964, 23218, 21800, 21799, 21815, 21811, 21819, 15041, 21744, on outer reef facing Mantapeitak Is., Ponape Group, VII–20–60; 21889, 15772, on reef flat at north end of Yap Is., VIII–19–60; 23634, on reef at Ponape Is., VII–20–60; 21605, 23408, 21942, 15488, 21401, 15176, 15279, 21869, 21868, on reef at Tafansak Village, Kusaie Is., VII–16–60; 21503, 23359, on reef at Yap Is., VIII–18;60; 21663, 21847, on reef near boat pier, Ponape Is., VII–20–60; 23076, 23455, 23590, on reef at Fefan Is., Truk Group, VII–28–60; 23695, on reef at north end of airport runway, Moen Is., Truk Group, VII–29–60; 21774, 15035, 15011, 15000, 15022, on reef flat at eastern side of Pepalap Peak, Ponape Is., VI–17–60; 21180, 21538 21082, 21631, 21053.1, 21695, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 21587, on reef near Utwa Village, Kusaie Is., VII–17–60; 15013, on reef flat at eastern side of Peipalap Peak, VI–16–60; 15889 near north end of airport runway, Moen Is., Truk Group, VII–29–60; 15916, from south end of Moen Is., Truk Group, VIII–1–60; 15214, 15495, 15238, 15252, 15244, 15495, on reef at Kusaie Is., VII–15–60; 15025, 15028, on reef flat at Epwelkapw, Ponape Is., VI–17–60.

GALAXAURA Lamouroux 1812

Key to species:

1. Thalli consisting of filaments not differentiated into the medullary and

cortical tissues..... *G. filamentosa*

1. Thalli consisting of filaments differentiated into medullary and cortical tissues..... 2
2. Cortex composed of short and extended assimilatory filaments..*G. fasciculata*
2. Cortex composed only of short assimilatory filaments.....*G. oblongata*

1. *Galaxaura filamentosa* Chou 1945:39, pl. 9, figs. 1–6; pl. 6, fig. 1; Abbott 1961:4.

Galaxaura rudis Kjellman, *In* Tanaka 1936, The Genus *Galaxaura* from Japan, p. 144, text figs. 1–2, pl. 34, fig. 1.

Galaxaura rudis Kjellman, *In* Tseng 1941, Studies on the Chaetangiaceae of China, p. 85, fig. 1.

Thalli are about 2 cm tall, forming small bushy clumps attached to the substrate by means of a small holdfast. Branches are villous, terete, about 1–1.5 mm thick including the extended assimilatory filaments.

The thalli consist of cylindrical filaments not differentiated into medullary and cortical tissues. The central filaments are about 18–22 μ thick and bear pigmented, extended assimilatory filaments which are about the same diameter as the central filaments.

Type: holotype is Taylor 39–46, III–17–39, on sheet 150 in HAHF, from Sulphur Bay, Clarion Is., Mexico.

Materials examined: 15935c, from lagoon, Puluwat Is., (Enderby Is.), VIII–7–60; 21505.8, on reef at Yap Is., VIII–18–60.

2. *Galaxaura fasciculata* Kjellman 1900:53, pl. 5, figs. 1–9; pl. 20, fig. 14; Chou 1945:44, pl. 2, fig. 2; pl. 8 fig. 1; Tanaka 1936:147, figs. 5–6; pl. 34, fig. 3; Tseng 1941:86, fig. 2; Okamura 1904:86.

Pl. 6, fig. 2

Thalli are up to 6 cm tall and are attached to the substratum by disc-like holdfasts. The thallus is uniformly villous, cylindrical, about 1–1.5 mm thick.

The medullary filaments are about 10 μ thick; the cortex is made up of short and extended assimilatory filaments, the latter of cylindrical, about 20 μ thick. The tip cells of the short assimilatory filaments are larger than the basal ones, about 31 μ thick, ovoid to somewhat spherical in shape.

Both the short and extended assimilatory filaments are fasciculate, a distinct characteristic of this species.

Type: from Celebes; now in Herbarium Upsalensis, Lund.

Materials examined: 21844, 21436, 21661, on reef near boat pier, Ponape Is., VII–20–60.

3. *Galaxaura oblongata* (Ell. & Sol.) Lamx.; Chou 1947:7, pl. 2, figs. 1–16; pl. 3, figs. 1–14; pl. 9, figs. 1–2; Boergesen 1915–20:459;.Boergesen 1942:49; Tseng 1941:93.

Pl. 6, fig. 1

Thalli are about 8 cm tall, attached by means of a small holdfast, forming subglobose clumps. The branches are glabrous, several times dichotomously branched,

about 1–1.5 mm in diameter. The tips of the branches appear to be slightly rugose; branches fragile when dried.

The medullary filaments are about 10–13 μ in diameter, giving rise to smaller filaments on which the moniliform assimilatory filaments are borne. The innermost cells of the assimilatory filaments are larger, about 18–23 μ, obovoid or ovate in shape and becoming smaller toward the surface of the thallus.

Slides made after decalcification of a portion of the thallus show that the assimilatory filaments do not easily dissociate from the medullary filaments.

Type: according to Chou (1947) "Ellis' and Solander's specimen from the West Indies no longer exists."

Materials examined: 21758, 21834, 15029, 15637, on reef flat at Epwelkapw, Ponape Is., VI–16–60; 21741, on reef facing Mantapeitak Is., Ponape Group, VI–20–60.

GELIDIUM Lamouroux 1813

Gelidium pusillum (Stackh.) Le Jolis 1864:139; Reinbold 1901:350; Boergesen 1927:83, fig. 44; Feldmann and Hamel 1936:112; fig. 19a–c, 20; Dawson 1944: 258, pl. 42, figs. 1–6; Taylor 1945:152; Fan 1951:17, fig. 10; Okamura 1904:86.
Fucus pusillus Stackhouse 1801:17, pl. 6.

Thalli, growing on pieces of dead corals, form tufts up to 15 mm tall, consisting of a horizontal, cylindrical stolon attached to the substratum by means of peg-like attachment organs, and erect branches. The erect branches are generally terete at the base, flattened above, simple or sparingly branched, the branches irregularly pinnate up to 1 mm broad, usually club-shaped in outline or narrowed towards the blunt apices. The apical cell is prominent.

In cross section the frond is composed of loosely arranged thick walled medullary cells, about 12–15 μ in dimaeter. Mixed among the medullary cells are many closely packed, straight rhizoidal filaments about 3–4 μ in diameter.

Fertile areas are limited to the terminal portions of the branches forming sori. Tetrasporangia are tetrahedral. Sexual thalli not seen.

Type: according to Dawson (1953) the holotype was not designated. From Sedmouth and Brighton, England; present whereabouts not known to the writer.

Materials examined: 23730 (pickled only), on reef at eastern side of Pulo Anna Is., IX–3–60.

GELIDIELLA Feldmann and Hamel 1934

Key to species:

1. Thalli forming loose, coarse, wiry clumps; main axes percurrent, generally arched; ultimate branchlets many, distichous or uniseriate on the axes..... .....*G. acerosa*
1. Thalli forming small, soft tufts; branches few and irregularly arranged..... 2
2. Branches compressed, oblong-oval in cross section; tips of branches blunt .....*Gelidiella* sp. 1

2. Branches terete; growth thickenings present; tips of the branches acute.... .....*Gelidiella* sp. 2

1. *Gelidiella acerosa* (Forskål) Feldmann and Hamel 1934:533; Dawson 1944: 261; Dawson 1949:246; Dawson 1953:82.
Fucus acerosus Forskål 1775:190.
Echinocaulon acerosum (Forskål) Boergesen 1932:5, pl. 1, fig. 3.
Pl. 6, fig. 5

Thalli form loose mats consisting of many semi-erect, rigid branches arising from a creeping stolon. The main axes possess 1–3 orders of branches, the branches cylindrical to somewhat compressed. The smaller ultimate branchlets are more or less equal in length, and may be opposite or alternate, and distichously arranged at the basal portion of the main axes but become more irregular near the upper portion.

In cross section the medullary cells are large, about 20–30 μ in diameter, becoming smaller towards the cortex. Rhizoidal filaments are absent. In fertile thalli the apical portions of the branchlets form stichidia, swollen to about double the diameter of the sterile base.

Thalli are variable in size, and in the abundance of the branches. In robust materials the secondary axes are more abundant and distichously arranged near the upper middle portion of the primary axes, or, unilaterally arranged on the upper side of the arching axes. Loose clumps occur on sandy to rocky substratum, sometimes forming a pure stand, or mixed with other smaller algae.
Type: from "Ad Mochhae littora" in the Red Sea; holotype is Forskål's original specimen (illustrated by Boergesen) under Number 874 in the Botanical Museum of the University of Copenhagen, Denmark.
Materials examined: 15141, 21762, on reef flat of Epwelkapw, Ponape Is., VI–19–60; 21775, 21813, 21820, 21804, 21818, 21772, 15662, 21369, 23011, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 15498, 21918, 23242, 23415, on reef at Kusaie Is., Kusaie Group, VII–15–60; 15397, at southern end of Helen Reef, VIII–28–60; 23403, 15436, on reef at Tafansak Village, Kusaie Is., VII–16–60.

2. *Gelidiella* sp. 1

Thalli form soft tufts up to 1.5 cm tall on dead corals. They consist of prostrate filaments, tightly interlaced with each other by hapters and attached to the substratum by strong tufts of rhizoids. The horizontal axes produce on their upper sides erect branches which may be simple when young but becoming branched in later stages. Branching is irregular, alternate to sub-opposite but somewhat distichously arranged. The main axis is percurrent and generally long and unbranched near the apical portion. The short lateral branchlets are somewhat clavate. Branches are compressed, oblong-oval in cross section, growing by means of a distinct apical cell. Branches are irregular in diameter, 80–135 μ thick.

In cross section the central tissue of the medulla consists of cells about 7–9 μ

in diameter with somewhat thickened and angular walls. The cells become smaller towards the surface of the thallus and are circular to oval in cross section.

Unfortunately the materials are sterile and for the present it seems desirable to leave this unnamed.

Materials examined: 21696, on dead corals on reef at Iwayama Bay, Palau Group, VIII–22–60; 23594, forming soft tufts on limestone rocks on reef at Duklon Is., Truk Group, VII–31–60.

3. *Gelidiella* sp. 2

Thalli are about 5–6 mm tall forming soft tufts on rocks. The horizontal filaments are attached to the substratum by dense tufts of rhizoids. Horizontal filaments give rise to erect branches which are generally unbranched, or, with few minor lateral branches. Branches are terete throughout, about 80–100 μ thick, the horizontal filaments coarser than the erect branches, the latter somewhat tapered with acute apices. The basal portions of the erect branches display growth "thickenings."

The materials examined are sterile and identification could not be certain. The size and habit of the materials however appear similar to *G. bornetii*, even in the somewhat oval shape of the erect filaments in cross section.

Materials examined: 23272, on reef at Dublon Is., Truk Group, VII–31–60.

Gelidiopsis Schmitz 1895

Key to species:

1. Thalli forming coarse, tough, wiry clumps, much branched; branches 250–280 μ in diameter ..... *G. intricata*
1. Thalli forming smaller, soft tufts; erect branches simple or sparingly branched; branches about 115–150 μ in diameter ..... *Gelidiopsis* sp.

1. *Gelidiopsis intricata* (Ag.) Vickers 1905:61; Yamada and Tanaka 1938:74, figs. 6a–c; Dawson 1954b:423, figs. 34a–d.
   Sphaerococcus intricatus C. Agardh 1822:333.

Thalli form clumps up to 3 cm tall together with *Amphiroa foliacea* and *Amphiroa fragilis*. Thalli are wiry and tough, densely matted, especially at the basal portion where the branches are attached to each other by small hapters. Branches are cylindrical to somewhat oval in cross section, irregularly branched, alternate, opposite. Erect branches are found on the upper side of the horizontal axes.

Branches are irregular in diameter, about 250–280 μ thick, generally finer towards the terminal portions, which are about 150–200 μ.

In cross section the medulla is composed of smaller cells in the center, about 7–12 μ in diameter, surrounded by larger cells which are somewhat oval in shape, and radially arranged. The cortex is made up of 2–3 layers of elongated cells also radially arranged. Our specimens are tetrasporic; stichidia are borne at tips of small branches; tetraspores are cruciate. The material agrees very well with figures and descriptions of the above authors for this species.

Forming clumps on rocks together with other smaller algae.

Type: from Ravak Island; present whereabouts not known to the writer.
Materials examined: 23003, 21956, 15285, on reef at Tafansak Village, Kusaie Is., VII–16–60; 23195, on dead coral at western side of Quoi Is., Truk Group, VII–2–60; 23287, 23656, 23665, 23261, on reef at Falas Is., Truk Group, VII–20–60; 23244, on reef around Utwa Village, Kusaie Is., VII–17–60; 23166, 23344, 23042, on reef at western side of Sorol Is., VII–13–60; 21684, on reef on eastern side of Mantapeitak Is., VI–20–60.

2. *Gelidiopsis* sp.

Thalli form tufts about 2 cm tall on fragments of dead corals with other algae, the basal portion is elongated and gives rise to a free, mostly simple-branched erect system. Branches are cylindrical, growing by means of a group of apical cells; diameter of the branches is irregular, about 115–150 μ, generally tapered towards the apices.

In cross section the central medulla is made up of angular cells, about 8 μ in diameter with somewhat thickened walls and more or less uniform in size. Cells of the subcortical tissue are somewhat larger and thin walled, circular to somewhat oval and becoming smaller towards the surface. In surface view the cells of the epidermis are oblong to oval in shape.

Unfortunately all the collections examined were sterile and therefore the writer deems it necessary to leave the specimen unnamed.
Materials examined: 21710, on reef at Epwelkapw, Ponape Group, VI–20–60; 21096, on reef at Iwayama Bay, Palau Is., VIII–22–60.

Desmia Lynbye 1819

Desmia hornemannii Lyngbye 1819:35, pl. 7, fig. c; Boergesen 1943:13.
Chondrococcus hornemannii Schmitz, *In* Engler's Bot. Jahrb. 21:170, 1896 (in part); *Sphaerococcus Lambertii* Suhr, Flora 17 (2):728, 1834: *Chondrococcus Lambertii* Kützing, Bot. Zeit. 5:23, 1847.

Thalli are caespitose, attached to rocks by their small bases. Branches are flattened, up to 4 cm tall, the main axes about 1 mm wide; 3–4 alternately and pinnately branched, somewhat flabellate, the laterals sparingly provided with simple, acute teeth. The tips of the terminal branches may be inrolled or straight. The axils formed by the branches are somewhat rounded.

Gland cells are scattered below the cortex, ovoid, elongate, about 20–23 μ high as seen in cross section.

Specimens examined were fragmentary and sterile, but there is little doubt as to their identity.

Papenfuss (1940) discussed the nomenclatural problem regarding this genus.
Type: according to Papenfuss (1940: 216) the type was probably collected by Forskål somewhere in the Red Sea or in the northwestern part of the Indian Ocean; present whereabouts not known to the writer.
Materials examined: 21547.1, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 21505a, on reef at Yap Is., VIII–18–60.

PEYSSONELIA Decaisne 1841

Key to species:

1. Thallus more than 150 μ thick; rhizoids multicellular ..... *Peyssonelia* sp.
1. Thallus less than 150 μ thick; rhizoids unicellular..... *P. rubra* var. *orientalis*

Peyssonelia rubra var. *orientalis* Weber van Bosse 1921:270, figs. 86–89; Dawson 1953:104, pl. 10, fig. 8; Taylor 1950:121; Dawson 1954b:424, fig. 36c.

Pl. 6, fig. 4, Pl. 8, fig. 2

Thallus are crustose, forming a calcified crust about 80–120 μ thick on rocks and old coral fragments. In well developed examples the margins become free and overlapping. The lower surface bears one-celled clavate rhizoids arising from the hypothallus. The hypothallus consists of one layer of cells which are rectangular in shape as seen in longitudinal section. The cells of the perithallus gradually become smaller towards the upper surface. Collections examined were sterile but their vegetative characters fit well with those of the above species as noted by the several authors.

Type: holotype not specifically designated but 17 Dutch East Indian localities were indicated, from intertidal to 120 meters depth. Original material of several collections deposited in the Rijksherbarium, Leiden, Netherlands.

Materials examined: 21564, on rocks and dead coral fragments on an islet near Koror Is., Palau Group, IX–6–60.

Peyssonelia (?) sp.

Pl. 6, fig. 3; pl. 8, fig. 1

Thalli crustose, up to 5 cm broad, forming calcified crusts on the substratum. In mature specimens the margins of the thalli become free and overlapping.

The crust irregular in thickness about 160–250 μ thick; attached to the substratum by means of one to several celled rhizoids.

Hypothallus one celled-thick. In longitudinal section the hypothallus is made up of elongated cells which give rise to rhizoids at their lower distal ends and to the perithallus filaments on the upper portions.

The perithallus consists of semi-erect, dichotomously branched filaments made up of cylindrical cells at their basal portions, about 2–3 diameters long and becoming very short towards the upper surface of the thallus.

Materials examined: 21061, on reef at southern end of Moen Is., Truk Group, VIII–1–60.

FOSLIELLA Howe 1920

Fosliella farinosa (Lamx.) Howe 1920:587; Dawson 1954b:425, fig. 37c; Dawson 1956:49.

Melobesia farinosa Lamouroux 1816:315, pl. 12, fig. 3.

Thalli form small calcareous crusts on *Sargassum* leaves, on other larger algae, and other vegetable materials. A thallus consists of a single layer of cells. The heterocyst is very conspicuous, about 26 μ long, somewhat ovate in shape. In

a decalcified and stained specimen, the heterocyst shows darkly stained contents near the basal portion.

The tetrasporic conceptacles are about 165–180 μ in diameter, forming circular bumps on the surface and have a single ostiole.

Type: from Europe; present whereabouts not known to the writer.

Materials examined: 23435, on *Sargassum* sp., 23441, 23443, on eel grass, 23446, on reef at Falas Is., Truk Group, VII–30–60; 23474, on eel grass, 23473.1, on *Stypopodium* sp., 23486.1, on *Sargassum* sp., on reef at Iwayama Bay, Palau Group, VIII–22–60; 23483, on eel grass, on reef near Malakal Pass, Malakal Is., Palau Group, VII–30–60; 23435, 23464, on *Sargassum* sp., on reef at Fefan Is., Truk Group, VII–28–60; 21393a, 23433, 21393a on *Chaetomorpha* sp., on reef at Nanmatol Is., Ponape Group, VII–23–60; 15211.1, on *Turbinaria* sp., on reef at Kusaie Is., VII–15–60.

Amphiroa Lamouroux 1812

Key to species:

1. Thalli decumbent; intergenicula dimorphic, cylindrical or flattened..*A. foliacea*
1. Thalli erect; intergenicula cylindrical with swollen ends..... 2
2. Branching generally dichotomous; ends of the intergenicula not prominently swollen; angles at dichotomies acute; thalli fragile..... .....*A. fragilissima* var. *fragilissima*
2. Branching verticillate; intergenicula with prominently swollen ends; branches forming right angles to the axes; thalli strong..... .....*A. fragilissima* var. *cyathifera*

1. *Amphiroa fragilissima* (L.) Lamouroux 1816:298; Weber van Bosse and Foslie 1904:89, pl. 16, figs. 1, 2, 5; Boergesen 1934:7; Dawson 1954b:430, fig. 40 g, h; Taylor 1960:403, pl. 47, figs. 1–2; Boergesen 1943:17.
   Corallina fragilissima Linnaeus 1767:1305.

Thalli grow to about 4 cm tall and are erect in habit. Branching is predominantly dichotomous to trichotomous, sometimes producing adventitious branches. The angles formed by the branches are variable, wide or acute. The segments are cylindrical, variable in diameter, about 0.8 mm below, about 0.3 mm above. Length of the segments is also variable, ranging 5–25 but more commonly 8–18 diameters long.

The medulla of the segments consists of 5–8 tiers of longer cells alternating with a tier of short cells, the latter about 16–33 μ long.

The materials show the characteristic swollen ends of the segments. (Conceptacles are few to many in the fertile segments, lateral, sometimes with the tendency to form a row of 3–4 conceptacles at the sides of the segments.)

Type: from the Caribbean; present whereabouts not known to the writer.

Two forms are recognizeable, namely fa. *fragilissima* and fa. *cyathifera*.

fa. *fragilissima* (Lamx.) Weber van Bosse and Foslie 1904:89. This form is characterized by its finer and fragile branches. The angles at dichotomies or tri-

chotomies are narrow 25–60–(80)°, very seldom more than 90°. My specimens were compared and found to be identical with material from Haiti (H. H. Bartlett, 17992) and also from Queensland (A. B. Cribb, 16.13) deposited in M. S. Doty herbarium, in the Department of Botany, University of Hawaii, under the name *A. fragilissima.*

Materials examined: 21203.1, on reef flat with a sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 23274, on reef at Dublon Is., Truk Group, VII–31–60; 15841, on reef at Kusaie Is., VII–15–60; 15033, on the reef flat on the eastern side of Peipalap Peak, Ponape Is., VI–17–60; 15255, 15246, 15237, 15212, 23414, 15496, on reef at Kusaie Is., VII–15–60; 15005, 15008, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 15103, on a reef flat with a sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 15821, 15822, 21490, on reef at north end of Yap Is., VIII–19–60; 21203, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 23432, 23427, on reef at Ponape Is., VII–20–60; 23361, on reef at Yap Is., VIII–18–60; 15431, on reef at Tafansak Village, Kusaie Is., VII–16–60; 21894, on reef flat at Yap Is., VIII–19–60; 15058, 15075, on reef at the eastern side of Mantapeitak Is., Ponape Group, VI–20–60.

fa. *cyathifera* (Lamx.) Weber van Bosse and Foslie 1904:89, pl. 14, fig. 5; pl. 16, fig. 2.

This form grows as loose, strong cushions, has very strongly swollen ends of the segments, and the branches are strongly verticillate in appearance due to the production of adventitious branches at the nodes.

Materials examined: 15053, 15071, 15066, 15063, 21679.1, on reef on eastern side of Mantapeitak Is., VI–20–60; 15146, 15230, on reef flat of Epwelkapw, Ponape Is., VI–20–60; 15193, on reef in Kusaie Is., VII–15–60; 21999, 23711, on reef at Yap Is., VIII–18–60; 23444, 21876, 23515, on reef at Falas Is., Truk Group, VII–30–60; 23339, on reef at Fefan Is., Truk Group, VII–28–60; 23448, among mangroves at south end Moen Is., Truk Group, VIII–30–60; 23614, on reef around Utwa Village, Kusaie Is., VII–17–60; 23876, collected (Pioneer 100 E-Cruise) near East Channel Mouth (Malakal Is.) Palau Group, VII–9–64; 23846, Koror Is., Palau Group, VII–9–64; 15821, on reef flat with sandy-rocky bottom at north end of Yap Is., VIII–19–60; 21203, on reef flat with sandy-rocky bottom at Iwayama Bay, Palau Is., VIII–22–60.

2. *Amphiroa foliacea* Lamouroux 1824:628, pl. 93, figs. 2–3; Taylor 1945:192, pl. 56; Weber van Bosse and Foslie 1904:92, pl. 14, figs. 1–11; Dawson 1953: 135; Dawson 1954b:430, fig. 40c.

Thalli are attached to rocks, shells, and other corallines by means of a small basal disc. Branches are sub-erect to decumbent, mostly dichotomous to trichotomous, but adventitious branches develop at the base of the intergenicula and produce a somewhat whorled arrangement. The intergenicula are dimorphic, flattened or cylindrical, 2–5 diameters long; the flattened intergenicula have a prominently thickened midrib at the lower surface. Sometimes the intergenicula

are up to 2.5 mm broad, in which case the margins are quite expanded and undulate. The angles at the forkings are widely divaricate. The terminal segments are blunt at the apices.

The medulla of the intergenicula consists of 3–4 (5) tiers of longer cells alternating with a single tier of short cells, the former about 50–100 μ long, about 18 μ broad; the latter about 18 μ long.

Conceptacles are not prominent, only slightly elevated.

Type: from Marianas Islands, Micronesia; holotype is a specimen without date or locality in Lamouroux's Herbarium, Institut Botanique, Université de Caen, France.

Materials examined: 15170, 21872, 15492, 15281, 15250, 15433, 15085, 15213, 15163, 15126, on reef at Tafansak Village, Kusaie Is., 21683, on reef on the eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 15293, on reef around Utwa Village, Kusaie Is., VII–17–60; 23438, 15879, on reef at Falas Is., Truk Group, VII–30–60; 23589, 23362, on reef at Yap Is., VIII–18–60; 23593, on reef at Dublon Is., Truk Group, VII–31–60.

Corallina Linnaeus 1758

Corallina pinnatifolia var. *digitata* Dawson 1953:125, pl. 9, figs. 14–20; pl. 30, fig. 1.

Corallina pilulifera Postels & Ruprecht, as interpreted by Dawson, 1944:275.

Thalli are up to 2.5 cm tall; branching of the main axes is generally dichotomous, but sometimes opposite.

Intergenicula are flattened throughout except at the basal portions, which may be sub-cylindrical to compressed. The basal segments produce branches made up of wholly cylindrical segments, terminal ones becoming modified into attachment structure.

The intergenicula are somewhat triangular in shape, with wings which are continuous with the unsegmented pinnae. The midrib is not prominent but is recognizeable as the thickened middle portion of the segment. The terminal unsegmented pinnae are identical with those described by Dawson (1953) from Mexico.

Tetrasporangial conceptacles are terminal on the flat unsegmented pinnae but sometimes are borne on a sub-cylindrical pinna and thus appear to be pedicillate.

The degree of variation in shape and form of the unsegmented pinnae are well within the limits of the variation in the type as shown in Plate 9, Figures 14–20 of Dawson (1953).

My materials differ from the type in their mainly dichotomous branching whereas the type has opposite branching. Also, my specimens do not form compact clumps but are rather lax in habit. Since the materials are somewhat fragmentary, I deem it necessary for the present to place this specimen under this present variety.

Type: from rocky shore at Punta Colorado, near Guaymas, Sonora, Mexico,

holotype is Dawson 557, II–13–46, on sheet 4275 and box 55047 in HAHF.
Materials examined: 15215, 23422, on *Caulerpa* sp. on reef at Kusaie Is., VII–15–60.

JANIA Lamouroux 1812

Key to species:

1. Intergenicula (segments) compressed throughout.....*J. tenella* var. *zacae*
1. Intergenicula (segments) cylindrical or slightly compressed at the basal portion of the thallus, or terminal segments broadly ungulate..... 2
2. Thallus dichotomously branched, decussate; intergenicula wholly cylindrical, more or less wide angled, usually over 45°..... 3
2. Thallus dichotomously branched, not decussate, intergenicula not wholly cylindrical, narrow angled, usually less than 45°..... 4
3. Intergenicula fine, less than 100 μ in diameter, sometimes slightly decussate .....*J. capillacea*
3. Intergenicula coarser, mostly 120–165 μ in diameter, commonly strongly decussate .....*J. decussato-dichotoma*
4. Terminal segments frequently broadly ungulate.....*J. ungulata* var. *brevior*
4. Terminal segments not broadly ungulate, cylindrical to slightly compressed ..... *J. tenella* var. *tenella*

1. *Jania capillacea* Harvey 1853:84; Dawson 1953: 116, pl. 9, fig. 1; Dawson 1954b:432, fig. 41a, g.

Thalli are usually epiphytic on old stumps of *Turbinaria ornata* or other larger algae. Thalli are branched dichotomously to irregularly decussate. Segments are cylindrical, very fine, about 60–100 μ in diameter, about 4–10 diameters long.

My specimens are identical with those reported by Dawson (1954) from Viet Nam and also with those from the Marshall Islands (1956). Unfortunately they are sterile. At least in one specimen accessory attachment discs were seen like those reported by Dawson (1953) from Mexico.
Type: holotype is Tuomey 70; now in the Harvey Herbarium, Trinity College, Dublin, Ireland.
Materials examined: 21124, on *Turbinaria ornata*, on reef flat of Epwekapw, Ponape Is., VI–20–60; 21906, 21948, 23607, on *Turbinaria ornata*, on reef at Tafansak Village, Kusaie Is., VII–16–60; 21732, on lagoon side of reef flat at northwestern tip of Mokil Is., VI–29–60; 23226, 23127, on lagoon side (western) of Ifaluk Is., Ifaluk Group, VIII–10–60; 23299, on other coralline algae, on reef at Yap Is., VIII–19–60.

2. *Jania decussato-dichotoma* (Yendo) Yendo 1905:37; Dawson 1953:117, pl. 27, fig. 3; Dawson 1954b:430, fig. 40f; Dawson 1956:49, fig. 44.
Corallina decussato-dichotoma Yendo 1902:25, pl. 3, figs. 1–3, pl. 7, figs. 3–4.

Thalli form coarse clumps to about 3 cm across and about 1 cm tall, or are sometimes epiphytic on larger algae. Branching is dichotomous, decussate, the

cylindrical branches variable, 120–165 μ thick, 4–8 diameters long, much branched towards the upper portion. Angles are wide, about 45–85°. The form of branching and the thickness of the thallus are in agreement with the characteristics of the species although my materials have longer segments than those reported by Dawson (1953) from Pacific Mexico, as well as those from Viet Nam (1954b) and from the Southern Marshall Islands (1956).

Conceptacles not seen.

Type: not designated, from Japan; no specific locality designated (Misaki: Prov. of Boshu; Prov. of Hiuga); present whereabouts not known to the writer.

Materials examined: 21547, on reef flat with sandy to rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 21712, 21560, 21614, 21722, on reef at Pulo Anna Is., IX–3–60; 15873, 21603, on reef at Quoi Is., Truk Group, VIII–2–60; 21364.1, on reef flat of Epwelkapw, Ponape Is., VI–20–60; 15058.1, 21647, on reef at Yap Is., VIII–19–60; 15720, on reef on eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 15895, 15940, 23192, on reef at Quoi Is., Truk Group, VIII–2–60; 15876, on reef at Falas Is., Truk Group, VII–30–60; 23349, on reef at eastern side of Sorol Is., VIII–13–60; 23535, at south end of Helen Reef, VIII–28–60; 23647.1, on reef at Dublon Is., Truk Group, VII–31–60.

3. *Jania ungulata* var. *brevior* (Yendo) Yendo 1905:38; Dawson 1954b:430, fig. 40e; Taylor 1945:198, pl. 53, figs. 2–4.

Corallina ungulata var. *brevior* Yendo 1902:27, pl. 3, fig. 9; pl. 7, fig. 9.

Thalli form small clumps, about 5–8 mm tall, generally dichotomously branched but sometimes trichotomous. The tips of the ultimate segments are frequently broad and ungulate, although these may be short and cylindrical.

Thalli are attached to the host or substratum by a basal disc. Branches are somewhat complanate. Segments, especially on the upper portions, are flattened and variable in length. Our examples are smaller than those reported by Taylor (1945) from the Caribbean but definitely identical with those reported by Dawson (1954b) from Vietnam. All collections are sterile.

Commonly found as epiphytes on larger algae, i.e., *Turbinaria.*

Type: from Boshyu Province, Japan; present whereabouts not known to the writer.

Materials examined: 23154.2, 21500.1, 21415, 21481–1a.1, on *Turbinaria ornata* on reef at Yap Is., VIII–19–60; 21409.1 on *Turbinaria ornata.* Washed ashore at Sorol Is., VIII–13–60; 21326.1 on reef on the eastern side of Mantapeitak Is., Ponape Group, VI–20–60.

4. *Jania tenella* var. *tenella* Dawson 1953:120, pl. 9, fig. 3.

Thalli are small, forming small dense tufts attached to *Turbinaria ornata* by means of small basal discs. Erect branches are dichotomously branched, the segments cylindrical to somewhat slightly compressed near the basal portions. Intergenicula are about 130 μ in diameter, about 3–6 diameters long, becoming smaller and shorter towards the apical portions, and sometimes quite reduced to antenna-like branches although the proportion in the segments remain the same.

Conceptacles are similar to those of *J. tenella* var. *zacae*, both in size and form. The collections were found frequently mixed with var. *zacae*.

Type: holotype is Kützing's original specimen from Naples, Italy, in the Rijksherbarium, Leiden, Holland. Two isotype fragments are on slide 1251 in HAHF.

Materials examined: 23154.3, on reef at Yap Is., VIII–19–60; 15832.1, 15833.1, 21255.1, 15938, 21598.1, on reef at Quoi Is., Truk Group, VIII–1–60; 15955.1 on reef between Moen Is., and Falo Is., Truk, Group, VII–29–60; 15806.1 near north end of airport runway at Moen Is., Truk Group, VII–29–60.

5. *Jania tenella* var. *zacae* Dawson 1953:121, pl. 8, fig. 3; pl. 31, fig. 1.

Thalli are epiphytic on *Turbinaria ornata*, forming small tufts less than 1 cm tall. Erect branches may be simple but are usually 1–2 dichotomously branched, with angles of dichotomies acute. Intergenicula are compressed, about 125–165 μ wide, about 1.5–2.5 diameters long, becoming smaller towards the upper portions but maintaining the same proportions. Segments bearing the dichotomies may be subcuneate, the distal portions of the segments broader than the proximal end. The terminal segments are blunt, very seldom appearing ungulate.

Conceptacles are single, ovoid and anternniferous, or, sometimes the two horn-like branches bear up to 3 conceptacles, though not in regular series. Some conceptacles are strictly terminal, oblong-ovoid and non-antenniferous.

My materials, although less than 1 cm tall, agree well with those described by Dawson (1953) from Mexico.

Type: holotype is Crocker 19, II–2–38; in the Herbarium of the California Academy of Sciences, San Francisco, California. An isotype is on sheet 54868 in HAHF. epiphytic on old *Padina* blade from Bahia, Piedra Blanca, Costa Rica.

Materials examined: 21737.2, 15601.1, on reef on eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 15771.1 collected at Yap Is., VIII–19–60.

Halymenia C. Agardh 1817

Key to species:

1. Frond segments flattened; surface of the thallus not mottled or verrucose ..... *H. durvillaei* var. *ceylanica*
1. Frond segments sub-cylindrical to compressed; surface of the thallus prominently mottled or verrucose ..... *H. floresia*

1. *Halymenia durvillaei* var. *ceylanica* (Kütz.) Weber van Bosse 1921:232, pl. 8, fig. 1; Boergesen 1936:83.
Halymenia ceylanica Kütz., Tab. Phyc., Vol. 16, tab. 93.

Pl. 7, fig. 1

Thalli, up to about 15 cm tall, are attached to the substratum by disc-like holdfasts; frond much branched, without stipe, flattened; basal segment small or broad, variable in shape but mostly cuneate or palmatifid. Branching is alternately pinnate, the main rachis up to 2 cm or more broad, decreasing in width towards the tip. The pinnules are divided the same way as the rachis. The margins of

the frond are serrate. The flat surface of the center frond has short tooth-like projections which are mostly simple, or, in the older portions of the frond, these projections are shortly branched at the tips.

The soft, gelatinous consistency of the pickled materials made sectioning of the frond impossible but smear mounts show long medullary filaments about 8–10 μ thick, 6–10 diameters long. Here and there are large ganglia-like or star-like cells which are connected to the other tissues by means of long, thin filaments. The cortex consists of 6–8 layers of cells, larger and more ovoid-elongate in shape from those of the inner portion, becoming smaller towards the outside. The outer two layers of the cortex are made up of elongated cells, the peripheral layer being composed of clavate cells, about 12–14 μ tall, and about 4 μ thick, 3–4 diameters long.

The materials studied were sterile but seem identical with the specimens described by Weber van Bosse from Ceylon, although the present materials are more robust and larger than those of Weber van Bosse 1921, pl. 8, fig. 1.

Type: from Ceylon; whereabouts not known to the writer.

Materials examined: 21374, on reef north of channel, near Yap Harbor, Yap Is., VIII–18–60; 21875, 23237, on reef at Kusaie Is., VII–15–60; 21495, on reef at Iwayama Bay, Palau Is., VIII–22–60.

2. *Halymenia floresia* (Clem.) C. Agardh 1822:209; Weber van Bosse 1921:231.
Fucus floresius Clemente, Ensajo sobre delas variedades, 1807:312.

Pl. 7, figs. 2–3; 4

Thalli are up to 25 cm tall, their basal attachment organs not seen. The fronds are generally sub-cylindrical to somewhat compressed, but sometimes may develop a broadly, flattened segment at the basal portion in which case these are provided with teeth at the margins. The surface of the thallus is highly and irregularly mottled or verrucose, bearing small and short papillae, which may be simple but are usually shortly branched and scattered all over the surface of the thallus.

Branching is very irregular. The base of the erect frond is narrow and becomes enlarged within a short distance. A single main axis may be conspicuous, giving rise to lateral branches and appearing somewhat pinnately branched; or there may be production of several main axes which may be dichotomous, trichotomous, or, palmatifid; or the main axis at certain portions may become enlarged and produce many secondary branches. The secondary branches may be long and unbranched and simple at the tips but more usually these are either dichotomous or palmatifid, the tips bearing many small proliferations. It is interesting to note that the segments of the secondary branches have fewer lateral proliferations near their basal portions than those at the tips and that the segments are enlarged towards their distal ends.

Smear slides of a portion of the thallus show a medulla of long slender filaments composed of long cylindrical cells about 8–10 μ in diameter, commonly 5–10 diameters long. Star shaped and ganglionic type cells are also present;the ganglionic cells large and sending out branches which are swollen at certain portions

and deeply stained with aniline blue. The medullary filaments are much branched, sending out branches to the cortex.

The cortex consists of about 6–8 layers of cells, the innermost 1/3 being of larger, sub-parenchymatous cells, irregularly shaped with granular content. The outermost 2/3 of the cortex is sub-filamentous, once or twice dichotomously branched; the cells composing this portion of the cortex are ovoid to oblong-elongate, becoming more elongate and narrower in diameter towards the surface. The outermost layer consists of cylindrical to clavate cells about 10–15 μ tall. The cortical filaments are radially arranged.

In cystocarpic specimens the cells of the outermost layer of the cortex taper toward the tips, either ending as a point or with small swollen tips. The cystocarp is ovoid, about 40 μ in diameter, sunken in the cortex, opening towards the outside by means of a single ostiole. The dense gonimoblast is surrounded by a distinct pericarp consisting of branched filaments, irregular in diameter and giving rise to an outer sub-filamentous tissue somewhat densely compacted to form the outer portion of the pericarp.

Type: from the Mediterranean Sea; present whereabouts not known to the writer.
Materials examined: 21697, 15692, 15763, on reef at Kusaie Is., VII–15–60; 15775, on reef north of channel near Yap Harbor, Yap Is., VIII–19–60.

Hypnea Lamouroux 1813

Key to species:

1. Branches wholly cylindrical; tetrasporangial stichidia terminal or forming bands near the bases of the ultimate branchlets..... 2
1. Branches compressed to sub-terete; tetrasporangial sori saddle-shaped .....*H. pannosa*
2. Main axis percurrent; branches bearing long, slender determinate branchlets often at right angles to the axis; tetrasporangial stichidia generally forming a band near the bases of the determinate branchlets.....*H. valentiae*
2. Main axis not percurrent; branches bearing relatively short, spinose determinate branchlets; tetrasporangial stichidia sub-terminal to terminal..... .....*H. esperi*

1. *Hypnea esperi* Bory 1829:157; Dawson 1954b:436, fig. 46h–j; Tanaka 1941: 243, fig. 15a–d; Yamada 1944:39.

Pl. 7, fig. 9

Thalli form soft, dense clumps, about 2 cm tall, attached to the substratum and to each other by many small hapters. Branching is irregular, alternate but sometimes uniseriate in the lower prostrate main axes. Branches are cylindrical, about 0.2–0.5 mm in diameter with short, spinous, determinate, lateral branches.

In cross section, the axial cell is distinct, surrounded by pericentral cells and a layer or more of cortical cells. The epidermis is made up of a single layer of somewhat oval cells which are arranged radially. Lenticular thickenings were seen.

The specimens are tetrasporic, with zonate tetrasporangia forming terminal stichidia commonly at the tips or just below the tips of the determinate branches.

My examples resemble those described by Tanaka (1941) from Japan and those reported by Dawson (1954b) from Vietnam. Materials included under this species are the most delicate of the 3 species reported.

Dawson (1961:240) stated that *H. esperi* most probably is a "juvenile" form of *H. valentiae*. My materials however are tetrasporic and the stichidia are borne at the tips of the simple, determinate branchlets rather than at the "middle or more usually at the lower portion of the short fructiferous branchlets" as in *H. valentiae*. I am therefore retaining this name for the present materials. Moreover, the ultimate branchlets of my specimens are shortly spinous and not long and slender as in *H. valentiae*, as well as being densely intricate, and having finer main axes.

Type: type locality uncertain; present whereabouts not known to the writer.
Materials examined: 23289, on *Halimeda*, 23342, 23039, 23164, on reef at western side of Sorol Is., VIII–13–60; 15302 on reef flat at Fefan Is., Truk Group, VII–28–60; 15648, on reef in Koror Is., Palau Group, IX–5–60; 15964.1, on reef at Tafansak Village, Kusaie Is., VII–16–60; 15110, 21181, 21688, 15978, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 23133, on reef at western side, lagoon side of Puluwat Is., VIII–7–60; 23242.1, 21923.2, on reef at Kusaie Is., VII–15–60.

2. *Hypnea pannosa* J. Agardh 1847:14; Taylor 1945:227, pl. 71, fig. 2; Setchell and Gardner 1924:758.
Hypnea nidulans Setchell 1924:161; Dawson 1944:291; Dawson 1959:25; Dawson 1954b:438, fig. 46e–g.

Thalli form a low intricate caespitose mass to about 4 cm tall attached to the substratum by disc-like hapters. The main axes are compressed to sub-terete, about 0.5–1.0 mm thick. Branching is irregularly alternate, sometimes somewhat pinnate, branches disposed closely, usually wide angled, the branches provided with few to many short, stout, spinous, ultimate branchlets.

Fertile collections are tetrasporic, with saddle-shaped stichidia.

The specimens included under this species are so variable in size and degree of development that at first I felt that the well developed plants should be placed under the name *H. nidulans*. However, upon examining more examples I find it impossible to delimit those that I called *H. nidulans* from *H. pannosa* because of their overlapping vegetative characteristics. I agree with Dawson (1961) that, at least as far as the materials from the Caroline Islands are concerned, *H. nidulans* is conspecific with *H. pannosa*.

It forms intricate clumps on rocks or dead corals or gorws mixed with other algae.

Type: a collection by Liebman from San Agustin Oaxaca (?), Pacific Mexico; now in Agardh Herbarium, Lund, Sweden. Isotype fragment is in Herbarium University of California according to Dawson (1961).
Materials examined: 21431, 21483, 21888, on reef at Yap Is., VIII–19–60; 21271,

21105, 21541, 21149, 21191, 21535, 21248, 21008, 23546, 21205, 21233, 21141, 23559, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 21551, on reef at eastern side of Mantapeitak Is., Truk Group, VI–20–60; 21021, on reef at Falas Is., Truk Group, VII–30–60; 23384, on reef between Falo Is. and Moen Is., Truk Group, VII–29–60; 15686, on reef with a sandy, muddly bottom with rocks, Koror Is., Palau Group, IX–3–60; 23872, on reef near mouth of east channel, Malakal Is., Palau Group, VII–9–64. This particular material was collected by Vicente Alvarez during the Pioneer Cruise 110–E. Although this specimen seems to resemble *H. yamadai* in cross section, its specific identity can not be ascertained due to the lack of fertile material. This is temporarily placed with *H. pannosa* to which it resembles in habit.

3. *Hypnea valentiae* (Turner) Montagne 1840:161; Boergesen 1934:17; Dawson 1961:238, pl. 37.

Thalli are variable in size, forming loose tufts about 5–15 cm tall, either growing on larger algae or eel grass leaves.

Branching in the main axes is lax, alternate; the main axes and minor branches are cylindrical, covered with long slender determinate branchlets which may be simple or branched, and disposed in all directions. The determinate branches at the basal portion of the main axes are usually modified at their tips as small disc-like attachment hapters.

The materials are tetrasporic, with stichidia borne on the determinate branchlets, generally forming a band, a short distance from or more often near the base of the ultimate branchlets, or sometimes below the tips, forming a cap at the tips in very short branchlets.

Since the variation in the form of stichidial branches and the range in the size of the materials is quite broad, it is sometimes very difficult to distinguish these collections from those I call *H. esperi*, except for the generally distinct main axis, lax habit, and the long slender determinate branchlets.

Cystocarpic materials were seen.

Type: a collection by V. Valentia from the Red Sea; presumably in the Royal Herbarium at Kew, England according to Dawson (1961).

Materials examined: 21987, 21638, 15815, on reef at north end of Yap Is., VIII–19–60; 21764, on reef flat at Epwelkapw, Ponape Is., VI–16–60; 21971, 21787, 21812, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21850, on reef near boat pier, Ponape Is., VII–20–60; 21962, on reef flat facing Mantapeitak Is., VI–20–60; 15689, on reef with sandy, muddy bottom with rocks, Koror Is., Palau Group, IX–3–60; 15767, on reef at Tafansak Village, Kusaie Is., VII–16–60; 23354, on reef at western side, lagoon side, Paluwat Is., Puluwat Is., VIII–4–60.

Ceratodictyon Zanardini 1878

Ceratodictyon spongiosum Zanardini 1878:36; No. 8; Okamura 1909, Icones 2, pls. 51–52; Dawson 1954b:438, fig. 48c; Okamura 1916:10.

Pl. 6, fig. 7

Thalli live symbiotically with sponges, forming terete, anastomosing and bran ched fronds, and assuming a sponge-like appearance. On close examination the sponge-like fronds are seen to consist of a very closely and intricately branched anastomous thallus of the alga.

The symbiotic association occurs on rocks and corals.

Type: from Papua; present whereabouts not known to the writer.

Materials examined: 21756, on reef at Urak Is., Mokil Group, VI–29–60; 23269, 23275, on reef at Dublon Is., Truk Is., VII–31–60; 21640, on reef at north end of Yap Is., VIII–19–60; 21770, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 23400, 23297, on reef at western side of Quoi Is., Truk Is., VIII–2–60; 21667, on reef near boat pier at Ponape Is., VII–20–60; 23200, on reef at Fefan Is., Truk Is., VII–28–60; 23525, 23531, on reef at south end of Helen Reef, VIII–28–60; 21584, on reef at Utwa Village, Kusaie Is., VII–17–60.

Gracilaria Greville 1830

Key to species:

1. Thalli prostrate; branches distinctly flattened.....*G. eucheumoides*
1. Thalli erect or decumbent; branches cylindrical to somewhat compressed.... 2
2. Segments cylindrical, constricted or articulated 3
2. Segments cylindrical or portions compressed, not constricted or articulated 4
3. Segments markedly constricted at dichotomies; interdichotomal constrictions present.....*G. crassa*
3. Segments deeply articulated at dichotomies or trichotomies, interdichotomal constrictions absent, segments distinctly clavate.....*G. salicornia*
4. Thalli irregularly branched, alternate to somewhat distichous, somewhat compressed at point of branching.....*Gracilaria* sp. 4
4. Thalli dichotomously to sometimes trichotomously branched; segments cylindrical throughout .....*Gracilaria* sp. 5

1. *Gracilaria crassa* Harvey ex J. Agardh 1876:417; Boergesen 1936:86, fig. 8; Boergesen 1952:33; Ohmi 1958:25, pl. 5, figs. d–e; text-fig. 11; Dawson 1954b: 438, fig. 48b.

   Corallopsis opuntia J. Agardh 1876:409; Okamura 1933; Icones 7:13, pl. 308, figs. 6–11.

Thalli form prostrate caespitose clumps on rocks and dead coral, attached to the substratum by disc-like hapters. The thalli are decumbent, cartilaginous and turgid. Branching is dichotomous to sometimes trichotomous, somewhat divaricate, and in close clumps becoming slightly decussate. Secondary hapters may be formed near the basal portion of the thallus which attach the branches to each other. Adventitious branches may obscure the type of branching.

The branches, especially the upper portions, are constricted at the dicho-

tomies, articulated, 1–4 diameters long; the segments variable, about 3.5 mm thick, ovate, oblong, cuneate, or obpyriform. The basal portions of the thalli are less conspicuously constricted than those at the upper portion.

In cross section the medulla is made up of large, thin walled cells up to 500 μ at their widest diameter, gradually becoming smaller toward the outer portion. The cortex is made up of 2 layers of small cells, the outer layer elongate, about 6–8 μ long, 4–5 μ wide; some are rather quadrate, produced by periclinal division of the cortical cells. The gland cells are ovoid to elongate as seen in surface view, scattered all over the thallus, about 25 μ at their widest diameter; in cross section, they are elongate to obpyriform, about 24–26 μ tall, 9–12 μ thick.

In fertile portions of the thallus the cells of the cortex become very much elongated and the cortical region appears thicker, to about 100 μ thick, or about six times thicker than the sterile cortex. Tetrasporangia are cruciate, large, about 30–50 μ tall, ovoid to oblong-ovate in shape. They are embedded among the elongated cortical cells. The gland cells in the fertile thalli also become enlarged but can be distinguished from the tetrasporangia by their larger size and yellowish color even in stained specimens.

In habit as well as anatomy, my specimens beautifully conform to the descriptions and figures of *G. crassa* as described by the above authors. The variation in the habit of the plants examined is well within the range of those noted by Boergesen among the materials from Ceylon.

Our collections were growing on rocks and dead coral fragments.

Type: holotype Harvey No. 29, from Ceylon, now in the herbarium in the Botanical Museum in Copenhagen.

Materials examined: 21959, on reef flat of Epwelkapw, Ponape Is., VI–16–60; 21394, on reef at Nanmatol Is., Ponape Group, VII–23–60; 21650, on reef around Utwa Village, Kusaie Is., VII–17–60; 15024, on reef flat on the eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21398, on reef at Nanmatol Is., Ponape Group, VII–23–60; 21817, 21769, 21367, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 23183, on reef at Kusaie Is., VII–15–60.

2. *Gracilaria eucheumoides* Harvey 1859:331; Dawson 1954b:438, fig. 48e; Weber van Bosse 1928:433.

Pl. 6, fig. 8

The specimens were growing on rocks and coral fragments, irregularly branched, creeping on the substratum and the branches also attached to the substratum by means of hapters.

The thalli are flattened, irregular in width, up to 1 cm at their bradest portion. The margins of the thalli are dentate, or with short spines.

Specimens examined are sterile but are identical with those cited by the above authors.

Type: from Ousima, Ryukyu Islands; present whereabouts not known to the writer.

Materials examined: 21179, 21262, 21689, 23544, on reef flat at Iwayama Bay, Palau Is., VIII–22–60.

3. *Gracilaria salicornia* (C. Agardh) Dawson 1954a:4, fig. 3; Ohmi 1958:27, pl. 5, fig. F; pl. 6, fig. A, text-fig. 12.
Corallopsis salicornia (C. Ag.) Grev. Alg. Brit. S. LIII. *Sphaerococcus salicornia* (C. Ag.) Icon. Alg. ined. 1820, Taf. 8, Sp. Alg., p. 302.

Thalli form caespitose clumps up to about 6 cm tall. Branches are cylindrical, dichotomous, divaricately arranged. The branches are deeply articulated at the dichotomies, forming segments. The segments are cylindrical, about 1.75–2.5 mm thick, about 2–8 diameters long, with swollen distal ends and abruptly tapered proximal ends.

The materials examined are sterile but are definitely identical with those reported from Japan and from the Philippines. See Dawson (1954a), "Notes on tropical Pacific marine algae." Bull. South. Calif. Acad. Sci. 53: 4, for synonymy. The plants were growing on rocks and pieces of dead corals.
Type: *topotype*, Dawson 11546 from Manila Bay, Manila, Philippines, deposited in HAHF.
Materials examined: 15549, 15626, 15682, 15565, 15680, on reef with sandy, muddy bottom with rocks, Koror Is., Palau Group, IX–3–60.

4. *Graciliaria* sp. 4

The material examined is a male thallus with very irregular branching which is somewhat distichous. The diameter of the axis is variable but appears cylindrical to somewhat compressed at portions from which the branches arise. Because of the presence of hapters among the branches, the thallus is presumed to be prostrate, with branches attached to each other by hapters, forming loose clumps. The short ultimate branchlets are spinose, curved and somewhat crowded at the apices of the secondary axes.

The antheridial pockets as seen in cross section form deep, elongate cavities, arranged radially; the anteridia line the wall of the cavity and resemble those of *G. coronopifolia*. The habit and form of branching, however, are different. The branches of the thallus of the present material are much coarser than those of the above mentioned species.
Materials examined: 23670, on reef with sandy muddy to rocky substratum near Utwa Village, Kusaie Is., VII–17–60.

5. *Gracilaria* sp. 5

Pl. 6, fig. 9

Specimens are up to about 8 cm long and are attached to the substratum by well-developed, disc-like hapters. Branches are cylindrical, about 1 mm thick. Branching is generally dichotomous, sometimes trichotomous, branches not constricted at the base although these are slightly narrower than the distal portion of the segments. Terminal branches are irregularly decussate and tapered to an acute point, appearing bifid when the terminal branches are still very short.

In cross section, the medulla is made up of comparatively large parenchymatous cells up to 210 μ at their largest diameter, gradually becoming smaller towards the cortex. The walls of the adjacent cells of the medulla are about 9–10 μ thick. The cortex consists of 1–(2) layers of quadrate, elongate or, globose cells, and arranged radially, about 5–6 μ wide, 6–7 μ tall. Cortical cells, as seen from surface, are irregularly shaped, unequally angular. Gland cells are scattered all over the cortical tissue, ovoid to elongate about 15–18 μ in their widest diameter. Materials examined were sterile and in the absence of any reproductive structure identification even to generic level is tentative.

Materials examined: 21807, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21759.1, on reef flat of Epwelkapw, Ponape Is., VI–16–60; 15666, on reef at Kusaie Is., VII–15–60; 15779, from river outlet on rocks and drift logs at Tafansak Village, Kusaie Is., VII–16–60.

Eucheuma J. Agardh 1847

Eucheuma sp.

Only fragmentary pieces were found among the collections but their internal anatomy is undoubtedly of this genus. The specimens are sterile and specific identification was not possible. However, the habit is reminiscent of *E. cottonii*.

Materials examined: 15236, on coralline, on reef at Ponape Is., VI–20–60.

Rhodymenia Greville 1830

Rhodymenia divaricata Dawson 1941:141, pl. 23, fig. 31.

Pl. 8, fig. 6

Thalli are 2–4 cm tall, forming clumps, non-stipitate, arising directly from a simple or shortly stoloniferous basal holdfast which may give rise to a single or several erect flattened, membranous fronds. Branching is sympodial, dichotomous, slightly divaricate, or this type of branching may become obscured by the production of new proliferations, especially near the base. The segments near the base are mutually connected by hapters.

The segments are irregular in width, narrow at the base, broadest at the distal portion below the dichotomies, up to 3 mm wide. The terminal branch is broadly rounded at the apices.

In cross section, the flattened segments are about 200–350 μ thick, consisting of large, thick-walled medullary cells about 50–60 μ in their widest diameter and gradually becoming smaller towards the cortex. The cortex consists of one layer of small, irregularly placed cells, about 6–9 μ tall.

Of the two collections, Number 21767 seems to be more nearly identical with *R. divaricata*, especially in its habit, although the thickness and anatomy of the flattened branches seem to be identical. The specimens are sterile and are tentatively placed under this species.

Type: holotype is E. Y. Dawson 53, from Guaymas Bay, Sonora, Mexico; now in HAHF, AHF No. 1.

Materials examined: 21968, on outer reef, Ponape Is., facing Mantapeitak Is., VII–20–60; 21767, on reef flat, Epwelkapw, Ponape Is., VII–17–60.

Coelothrix Boergesen 1920

Coelothrix irregularis (Harvey) Boergesen 1915–20:389, figs. 373–374; Dawson 1957: 115, fig. 23b; Taylor 1960:488.

Cordylecladia (?) *irregularis* Harvey 1853:156.

Pl. 6, fig. 6; Pl. 7, fig. 5

Thalli form tufts on corals and stones; they consist of a laxly intricated base giving rise to erect filiform branches which are irregularly branched, alternate to sub-opposite, or sometimes somewhat dichotomous. Branches at the lower portion of the tufts are attached to each other at points by hapters.

Erect branches are about 200–400 μ thick, growing by means of a group of apical cells. In cross section the central portion of the medulla is hollow, surrounded by somewhat loosely arranged cells, about 18–25 μ in diameter, irregular in shape, the innermost layer of cells protrude freely in the cavity. Gland cells were seen attached to the cells lining the cavity. Next to the innermost layer of cells are 2–3 layers of much larger cells, about 25–35 μ in diameter, loosely arranged, the ones immediately below the epidermis smaller. The epidermis is made up of oblong to squarish cells radially arranged, about 22 μ tall, 12–20 μ broad.

Tetrasporangia are tetrahedral, about 30 μ tall, immersed among the epidermal cells. Stichidia are enlarged about 2–3 times the diameter of the strile portion of the branch, larger at the base and tapering towards the apical portion. Tetrasporangia at the basal portion mature ahead of those at the upper portion of the stichidia.

Terminal stichidia seen among the materials were identical with those of Figure 23b of Dawson (1957) for *C. irregularis* from Eniwetok. The anatomy of the present materials is also identical with those reported by Boergesen (1915–20) from Danish West Indies.

When Harvey (1853:156) first described this species as *Cordylecladia irregularis* from Key West, Florida, he expressed doubt as to the taxonomic position of this entity because of the absence of any reproductive structure. Boergesen (1915–20:389) erected the genus *Coelothrix* which received the same species, resulting in the combination, *C. irregularis* (Harvey) Boergesen. Like Harvey's, Boergesen's materials were also sterile. He cited Collins (1901:255) as having found tetraspores though no specific information regarding the type of spores were made. In 1944, Boergesen (p. 14) described a new species, *Coelothrix indica*, from Mauritius. In justifying this species as distinct from *C. irregularis* he discussed anatomical differences between the two species, although clearly of the opinion that these two species are very closely related. Comparing his figures and descriptions for both species, one finds a very strong similarity between the two species. Dawson (1957: 115) is of the opinion that they are probably identical. The present writer agrees with this opinion.

In discussing the type of fruiting in *C. indica* Boergesen (1944:14) said, "It is somewhat strange that in none of the papers it is said directly that the sporangia are cruciately divided, but as the plant was referred to the genus *Cordylecladia* which has cruciately divided sporangia, it is of course justifiable to presume that in *C. irregularis* also the sporangia were cruciately divided." Kylin (1931:31) although describing the tetraspores of the genus *Coelothrix* as being tetrahedral, when asked by Boergesen (1944-17) as to his source of this information, says that he himself has not seen the sporangia, nor can he remember from what source he got his information, and finally says that this information was presumably wrong. Based on this, Boergesen strongly believed, though without actual observation, that the tetraspores of the genus *Coelothrix* are cruciately divided.

The presence of the stichidia with tetrahedral spores in the present materials seems to negate Boergesen's assumptions. It is also interesting to note that Taylor (1960) placed this genus under the family *Champiaceae*, which is characterized by having tetrahedral spores.

Type: Harvey's specimen from Key West, Florida; whereabouts presumably in the Herbarium, Botanical Museum at Copenhagen.

Materials examined: 23439, 21022, 23287.1, on reef at Falas Is., Truk Group, VII–30–60; 21740, on reef on eastern side of Mantapeitak Is., Truk Group, VI–20–60; 15552, 15560, at Koror Is., Palau Group, Caroline Is., IX–5–60; 23155, on reef at Yap Is., VIII–19–60; 21100, on reef at Iwayama Bay, Palau Is., VIII–22–60.

Lomentaria Lyngbye 1819

Lomentaria hakodatensis Yendo 1920:6; Dawson 1954b:308, pl. 75, fig. 2; Dawson 1956:52, fig. 30.

Lomentaria sinensis Howe 1924:139, pl. 1, fig. 1.

Thalli are epiphytic on eel grass and *Gracilaria crassa*, attached to the host plant by basal disc-like hapters, the arched, creeping stolons attached by hapters at several points, and the branches also attaching by modified tips. Branches on the creeping stolons are unisertiate, arising on the upper side, very slightly narrowed at their bases. Branches sometimes become fused to each other at point of contact. Growth resulting from the activity of a group of apical cells, tips of branches blunt.

Branches cylindrical throughout, hollow, about 220–280 μ in diameter. The wall of the hollow branch consists of three layers of cells, irregular in size and mostly ovoid as seen in cross section. The wall of the hollow thallus is about 50 μ thick, the cells showing a slightly radial arrangement. Cells of the surface layer are about 15 μ tall. In surface view the cells are elongate, somewhat longitudinally arranged, about 8–10 μ wide, 2–3 diameters long. Interspersed among these elongated cells are smaller ovoid to very slightly elongate cells, 4–6 μ in diameter.

Materials examined are tetrasporic. Fertile portions of the branches, often below the tips, are swollen up to twice the diameter of the sterile portions. Tetrasporangia are scattered, solitary, or in groups of 3–6, borne inside the tetrasporangial cavities, each of which has its own opening, which is bordered by very small

angular cells. Tetrasporangia are tetrahedral, about 23–26 μ in diameter.

The specimens seem to resemble *L. baileyena* mentioned by Dawson (1944: 309), especially in the habit of the specimen.

Our specimens also differ from *L. sinensis* Howe by the smaller and more elongate cells of the superficial layer as seen from the surface view, otherwise they seem to be identical.

Type:from Japan; present whereabouts of the type not known to the writer.

Materials examined: 15666.1, seen once, on reef at Kusaie Is., VII–15–60.

Chrysymenia J. Agardh 1842

Chrysymenia sp.

Thalli are about 5 cm tall, prostrate, attached to the substrate by several small, solid, cylindrical roots with disc-like attachment structure at the tip.

Thalli are hollow, compressed, very irregularly branched, although appearing basically oppositely branched; branches are spreading, overlapping, mutually attached at certain points and producing a firm clump; where the branches are mutually attached, a septum is present made up of small, parenchymatous cells.

In cross section, the thallus consists of a hollow central portion surrounded by 3–4 layers of large oval to elongate cells, those towards the innermost largest and elongate and periclinally disposed, becoming oval to spherical towards the epidermis. Gland cells, about 8–12 μ thick were found on the large cells bordering the cavity.

The epidermis, in sterile portions of the thallus, is made up of a single layer of elongate cells, about 10–14 μ tall and 3–6 μ thick. In fertile portions of the thallus the epidermal cells become a little longer and thinner, in general about half as tall as the tetrasporangia.

Tetrasporangia are elongate, cruciate, scattered among the epidermal tissue, not forming sori, about 30–35 μ tall and 16–20 μ thick. The wall of the hollow thallus in fertile portions is thicker than in the sterile portion, about 250–300 μ thick.

Only one dried specimen was available for study (No. 21516). When soaked in water, the thallus tends to regain its form and cartilaginous nature.

The material is placed here provisionally under this genus in the absence of proof of its true identity. Further study, when more materials are available in the future, is needed.

Materials examined: 21516, on reef at Kusaie Is., VII–15–60.

Erythrocolon J. Agardh 1896

Erythrocolon podagricum (Harvey) J. Agardh 1896:90; Kylin 1956:33.

Chylocladia podagrica Harvey in Alg. exicc. Friendly Is., No. 53.

Chrysymenia podagrica (J. Agardh) Svedelius 1911:226.

Pl. 8, fig. 5

Forming small clumps about 2 cm tall, the thalli consist of articulated, hollow

vesticles which are constricted at the nodes. The main vesicle is large, oblong to shortly cylindrical, becoming ruptured ultimately. Branching is basically dichotomous but is obscured by the production of minor lateral vesicles. The vesicles are larger at the base, becoming smaller towards the upper portion, somewhat obovoid in shape, but the ultimate vesicles are spherical. The vesicles are connected to each other here and there, forming a compact clump.

In cross section the vesicular wall is about 90–110 μ thick, made up of a single layer of large medullary cells, bordered on both sides with a layer or two of subcortical cells and grading into the cortex. The cortex at the outer surface of the vesicular wall is two cells thick, made up of irregularly placed, small, somewhat spherical cells. The subcortical and the cortical tissue adjacent to the cavity of the vesicle are thinner, not as well developed as that of the outer surface of the wall of the vesicle, consisting of a layer of subcortical cells and one layer of cortical cells. No gland cells were observed on the inner wall of the vesicular cavity.

As seen in surface view the surface cells of the cortex are spherical to slightly angular. The large medullary cells are faintly discernible.

Our specimens are cystocarpic, the cystocarps elevated, opening by means of a single pore. The outer cortical tissue of the cystocarp become thick and well developed, comprising many layers of cells while the inner cortex remain more or less the same although the subcortical tissue becomes well-developed. This resembles Figure 204 of Weber van Bosse (1928:472) for *Chrysymenia podagrica.*

In longitudinal section the vesicles are divided at the joints by a diaphragm which is identical in anatomy to the walls of the vesicle.

In habit, the material is like *Coelarthrum boergesenii* but the anatomy of the wall of the vesicle differs in the presence of a cortical tissue both on the outer and inner surface of the vesicular wall. In this respect it resembles the cross section of the wall of the *Erythrocolon podagricum* but differing in many respects from this species.

The anatomy of the diaphragm is unique. It is identical with the anatomy of the vesicular wall. The gland cells common in these two genera and also in the genus *Chrysymenia* were not observed in this particular material.

The specimen is provisionally placed under this species which it resembles in basic anatomy until its true identity is established.

Type: Harvey Friendly Island Algae No. 53; present whereabouts of the type not certain, presumably in the Agardh Herbarium at Lund.

Materials examined: 21552, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–30–60.

Champia Desvaux 1808

Champia parvula (C. Ag.) Harvey 1853:76; Dawson 1954b:443, fig. 52c; Setchell and Gardner 1930:153.

Chondria parvula C. Agardh 1824:207.

The thalli grow mixed with other smaller algae, forming small clumps about

1 cm tall. Thallus irregularly branched, the branches attached to each other or to the substratum by short, modified branchlets.

The hollow segmented thallus provided with transverse diaphragms, and the group of longitudinal, cylindrical central filaments are very distinctive of this species. *Type*: from Cadiz, Spain; present whereabouts of the type according to Dawson (1954) presumably in Agardh Herbarium.

Materials examined: 15055.1, on reef on eastern side of Mantapeitak Is., Truk Group, VII–30–60; 21078.1, mixed with *Laurencia papillosa*, on southern portion of Helen Reef, VIII–28–60; 21923.1, on reef at Kusaie Is., VII–15–60.

Antithamnion Nägeli 1847

Antithamnion antillanum Boergesen 1915–1920:226, figs. 213–215.
Pl. 11, fig. 4

The minute thalli, growing on small rock, consist of a creeping, cylindrical main axis and erect filaments. The filaments are about 28 μ in diameter, attached to the rock by well-developed haptera, the stalk of which consists of a cylindrical, simple or branched, 3–4 celled filament, about 20 μ thick, the cells up to 5 diameters long, arising a short distance from the distal end of the cells of the prostrate axis at the lower side.

The erect filaments are about 1 mm tall, single or in pairs, the basal cells of which are short and directly opposite the rhizoids on the ventral side of the horizontal filaments. The next cell above is as thick as the stalk of the haptera. Branching in the erect filaments is alternate and distichous, the erect main axes gradually tapering towards the tips. The cells of the main axes are cylindrical, slightly enlarged at the distal ends where the branchlets arise. The basal cells of the branchlets are shorter, almost half the length of the cells above. The gland cells are located at the axial side of the pinnules, abutting with the first and second, sometimes including the third cell of the pinnules.

My materials are sterile, but their vegetative characters fit the descriptions and figures for the type from the West Indies, differing from *C. antillanum* from the Canary Islands only in the smaller diameter of main axes of the erect filaments. *Type*: from the harbour of St. Thomas Is., Danish West Indies; present whereabouts not known to the writer.

Materials examined: 23690.2, near northern portion of airport runway at Moen Is., Truk Group, VII–29–60.

Wrangelia C. Agardh 1828

Wrangelia bicuspidata Boergesen 1915–20:118, figs. 128–130.
Pl. 11, fig. 8

The thalli grow among low clumps of coarser algae, e.g., *Jania* sp., *Hypnea* sp., *Crouania minutissima, Ceramium*, reaching a height of about 2 cm tall, attached to other algae by many unbranched slender rhizoids, which are about 39 μ in diameter, the cells up to 10 diameters long.

The main axes are laxly branched, percurrent, composed of cylindrical cells about 140–190 μ in diameter, about 4–6 diameters long. Whorls of determinate branches arise from the distal end of the cells of the primary filaments. In the lower portion of the main filaments, the determinate branchlets are of two types, the coarser ones and some finer ones. The fine branchlets tend to be closely appressed to the main axes at the nodes. The fine branchlets correspond to the "cortical layer" of Boergesen (1915–20). Both kinds of branches are subdichotomously branched but the coarser ones are commonly tipped with a pair of small, acute conical cells.

Tetrasporangia are about 50–100 μ in diameter, surrounded by whorls of curved, fine filaments, about 6–8 μ thick. The spores are tetrahedral.

Boergesen (1915–20) described *W. bicuspidata* from the Danish West Indies without fertile material. My specimen are almost identical with Boergesens' figures except that they are shorter, and the cells of the main axes are larger in diameter, although only 4–6 diameters long. The specimens figured by Boergesen are taller but slender specimens, the cells of the main axes only 120 μ in diameter and up to 10 diameters long.

My materials are fertile. The fertile branches, the size of the tetrasporangia, and the vegetative morphology are somewhat similar to *W. argus* reported by Dawson (1954b) from Viet Nam but distinctly recognizeable from it by the bicuspidate tips of the lateral branches.

Type: collected as epiphyte on larger algae between St. Jan and St. Thomas Islands, Danish West Indies; present whereabouts not known to the writer.

Materials examined: 15563.4, found only once, growing among smaller algae, Koror Is., Palau Group, IX–15–60.

Spyridia Harvey 1833

Key to species:

1. Ultimate branchlet tipped with a single 2–3-celled spine..... *S. filamentosa*
1. Ultimate branchlet without spine at the tip..... *Spyridia* sp.

1. *Spyridia filamentosa* (Wulf.) Harvey, *In* Hooker 1833:337; Setchell and Gardner 1930:167; Dawson 1949:230; Dawson 1954b:444, fig. 541; Dawson 1962:69, pl. 30, figs. 1–3; Taylor 1950:139; Taylor 1960:359, pl. 66, fig. 15.

The bushy, irregularly branched, thallus grows on rocks or on larger algae. The main axes are fully corticated, the cortications made up of tiers of longer cells alternating with shorter ones. The determinate branches are corticated only at the nodes, and tipped with a single 2–3-celled spine.

The presence of a single 2–3-celled spine at the tips of the determinate branches is distinctive for this species.

Type: from the Adriatic Sea; present whereabouts of the Wulfen type not known to the writer.

Materials examined: 23280.1, on rocks, or epiphytic on other larger algae, on reef at Falas Is., Truk Group, VII–30–60; 15419.1, 15410b, at southeastern region

of Helen Reef, VIII–28–60; 15383, on north side of Helen Is., VIII–28–60; 15563.5, at Koror Is., Palau Group, IX–5–60.

2. *Spyridia* sp.

Pl. 11, fig. 5–6, 9

The thalli are irregularly branched, basically alternate but sometimes opposite; the larger and smaller branches mixed. The main axes are fully corticated; the cortication are made up of a series of alternating tiers of short and longer cells. The shorter cells are about 50 μ long, the longer cells about 75 μ long. The shorter tiers consist of rectangular cells about 26 μ broad, alternating with slender cells, about 13 μ broad; the longer tiers consist of somewhat uniformly elongated slender cells. This is especially striking in the older portions of the main axes. The cells in the shorter tiers in the younger portions of the main axes are uniformly rectangular in shape.

Determinate branches are corticated only at the nodes. One striking characteristic of this species is the absence of the spines at the tips of the determinate branches.

Tetrasporangia are spherical, about 50–60 μ in diameter, sessile on the cortical bands of the determinate branches, single, or, as many as four in a node.

This particular collection differs primarily from *S. filamentosa* in the absence of the spines at the tips of the determinate branches and also the somewhat untapered apical portions of the determinate branches. At least, this is not noticeable without measuring the branches.

Materials examined: 15654.7, from Koror Is., Palau Group, Caroline Islands.

CROUANIA J. Agardh 1842

Crouania minutissima Yamada 1944:40; Dawson 1956:55, fig. 56.

Pl. 9, fig. 1–2

Thalli are minute about 5 mm tall, epiphytic, attached to the host by rhizoids arising from the nodes at the basal portion of the main filaments. Main filaments are cylindrical, uncorticated, abut 50–55 μ at the basal portion, about three diameters long, sparingly and irregularly branched.

The primary, determinate branches are three in each whorl at the distal ends of the axial cells, 2–4 times trichotomous, the tips of the ultimate segments blunt.

My specimens fit the descriptions of *C. minutissima* described by Yamada (1944) from the Atoll of Ant, except for the occurrence of three primary branchlets in each whorl. Dawson (1956) also noted this discrepancy in the plants from the Marshall Islands. My specimens are sterile and more laxly branched than Dawson's Figure 56 for the same species. The fronds are slightly mucilaginous. Found epiphytic on larger algae and eel grass, or mixed with other smaller algae forming tufts.

Type: none designated, from Atoll of Ant, Ponape Is., Caroline Islands; present whereabouts not known to the writer.

Materials examined: 15563.10, 15654, 15689.11, on reef at Koror Is., Palau Group,

IX–3–60; 21518.2, on northern seaward reef flat, Mokil Is., Mokil Group, VI–29–60.

CENTROCERAS Kützing 1842

Key to species:

1. Branches dichotomously branched with furcipate apices..... *C. clavulatum*
1. Branches irregularly branched, alternate with non-furcipate apices.. *C. minutum*

1. *Centroceras clavulatum* (C. Ag.) Montagne, *In* Durieu 1846:140; Setchell and Gardner 1924:779; Dawson 1944:321; Dawson 1949:224, 235; Dawson 1954b: 446, fig. 54h; Dawson 1962:68, pl. 26, fig. 7; pl. 27, fig. 3; Taylor 1950:139; Taylor 1960:537; Boergesen 1915–20:241.

Mostly fragmentary and sterile specimens were found mixed with other members of the order Ceramiales. The filaments are attached to the substratum or to the host by a few 2–3-celled rhizoids arising at the nodes. Branching is generally dichotomous, tips of branches are furcipate. Cortical cells are generally quadrate; nodes short, not more than twice as long as broad. The spines are two-celled, sharply pointed, verticillately arranged at the nodes. Growing on rocks or epiphytic on larger algae. Usual component of low, soft tufts of algae on rocks.

Type: a Humbolt and Bonpland specimen from Callao, Peru; now in the Agardh Herbarium at Lund, Sweden.

Materials examined: 15093.1, on the eastern seaward reef flat, Urak Is., Mokil Group, VII–29–60; 15563.8, 15563.9, at Koror Is., Palau Group, IX–5–60; 21718.10, on reef at Pulo Anna Is., IX–3–60.

2. *Centroceras minutum* Yamada 1944:42; Dawson 1956:54, fig. 54.
Pl. 9, fig. 4, 5

Thalli are minute growing among other smaller algae. Branching is irregular; semi-erect branches are mostly on the upper side of the creeping filaments. Tips of branches non-furcipate. Internodes about 85–100 μ thick.

Cortical cells rectangularly arranged in rows along the longitudinal axis, but no transversely. Nodes with whorls of eight two-celled spines; internodes more than twice as long as broad.

This minute, creeping species is distinguished from *C. clavulatum* by its creeping habit, non-dichotomous branching, and non-furcipate tips of the branches.

Type: none designated by Yamada, from the Atoll of Ant, Ponape Is., Caroline Islands; present whereabouts not known to the writer.

Materials examined: 15093, in eastern seaward reef flat in Urak Is., Mokil Group, VII–29–60; 21710.10, on reef flat at Epwelkapw, Ponape Is., VI–20–60.

CERAMIUM Roth 1797

Key to species:

1. Filaments wholly corticated..... *C. huysmansii*
1. Filaments not wholly corticated, cortications limited at the nodes, or at least a portion of the axial filaments bare 2

2. Nodal cortications clearly divided at the lower third by a clear line..... 3
2. Nodal cortications not clearly divided at the lower third by a clear line.... 4
3. Nodes of filaments bearing generally one short, unicellular, apically rounded hair at their abaxial side, or sometimes whorled.....*C. fimbriatum*
3. Nodes not bearing short, unicellular, apically rounded hairs; the lower 1/3 of the nodal cortication consistently composed of 1 to 2 tiers of horizontally elongated cells .....*C. gracillimum* v. *byssoideum*
4. Nodal cortication very short, 1/3 or less tall than broad..... 5
4. Nodal cortication not as above, at least 1/2 as tall as broad..... 6
5. Filament fine not more than 30 μ at their greatest diameter; tetrasporangia prominently projecting, naked, secund, solitary on the adaxial side..... ..... *C. affine* v. *affine*
5. Filament coarse more than 50 μ in diameter; tetrasporangia projecting at the abaxial side, conspicuously involucrate.....*C. mazatlanense*
6. Cortical bands closely placed to each other especially near the upper portions of the filament, the bare internodal portions of the filaments short, or at most, as tall as the cortical bands; tetrasporangia verticillately arranged, immersed on the swollen involucre; tips of filaments non-furcipate ....*C. vagabunde*
6. Cortical bands not closely placed to each other, the bare internodal portion of the axial filament at the lower portion always taller than the cortical bands; branching dichotomous with furcipate apices.....*Ceramium* sp.

1. *Ceramium mazatlanense* Dawson 1950:130, figs. 14–15; Dawson 1954b:448, fig. 55g–j; Dawson 1962:59, pl. 23, figs. 1–2.

Pl. 10, figs. 3, 8

Thalli are minute, epiphytic, composed of prostrate and erect filament, attached to the host by 1–(3) celled unbranched rhizoids with modified tips located at the nodes at the ventral side of the prostrate portion of the filaments and directly opposite the erect branches. Erect filaments are simple, or dichotomously branched, slightly curved at the shortly attenuated, furcipate apices. The filaments are about 70–75 μ in diameter at the nodal cortications.

The central cells are cylindrical, about 2–3 diameters long, and becoming short and oval towards the tips. The cortical bands narrow, about 2–2.5 times broader than tall, made up of large, angular to oval cells about 20 μ long, at the lower portion, which are vertically disposed. The large cells cut off very much smaller, angular cells mostly at their upper portions.

Tetrasporangia are about 40 μ in diameter, one or two at each node, and projecting at the abaxial side of the fertile branches, and half surrounded by a cortical involuvre. Spores tetrahedral. Sexual specimens not seen.

The specimens resemble the descriptions and figures for *C. mazatlanense* reported by Dawson (1962) from Mexico as to the form of the tetrasporangia, although differing from it by the smaller diameter of the filaments, by the absence of the fine hairs at the cortical bands, in the shape of the central cells which are

cylindrical at least below, and the commonly simple, erect branches. Found epiphytic on *Hypnea.*

Type: E. Y. Dawson 3606, December 8, 1946, in HAHF (48798) found epiphytic on *Codium* at Mazatlan, Sinoloa, Mexico.

Materials examined: 21094.7, on reef at Iwayama Bay, Palau Is., VIII–22–60; 15093.1, on the eastern seaward reef flat at Urak Is., Mokil Group, VII–29–60.

2. *Ceramium vagabunde* Dawson 1957:121, fig. 27e; Dawson 1962:66, pl. 27, fig. 5
Pl. 10, figs. 1–2

Thalli consist of creeping and sparsely branched erect filaments. Attached to the substratum by rhizoids arising at the nodes on the ventral side of the prostrate filaments, opposite that of the erect branches.

Filaments are irregularly and sparsely branched; erect branches with blunt and non-furcipate tips. The cortications at the nodes are about 1.5 times broader than tall. The fertile portions of the erect filaments are much broader than the sterile portions, up to 260 μ in diameter. The cortical bands are closely placed to each other, especially at the fertile potions of the filaments giving it an almost completely corticated appearance.

Collections examined were tetrasporic. The tetrasporangia ovate, about 50 μ long; tetraspores cruciate and arranged verticillately around the nodal bands.

The specimens fit very nicely the descriptions and figures of Dawson (1957) for this species, except for the slightly larger tetrasporangia. Growing among *Jania* sp. and other coarser algae.

Type: E. Y. Dawson 13620a, August 19, 1955, in Herb. Bernice P. Bishop Museum, Honolulu, Hawaii; found growing within tufts of *Ectocarpus breviarticulatus* near the margin of the seaward reef opposite EMBL Parry Is., Eniwetok.

Materials examined: 23343, 23045.1, on reef at western side of Sorol Is., VIII–13–60; 21315a, on *Chaetomorpha,* on western seaward reef flat of Pingelap Is., VII–1–60.

3. *Ceramium huysmansii* Weber van Bosse 1923:322, fig. 115 a, b; Dawson 1954b: 446, fig. 55d; Dawson 1956:54.
Ceramiella huysmansii (W. v. B.) Boergesen 1953:47, figs. 18–19.
Pl. 9, fig. 3

Specimens were found mixed with *C. fimbriatum, Crouania minutissima, Centroceras clavulatum,* and *Spyridia filamentosa.*

Thalli are laxly branched, attached to the substratum by long multicellular rhizoids arising from the nodes. The characteristic cortications consisting of rectangular cells forming vertical rows completely covering the entire filament, and the simple tips, fit very well Weber van Bosse's descriptions of this species. The specimens were, however, sterile.

My specimens differ from the descriptions and figures of *Ceramiella huysmansii* (W. v. B.) Boergesen (1953) by the smaller size of the central filaments, about 28 μ thick and about 105 μ long in the basal portion of the thallus. Also, the cortical

cells of my specimens are about 15 μ wide and 5 μ high.

Like Dawson (1954) I am of the opinion that this species be retained under the genus *Ceramium.*

Type: epiphytic on *Liagora fragilis, Jania,* and *Sargassum* collected from Station 215 Ile Kabia, Station 225 at Luciparas Island, and Station 261 at Grand Kei Island, Indonesia; present whereabouts not known to the writer.

Materials examined: 15563.6, mixed with other algae, at Koror Is., Palau Group, IX–5–60.

4. *Ceramium fimbriatum* Setchell and Gardner 1924:777, pl. 26, figs. 43–44; Setchell and Gardner 1937:88, pl. 7, fig. 18; Dawson 1954b:446, fig. 55a; Dawson 1953:56, pl. 19, fig. 3; pl. 20, figs. 6–7; Dawson 1950:123.

Pl. 10, fig. 9

Thalli were found mixed with *C. gracillimum* var. *byssoideum*, epiphytic on larger algae. Sterile filaments are about 60–75 μ in diameter at the nodal corticications.

The corticications which are restricted at the nodes, their division at the lower 1/3 by a distinct line into two distinct portions, and the presence of short, stout whorls of hairs at the nodes, are distinct characteristics of this species.

My specimens differ somewhat from the descriptions and figures of *C. fimbriatum* reported by Dawson (1962) from Baja California, Mexico, in that the cortical bands are about 3/4, instead of 1/2 as long as broad.

Type: Marchant 87a, from Eureka, near La Paz, Baja California, Mexico; now in Herbarium University of California, Berkeley.

Materials examined: 15545.2, on *Halimeda,* 15645.3, on *Padina,* 15689.3, on *Hypnea,* 15568.1, on *Halimeda*, on reef with sandy-muddy bottom with rocks, Koror Is., Palau Group, IX–3–60; 21718.1, on *Jania*, on reef at Pulo Anna Is., IX–3–60.

5. *Ceramium gracillimum* var. *byssoideum* (Harv.) Mazoyer 1938:323; Dawson 1962:57, pl. 20, figs. 2–3; pl. 21, figs. 2–3; Dawson 1954b:448, fig. 55 e, f; Dawson 1956:53.

Ceramium byssoideum Harvey, *In* Taylor 1960:528, pl. 67, figs. 1–3; *Ceramium byssoideum* Harvey 1853:218; *Ceramium masonii* Dawson 1950:126, pl. 2, figs. 11–12; *Ceramium transversale* Collins and Hervey 1917:145, pl. 5, figs. 29–31.

Pl. 9, fig. 6–7, 9; Pl. 10, figs. 6–7

Thalli are epiphytic on other algae, attached to the host by rhizoids arising from the nodes at the basal portion of the filament. The branching is distinctly althernate; filaments are coarser at basal portions, 60–75 μ in diameter, 45–55 μ at the upper portion. The cortication is limited at the nodes. The cortical bands divided at their lower third by a clear line, consisting at the upper 2/3 portion of large angular cells cutting off smaller superficial cells; the lower third consists of 1–2 tiers of horizontally elongated cells.

My specimens are identical to the descriptions and figures of this species given by the above authors.

Type: a collection by W. H. Harvey from Key West, Florida; epiphytic on "gorgoniae" and according to Dawson (1962) the specimens are probably in the Harvey Herbarium, Dublin, Ireland.

Materials examined: 15689.8, on *Hypnea* sp., 15563.3, on *Laurencia* sp., 15689.10, on *Acanthophora spicifera*, 15658.3, on *Acanthophora spicifera*, 15568.2, on *Halimeda* sp., 15545.1, on *Halimeda* sp., 15586.8, on *Padina* sp., 15548.2, on *Padina* sp., 15654.2, on *Hypnea* sp., at Koror Is., Palau Group, IX–5–60; 15416.1, on *Laurencia* sp., at southeastern region of Helen Reef, VIII–28–60; 21817.1, on *Gracilaria* sp., on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21877.1, on *Padina* sp., on reef on eastern lagoon side, at Falas Is., Truk Group, VII–30–60.

6. *Ceramium affine* var. *affine* Setchell and Gardner 1930:172; Dawson 1962:50, pl. 17, fig. 6; Dawson 1944:317, pl. 51, fig. 4; Dawson 1950:132.

Pl. 10, figs. 4–5

Thalli are minute, about 1–2 mm tall, epiphytic on *Halimeda macroloba*, composed of erect and prostrate filaments. The prostrate filaments are about 26 μ in diameter, dichotomously branched, and attached to the host by well-developed hapters. The stalks of the hapters are generally short and one-celled, up to 60 μ in length, arising from the nodes opposite a single or a pair of erect branches.

The basal cells of the erect filaments are very short, about 20 μ long, always less than half the length of the next cell about it. The erect filaments are about 26 μ in diameter, generally simple or dichotomously branched producing small branchlets here and there. The erect filaments are not noticeably tapered except in the last 2–3 nodes. Cortical bands of both the prostrate and erect filaments are strikingly simple and narrow, about 7 μ tall, composed only of one or two rows of somewhat rounded to angular cells. The simplicity of the cortical bands is more pronounced in the prostrate filaments and at the basal portion of the erect filaments, while those near the apices of the erect filaments are a little broader. Slender hairs are present at the abaxial side of the erect branches near the furcipate apices.

The axial cells are about 4 diameters long, a little more in the upper portions of the erect filaments.

Tetrasporangia are about 36–46 μ in diameter, spherical, naked, solitary or sometimes two in each node, secund on the adaxial side of the branch. The tetraspores are tetrahedral.

My specimens are very much smaller in size and in the thickness of the main filaments compared to the description and figures of *C. affine* var. *affine* described by Setchell and Gardner (1930) from Guadalupe Is., Revilla Gigedo Islands. It has a close resemblance in the simplicity of the nodal cortications to figure 6 for this species reported by Dawson (1962) from Puerto Refugio, Isla Angel dela Guarda. The cortical bands of my specimens, however, are very narrow and simple, consisting only of one row of 2–4 cells in the prostrate filaments, as well as those found at the basal portion of the erect filaments, and up to eight angular cells near the apical portion of the erect filaments, which may cut off one row of very much smaller cortical cell towards their upper portions. Another very distinct charac-

teristic of my specimens is the well-developed hapter and the presence of hairs near the furcipate apices. Those reported by Dawson (1962) are attached by means of rhizoids and are without hairs. The tetrasporangia appear, however, to be similar to those of the *C. affine* var. *affine.*

Type: H. L. Mason 36, epiphytic on *Codium* from Isla Guadalupe, Baja California; now in Herbarium California Academy of Sciences (173642); isotype slide in HAHF.

Materials examined: only seen once, 15545.3, on *Halimea* sp., on reef at Koror Is., Palau Group, IX–5–60.

7. *Ceramium* sp.

Pl. 7, fig. 6; Pl. 9, fig. 8

Thalli are epiphytic on larger algae, mixed with *C. gracillimum* var. *byssoideum.* The filaments are attached by rhizoids arising from the nodes of the basal prostrate portion of the filaments. Branching is dichotomous, the diameter of the middle portions of the erect filaments is somewhat larger than the basal and terminal portions, to about 95–115 μ in diameter at the cortical bands. The branches are tapered towards the furcipate apices.

Cortical bands are about 50 μ tall, about twice as broad as tall, consisting of large rounded to slightly angular cells which are about 25–30 μ in diameter cutting off smaller angular surface cells which are irregularly disposed in the middle portion of the cortical band; those found at the lower and upper margins of the cortical bands forming a horizontal row of rectangular cells which are vertically disposed. The lower 2/5 of the cortical band in the older portions of the filaments become slightly separated from the upper 3/5 by an indistinct, irregular, transparent line. The lower portion of the cortical band is made up of one or two rows of squarish to rectangular cells about 15–16 μ tall, 13–14 μ broad, and are vertically disposed, and may cut off smaller triangular cells in one or both of their lower or upper corners.

My specimens are sterile, but they have some similarity to figures 4–6 of Dawson (1962) for *C. zacae.* The regularity and precise arrangement of the cells of the nodal cortication is very distinctive of this species.

Materials examined: 15563.2, epiphytic on larger algae, mixed with *C. gracillimum* var. *byssoideum*, on reef at Koror Is., Palau Group, IX–5–60.

Tolypiocladia Schmitz 1897

Tolypiocladia glomerulata (C. Ag.) Schmitz and Hauptfleisch 1896–1897:441; Falkenberg 1901:177, pl. 21, figs. 27–29; Dawson 1954b:452, fig. 59b c; Okamura 1904:90.

Hutchinsia glomerulata C. Agardh 1824:158.

Pl. 5, fig. 1; Pl. 7, fig. 7 Pl. 11, fig. 7

Specimen no. 15362 is tetrasporic, about 6 cm tall; the main axes are laxly branched, alternate; attached to the substratum by numerous unicellular rhizoids,

the tips of which are modified into flattened, somewhat regularly lobed attachment organs.

The main axes provided with four pericentral cells throughout. The short, determinate, and branched laterals are arranged spirally around the main axes. These bear several short and pointed ultimate branchlets.

Long multicellular hairs are present at the tips of the short determinate branches; the hairs are about 10 μ thick.

The tetrasporangia are borne on the short determinate branches with tetrahedral spores.

My specimens differ from the figures and descriptions of this species reported by Dawson (1954b) from Nha Trang, Viet Nam by the production of a row of 4–5 central cells at the tips of the pointed ultimate branchlets before the four pericentral cells are produced. The specimens from Nha Trang, as seen in Dawson's figure 59a, have short and stubby ultimate branchlets made up of 2–3 cells before the four pericentral cells are produced. Found growing on coral rocks, shells, or epiphytic on larger algae and eel grasses.

Type: from Baie de Chien Marin, Australia; present whereabouts not known to the writer.

Materials examined: 15362, 15410, 15449.1, 15443, 15417, on southeast portion of Helen Reef, VIII–28–60; 23263.1, 23659, 23664.1, 21025, 23279.1, on reef at Falas Is., Truk Group, VII–30–60; 23244.1, 23620, 23628, on reef near Utwa Village, Kusaie Is., VII–17–60; 23215.1, 23271, on reef at Dublon Is., Truk Group, VII–31–60; 23243, on reef at Kusaie Is., VII–15–60; 21243, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 15383.1, on north side of Helen Is., VIII–28–60.

Bostrychia Montagne 1842

Bostrychia binderi Harvey 1847:68, pl. 28; Tseng 1943:177, pl. 1, figs. 7–8. Pl. 8, figs. 7–9

Thalli are small, growing to about 1 cm long, forming thin mat mixed with *Lyngbya* sp.

Thalli prostrate, overlapping with each other, attached to the substrate by multicellular, branched rhizoids. Here and there "peripherohapter" (Tseng: 1943) are found at the lower side of the prostrate main axis usually at the point of branching. The tips of the terminate branchlets may be modified into attachment organs.

Branching is generally three-alternately-decompound, very distinctly distichous. Both the secondary and dterminate branches become short towards the tip of the axes. Main axes about 180–210 μ thick, growing by means of an apical cell.

Determinate branchlets are tapered towards the apices, straight to slightly curved towards the distal end, their tip cells blunt. The basal portions of the determinate branchlets are with or without pericentral cells. In cross section the main axis is composed of a central filament and surrounded by large pericentral cells; both are thick-walled. The cortical tissue consist of 1–2 layers of irregularly placed

pigmented cells.

The cells of the central siphon of the main axis are about 125–130 μ long, twice as long as the elongated pericentral cells.

The cortical cells as seen from surface view are irregularly arranged without any definite arrangement, and are generally elongate and slightly angular, placed longitudinally, transversely, or diagonally in reference to the main axes. The simple determinate branchlets consist of quadrate cells about 15 μ long.

This alga is characterized by a very distinct arrangement of both the secondary and determinate branchlets which is alternate and distichous. The determinate branchlets are uniformly placed at about 75–80° in reference to the main axis.

My specimens seem to be distinct from the other previously described species of *Bostrychia*. These are, however, nearest to *B. tenella* (Vahl) J. Ag. and *B. binderi* Harvey, but differ from *B. tenella* by the unbranched nature of the determinate branchlets and shape of the cells composing them and the anatomy of the main axes; and from *B. binderi* by having simple monosiphonous determinate branchlets which if provided with pericentral cells only at the basal portions, usually the first 2–3 cells or, at most, only the basal half of the determinate branchlets.

The absence of the reproductive structure is unfortunate, but this seems distinct from either species mentioned above. The present material is nearest to *B. binderi* Harvey and is provisionally placed under this species. The specimens were found growing on lower surface of overhanging rock above tide level, forming thin but dense layer with blue-green algae.

Type: from Port Natal; present whereabouts of the type not known to the writer.
Materials examined: 21596, above tide line under the overhanging rock at Palau Is., near Koror Is., IX–6–60.

Vanvoorstia Harvey 1854

Vanvoorstia spectabilis Harvey 1854:191, fig. 141; Papenfuss 1937:31, figs. 28–41; Weber van Bosse 1923:390, fig. 141; Segawa 1936:196.

Only two fragmentary, dried, sterile collections were available for study, but are undoubtedly of this species. Number MD 21012 is quite a robust specimen and judging from the size of the incomplete blade, the thallus is about 5 cm tall. The specimen lacks the basal portion.

Specimen number 21143 is quite small, about 2 cm tall.

Both materials are sterile, but the net-like flattened blades are distinctive.

Type: Harvey's specimen from Ceylon; presumably at Harvey Herbarium at Dublin, Ireland.
Materials examined: 21012, on *Halimeda opuntia*, 21143, on rocks on reef flat with sandy-rocky bottom at Iwayama Bay, Palau Is., VIII–22–60.

Polysiphonia Greville 1824

For this genus the specific epithets and the information regarding their publication and their types have been taken, with the permission of Dr. G. J. Hollenberg,

from his two papers (1968 a, b). They are included here so that this paper can serve as a more complete floristic manual for the Caroline Islands. It is to be noted that I take no credit for having distinguished or described the taxa themselves.

Of the 31 species described and figure in Dr. G. J. Hollenberg's papers 12 are reported from the Caroline Islands. Of them the following are new species, varieties, or combinations: *P. apiculata, P. delicatula, P. herpa, P. poko, P. setacea, P. upolensis, P. dotyi,* and *P. pentamera; P. scopulorum* var. *villum, P. scopulorum* var. *macrotrichia, P. scopulorum* var. *minima,* and *P. sphaerocarpa* var. *sphaerocarpa.*

The following key is abstracted from Hollenberg (1968a, 1968b).

Key to species:

1. With 4 pericentral cells 2
1. With more than 4 pericentral cells 10
2. Erect branches with trichoblasts, a scar cell or a branch at every segment, except those near the base of a branch..... 3
2. Erect branches with frequent to numerous segments without a trichoblast, a scar cell or a branch (mostly on each segment in *P. delicatula*..... 8
3. With limited to extensive prostrate branches 4
3. Attached by a basal tuft of rhizoids, with usually no creeping branches, plants epiphytic..... *P. savatieri*
4. With prominent prostrate branches and with erect branches simple or with only a few lateral branches..... 5
4. Chiefly erect and branched, with mostly limited prostrate branches..... 7
5. Scar cells mostly undivided 6
5. Scar cells on prostrate branches divided into groups of small cells.... *P. herpa*
6. Erect branches 50 μ or less in diameter..... *P. delicatula*
6. Erect branches 100 μ or more in diameter..... *P. poko*
7. Sublittoral plants, with branch apices abruptly acute to apiculate; tetrasporangia not protuberant..... *P. apiculata*
7. Mostly littoral plants, with branch apices not abruptly pointed; tetrasporangia protuberant (in certain varieties)..... *P. sphaerocarpa*
8. Rhizoids cut off by a cross wall from the pericentral cell 9
8. Rhizoids remaining in open connection with the pericentral cell.... ..... *P. scopulorum*
9. Mature rhizoids mostly with multicellular apices, arising at the distal end of the pericentral cells..... *P. setacea*
9. Mature rhizoids unicellular, although often digitate, arising mostly at the proximal end of the pericentral cells..... *P. upolensis*
10. With 5 pericentral cells..... *P. pentamera*
10. With 7 or more pericentral cells..... 11
11. Pericentral cells in longitudinal rows; wall scars relatively prominent where trichoblasts shed ..... *P. exilis*
11. Pericentral cells in offset position in successive mature segments..... *P. dotyi*

1. *Polysiphonia apiculata* Hollenberg 1968a:61, fig. 1 D 8, 9.
Type: D. 19127P, tetrasporic, dredged from 10–14 fa., Pokai Bay, Oahu, Hawaii, July 30, 1959; now in the Smithsonian Institution, Washington, D. C.
Materials examined: D. 21857.1, tetrasporic and cystocarpic materials growing on other algae on reef flat at Yap Is., VIII–18–60.

2. *Polysiphonia delicatula* Hollenberg 1968a:62, fig. 1F.
Type: D. 19116G2, cystocarpic, on *Galaxaura* sp. dredged from 15 fa., Pokai Bay, Oahu, Hawaii, August 1, 1959.
Materials examined: D. 23032.5, on *Microdictyon okamurai*, on reef between Flalap and Ifaluk Is., VIII–10–60.

3. *Polysiphonia herpa* Hollenberg 1968a:68, fig. 1I; fig. 2G.
Lophosiphonia bermudensis Dawson 1956:59, fig. 65; non *Lophosiphonia bermudensis* Collins & Hervey 1917:126, which is *Dipterosiphonia rigens* (Schousb.) Falk.
Type: D. 11857.2, on reef near Otetu, Raroia Atoll, Tuamoto Archipelago, collected by Jan Newhouse and M. S. Doty, Aug. 21, 1952.
Materials examined: 15989.3, on other algae, Helen Reef, VIII–28–60.

4. *Polysiphonia poko* Hollenberg 1968a:70 fig. 3A.
Type: H. 65–113.1, cystocarpic and spermatangial materials growing on dead coral, at outer margin of reef, north of North Is., Johnston Islands, collected by R. S. Jones, April 22, 1965.
Materials examined: Materials from the Caroline Islands were placed by Dr. G. J. Hollenberg under variety *P. poko* var. *poko*: D. 23032.2, on *Microdictyon okamurai*, growing on reef between Ifaluk and Flalap Is., VIII–10–60; D. 23056.1, on coral and other algae, on reef at northeast end of Puluwat Is., VIII–7–60; D. 23167.1, and D. 23207.1, among smaller algae, at southern tip of Sorol Is., VIII–13–60; D. 23674.1, with other algae at western end of Puluwat Is., VIII–7–60.

5. *Polysiphonia savatieri* Hariot 1891:226; Hollenberg 1968a:77, figs. 37, 38.
Type: from Yokosuka, Japan, found epiphytic on larger algae. According to Hollenberg (1961) the type may probably be in the cryptogamic herbarium, Museum Nacional d'Histoire Naturelle, Paris.
Materials examined: D. 15586.3A, male plant on *Padina* sp., on reef at Koror Is., Palau Group, IX–5–60; D. 15654.8, tetrasporic, and D. 15656.1, cystocarpic, on *Sargassum* sp., on reef at Pulo Anna Is., IX–3–60; D. 23423, cystocarpic, on sea grass, on reef near Utwa Village, Kusaie Is., VII–17–60.

6. *Polysiphonia setacea* Hollenberg 1968a:85, figs. 5A, 5B, 5C.
Type: D. 14696, in high tidepool near Koko Parking Lot, eastern Oahu, Hawaii, collected by E. Choy, Nov. 14, 1954; now in the Smithsonian Institution, Washington, D. C.
Materials examined: D. 15897.6, tetrasporic, on dead coral on reef at Quoi Is., Truk Is., VII–30–60; D. 21708.5, on reef flat at Epwelkapw, Ponape Is., VIII–18–60; D. 21740.1, on dead coral on reef at eastern side of Mantapeitak Is., Truk

Group, VI–20–60; D. 23154.1, on dead coral on reef at Yap Is., VIII–19–60.

7. *Polysiphonia sphaerocarpa* Boergesen 1918:271; Hollenberg 1968a:87.
P. pulvinata Menez 1964:215; *P. pulvinata* Segi 1951:195.

Type: from St. Thomas Island, Viergin Islands, now at the Herbarium at the University of Copenhagen.

Materials examined: One collection from the Caroline Islands was placed by Dr. G. J. Hollenberg under the var. *sphaerocarpa*, (Hollenberg 1968a, :90, figs. 21, 26); D. 23621, on reef at Utwa Village, Kusaie Is., VII–17–60.

8. *Polysiphonia upolensis* (Grunow) Hollenberg 1968a:94, figs. 6D, 6E, 29, 35, 42.
P. tongatensis (?) var. *upolensis* Grunow 1873:49.

Type: from Upolu, British Samoa, collected by Dr. Graeffe, now at the Grunow Herbarium, at the Natural History Museum, Wien, Austria.

Materials examined: D. 15546.1, on *Sargassum* sp., D. 15556.1, cystocarpic, male, on *Sargassum* sp., D. 15557.1, tetrasporic, on *Padina* sp., D. 15559.2, tetrasporic, on *Acanthophora spicifera*, D. 15563.1 and D. 15566, on *Padina* sp., D. 15567.1, male, D. 15586.3, B, tetrasporic, cystocarpic, on *Padina* sp., all from Koror Is., Palau Group, IX–5–60; D. 15576.1, cystocarpic, male, D. 15645.1, cystocarpic, D. 15656.1, B, tetrasporic, on *Sargassum* sp. These last three collections are from Pulo Anna Is., IX–3–60; D. 15721.2, D. 21737.1, tetrasporic, on dead coral, Mantapeitak Is., Ponape Group, VI–20–60; D. 21709.5, D. 21737.1, tetrasporic, from Epwelkapw, Ponape Is., VI–20–60; D. 21796.5, tetrasporic, cystocarpic, at eastern side of Peipalap Peak, Ponape Is., VI–20–60; D. 21046, procarpic, at south end of Moen Is., Truk Group, VII–29–60; D. 23020, on coral pebbles on reef at Utwa Village, Kusaie Is., VII–17–60; D. 23207, on *Microdictyon okamurai* at southern tip of Sorol Is., VIII–13–60; D. 15879.1 and D. 23854, cystocarpic, tetrasporic, Falas Is., Truk Group, VII–30–60.

9. *Polysiphonia scopulorum* Harvey 1854:540; Hollenberg 1968a:79.
Lophosiphonia scopulorum (Harvey) Womersley 1950: 188.

Type: from "Ad littus americae tropica," probably from Pacific coast of Mexico.

Materials from the Caroline Islands were placed by Dr. G. J. Hollenberg under three separate varieties:

A. *Polysiphonia scopulorum* var. *villum* (J. G. Agardh) Hollenberg 1968a:81, fig. 74.
Polysiphonia villum J. G. Agardh 1863:941.
Lophosiphonia villum (J. Agardh) Setchell and Gardner 1903.

Type: from "Ad littus americae tropica," probably from the Pacific coast of Mexico.

Materials examined: D. 15586.1, on *Padina* sp., on reef at Koror Is., Palau Group, IX–5–60; D. 21708.3, tetrasporic, on reef flat at Epwelkapw, Ponape Is., VI–20–60.

B. *Polysiphonia scopulorum* var. *macrotrichia* Hollenberg 1968a:83, fig. 7c.

Type: D. 11514A1, collected by M. S. Doty and J. Newhouse from a depth of

3–4 ft. in reef channel north of Oneroa, Raroia Atoll in the Tuamoto Archipelago, Aug. 5, 1952. It is represented by a glucose mount.

Materials examined: D. 21079.1, tetrasporic, on other algae, Helen Reef, West Caroline Islands, VIII–28–60; D. 23112.4, on *Microdictyon* sp., on reef at eastern side of Ifaluk and Flalap Is., VIII–10–60.

C. *Polysiphonia scopulorum* var. *minima* Hollenberg 1968a:85, figs. 6G, 7B, 34.

Type: the type for this variety is H. 65–113.4, tetrasporic, cystocarpic, and antheridial materials collected by R. S. Jones from North Is., Johnston Islands, April 22, 1965.

Materials examined: D. 23112.7, tetrasporic, on *Halimeda stuposa*, on reef at eastern side of Ifaluk Is., VIII–10–60.

10. *Polysiphonia exilis* Harvet 1853:47; Hollenberg 1968b:200, figs. 1C, 3C.

Type: from Key West, Florida; whereabouts not known to the writer.

Materials examined: All legit E. G. Menez: 15413.1, D. 15416.1, on *Hypnea* sp., on eastern part of Helen Reef, VIII–28–60; D. 15897.8, tetrasporic, on dead coral, on reef at Quoi Is., Truk Group, VIII–1–60; D. 23187.2, D. 23751.1, D. 23756.2, on dead coral and other algae, Quoi Is., Truk Group, VIII–2–60; 23565, tetrasporic, on other algae, on reef at Iwayama Bay, Palau Is., VIII–22–60.

11. *Polysiphonia dotyi* Hollenberg 1968b:199, figs. 1A, 1B, 4, 5.

Type: H. 481213.16, tetrasporic, Mon Is., Bikini Atoll, July 7, 1948.

Materials examined: D. 23688.2, on dead coral on reef at Quoi Is., Truk Group, VIII–2–60.

12. *Polysiphonia pentamera* Hollenberg 1968b:204, fig. 2D.

P. fragilis Tsuda 1964: 11, not of Suringar 1870: 37; *P. mollis* (?) Weber van Bosse (1923:356), (in part), not of Hooker and Harvey.

Type: G. 524.2, tetrasporic, from a depth of 28 m, in the lagoon, Eniwetok Atoll, Aug. 30, 1955.

Materials examined: D. 21223.1, tetrasporic, creeping on *Padina* sp., on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60.

Herposiphonia Nägeli 1846

The inclusion here of the seven species of this genus should likewise be treated like those of the genus *Polysiphonia*. They are included here with the permission of Dr. Hollenberg.

The following key to species was abstracted from Hollenberg (1968c).

Key to species:

1. Mostly with determinate or an indeterminate branch or branch primordium on every segment 2
1. Mostly with one or more segments between successive indeterminate branches without a branch of either type 4
2. Trichoblasts unbranched..... *H. trichia*
2. Trichoblasts branched 3

3. Trichoblasts and/or scar cells not more than 2 per branchlet, strictly terminal, with percurrent axis and 7 or more laterals; scar cells large. . *H. dendroidea*
3. Trichoblasts and scar cells otherwise..... *H. parca*
4. Most of the indeterminate branches developing into conspicuous laterals; main axes commonly growing free from the substratum in terminal parts ..... *H. arcuata*
4. Most of the indeterminate branches remaining rudimentary or short..... 5
5. Central cells of the indeterminate branches conspicuously larger than the pericentral cells..... *H. pacifica*
5. Central cells of the indeterminate branches not conspicuously larger than the pericentral cells..... 6
6. Determinate branches mostly 30–50 μ in diameter, composed of 12–14 segments; procarps and spermatangial stichidia arising mostly from the basal half of the determinate branches..... *H. delicatula*
6. Determinate branches mostly 60–100 μ in diameter, composed of 16–18–(30) segments; procarps and spermatangial stichidia arising terminally, or in the upper half of the branches, with short sterile tips.... *H. tenella* form *secunda*

1. *Herposiphonia arcuata* Hollenberg 1968c:538–539, fig. 5.
Type: D. 19611, tetrasporic, cystocarpic, spermatangial, on reef at Kailua, Oahu, Hawaii, now in M. S. Doty herbarium, Dept. of Botany, Univ. of Hawaii, Honolulu, Hawaii.
Materials examined: 23756.4, in algal turf at Quoi, Truk Is., VIII–2–62.

2. *Herposiphonia delicatula* Hollenberg 1968c:540, figs. 1A, 1B, 2H, 3.
Type: D. 21876.2, tetrasporic, cystocarpic, spermatangial, on *Amphiroa fragilissima* var. *cyathifera*, on reef at Falas Is., Truk Group, VII–30–60.

3. *Herposiphonia dendroidea* var. *minor* Hollenberg 1968c:543, figs. 7, 24.
Type: 11533.2, sterile on *Caulerpa* sp., on reef at Raroia Atoll, 1952; now in herbarium of M. S. Doty, Dept. of Botany, University of Hawaii, Honolulu, Hawaii.
Materials examined: 23032A, 23116.6, abundant on *Microdictyon* sp., on reef between Ifaluk and Flalap Is., VIII–10–60; 23207.2, abundant in algal turf, at southern tip of Sorol Is., VIII–13–60; 23756.3, in algal turf, on reef at Quoi Is., Truk Group, VIII–2–60.

4. *Herposiphonia tenella* from *secunda* Hollenberg 1968c:556.
Type: none designated yet as of August 1967.
Materials examined: D. 15559.3, on *Acanthophora spicifera*, on Koror Is., Palau Group, IX–5–60.

5. *Herposiphonia pacifica* Hollenberg 1968c:549, figs. 2A, 2B, 4, 19.
Type: D. 22396, tetrasporic, saxicolous, on reef at Papawai Pt., Maui, Hawaii, IV–19–65; now in the herbarium of M. S. Doty, Dept. of Botany, University of Hawaii, Honolulu, Hawaii.
Materials examined: D. 15396.2, on *Hypnea* sp., Helen Reef, VIII–28–60; D. 15989.1, D. 15676.1, D. 15721.1, in algal mat near Helen Reef, VIII–28–60; D.

21079.3, Helen Reef, VIII–28–60; D. 21709.6, D. 21710.5, D. 15721.1, D. 15676.1, on other algae, reef flat, Epwelkapw, Ponape Is., VI–17–60; D. 21739.1, D. 15721.1, on dead coral, eastern side of Mantapeitak Is., Ponape Group, VI–20–60; D. 23491.2 on *Turbinaria* sp., south end of Helen Reef, West Caroline Islands, VIII–28–60; D. 15586.5, on *Padina* sp., on reef at Koror Is., Palau Group, IX–15–60; D. 23112.2A, on reef on eastern side of Ifaluk and Flalap Is., VIII–10–60; D. 23207.3, among other algae, southern tip of Sorol Is., VIII–13–60.

6. *Herposiphonia parca* Setchell 1926:103, pl. 20, fig. 2.
H. terminalis Segi 1953:365, nomen nudum.

Type: Setchell's specimen from Arue Reef at Tahiti; now in the Herbarium, University of California, No. 261147.

Materials examined: D. 21838.2, D. 15071.1, D. 21795.5, on *Amphiroa* sp., on reef at eastern side of Mantapeitak Is., Ponape Group, VI–2–60; D. 21046, tetrasporic, on sea grass, on reef at south end of Moen Is., Truk Group, VIII–1–60; D. 23656.2, on *Padina* sp., D. 23811, D. 21876.1, on coralline algae, on reef at Falas Is., Truk Group, VII–30–60; D. 23804.1, on branching coralline, at Falas Is., Truk Group, VII–20–60; D. 23648.1, D. 23253.2, on dead coral, on reef at Dublon Is., Truk Group, VII–31–60; D. 23359.1, D. 21857.3, on other algae, D. 23471.3, tetrasporic, on coralline algae, on reef at Yap Is., VIII–18–60; D. 15586.2, tetrasporic, on *Padina* sp., on reef at Koror Is., Palau Group, IX–15–60; D. 15891.1, on *Sargassum* sp., on reef at Quoi Is., Truk Group, VIII–1–60; D. 15556.2, spermatangial, on *Sargassum* sp., Koror Is., Palau Group, IX–15–60; D. 15654.1, tetrasporic, on other algae, on reef at Koror Is., Palau Group, IX–3–60; D. 21721, on other algae, on reef at Pulo Anna Is., IX–3–60; D. 23359.1, on other algae, on reef at Yap Is., VIII–18–60; D. 15576.2, on *Padina* sp., on reef at Pulo Anna Is., IX–3–60; D. 21838.2, on other algae on reef flat at Epwelkapw, Ponape Is., VI–16–60; D. 21795.5, tetrasporic, at eastern side of Peipalap Peak, Ponape Is., VI–17–60; D. 23632.1, on other algae, on reef at Ponape Is., VII–20–60.

7. *Herposiphonia trichia* Hollenberg 1968c:557, fig. 1G.

Type: D. 23461.1, tetrasporic, on *Amphiroa* sp., on reef at Yap Is., VIII–18–60. *Other materials examined*: D. 23466, antheridial, D. 23471.1, cystocarpic, on *Amphiroa* sp., on reef at Yap Is., VIII–18–60.

Cottoniella Boergesen 1919

Cottoniella triseriata Hollenberg 1967:1199–1201, figs. 6, 7, 9, 10.
Pl. 11, figs. 1–3

Thalli minute, about 5 mm tall, found growing on coralline algae. Main axes are prostrate on the host, about 75–88 μ in diameter; attached to the host by stout, single-celled exogenous rhizoids which have modified disc-like, lobed tips.

Filaments are polysiphonous; segments consist of axial cells with 4 pericentral cells, the segments about a little longer than broad. The tips of the main axes are bent away from the host. The main axes produce two types of erect branches on its dorsal side, namely the endogenous and exogenous branches. The endogenous

branches originate by the cutting off of an initial from the distal end of the axial cell which later become polysiphonous. They may also produce one or two lesser branches. The exogenous branches are monosiphonous throughout also originating from the dorsal side of the prostrate main axes as well from the erect polysiphonous branches. They are produced in pairs at the distal ends of the pericentral cells.

The exogenous branches are arranged in a peculiar way. The middle, dorsal pericentral cell in each segment cuts off an initial at its distal, end, which give rise to a middle dorsal row of monosiphonous filaments. The other of the pair of monosiphonous filaments in each segment is formed in the same way as above either from the left or right dorsal pericentral cell. These are alternate to each other, thus when viewed from the dorsal side of the main axis three rows of monosiphonous filaments are seen in regular sequence.

The monosiphonous filaments consist of as many as 15 cells which are about 15–18 μ in diameter at their thickest portion; they are distinctly tapered from the middle towards the proximal and distal ends. The tapering is, however, more abrupt towards the proximal end compared to that of the distal ends. The monosiphonous filaments form long, filiform tips. The basal cell of the monosiphonous filaments are small and short in comparison to the cells in the rest of the filament.

The specimens examined are sterile but characters leave no doubt as to its generic identity. Dr. G. J. Hollenberg had examined the materials and noted their similarity to the plants he named *C. triseriata.* However, one peculiar character of the specimens from the Caroline Islands is the cutting off of the initial cells from the dorsal pericentral cells at about a third from their distal ends.

Materials examined: 151291, on eastern seaward reef flat at Urak Is., Mokil Group, VI–29–60.

ACANTHOPHORA Lamouroux 1813

Acanthophora spicifera (Vahl) Boergesen 1910:201, figs. 18–19; Taylor 1960:620, pl. 71, fig. 3; pl. 72, figs. 1–2; Boergesen 1915–20:259, figs. 253–254; Dawson 1954b:456, fig. 61 a, b.

Fucus spiciferus Vahl 1799:44.

The thalli are up to 12 cm tall, bushy and irregularly branched, attached to the substratum by disc-like holdfasts. The determinate branches are arranged spirally around the main axes. They are beset by spirally arranged spines. This species is distinguished from *A. muscoides* by the presence of the spines only on the determinate branches and their absence on the main axes.

They grow on rocks and dead corals and sometimes epiphytic on larger algae. Doty (1961) considered *A. muscoides* reported by Yamada (1944) from the Atoll of Ant, and *A. orientalis* reported by Kanda (1944) from Palau as conspecific with *A. spicifera.* Some of the materials from Palau and Kusaie Islands of this genus have spines on both the main axes and determinate branchlets. These materials are included here under this species.

Type: West's specimen from St. Croix; now in Vahl's Herbarium, Botanical

Museum at Copenhagen.

Materials examined: 21784, 21810, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–20–1960; 21763, on reef flat at Epwelkapw, Ponape Is., VI–16–20; 21482, 23016, 21904, 21952, 21828, 15310, on reef near Utwa Village, Kusaie Is., VII–17–60; 15551, Koror Is., Palau Group, IX–5–60; 15653.1, 15654.3, 15658.1, Koror Is., Palau Group, IX–5–60; 21330, on reef flat on esatern side of Peipalap Peak, Ponape Is., VI–17–60; 15688, on reef with sandy-muddy substratum with rocks, Koror Is., Palau Group, IX–3–60; 23016, 15652, 23627, 21920, on reef near Utwa Village, Kusaie Is., VII–17–60.

Laurencia Lamouroux 1813

Key to species:

1. Cortical cells elongate and radially arranged into a palisade as seen in cross section 2
1. Cortical cells not elongate and not radially arranged into a palisade..... 4
2. Cortical cells projecting on the surface of the thallus; lenticular thickenings present in the medullary cells; secondary vertical pit connections present in epidermis .....*L. marianensis*
2. Cortical cells not projecting on the surface; lenticular thickenings and secondary pit connection absent..... 3
3. Thalli cartilaginous, densely covered with wart-like branchlets....*L. papillosa*
3. Thalli soft and somewhat fleshy; not densely covered with wart-like branchlets .....*L. yamadana*
4. Cortical cells distinctly projecting as seen from the surface view..... 5
4. Cortical cells not projecting as seen from surface view, thalli cartilaginous .....*L. cartilaginea*
5. Thalli up to 10 cm tall, much branched, soft and fleshy; secondary vertical pit connections present.....*L. majuscula*
5. Thalli short, not more than 6 cm tall; cartilaginous; main axis simple or sparingly branched .....*Laurencia* sp.

1. *Laurencia papillosa* (Forsk.) Greville; Reinbold 1901:351; Yamada 1931b: 190, pl. 1, figs. a, b; Taylor 1942:133, Dawson 1954b:548, fig. 61i; Taylor 1960: 623, pl. 74, fig. 2; Okamura 1916:11.
Fucus papillosus Forskål 1775:190.

Thalli form dense clusters up to 8 cm tall; branching is primarily alternate, the axes percurrent and densely covered with short determinate branchlets which are simple and turbinate, or somewhat truncate at the apices, or in well-developed specimens the determinate branchlets may bear 3–5 bumps or very short lesser branchlets.

In transverse section the cortical cells are clearly elongate and radially arranged into a palisade. They do not project on the surface of the branches. Lenticular thickenings are absent.

Included under this species are specimens which agree perfectly with regards

to their anatomy to the typical *L. papillosa*, but which differ in their habit forming low somewhat dense clumps with fewer determinate branchlets.

This species is one of the most common species in the Caroline Islands as well as in southern Asia.

Type: holotype collected by Forskål himself from the Red Sea in 1763; now in the Forskål Herbarium, Botanical Museum, Copenhagen.

Materials examined: 21399, 21462, 21479, 21399, 21621, 21617, 23308, on reef at Nanmatol Is., Ponape Group, VII–23–60; 15219, 21515, 21919, 23413, on reef at Kusaie Is., VII–15–60; 21216, 21761, 15676.2, on reef flat of Epwelkapw, Ponape Is., VI–20–60; 21628, 21198, 21429, 21182, 21137, 21088, 21093, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 21822, 21372, 21778, 15664, 15021, 23014, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21658, 21628, on reef near boat pier, Ponape Is., VII–20–60; 21891, 21645, 21432.1, 15816, on reef at north of Yap Is., VIII–19–60; 21961, on reef flat facing Mantapeitak Is., Ponape Group, VI–20–60; 15353, 15332, 15990, 23537, southern region of Helen Reef, VIII–28–60; 23150, in man-made pool dredged inside Moen Is. harbor, Truk Group, VII–29–60; 23657, on reef at Falas Is., Truk Group, VII–30–60; 15676, on reef at Epwelkapw, Ponape Is., VI–20–60; 23450, in mangrove region near south end of Moen Is., Truk Group, VII–29–60; 21265, 21498, on reef flat between Kolonia and Jokaj Is., Ponape Group, VI-25–60; 23552, 21778, on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21501, 21424, 21420, 23363, 23777, on reef at Yap Is., IX–18–60; 15444, at southeast portion of Helen Reef, IX–28–60; 23638, on reef at Ponape Is., VII–20–60; 21998, on reef at Yap Is., VIII–18–60.

2. *Laurencia cartilaginea* Yamada 1931b:230, pl. 19, fig. a; text-fig. 0.

Some specimens closely resemble the young *L. papillosa* in external appearance, but the above-mentioned species have elongated and palisade-like cortical cells as seen in cross section. Like *L. papillosa* there are no secondary vertical pit connections between the cortical cells.

Found only once mixed with clumps of *L. papillosa*.

Type: collected from Mogi, Province Chikuzen and from Province Iyo, Japan; preseumably in Tokyo University, Japan.

Materials studied: 15664, on reef flat with sandy-muddy to rocky bottom at the eastern side of Peipalap Peak, Ponape Is., VII–17–60.

3. *Laurencia yamadana* Howe 1934:37, fig. 4.

L. amabilis Yamada, *In* Yamada and Segawa 1953:113, text figs. 6–7.

The thalli form loose clumps; branches are cylindrical and irregularly branched, the ultimate branchlets few to many and generally uniseriately arranged on the dorsal side of the arched main axes, although they may be disposed in all direction in erect branches.

The cortical cells are elongate and arranged radially into a palisade. There are no secondary vertical pit connections between the cortical cells. Lenticular thickenings are absent.

Thalli are somewhat soft and fleshy than the other members of section Palisadae.

Type: holotype collected from Kaneohe Bay by Paul C. Galtsoff, July, 1930; now in New York Botanical Garden, U. S. National Museum.

Materials examined: 21915, on reef with sandy-rocky substratum, Ulul Is., Namonuito Group, VIII–6–60; 21751, 15699, on reef flat at Mokil Is., Mokil Group, VI–29–60; 15413, on south eastern portion of Helen Reef, VIII–28–60; 21760, on reef at Epwelkapw, Ponape Is., VI–17–60; 15868, 23716, on reef at southern portion of Ulul Is., VIII–6–60; 23777, 23706, 21573, 21432, 21645, 21990, 21645a, on reef near Yap Harbor, Yap Is., VIII–19–60; 21760, on reef flat with sandy-muddy substratum, Epwelkapw, Ponape Is., VI–17–60; 15630a, on reef at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 23716, 21915, on reef at southern portion of Ulul Is., VIII–6–60; 15699, 21751, on reef flat with sandyrocky substratum at Mokil Is., VI–29–60; 23654, on reef at southern portion of the Helen Reef, VIII–28–60; 15413, on reef at southeastern portion of Helen Reef, VIII–28–60; 21751, on northern seaward reef flat at Mokil Is., VI–29–60.

4. *Laurencia marianensis* Yamada 1931b:200, pl. 5, fig. b; figs. F, G; Taylor 1950:144, pl. 55, fig. 1; Dawson 1956:60, fig. 66; Dawson 1957:124.

Thalli are up to 5 cm tall, forming soft tufts or clumps irregularly branched, generally alternate, sometimes sub-opposite, paniculate. Branches cylindrical; ultimate branchlets short, truncate, cylindrical to somewhat clavate arising from all direction.

In cross section the medulla is made up of large somewhat thick-walled cells; cortical cells squarish to slightly elongate, disposed radially forming a palisade, distinctly projecting in the younger portions of the branches. Lenticular thickenings present. Longitudinal secondary pit connections present between the cortical cells.

Thalli tetrasporic; fertile ultimate branchlets simple, tapering towards the sterile base, swollen at the apical fertile portion which has rough, uneven surface.

The appearance of the tetrasporangial branchlets are somewhat similar to that of *L. nidifica* as illustrated by Boergesen (1945, fig. 23a), but the present species has lenticular thickenings. In habit, some of my specimens resemble *L. majuscula* but this species has no lenticular thickenings.

Type: from Saipan, Marianas Islands; whereabouts presumably at Tokyo University, Japan.

Materials examined: 21561, 21723, 21725, on reef at Pulo Anna Is., IX–3–60; 23105, on reef with snady-muddy bottom at Ella Is., Ifaluk Is., VIII–10–60; 21561, 21713, on reef at Pulo Anna, IX–3–60; 21922, on reef at Kusaie Is., VII–15–60.

5. *Laurencia majuscula* (Harv.) Lucas, *In* Lucas and Perrin 1947:249.
Laurencia obtusa (Hudson) Lamouroux var. *majuscula* Harvey, *In* Yamada, 1931b.

Only one dried mature specimen was available for study. The fronds soft and fleshy and adhere well on the paper on drying. The cortical cells clearly pro-

ject above the surface of the thallus near the tips of the ultimate branchlets. Secondary vertical pit connections are present between the cortical cells. No lenticular thickenings in the walls of the medullary cells were seen.

Type: Harvey Australian Algae No. 236; whereabouts not certain but presumably in Harvey Herbarium, Dublin, Ireland.

Materials examined: 23313, on reef flat with sandy-muddy bottom, Nanmatol Is., Ponape Group, VII–23–60; 15992, at southern region of Helen Reef, IX–28–60; 23664, on reef at Falas Is., Truk Group, VII–30–60; 15718, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 21355, on northern seaward reef flat at Mokil Is., VI–29–60.

6. *Laurencia* sp.

Thalli up to 5 cm high, cartilaginous. Branching alternate, main axis percurrent, cylindrical throughout. Determinate branchlets densely disposed on the secondary axes, simple or bearing few short minor branchlets, clavate, prominently swollen at the apices. The axis somewhat naked at the base. The determinate branchlets longest at the middle of the main axis, about 1.5 mm long becoming shorter towards the distal and proximal ends, though more numerous and crowded at the distal ends. In cross section the medulla is made up of large cells with very thick walls. No lenticular thickenings are seen among them. The epidermis in transection is neither elongated radially nor arranged like palisade cells. Epidermal cells prominently projecting, almost half their length above the surface of the thallus and thus producing regular semi-circular bumps.

Materials examined: 15360, on sandy-rocky bottom in southeastern region of Helen Reef, VIII–28–60. It has also been collected at the south end of Helen Reef (15740).

Chondria Agardh 1817

Chondria repens Boergesen 1924:300, fig. 40; Dawson 1954b:460, fig. 62 d, e.

A few sterile thalli found creeping among the branches of a coralline alga resemble this species. The main axes arching and closely appressed on the host and giving rise to simple, arched branches on the upper side. The materials resemble closely the Figure 62 d, e of Dawson (1954b) for this species.

Type: Boergesen's specimen from Easter Island; present whereabouts not known to the writer.

Materials examined: 15129.2, creeping on thalli of coralline algae, on eastern seaward reef flat at Urak Is., Mokil Group, VI–29–60.

Leveillea Decaisne 1841

Leveillea jungermannioides (Mart. & Her.) Harvey 1855:539; Falkenberg 1901: 392, pl. 6, figs. 1–13; pl. 14, figs. 1827; Scagel 1953: 51, fig. 8; Dawson 1954b:461, fig. 63 a; Boergesen 1945:42.

Amansia jungermannioides Martens and Hering 1836:485, pl. 1.

Pl. 8, fig. 4

Thalli commonly found growing among other algae, i.e., *Jania* sp., *Hypnea* sp., *Ceramium* sp., and other smaller algae forming small clumps.

Prostrate axes sparsely branched, attached to other algae by means of polysiphonous rhizoids arising from every other 5th internode at the ventral side of the axes. The rhizoids may be short or long, simple or branched, with flattened disc-like attachment organ at the tips. The blades sessile, distichous, alternate to each other on either side of the upper portion of the prostrate axes, the blades overlapping. The uniaxial midrib of the blades distinct giving rise to hairs at their tips. The main axes of the apical hairs are provided with 4 pericentral cells, their primary branches distichous, opposite. The primary branches of the hairs are simple without pericentral cells and are dichotomously branched, sometimes trichotomous near the base, tapered towards the ultimate branches.

A common component of low bushy clumps of smaller algae, or, epiphytic on larger species.

Type: locality not indicated; present whereabouts not known to the writer.

Materials examined: 21718.2, 21616.6a, 21716.1, 21557.2, 21563.3, on reef at Pulo Anna Is., IX–3–60.

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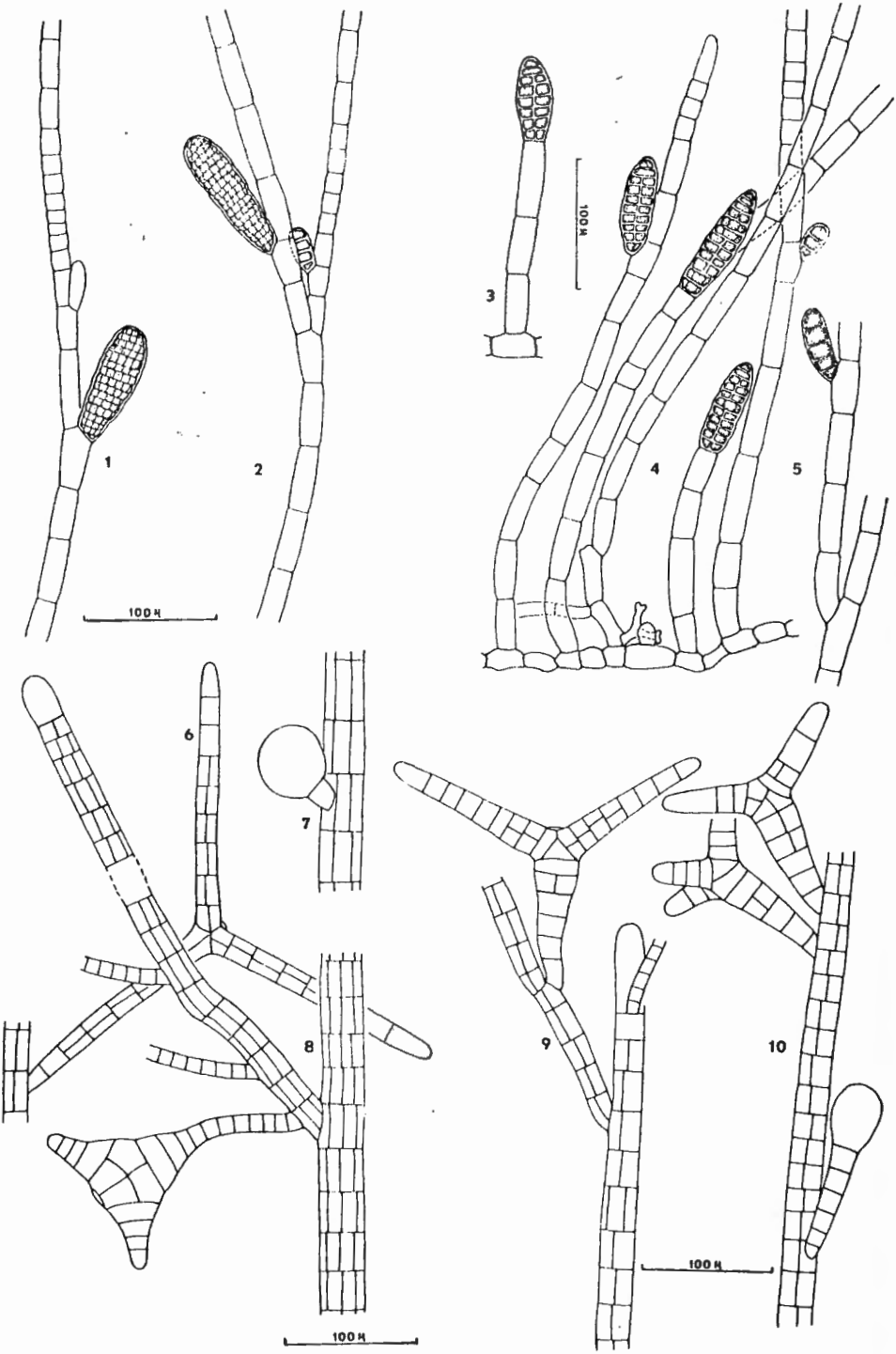
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PLATE 1

Figs. 1–2. *Ectocarpus indicus*, portions of the filaments showing plurilocular sporangia and intercalary meristems.

Fig. 3. *Ectocarpus columellaris*, a short erect filament bearing terminal plurilocular sporangium.

Fig. 4. *Ectocarpus columellaris*, a portion of the thallus showing the prostrate and erect filament with plurilocular sporangia.

Fig. 5. *Ectocarpus columellaris*,a portion of the erect filament bearing young lateral plurilocular sporangium.

Fig. 6. *Sphacelaria furcigera*, a portion of the filament with propagulum.

Fig. 7. *Sphacelaria rigida*, a portion of the filament with a unilocular sporangium.

Fig. 8. *Sphacelaria rigida*, a portion of the filament with a lateral branch with a series of propagula on its abaxial side.

Fig. 9–10. *Sphacelaria* sp., portions of the erect filament showing propagula.

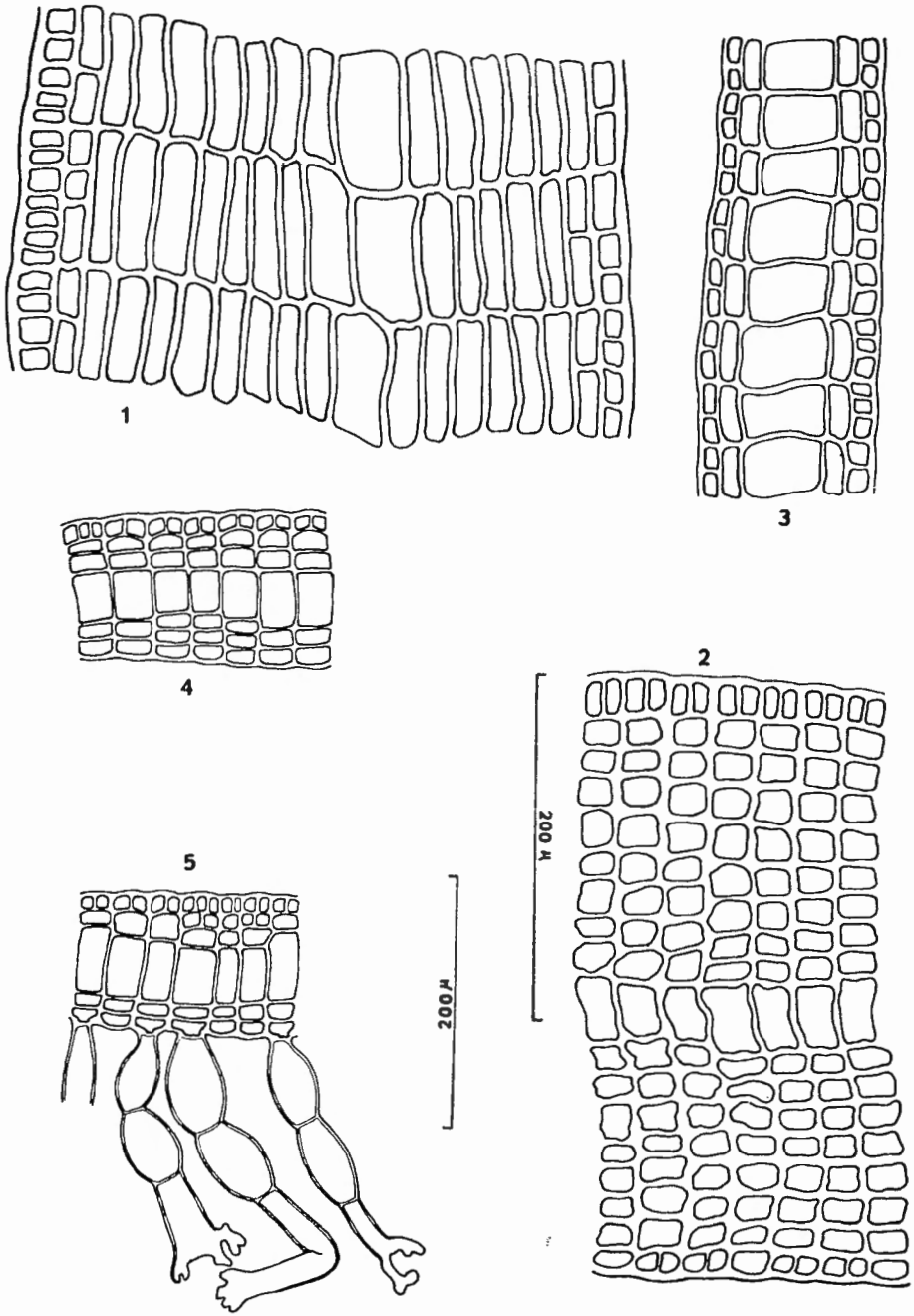
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PLATE 2

Fig. 1. *Pocockiella* sp., longitudinal section of the blade showing several layers of cortical cells.

Fig. 2. *Pocockiella* sp., cross section of the same blade.

Fig. 3. *Pocockiella variegata*, longitudinal section of the blade with one layer of cortical cells.

Fig. 4. *Pocockiella variegata*, longitudinal section of the blade with one to two layers of cortical cells.

Fig. 5. *Pocockiella variegata*, longitudinal section of the blade showing rhizoids with modified tip cells for attachment.

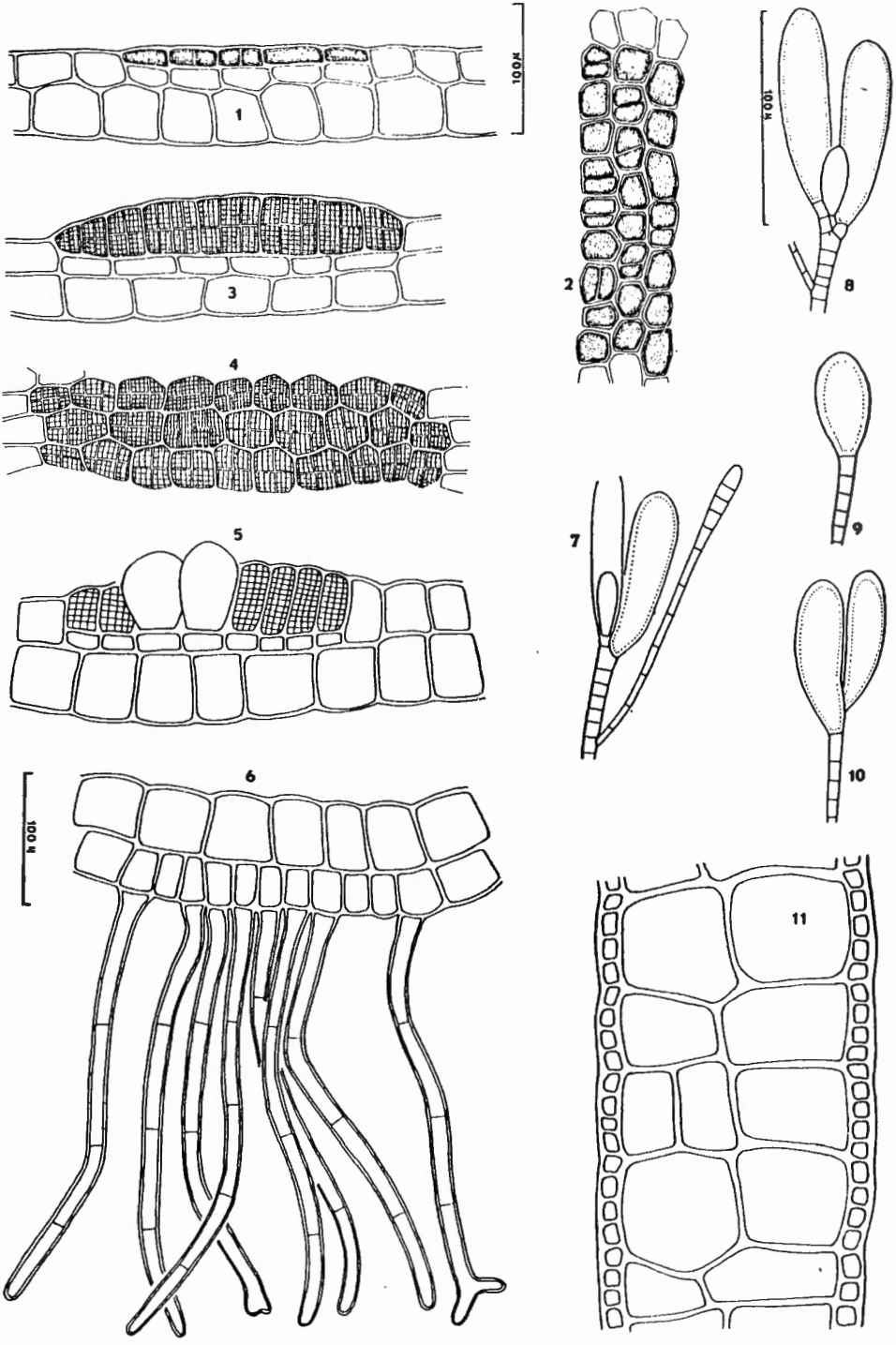
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PLATE 3

Figs. 1–2. *Padina minor*, longitudinal section and surface view of the blade showing young spermatangia.

Figs. 3–4. *Padina minor*, longitudinal section and surface view of the blade showing mature spermatangia.

Fig. 5. *Padina australis*, longitudinal section of the blade showing oogonia and spermatangia.

Fig. 6. *Padina australis*, longitudinal section through the piliferous zone of the blade.

Figs. 7–10. *Ralfsia expansa*, unilocular sporangia.

Fig. 11. *Stypopodium lobatum*, longitudinal section of the blade.

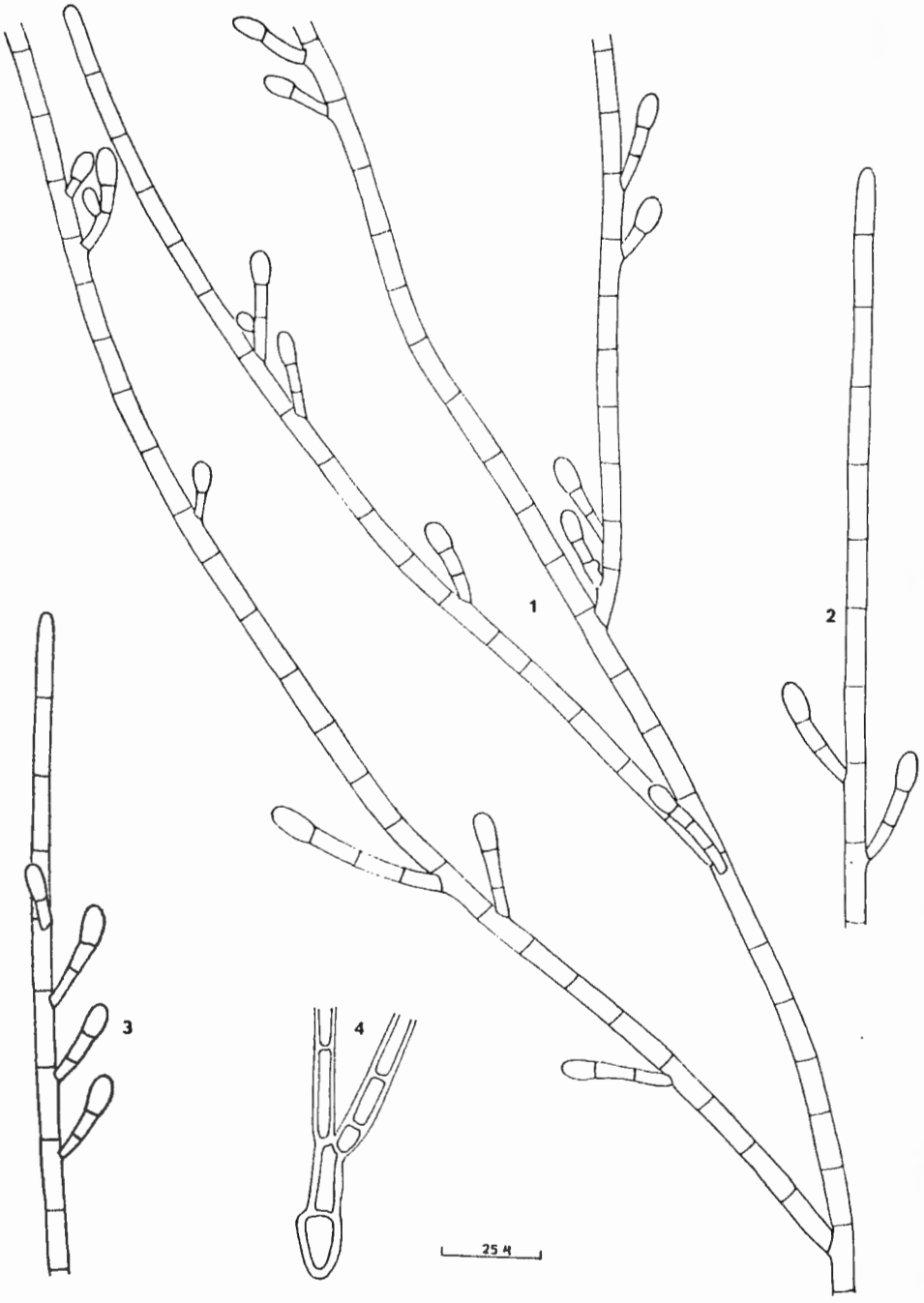
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PLATE 4

Acrochaetium robustum

Fig. 1. A portion of the filament showing the type of branching.

Fig. 2. Tip portion of the filament showing alternate arrangement of the short determinate branchlets bearing sporangia.

Fig. 3. Tip portion of the filament showing uniseriate arrangement of the short determinate branchlets bearing monosporangia.

Fig. 4. Basal portion of the main filament showing the basal cell.

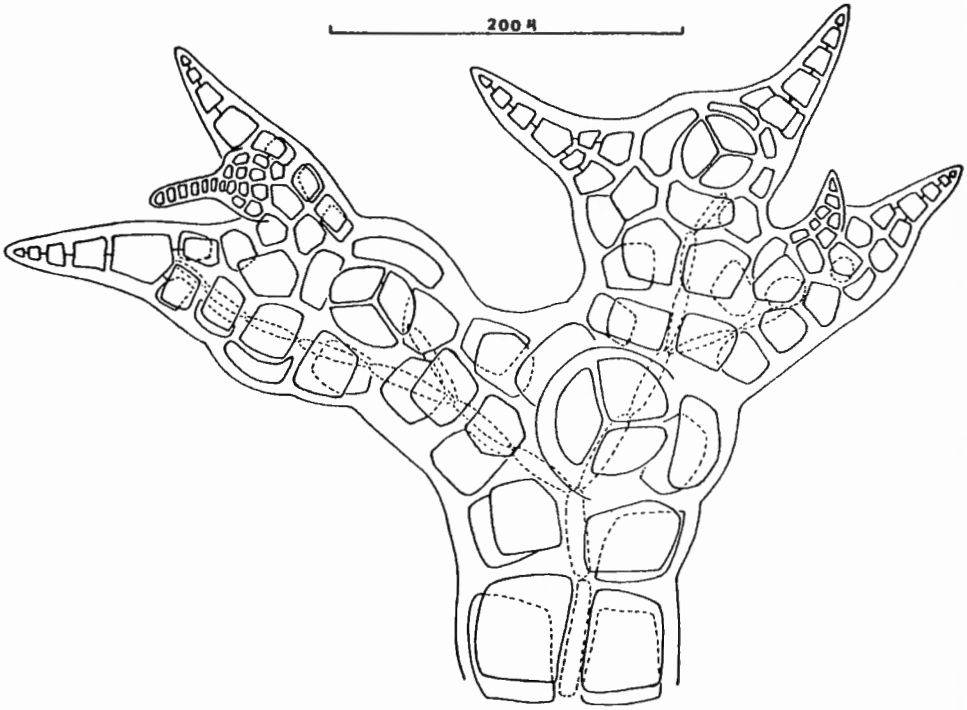
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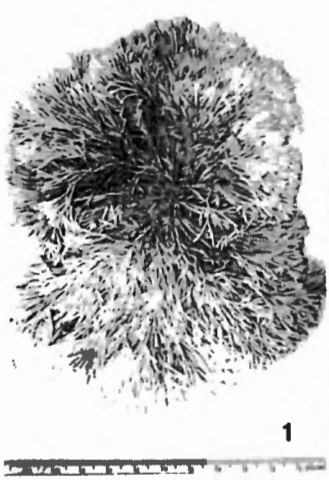
PLATE 5

Tolypiocladia glomerulata. A portion of the branch showing tetrasporangia and tips of the determinate branchlets consisting of a row of 4 to 5 uncorticated cells.



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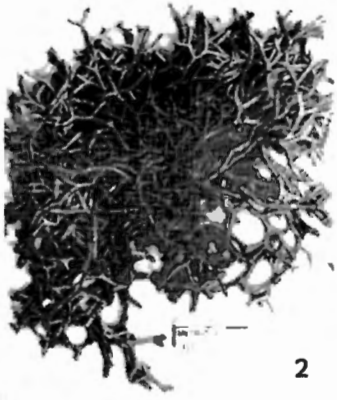

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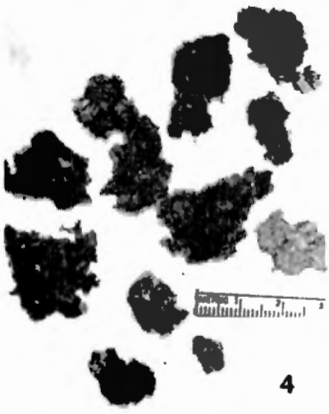

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5

Algae of the Caroline Islands
From the Herbarium of Maxwell S. Doty, # 21813

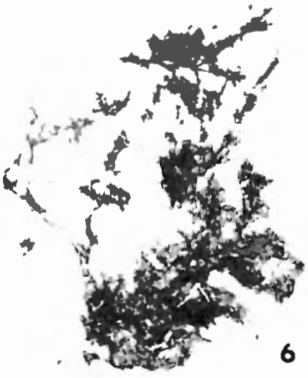

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PLATE 6

Fig. 1. *Galaxaura oblongata*, habit.
Fig. 2. *Galaxaura fasciculata*, habit.
Fig. 3. *Peyssonelia* sp., habit.
Fig. 4. *Peyssonelia rubra* var. *orientalis*, habit.
Fig. 5. *Gelidiella acerosa*, habit.
Fig. 6. *Coelothrix irregularis*, habit.
Fig. 7. *Ceratodictyon spongiosum*, habit.
Fig. 8. *Gracilaria eucheumoides*, habit.
Fig. 9. *Gracilaria* sp., habit.


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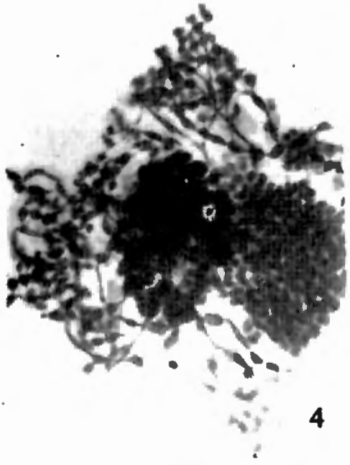
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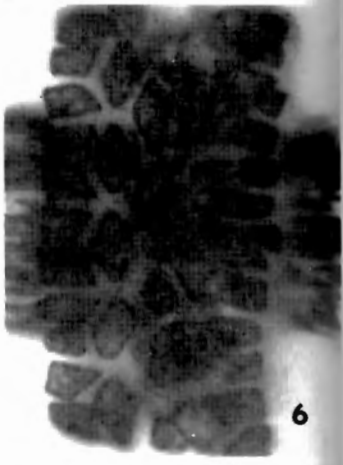
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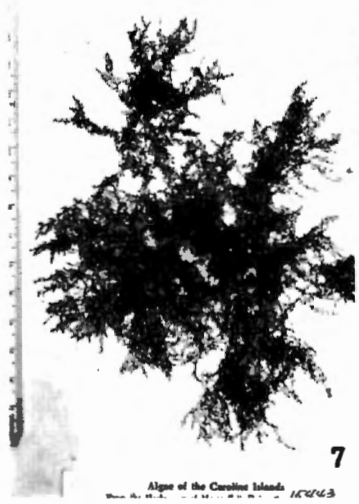

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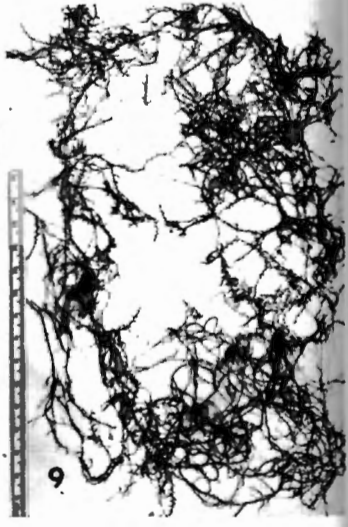
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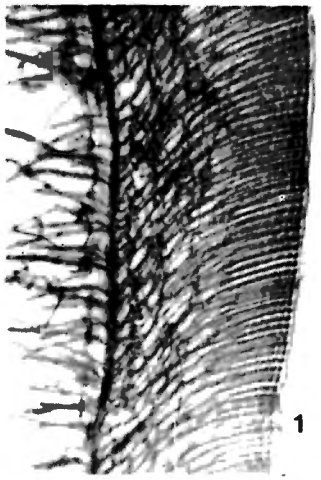
PLATE 7

Fig. 1. *Halymenia durvillaei* var. *ceylanica*, habit.
Figs. 2–3. *Halymenia floresia*, habit of the male and female thalli, respectively.
Fig. 4. *Halymenia floresia*, carposporophyte.
Fig. 5. *Coelothrix irregularis*, tetrahedral spores (30 μ in diameter).
Fig. 6. *Ceramium* sp. nodal cortication (50 μ tall).
Fig. 7. *Tolypiocladia glomerulata*, habit.
Fig. 8. *Stypopodium lobatum*, habit.
Fig. 9. *Hypnea esperi*, habit.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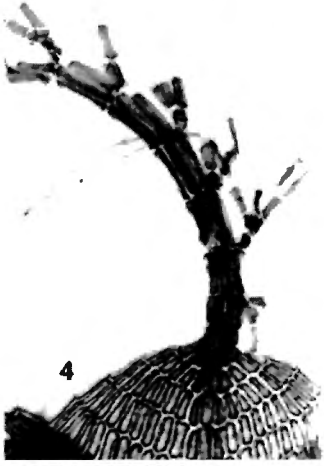
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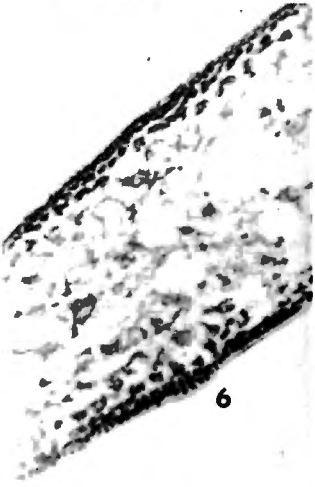
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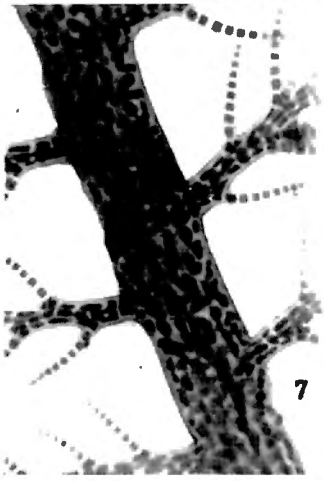
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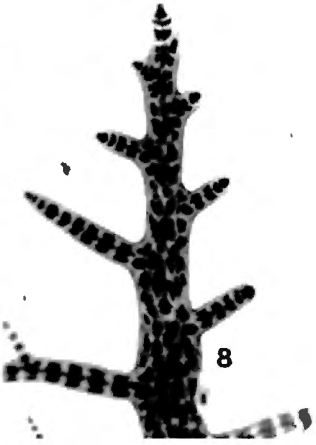
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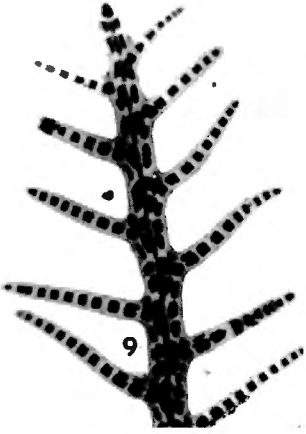
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PLATE 8

Fig. 1. *Peyssonelia sp.*, longitudinal section of the crustose thallus (160–250 μ thick).

Fig. 2. *Peyssonelia rubra* var. *orientalis*, longitudinal section of the crustose thallus (80–120 μ thick).

Fig. 3. *Liagora farinosa*, smear mount showing assimilatory filaments and mature cystocarp.

Fig. 4. *Leveillea jungermannioides*, tip portion of the blade showing apical hairs.

Fig. 5. *Erythrocolon podagricum*, cross section of the wall (90–110 μ thick) of the vesicle showing the inner and outer cortical tissues.

Fig. 6. *Rhodymenia divaricata*, cross section of the flattened branch (200–210 μ thick).

Fig. 7. *Bostrychia binderi*, portion of the main axis (180–210 μ in diameter) showing the regular arrangement of both the determinate and indeterminate branches.

Fig. 8. *Bostrychia binderi*, apical portion of the main axis showing indeterminate branches.

Fig. 9. *Bostrychia binderi*, apical portion of the indeterminate branch showing the generally uniseriate determinate branchlets.

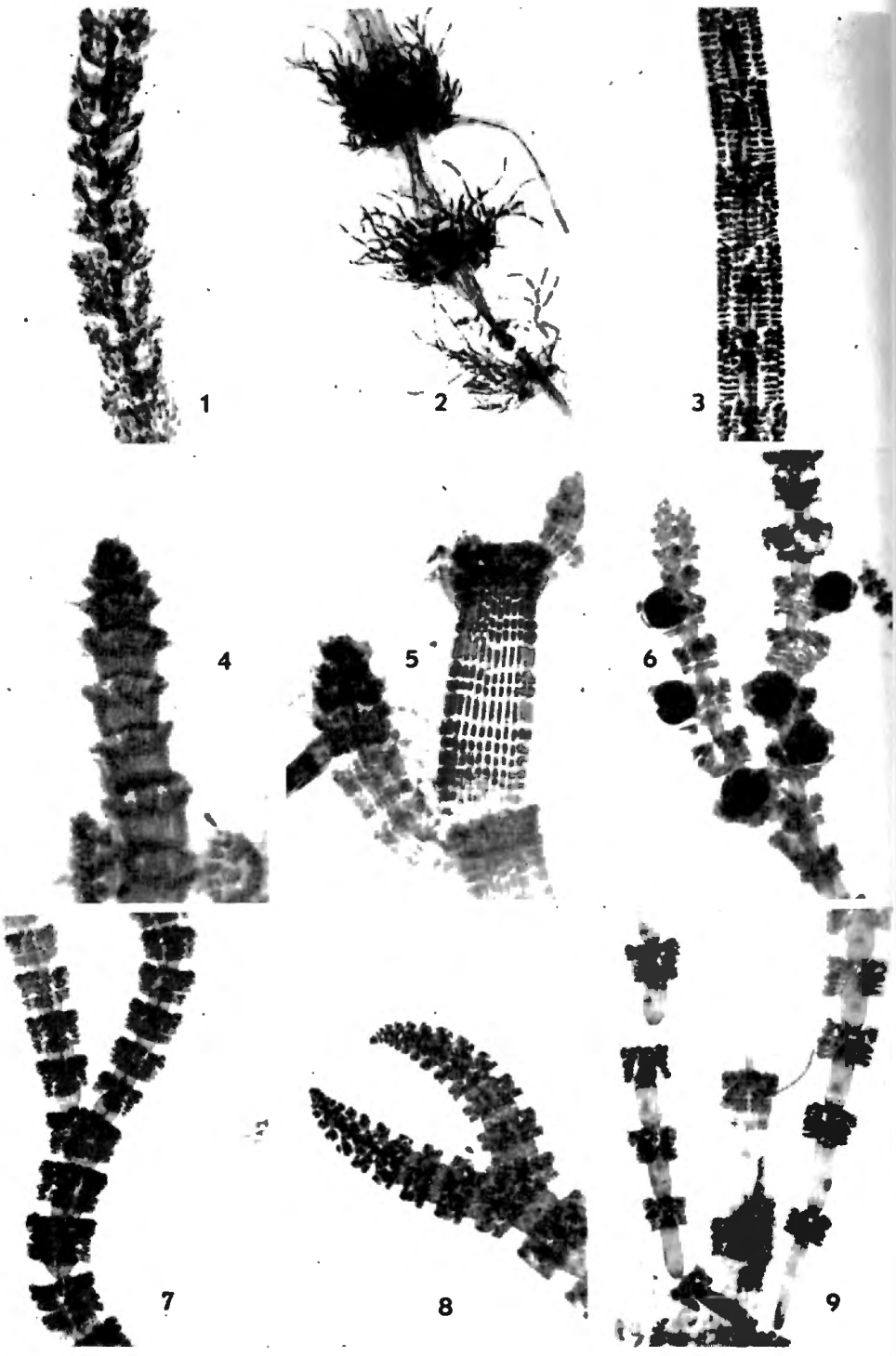
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PLATE 9

Fig. 1. *Crouania minutissima*, a portion of the young branch.
Fig. 2. *Crouania minutissima*, a portion of the main branch (main axis 50–55 μ in diameter).
Fig. 3. *Ceramium huysmansii*, a portion of the filament (about 100 μ in diameter).
Fig. 4. *Centroceras minutum*, showing the non-furcipate tip of a branch (about 85–100 μ in diameter).
Fig. 5. *Centroceras minutum*, a portion of the main filament showing the alternate branching and the longitudinally arranged cortical cells.
Fig. 6. *Ceramium gracillimum* var. *byssoideum*, a portion of the fertile filament (vegetative filament about 65–80 μ in diameter).
Fig. 7. *Ceramium gracillimum* var. *byssoideum*, middle portion of the filament of a coarser specimen.
Fig. 8. *Ceramium* sp., furcipate tip of a filament.
Fig. 9. *Ceramium gracillimum* var. *byssoideum*, basal portion of filaments.

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PLATE 10

Fig. 1. *Ceramium vagabunde*, apical portion of a sterile erect filament.

Fig. 2. *Ceramium vagabunde*, a portion of a fertile filament (about 250 μ in diameter) showing a whorl of tetrasporangia at each nodal cortication.

Fig. 3. *Ceramium mazatlanense*, a sterile filament showing furcipate apex (70–75 μ in diameter).

Fig. 4. *Ceramium affine* var. *affine*, a portion of the sterile filament.

Fig. 5. *Ceramium affine* var. *affine*, a fertile portion of the filament with naked tetrasporangia (36–46 μ in diameter) secund n the abaxial side of the filament.

Fig. 6. *Ceramium gracillimum* var. *byssoideum*, a portion of the sterile filament.

Fig. 7. *Ceramium gracillimum* var. *byssoideum*, a magnified picture of the nodal cortications.

Fig. 8. *Ceramium mazatlanense*, a fertile portion of the filament (about 70–75 μ in diameter) with involucrate tetrasporangia at its abaxial side.

Fig. 9. *Ceramium fimbriatum*, a portion of the filament 65–70 μ in diameter) showing whorls of short, stout hairs at the nodes.

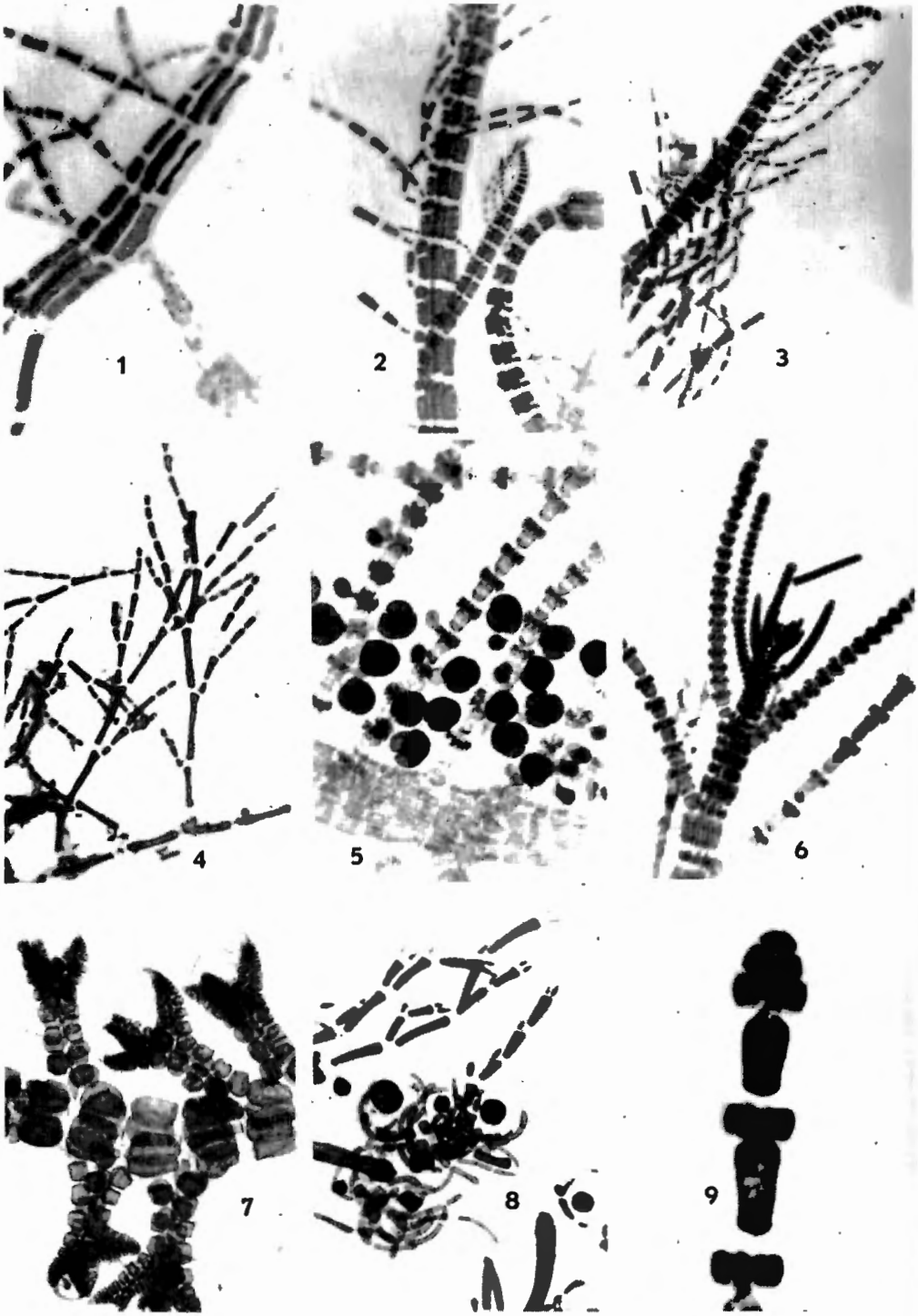
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PLATE 11

Figs. 1–3. *Cottoniella triseriata*, portions of the filaments (about 75–88 μ in diameter) from the base, middle and tip of the main filament, respectively.

Fig. 4. *Antithamnion antillanum*, portion of the alga showing the prostrate and erect portions of the filament.

Fig. 5. *Spyridia* sp. fertile portion of the thallus; tetrasporangia about 50–60 μ in diameter.

Fig. 6. *Spyridia* sp., tip of an indeterminate branch.

Fig. 7. *Tolypiocladia glomerulata*, a portion of the thallus showing determinate branches with hairs.

Fig. 8. *Wrangelia bicuspidata*, fertile portion of the filament (about 140–190 μ in diameter) showing tetrasporangia with whorls of fine, curved filaments.

Fig. 9. *Spyridia* sp., a magnified picture of the tip of a determinate branch without apical spine (about 25 μ in diameter).