Marine Benthic Algae of Guam
I. Phaeophyta[1]

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INTRODUCTION

Previous publications on the Phaeophyta (brown algae) of Guam are based on incidental species listings in four papers. Safford (1905) in an account of the useful plants of Guam includes two species of brown algae, *Padina pavonia* (L.) Lamx. and *P. commersonii* Bory, which were identified by W. L. Maxon. In a systematic compilation of 484 species of marine algae from New Guinea and the western oceans, Schmidt (1928) lists five species of brown algae from the Mariana Islands, but fails to cite the specific islands from which the collections were made.

During the period from 1951 to 1954, extensive investigations on the geology and hydrology of Guam were undertaken in cooperation with the Pacific Geological Mapping Program of the U. S. Geological Survey and U. S. Army Corps of Engineers. Emery (1962) includes three species of brown algae collected from the floor of Cocos Lagoon on the southern end of Guam. The species, identified by E. Y. Dawson, were *Padina commersonii* Bory, *Sphacelaria novaehollandiae* Sonder, and *Turbinaria trialata* (J. Ag.) Kütz.

In a treatment of the genus *Turbinaria*, Taylor (1964) cites *T. ornata* (Turn.) J. Ag. and *T. condensata* Sonder from Guam. Later in a floristic account of Asian and western Pacific marine algae, Taylor (1966) cites *Hydroclathrus clathratus* (Bory) Howe and three species of *Sargassum* (*S. crassifolium* J. Ag., *S. duplicatum* J. Ag., and *S. polycystum* C. Ag.) from Guam.

The only other island within the Marianas from which members of the Phaeophyta has been reported is Saipan located about 175 km north of Guam. Okamura (1904) lists two species, *Hydroclathrus cancellatus* Bory and *Padina pavonia*, which were collected by S. Ayabe on March 23, 1903, from the island of Saipan. In another paper on marine algae from the western Pacific, Okamura (1916) cites *Sargassum cristaefolium* C. Ag. collected by N. Yanagi in May 1915 from Saipan. Taylor (1964) also cites *Turbinaria ornata* from Saipan.

The present floristic account treats 27 species of brown algae, of which one is described as a new species. Twenty of the species enumerated here represent new records for the Mariana Islands. The materials used in this study are based on extensive collections and observations made over a three-year period on Guam

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from various habitats, e.g., tidepools, coral reef flats, raised and submerged reef margins, and wave-washed benches. The use of SCUBA has been used extensively by the author when collecting those specimens inhabiting the lower subtidal depths (7 to 35 meters deep). Dredged specimens were also examined when available. Although several additional specimens have been collected during brief field trips to the other southern Mariana Islands, i.e., Saipan, Rota, Tinian, and Aguijan, these specimens are excluded in this paper, since the species are similar to those found on Guam.

Except for the recognition of the Order Scytosiphonales (Feldmann, 1949), the system of classification as outlined by Papenfuss (1951) is adopted here. Of the eleven orders within the Class Phaeophyceae, only six orders are represented in the Guam flora and can be distinguished by utilizing the author's artificial key presented in this paper.

A brief description of each species, its habitat, and growth forms is presented. The keys, descriptions, and illustrations are original and are based on the Guam specimens examined. The depth (corrected in terms of mean lower low water), collection site, and date of collection are also provided for each specimen listed. Specimen numbers cited are those of the author (RT), L. Brinks (LB), M. R. Carlson (MRC), M. V. C. Falanruw (MVCF), J. Fletcher (JF), B. C. Stone (BCS), and R. H. Randall (RHR). In most cases, the specimens cited represent only a portion of the total number of specimens examined. All specimens cited are deposited in the University of Guam Herbarium.

BRIEF DESCRIPTION OF GUAM

Guam (Fig. 1), a "peanut-shaped" island, is the southernmost and largest of the Mariana Islands which together with the Carolines, Marshalls, and Gilberts comprise the geographic region known as Micronesia. This island, well within the rich Indo-western Pacific area, is located at 13°28′N. Lat. and 144°45′ E. Long. It is 51 km long, 6 to 18 km wide, and encompasses an area of about 640 sq. km.

The northern half of the island is a raised limestone plateau and the southern half is basically a hilly volcanic area. There are numerous streams on the southern half of the island. Tracey *et al.* (1964) report that the andesitic rocks of Guam are believed to show continental affinities and range in age from late Eocene to Recent. Fringing reefs and lagoon environments comprise about 10 percent of the island's area. The only barrier reef present on Guam is located at the south end and encloses a small lagoon (Cocos Lagoon). Detailed information on the geology of Guam is provided by Emery (1962) and Tracey *et al.* (1964).

The major current in the vicinity of Guam is the North Equatorial Current which flows in a westerly direction and splits at the northeast corner of the island into two branches. These branches pass around the island to rejoin off Apra Harbor (Emery, 1962). The tides are semi-diurnal and range from 0.6 m during neap tides to about 1.1 m during spring tides.

The sea-surface temperature ranges from 26°C to 30°C. The mean annual

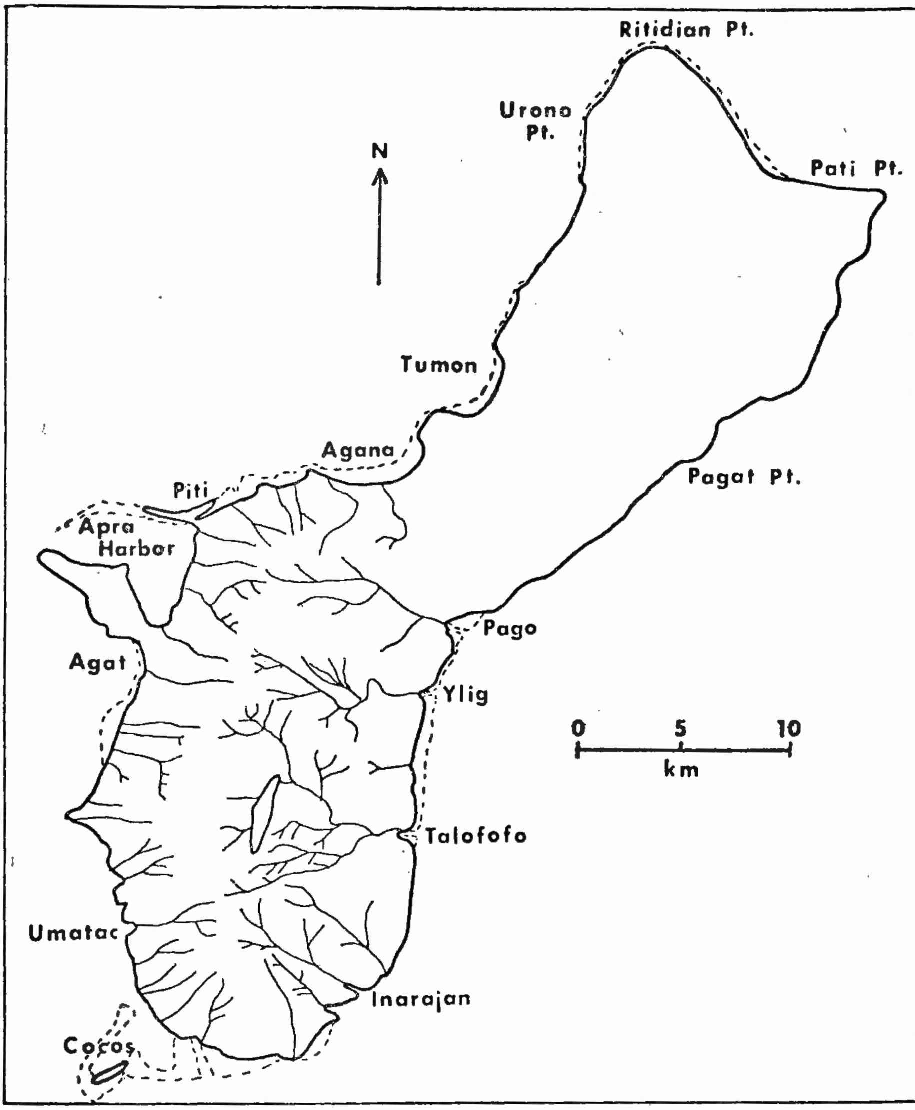

Fig. 1 Map of Guam showing reefs and drainage paterns. Adapted from Emery (1962:Fig. 28) and Tracey *et al.* (1964:Fig. 30).

rainfall ranges from 216 to 292 cm (85 to 115 inches) with a greater amount occurring during the months of July to November. The northeast tradewinds blow steadily from January to March but may be variable, though still easterly, in April to June. During the months from July to December, the winds are mostly from the southeast (Emery, 1962).

FLORISTIC ACCOUNT

ARTIFICIAL KEY TO THE ORDERS:

1. Thallus consisting of distinct "stem" bearing leaf-like appendages...... .... FUCALES
1. Not as above.. 2
   2. Thallus uniseriate or multiseriate filament, or crust-like; less than 5 cm tall 3
   2. Thallus parenchymous; usually more than 5 cm tall............ 4
3. Uniseriate filaments free or adhering to form crust-like thallus; unilocular or plurilocular reproductive organs usually present....ECTOCARPALES
3. Multiseriate filaments; propagulae usually present..SPHACELARIALES
   4. Thallus a flat blade; fan-shaped or dichotomously branched...... .... DICTYOTALES
   4. Not as above 5
5. Thallus hollow; bladder-like or dichotomously branched............. .... SCYTOSIPHONALES
5. Thallus solid; dichotomously branched.........DICTYOSIPHONALES

ORDER ECTOCARPALES

Key to families:

1. Thallus comprised of free uniseriate branched filaments; yellowish-brown..ECTOCARPACEAE
1. Thallus comprised of a prostrate crust adhering to the substratum; dark brown to black.................................RALFSIACEAE

FAMILY ECTOCARPACEAE

Key to genera:

1. Distinct growth regions absent at base of unbranched sterile filaments... .... **Ectocarpus**
1. Distinct growth regions present at base of unbranched sterile filaments.. .... **Feldmannia**

Ectocarpus Lyngbye

Ectocarpus breviarticulatus J. Agardh, 1847:7; Boergesen, 1914:17, figs. 10 a–d; Setchell, 1924:171, fig. 37; Dawson, 1954:398, figs. 14 a–b.

Plate 1, fig. 1; Plate 2, fig. 1

Thallus filamentous, tufted, up to 5 cm high, branches taper and curve in to form hook-like structures. Mature cells 30–35 μ diameter and 1–2 diameters long. Plurilocular organs subspherical, pedicelled, 38–45 μ wide, 46–50 μ long, and always arise at right angles to filament.

Two growth forms occur on the wave-washed intertidal zone along the coasts of Guam. When this alga is attached to solid substrata, e.g., basalt or limestone, the filaments appear as intertwined rope-like tufts and are up to 5 cm high. However, the filaments always occur as loose or compact tufts less than 1 cm high when occurring as epiphytes. Observations of *E. breviarticulatus* in Hawaii and Micronesia have shown this species to be frequently associated with *Chnoospora minima.* Setchell (1926) and Dawson (1954) have likewise reported this species as an epiphyte on *C. minima* from Tahiti and Vietnam, respectively. This species can be found throughout the year but is most abundant during the months from January to April. SPECIMENS EXAMINED: RT 2072, large coral near reef margin, intertidal, Tumon Bay, V–25–68; RT 2270, epiphytic on *Chnoospora minima*, wave-washed bench, Janum Pt., VIII–15–68.

Feldmannia Hamel

Key to species:

1. Plurilocular organs oblong with blunt apex..................*F. indica*
1. Plurilocular organs pyriform with tapered apex............*F. irregularis*

1. **Feldmannia indica** (Sonder) Womersley & Bailey, 1970:288; Setchell, 1924:170, fig. 35; Boergesen, 1941:16, figs. 6–7; Abbott, 1947:199, fig. 3; Taylor, 1950:95; Dawson, 1956:43, fig. 32; Buggeln and Tsuda, 1969:11.

Plate 1, fig. 2; Plate 2, fig. 2

Ectocarpus indicus Sonder *In* Zollinger, 1854:3.

Ectocarpus duchassaingianus Grunow, 1867:45, pl. 4 (fig. 1).

Giffordia duchassaingiana (Grunow) Taylor, 1960:207, pl. 29 (fig. 10); Misra, 1966:93, fig. 44.

Giffordia indica (Sonder) Papenfuss & Chihara *In* Papenfuss, 1968:30; Earle, 1969:136, fig. 27.

Thallus filamentous, loose or tufted, up to 5 cm high and diffusely branched. Mature cells 7–25 μ diameter and 1–3 diameters long, with discoid chromatophores. Plurilocular organs oblong, usually sessile but occasionally pedicelled, 16–25 μ wide, up to 175 μ long, and arising either laterally at acute angles to filaments or terminally.

The filaments occur as loose tufts, about 5 cm high, on coral in the intertidal zone or as scattered filaments, about 1 cm high, on coral in the subtidal zones to depths of 2 m. This species was found by Buggeln and Tsuda (1969) in 5 meters of water on Johnston Atoll. Mature filaments, less than 1 cm high, can also be found as epiphytes on *Sargassum* and *Turbinaria.* This species can be found throughout the year but is most dominant in the intertidal zone from January to April.

One specimen (RT 1893) possesses both lateral and terminal plurilocular organs which agrees very well with the illustration of *Ectocarpus duchassaingianus* by Setchell (1924). However, Boergesen (1941) and Abbott (1947), who have studied this species in detail, conclude that this species is synonymous with *E. indicus.* Taylor (1960) and Papenfuss & Chihara *In* Papenfuss (1968) later transfer *E. duchassaingianus* and *E. indicus*, respectively, to the genus *Giffordia*, based on the presence of discoid chromatophores and the presence of more than one type of gametangia. Recently, Womersley and Bailey (1970) in their treatise of the marine algae of the Solomon Islands transfer *E. indicus* to the genus *Feldmannia* after a detailed analysis of the Type.

SPECIMENS EXAMINED: RT 1893, epiphytic on *Turbinaria ornata*, tidal pool behind wave-washed bench, 0.5 m deep, Machadgan Pt., XI–21–67; MVCF 822, epiphytic on *Sargassum polycystum*, inner reef flat, 1 m deep, Pago Bay, IV–20–68; RT 2077, on dead *Acropora*, inner reef flat, 1 m deep, Agana Bay, V–25–68; RT 2211, epiphytic on *T. ornata*, reef margin, Tanguisson Pt., VII–11–68; RT 2260, epiphytic on *T. ornata*, reef margin, Urono Pt., VII–20–68; RT 2588, outer reef flat, intertidal, Ylig, II–9–69.

2. **Feldmannia iregularis** (Kütz.) Hamel, 1939:xvii, fig. 61f; Boergesen, 1941:23, figs. 8–11; Dawson, 1954:398, figs. 14 e–f.

Plate 1, fig. 3

Ectocarpus irregularis Kützing, 1845:234.

Thallus filamentous, loose, up to 4 cm high, rarely or diffusely branched. Mature cells 19–21 μ diameter and 2–4 diameters long. Plurilocular organs pyriform with tapered apex, about 25 μ in diameter at base, and 3 diameters long.

This species is very rare around Guam's waters. Only a single specimen (LB 3) has been found thus far.

SPECIMEN EXAMINED: LB 3, outer reef flat, Pago Bay, III–68.

FAMILY RALFSIACEAE

Ralfsia Berkeley

Ralfsia pangoensis Setchell, 1924:167, fig. 33.

Plate 2, fig. 3

Thallus crust-like, dark brown to black, 260–350 μ thick, with erect filaments uniform in diameter from base to apex. Fertile specimens have yet to be found, making this identification only tentative.

This species is found encrusted to the substratum in the upper intertidal zone throughout the year. At first glance, the appearance of *R. pangoensis* can be easily confused with *Lobophora variegata*. However, a cross-section of the specimen will easily distinguish the two species. In addition, *L. variegata* is restricted to the subtidal zone.

SPECIMENS EXAMINED: RT 2073, near reef margin on large coral, intertidal, Tumon Bay, V–25–68; RT 2179, near reef margin on large coral, intertidal, Asanite Bay, VI–23–68; RT 2280, wave-washed bench, Janum Pt., VIII–15–68.

ORDER SPHACELARIALES

FAMILY SPHACELARIACEAE

Sphacelaria Lyngbye

Key to species:

1. Propagula with 2 slender horns, up to 150 μ long.......... *S. furcigera*
1. Propagula with 2 knob-like horns, up to 10 μ long; or without horns.. 2
   2. Without horns, ultimate cell division perpendicular to axis of propagula .... *S. novaehollandiae*
   2. Two knob-like horns, ultimate division nearly parallel to axis of propagula .... *S. tribuloides*

1. **Sphacelaria furcigera** Kützing, 1855:27, pl. 90 (fig. 2); Boergesen, 1941:46, fig. 21; Dawson, 1954:40, fig. 14h.

Plate 1, fig. 4

Thallus multiseriately filamentous, up to 1 cm high, ca. 40 μ diameter, and sparsely branched. Propagula Y-shaped, 2-cell thick, and up to 150 μ long.

This alga is extremely rare on the reefs of Guam. Only a single specimen has thus far been collected. A few specimens have been found in the stomach of *Acanthurus* spp. *Sphacelaria furcigera* is very common in Hawaii and occurs exclusively as an epiphyte, especially on *Sargassum*. It is not surprising that the single Guam specimen was also found on *Sargassum*.

SPECIMEN EXAMINED: RT 2638, epiphytic on *Sargassum cristaefolium*, reef margin, Ipao Beach, III–23–69.

2. **Sphacelaria novaehollandiae** Sonder, 1845:50; Boergesen, 1941:45, figs. 20 a–d; Dawson, 1954:400, fig. 14 g.

Plate 1, fig. 5

Aside from a specimen determined by E. Y. Dawson (Emery, 1962) from Cocos Lagoon, the only other record of this species on Guam is a single propagula found by the author in the stomach of *Cirripectes* sp., a blenny, collected off Tanguisson in February 1970.

3. **Sphacelaria tribuloides** Meneghini, 1840:2; Boergesen, 1941:41, figs. 18 a–c; Dawson, 1954:400, figs. 14 i–j.

Plate 1, figs. 6–9; Plate 2, fig. 4

Thallus forming hemispherical tuft, up to 3 cm high, 45–50 μ diameter, and rather profusely branched. Terminal portion of the filaments may possess numerous colorless hairs. Propagula pedicelled, up to 125 μ in length, with two knob-like horns.

Some of the specimens possess larger propagulae, up to 200 μ long, which have two slender tapered horns comprised of two to three cells and may at first be relegated to the species *S. rigida* Hering. However, further microscopic examinations reveal all propagulae to be detached and these structures are now interpreted as being germinating propagulae of *S. tribuloides*.

This species can be found throughout the year, especially during January to

April, on coral substratum or as epiphytes in both the intertidal and subtidal zones.
SPECIMENS EXAMINED: RT 1769, dead coral, 20 meters deep, off Agana Outfall, X–10–67; RT 1815, outer reef flat, intertidal, Saupon Pt., XI–10–67; RT 2008, epiphytic on *Sargassum polycystum*, inner reef flat, Ipan Beach, IV–9–68; RT 2081, epiphytic on *Sargassum cristaefolium* and *Turbinaria ornata*, raised reef margin, Asan, V–25–68; RT 2589, outer reef flat, intertidal, Ylig, II–9–69.

ORDER DICTYOTALES

FAMILY DICTYOTACEAE

Key to genera:

1. Thallus fan-shaped 2
1. Thallus strap-like, palmately or dichotomously branched 3
    2. Fronds with inrolled apical margins, concentric rings conspicuous .... **Padina**
    2. Fronds without inrolled apical margins, concentric rings not conspicuous .... **Lobophora**
3. Thallus strap-like or palmately branched .... **Zonaria**
3. Thallus dichotomously branched 4
    4. Midrib present .... **Dictyopteris**
    4. Midrib absent .... **Dictyota**

Dictyopteris Lamouroux

Dictyopteris repens (Okamura) Boergesen, 1920:265; Dawson, 1956:4, fig. 34.
Plate 3, fig. 1

Haliseris repens Okamura, 1916:8.

Thallus flat, dichotomously branched, 2–3 cm high, 60–70 μ thick, with distinct midrib, 90–105 μ thick. Hair-like projections, present on some specimens, arise from ventral side of midrib and function as attachment organs and at times present on lateral margins.

Critical comparison between this species and *D. delicatula* Lamx. as found in the Atlantic will probably show them to be synonymous. However, this name is retained until fresh specimens from the Atlantic can be compared with the Pacific collections. Taylor (1950) cites *D. delicatula* as occurring on the reefs of Bikini.

Dictyopteris repens seems to be restricted to deeper waters and is probably present throughout the year.

SPECIMENS EXAMINED: RT 2644, terrace, 25 m deep, Tanguisson Pt., IV–17–69; RT 4315, reef slope, 13 m deep, Apra Harbor, I–19–72; RT 4471, dredged from 70–90 m deep off Babi I., Merizo, VI–7–72.

Dictyota Lamouroux

Key to species:

1. Margins serrated.......................................*D. patens*
1. Margins entire, proliferations may be present at basal portion........ 2
   2. Thallus spirally twisted.................................... 3
   2. Thallus not spirally twisted.................................. 4
3. Thallus erect, spirally twisted throughout..................*D. cervicornis*
3. Thallus prostrate forming clumps, terminal branches slightly twisted.... ....*D. bartayresii*
   4. Apex acute; thallus narrow, usually less than 1 mm wide.......... ....*D. divaricata*
   4. Apex rounded; thallus wide, 2 to 4 mm..................*D. friabilis*

1. **Dictyota bartayresii** Lamouroux, 1809a:331; Taylor, 1960:219, pl. 30 (fig. 2).

Plate 3, figs. 2–3

Thallus prostrate, greenish-brown, compact or loosely clumped, with dichotomous branches up to 8 cm long and 1–4 mm wide, forming angles of about 45°. Lower mature branches with or without proliferations, and terminal branches twisted or non-twisted with rounded or acute apex. Internodes vary from 3–15 times the width depending on depth collections were made.

Two growth forms can be found on Guam. The first, which is by far the most common *Dictyota* on the inner reef flats, consists of compact clumps usually wedged among the branches of the staghorn coral, *Acropora*, in water less than 1 m in depth. The branches are about 2 to 4 mm wide with short internodes, 3 to 5 times the width. In most cases, the terminal branches of the thallus are spirally twisted.

The second form inhabits deeper turbid waters. In this case, the alga forms loose prostrate mats. The branches are narrow, 1 to 2 mm wide, with extremely long internodes ranging from 10 to 15 times the width. The greater length of the internodes is probably due to limited light conditions in this habitat. The elongated internodes are analogous with that of terrestrial plants, e.g., legumes, kept in darkened environments.

SPECIMENS EXAMINED: RT 1744, inner reef flat, 0.5 m deep, Tumon Bay, X–13–67; RT 2041, intake channel, 3 m deep, Piti, IV–19–68; MVCF 795, terrace, 3 m deep, between reef margin and Alupan I., Agana Bay, III–31–68; RT 2078, inner reef flat, 0.5 m deep, Asan, V–25–68; RT 2507, terrace, 6 m deep, Gun Beach, XII–12–68; RT 2536, inner reef flat, 0.5 m deep, Tumon Bay, I–11–69; RT 2572, inner reef flat, 0.5 m deep, Piti, I–26–69; RT 2600, large pool, 6 m deep, Bomb Hole, Asan, III–1–69; RT 2612, reef front, 16 m deep, Manell Channel, III–8–69.

2. **Dictyota cervicornis** Kützing, 1859:11, pl. 24 (fig. 2); Taylor, 1960:222, pl. 31 (fig. 2).

Plate 3, fig. 4; Plate 4, fig. 1

Thallus erect, greenish-brown to brown, with twisted dichotomous branches up to 10 cm high and 1–2 mm wide arising from a slightly wider basal portion, 3–4 mm wide. Terminal branches taper to an acute apex. Tetrasporangia scattered on dorsal side of thallus.

A few of the specimens appear very much like *D. acutiloba* J. Ag. when the widened basal portion is absent. Other specimens which are narrow and conspicuously twisted appear like the terminal branches of *D. bartayresii*. However, repeated observations of populations of *D. bartayresii* on the inner reef flats of Tumon Bay have failed to reveal a transition to a long spirally twisted thallus.

SPECIMENS EXAMINED: RT 1983, inner reef flat, 0.5 m deep, Pago Bay, III–21–68; RT 2057, inner reef flat, 0.5 m deep, Pago Bay, V–1–68.

3. **Dictyota divaricata** Lamouroux, 1809b:43; Dawson, 1957:110, fig. 14b; Earle, 1969:160, figs. 45, 46, 58.

Plate 4, fig. 2

Thallus erect or prostrate, often in loose mats, 3–4 cm high and 0.5–3 mm wide at the basal portion, tapering to an acute apical tip. Angles between dichotomy usually wide, up to 100°, but in some cases acute.

The only specimens found on Guam are from deeper waters (7 to 33 m deep). The morphological variability and its occurrence in deeper waters may very well indicate these specimens to be another growth form of *D. bartayresii* growing under reduced light conditions. This situation is even more evident when narrow branches are found at the basal portion of some specimens of *D. bartayresii* inhabiting the reef flats. The narrow branches may form under low light conditions caused by the shading effect from the larger terminal branches.

SPECIMENS EXAMINED: RT 2248, on dead *Acropora*, 25 m deep, seaward side of Double Reef, VII–20–68; RT 2444, 8 m deep, seaward side of Double Reef, IX–26–68; RT 2643, on dead *Acropora*, 18 m deep, Tanguisson Pt., IV–17–69.

4. **Dictyota friabilis** Setchell, 1926:91, pl. 13 (fig. 4–7) and pl. 20 (fig. 1).

Plate 4, fig. 3

Thallus prostrate, iridescent bluish-green when living, often in compact clumps. Branches 3–4 cm long and 1–4 cm wide, with apices rounded or tapered. Sporangia scattered on the dorsal side of thallus.

Unlike the Type specimen from Tahiti which the author has examined, the Guam specimens possess both rounded and tapered apices in the same clump. The author has encountered similar morphological forms on the seaward Natatorium wall off Waikiki Beach in Hawaii. At times, brown bands may be present across the width of living thalli, but soon disappear when exposed to air.

SPECIMENS EXAMINED: RT 2014, outer reef margin, 0.5 m deep, Bordallo's Beach, IV–9–68; RHR 114, reef front, Tumon Bay, V–4–68.

5. **Dictyota patens** J. Agardh, 1882:93; Dawson, 1954:401, fig. 16c.

Plate 4, fig. 4

Thallus prostrate, up to 3 cm long and 2–4 mm wide, with dichotomous branches possessing conspicuous dentitions along margins which terminate to a rounded apex. Juveniles lacking dentitions. Internode length vary from 2–4 times width, depending on environmental conditions. Reproductive organs and rhizoids scattered throughout the dorsal side of thallus.

This species is restricted to the terraces beyond the reef margin in 3 to 20 meters of water.

SPECIMENS EXAMINED: RT 2225, terrace, 13 m deep, Orote Pt., VII–16–68; RT 2513, reef front, 3 m deep, east side of Anae I., I–1–69.

Lobophora J. Agardh

Lobophora variegata (Lamx.) Womersley, 1967:221.

Plate 5, fig. 1

Dictyota variegata Lamouroux, 1809a:331.
Zonaria variegata (Lamx.) C. Agardh, 1817:xx.
Pocockiella variegata (Lamx.) Papenfuss, 1943:467, figs. 1–14.

Thallus fan-shaped, prostrate in overlapping clusters attached by numerous rhizoids on lower surface. Blades, up to 3 cm long and 100 μ thick; cross-section consisting of a single layer of medullary cells, up to 50 μ wide, between 2 or more layers of subcortical cells with a single layer of cortical cells present on the dorsal and ventral surfaces.

This species occurs throughout the year on both the shallow reef flats and the deeper reef slopes, but is more abundant from November to April.

SPECIMENS EXAMINED: RT 1785, on *Trochus* shell, 30 m deep, near Agana Outfall, VIII–10–67; RT 1995, inner reef flat, 0.5 m deep, Pago Bay, III–21–68; RT 2017, inner reef flat, 0.5 m of water, Pago Bay, IV–16–68; RT 2187, outer reef flat, Ylig, VI–30–68; RT 2251, terrace, 35 m deep, seaward side of Double Reef, VII–20–68; RT 2257, wave-washed bench, Urono Pt., VII–20–68; RT 2573, inner reef flat, 0.5 m deep, Piti, I–26–69.

Padina Adanson

Key to species:

1. Reproductive organs occurring in concentric rows above every hair zone .... *P. minor*
1. Reproductive organs occurring in concentric rows above every other hair zone 2
    2. Fertile zone slightly narrower than sterile zone, slightly calcified .... *P. tenuis*
    2. Fertile zone equal in width to sterile zone, heavily calcified .... *P. jonesii* sp. nov.

1. **Padina minor** Yamada, 1925:251.

Plate 5, fig. 2

Thallus moderately calcified, up to 7 cm high; blades 2-cell thick throughout and 60–75 μ thick at basal portion. Tetrasporangia non-indusiate, in concentric rows on ventral surface above and touching every hair zone. Fertile and sterile zones equal in width.

This species is found throughout the year on the inner reef flats and in tidal pools on the outer reef flats. *Padina tenuis* is often found in association with this species. If not for the absence of indusia, these specimens would be comparable to *P. japonica* Yamada.

SPECIMENS EXAMINED: BCS 4878b, Asanite Bay, XI–2–63; RT 2023, inner reef flat, 0.5 m deep, Pago Bay, IV–16–68; RT 2043, intake channel, 3 m deep, Piti, IV–19–68; RT 2063, inner reef flat, 0.5 m deep, Tumon Bay, V–11–68; RT 2147, beachdrift, Pago Bay, VI–22–68; RT 2176, inner reef flat, 0.5 m deep, Pago Bay, VII–24–68; RT 2285, wave-washed bench, in pool, between Catalina Pt. and Anao Pt., VIII–16–68.

2. **Padina jonesii** n. sp.

Plate 5, fig. 3

Thallus altitudinem 10 cm attingentes, subbrunnei calce valde incrustati, fragiles, superficie ventrali zonis conspicue insigniti; aspectes proni; laminis reniformibus omnino duarum cellularum crassis, 70–75 μ ad basim crass; tetrasporangiis non indusiatis, diametro ca. 75 μ, inseriebus concentricis supra zonas piliferas alternantes prositis.

Thallus up to 10 cm tall, light brown, heavily calcified, brittle, conspicuously zoned on ventral surface (away from inrolled margin), consisting of blades which adhere to each other or to substratum by rhizoids arising from ventral surface; prostrate in appearance. Small discoid holdfast evident on solitary thallus but inconspicuous or absent when thalli occur in aggregated stands. Blades reniform, 2-cell thick throughout and 70–75 μ thick at basal portion. Tetrasporangia non-indusiate, ca. 75 μ in diameter, occurring in concentric rows above every other hair zone on ventral surface only; fertile and sterile zones equal in width. Sexual thalli not seen.

The prostrate nature of the blades differ from *Padina thivyi* Doty & Newhouse in being only loosely attached to each other. *Padina jonesii* also differs from *P. thivyi* by lacking indusia over the sori, possessing reproductive organs on only the ventral surface, and being much more calcified. The physical appearance of *P. jonesii* is similar to *P. mexicana* Dawson but the distromatic character easily separates it from the Mexican species.

Padina jonesii is restricted to the deeper waters (3 to 40 meters) over the reef margin and is present throughout the year. This species is named in honor of Dr. Robert S. Jones, a colleague and friend, who was the author's sole diving partner during the early years of our tenure with the University of Guam.

Holotype: Tsuda 2205, collected by the author on coral rubble from the seaward slope in 3 meters of water at Double Reef on the island of Guam on July 11, 1968. The specimen is deposited in the Herbarium of the U. S. National Museum of the Smithsonian Institution.

OTHER SPECIMENS EXAMINED: RT 2227, terrace, 13 m deep, seaward side of Camel Rock, Asan, VII–16–68; RT 2247, terrace, 33 m deep, seaward side of Double Reef; VII–20–68; RT 4316, 13 m deep, reef slope, Apra Harbor, I–19–72.

3. **Padina tenuis** Bory, 1827:590; Womersley and Bailey, 1970:292.

Plate 5, fig. 4

Padina commersonii Bory, 1829:144; Emery, 1962:20.

Padina boryana Thivy *In* Taylor, 1966:355, fig. 2.

Thallus slightly calcified, up to 13 cm high, consisting of numerous light brown fan-shaped blades which arise from a conspicuous holdfast. Blades 2-cell thick throughout and 75–110 μ thick at basal portion. Tetrasporangia non-indusiate, in concentric rows on ventral surface, rarely on dorsal surface, above every other hair zone (includes hair zones on both surfaces), or sometimes scattered towards the base on every hair zone. Hair zones well developed on dorsal surface; fertile zones slightly narrower than sterile zones.

This species is commonly found in the inner reef flats and is most abundant during March to June.

SPECIMENS EXAMINED: BCS 4878a, Asanite Bay, XI–2–63; JF 54, inner reef flat, Inarajan, IV–5–66; RT 1742, inner reef flat, 0.5 m deep, Tumon Bay, X–13–67; RT 1873, inner reef flat, 0.5 m deep, Asanite Bay, IV–6–67; RT 2010, inner reef flat, 0.5 m deep, Ipan Beach, IV–9–68; RT 2080, inner reef flat, 0.5 m deep, Asan, V–25–68; RT 2484, inner reef flat, 0.5 m deep, Tumon Bay, I–11–69.

Zonaria C. Agardh

Zonaria stipitata Tanaka and K. Nozawa, 1962:183, fig. 4 and pl. IB.

Thallus flabellate or palmately branched, occasionally strap-like in appearance, up to 8 cm high and 150–175 μ thick. Stipe cylindrical, up to 2 cm long, attached to substratum by a hairy discoid holdfast. Vague line radiates from upper portion of stipe and become indistinct at apex. Five layers of similar size cells present at upper portion of thallus; basal portion usually possesses six layers of cells. All specimens examined were sterile.

SPECIMENS EXAMINED: RT 4472, dredged from 70–90 m deep off Babi I., Merizo, VI–7–72.

ORDER SCYTOSIPHONALES

FAMILY SCYTOSIPHONACEAE

Key to genera:

1. Thallus bladder-like .... **Colpomenia**
1. Thallus not bladder-like, branched 2
   2. Thallus with dichotomous to subdichotomous branches.. **Rosenvingea**
   2. Thallus with a network of branches .... **Hydroclathrus**

Colpomenia Derbès & Solier

Colpomenia sinuosa (Roth) Derbès and Solier, 1856:11, pl. 22 (figs. 18–20); Dawson, 1954:402, figs. 18 a, c, d.

Plate 6, fig. 1

Thallus bladder-like, light brown to yellow, and up to 10 cm in diameter.

Colorless hairs scattered throughout thallus.

Only three specimens (gametophyte generation) have been found to date along the coast of Guam and all collected in the month of March. It seems that this species is merely a "visitor" to the coast of Guam. In Hawaii, this species is common throughout the year on the inner reef flats attached to corals or occurring as epiphytes on *Sargassum* spp.

SPECIMENS EXAMINED: RT 2635, beachdrift, Tumon Bay, III–25–69; RT 2822, attached to *Hydroclathrus clathratus*, near reef margin, Tumon Bay, III–22–69; RT 2831, epiphytic on *Sargassum cristaefolium*, reef margin, Tumon Bay, III–23–69.

Hydroclathrus Bory

Hydroclathrus clathratus (C. Ag.) Howe, 1920:590; Dawson, 1954:403, fig. 18b; Taylor, 1950:96.

Plate 6, fig. 2

Hydroclathrus cancellatus Bory, 1825:419; Okamura, 1904:81.

The light brown irregularly shaped thallus consists of extensive network of hollow branches up to 50 cm in diameter. This species, i.e., the gametophyte generation, is restricted to the outer reef flat and margin during its initial stage of growth in January and February. However, large thalli can be found throughout the reef flat during March and April. This generation is absent during the remainder of the year.

SPECIMENS EXAMINED: BCS 4964, beachdrift, Tumon Bay, II–2–64; JF 36, outer reef flat, Asanite Bay, IV–5–66; RT 1860, outer reef flat, Saupon Pt. IV–27–67; RT 1878, outer reef flat, Asanite Bay, III–21–68.

Rosenvingea Boergesen

Rosenvingea intricata (J. Ag.) Boergesen, 1914:181; Dawson, 1957:111, fig. 15.

Plate 6, fig. 3

Thallus producing short branches with blunt tips, spongy in texture. Branches hollow throughout consisting of a single layer of cortical cells and approximately 1 to 2 layers of larger medullary cells.

This species seems to be rare in Guam waters.

SPECIMENS EXAMINED: RT 2908, outer reef flat, Tanguisson Pt., II–18–70; RT 3792, on rubber tire, 6–7 m deep, Cocos Lagoon, XII–16–70.

ORDER DICTYSIPHONALES

FAMILY CHNOOSPORACEAE

Chnoospora J. Agardh

Key to species:

1. Thallus consisting of erect compressed branches............*C. minima*

1. Thallus consisting of loose or intertangled cushions of stiff cylindrical branches . . . . *C. implexa*

1. **Chnoospora implexa** (Hering) J. Agardh, 1848:172; Dawson, 1954: 404, figs. 20 a, b.

Plate 6, fig. 4

Thallus dichotomously branched, forming intertangled clumps up to 10 cm high or free thalli up to 30 cm high. Branches solid or hollow, less than 2 mm in diameter terminating in tapered or rounded tips. In cross section, the solid cylindrical branches consist of a single outer layer of cortical cells and approximately 7 layers of larger medullary cells.

This species is not too abundant in Guam waters. It is of interest to note here that when dried herbarium specimens of matured forms are resoaked for further examination, the branches become very flaccid with the tips becoming very tapered. This form then resembles *Rosenvingea orientalis* (J. Ag.) Boerg.

SPECIMENS EXAMINED: MRC 16, inner reef flat, 0.5 m deep, Tumon Bay, IV–16–68; RT 2032, intake channel, 3 m deep, Piti, IV–19–68; RT 2079, inner reef flat, 0.5 m deep, Asan, V–25–68; RT 2249, terrace, 10 m deep, seaward side of Double Reef, VII–20–68.

2. **Chnoospora minima** (Hering) Papenfuss, 1956:69; Misra, 1966:123.

Plate 6, fig. 5

Chnoospora pacifica J. Agardh, 1847:7; Dawson, 1954:405, fig. 20c.

Thallus dichotomously branched, up to 10 cm high, attached by a single disc-shaped holdfast. Branches flattened, ca. 1 mm wide, with numerous tufts of colorless hairs. In cross section, the solid branches consist of a single layer of cortical cells, ca. 6 μ in diameter, and numerous larger medullary cells up to 9 μ in diameter.

This species is restricted to the upper intertidal zone in wave-washed areas and is most abundant during January to June. *Ectocarpus breviarticulatus* is the most common epiphyte on this species.

SPECIMENS EXAMINED: RT 2031, large coral, intertidal zone, entrance to Piti channel, IV–19–68; RHR 103, intertidal, seaward side of Facpi Pt., V–9–68; RT 2239, periphery of blow hole, Camel Rock, Asan, VII–16–68; RT 2269, wave-washed bench, Janum Pt., VIII–15–68; RT 2282, wave-washed bench, between Catalina Pt. and Anao Pt., VIII–16–68.

ORDER FUCALES

FAMILY SARGASSACEAE

Key to genera:

1. Thallus with fleshy simple "leaves" . . . . **Sargassum**
1. Thallus with hard peltate "leaves" . . . . **Turbinaria**

Sargassum C. Agardh

The genus *Sargassum* has always been the most difficult tropical genus in terms of species separation within the Division Phaeophyta. This is mainly due to the various growth forms that appear among the specimens, both in terms of maturity stages and ecological growth forms.

Although several species appear to be present on Guam, the author has "lumped" them into three species which are not only distinguished by their general morphology but in their habitat preference. The author has already presented a paper (Tsuda, in press) on the morphology, zonation, and seasonality of the two species of *Sargassum* which inhabit the reef flats at the VII International Seaweed Symposium.

Key to species:

1. Proliferations present on branches .... *S. polycystum*
1. Proliferations absent on branches 2
   2. Secondary branches flattened, "leaves" expanded at upper portion .... *S. cristaefolium*
   2. Secondary branches cylindrical, "leaves" not expanded but elongated .... *S. tenerrimum*

1. **Sargassum cristaefolium** C. Agardh, 1820:13; Womersley and Bailey, 1970: 296, fig. 6.

Plate 7, figs. 1–2

Sargassum crassifolium J. Agardh, 1848:326; Taylor, 1966:357.

Sargassum duplicatum J. Agardh, 1889:90; Taylor, 1966:357; Tsuda, in press.

Thallus up to 30 cm high, attached to substratum by a single discoid holdfast. Secondary branches flattened and smooth. "Leaves" narrow and strap-like, about 4–5 cm long in juvenile plants; successive "leaves" during maturation becoming shortened (1–3 cm long) and thickened to form the characteristic "duplicate leaves". Air bladders spherical and smooth, up to 15 mm in diameter. Receptacles slightly moniliform, with few spines, forming loose or compact clusters about 5 mm long.

Two distinct forms occur on the reef margins during the months of January to August and seem to represent the male and female thalli (dioecious) of this species. The female thalli are dark brown in color and characterized by their slightly longer (2–3 cm long) "duplicate leaves" which are not widely expanded at the apex. On the other hand, the male thalli are lighter brown and possess short fleshy "duplicate leaves" about 1 to 2 cm long. This latter form falls within the circumcription of *S. crassifolium* J. Ag.

SPECIMENS EXAMINED: RT 1838, reef margin, Bordallo's Beach, V–25–67; RT 1871, reef margin, Asanite Bay, IV–6–67; RT 2076, reef margin, Agana Bay, V–25–68; RT 2135, reef margin, Karen Beach, VI–5–68; RT 2177, reef margin, Asanite Bay, VI–23–68; RT 2221, reef margin, Asanite Bay, VII–13–68; RT 2241, seaward reef margin, Camel Rock, Asan, VII–16–68; RT 2301, wave-washed bench, NE of Ritidian Pt., VIII–16–68; RT 2308, reef margin, Inarajan, VIII–19–68; RT 2575, reef margin, Piti, I–26–69; RT 2640, reef margin, Tanguisson Pt., IV–18–69.

2. **Sargassum polycystum** C. Agardh, 1824:304; Taylor, 1966:357.

Plate 7, fig. 3

Thallus up to 2 m long, attached to substratum by a discoid holdfast as well as a dense rhizoidal basal system with gives rise to several erect primary branches. Secondary branches cylindrical with numerous Y-shaped proliferations. "Leaves" thin, with frilled serrated margins, up to 5 cm long and 1 cm wide on immature thalli, decreasing in size to ca. 1 cm long and 4 mm wide on more mature terminal branches. In some cases, the terminal portions of mature thalli consist of leafless axis bearing numerous receptacles and minute spherical air bladders about 2 mm in diameter.

This species, a perennial, is abundant on the inner reef flats especially near shore.

SPECIMENS EXAMINED: RT 1921, inner reef flat, 1 m deep, Pago Bay, XI–30–67; RT 2042, intake channel, 3 m deep, Piti, IV–19–68; RT 2075, inner reef flat, 0.5 m deep, Agana Bay, V–25–68; RT 2135, inner reef flat, 0.5 m deep, Karen Beach, VI–5–68; RT 2263, inner reef flat, 0.5 m deep, Pago Bay, VII–24–68; RT 2482, inner reef flat, 1 m deep, Tumon Bay, XI–1–68.

3. **Sargassum tenerrimum** J. Agardh, 1848:305; Misra, 1966:174, fig. 92 and Pl. VI.

Plate 7, fig. 4

Thallus light brown, up to 40 cm tall, and attached to substratum by a single discoid holdfast. Axis smooth, usually cylindrical but at times slightly compressed, bearing several short branches radially arranged. "Leaves" narrow, serrated, 1–2 mm wide and up to 6 cm long. Air bladders rare or absent. Receptacles branched forming small clusters.

This species is restricted to tidepools on wave-washed benches, particularly along the windward coast of Guam.

SPECIMENS EXAMINED: RT 2267a, tidepool on wave-washed bench, 1 m deep, Janum Pt., VIII–15–68; RT 2296, tidepool on *Porolithon* ridge, 0.5 m deep, Pati Pt., VIII–16–68.

Turbinaria Lamouroux

Turbinaria ornata (Turner) J. Agardh, 1848:266; Taylor, 1964:483, pl. 3 (figs. 1–6).

Plate 8, figs. 1–3

Turbinaria trialata (J. Ag.) Kützing, 1860: pl. 67 (fig. 2); Emery, 1962:20.

Turbinaria condensata Sonder *In* Kützing, 1860:25, pl. 69II; Taylor, 1964: 482, pl. 2 (figs. 18–28).

Thallus 8–40 cm high, attached to substratum by a dense rhizoidal basal system; main axis bearing few to several branches (up to 8 cm long) or absent. "Leaves" 15–20 mm long and 7–15 mm wide, but shrinking to one-half to two-thirds their original size when dried; dentitions on lateral ridges absent or present (1–3 in number). Inflated vesicles present or absent. Intramarginal crowns with blunt teeth. Receptacles racemose and located about one-third the distance from the axis of the "leaf" stalk.

Two ecological growth forms of this species can be found on the reefs of Guam. The most abundant form occurs in crevices or exposed on reef margins during low tides, and is characterized by being turgid and erect, up to 10 cm high, bearing few or no branches. The peltate "leaves" are large (10–15 mm wide) and possess conspicuous intramarginal crowns.

The second form is rather distinct in that it is profusely branched with reduced "leaves", 7–10 mm wide, and possesses conspicuously inflated vesicles. A few of the specimens collected are up to 40 cm in height. This form is restricted to the inner reef flats, and is comparable to *Turbinaria condensata* Sonder as cited from Guam by Taylor (1964). Taylor (1964) cites the dentate nature of the lateral longitudinal ridges as one characteristic which separates *T. condensata* from *T. ornata*. Examination of hundreds of specimens of *T. ornata* revealed this characteristic to be present in more than 60 percent of all specimens examined.

Personal communications with both Dr. Paul C. Silva, University of California-Berkeley, and Dr. Wm. Randolph Taylor, University of Michigan, reveal that Rodin's specimen (viii 65, UC) from Guam on which Dr. Taylor's identification of *T. condensata* is based cannot be located at this time in either Herbaria. Thus, there is no way for the author to verify that Rodin's specimen does in fact differ significantly from the profusely branching form of *T. ornata* present on Guam.

The author is convinced that the unbranched and profusely branched specimens which occur throughout the year belong to the same taxon because he has been able to follow the developmental transformation in the field. It seems logical for a short turbid form to occur on the reef margins where the thalli have to withstand the continual surge of the incoming waves.

E. Y. Dawson (Emery, 1962) identified a specimen from Cocos Lagoon as *Turbinaria trialata* (J. Ag.) Kütz. The only other Pacific record of this species is reported by Dawson (1956) from Jaluit Island in the southern Marshalls. Since Taylor (1964) cites this specimen (D. 13062) under *T. ornata* v. *ornata* f. *ecoronata*, it seems that the Guam specimen may be also referrable to f. *ecoronata*.

Until such time as Rodin's specimen can be located and shown to be a separate entity, the author recognizes only one species, *T. ornata,* from Guam.

SPECIMENS EXAMINED: RT 1834, outer reef flat, Nimitz Beach, IV–22–67; RT 1842, reef margin, Bordallo's Beach, V–25–67; RT 2012, inner reef flat, 0.5 m deep, Ipao Beach, IV–9–68; RT 2018, in crevices on reef margin, 0.2 m deep, Pago Bay, IV–16–68; RT 2022, inner reef flat, near channel, 0.5 m deep, Pago Bay, IV–16–68; RT 2481, outer reef flat, 0.5 m deep, Tumon Bay, XI–1–68; RT 2641, terrace, 13 m deep, Tanguisson Pt., IV–18–69.

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LITERATURE CITED

Abbott, I. A. 1947. Brackish-water algae from the Hawaiian Islands. Pac. Sci. 1(4):193–214.

Agardh, C. A. 1817. Synopsis algarum Scandinaviae. Lund. xl+135 p.

———. 1820. Species Algarum Rite Cognitae, cum Synonymis, Differentus Specificis et Descriptionbis Succinctis. 1(1):1–68. Lund.

———. 1824. Systema algarum. Lund. xxxviii+312 p.

Agardh, J. G. 1847. Nya alger från Mexico. Svenska Vetensk. Akad., Ofversigt af Forhandl. 4:5–17.

———. 1848. Species genera et ordines algarum. Vol. 1, Lund. viii+363 p.

———. 1882. Till algernes systematik. Nya bidrag. (Första afd.). Lunds Univ. Arsskr. 17(Afd. 3, Nr. 4):134 p.

———. 1889. Species Sargassorum australiae. K. Svenska Vet.-Akad. Handl., (ser. 4), 23(3):133 p.

Boergesen, F. 1914. Marine algae of the Danish West Indies. Part 2. Phaeophyceae. Dansk Bot. Arkiv 2(2):157–224.

———. 1920. Marine algae from Easter Island, *In* C. Skottsberg, The natural history of Juan Fernandez and Easter Island, 2(9):247–309, Almqvist and Wiksells, Uppsala.

———. 1941. Some marine algae from Mauritius. II. Phaeophyceae. K. Danske Vid. Selsk., Biol. Medd. 16(3):1–81.

Bory De Saint-Vincent, J. B. G. M. 1825. Hydroclathre. Dict. Class. Hist. Nat. 8:419–420.

———. 1827. Padine. Dict. Class. Hist. Nat. 12:589–591 (Paris).

———. 1829. Voyage Autour du Monde, exécuté par ordre du Roi sur la Corvette de sa Majesté, "La Coquille", pendant des annees 1822–1825, Botanique, Cryptogamie. Paris. 137–300.

Buggeln, R. G., and R. T. Tsuda. 1969. A record of benthic algae from Johnston Atoll. Atoll Res. Bull. 120:1–20.

Dawson, E. Y. 1954. Marine plants in the vicinity of the Institut Oceanographique de Nha Trang, Viet Nam. Pac. Sci. 8(4):373–481.

———. 1956. Some marine algae of the southern Marshall Islands. Pac. Sci. 10(1):25–66.

———. 1957. An annotated list of marine algae from Eniwetok Atoll, Marshall Islands. Pac. Sci. 11(1):92–132.

Derbès, A., and A. J. J. Solier. 1856. Memoire sur quelques points de la physiologie des algues. Acad. des Sci. Compt. Rend. (Paris), Suppl. 1:1–120.

Earle, S. A. 1969. Phaeophyta of the eastern Gulf of Mexico. Phycologia 7(2):71–254.

Emery, K. O. 1962. Marine geology of Guam. U.S. Geol. Surv., Prof. Pap., 403–B:76 p.

Feldman, J. 1949. L'ordre des Scytosiphonales. Mem. Hist. Nat. Afr. Nord., hors-ser, 2:103–115.

Grunow, A. 1867. Algae. *In* Reise der Österreichischen Fregatte "Novara" um die Erde in den Jahren 1857, 1858, 1859 . . . Bot. Thiel, 1:1–104.

Hamel, G. 1939. Phaeophycées de France, Paris. Fasc. v:337–432.

Howe, M. A. 1929. Algae. *In* N. L. Britton and C. F. Millspaugh, The Bahama flora. New York. 553–626.

Kützing, F. T. 1845. Phycologia germanica. Nordhausen. 242 p.

————. 1855. Tabulae phycologicae . . . Nordhausen. Vol. V, ii+30 p.

————. 1859. Tabulae phycologicae . . . Nordhausen. Vol. IX. vii+42 p.

————. 1860. Tabulae phycologicae . . . Nordhausen. Vol. X. iv+39 p.

Lamouroux, J. V. F. 1809a. Observations sue la physiologie des algues marines, et description de cinq nouveaux genres de cette famille. Nouv. Bull. Sci. Soc. Philom., Paris 1:330–333.

————. 1809b. Exposition des caracteres du genre *Dictyota*, et tableau des especes qu'il renferme. J. Bot. (Desvaux) 2:38–44.

Meneghini, G. 1840. Lettera al Dott. J. Corinaldi a Pisa. Padova.

Misra, J. N. 1966. Phaeophyceae in India. Indian Council of Agricultural Research, New Delhi. 203 p.

Okamura, K. 1904. List of marine algae collected in Caroline Islands and Australia. Bot. Mag. (Tokyo) 18:77–96.

————. 1916. List of marine algae collected in Caroline Islands and Marianna Islands, 1915. Bot. Mag. (Tokyo) 30:1–14.

Papenfuss, G. 1943. Notes on algal nomenclature. II. *Gymonosorus* J. Agardh. Amer. J. Bot. 30:463–468.

————. 1951. Phaeophyta. *In* G. M. Smith, Manual of Phycology. Chronica Botanica Co., Mass. xi+375 p.

————. 1956. Notes on South African marine algae. IV. J. South African Bot. 22(2):65–67.

————. 1968. A history, catalogue, and bibliography of Red Sea benthic algae. Israel J. Bot. 17:1–118.

Safford, W. E. 1905. The useful plants of the Island of Guam. Contrib. U.S. National Herbarium 9:1–416.

Schmidt, O. C. 1928. Verzeichnis der Meeresalgen von New-Guinea und dem westlichen Oceanien. Hedwigia 68:19–86.

Setchell, W. A. 1924. Vegetation of Tutuila Island. Carnegie Inst. Washington, Dept. Mar. Biol. 20(341):1–188.

————. 1926. Tahitian algae collected by W. A. Setchell, C. B. Setchell, and H. E. Parks. Univ. Calif. Publ. Bot. 12:61–142.

Sonder, G. O. 1845. Nova algarum genera et species, quas in itinere ad oras occidentalis Novae Hollandiae collegit L. Preiss. Bot. Ztg. 3:49–57.

Tanaka, T., and K. Nozawa. 1962. Some notes on the genera *Padina* and *Zonaria* in the southwestern islands of Japan. Mem. Fac. Fish. Kagoshima Univ. 11(2):179–187.

Taylor, W. R. 1950. Plants of Bikini and other northern Marshall Islands. Univ. Mich. Press, Ann Arbor. ix+220 p.

————. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Univ. Mich. Press, Ann Arbor. ix+870 p.

————. 1964. The genus *Turbinaria* in eastern seas. J. Linn. Soc. Bot. 58:475–490.

————. 1966. Records of Asian and western Pacific marine algae, particularly from Indonesia and the Philippines. Pac. Sci. 30(3):342–359.

Tracey, J. I. Jr., S. O. Schlander, J. T. Stark, D. B. Doan and H. G. May. 1964. General geology of Guam. Geol. Surv., Prof. Pap. 403–A:104 p.

Tsuda, R. T. In Press. Morphological, zonational, and seasonal studies of two species of *Sargassum* on the reefs of Guam. Proc. VII Int. Seaweed Symposium.

Womersley, H. B. S. 1967. A critical survey of the marine algae of southern Australia. II. Phaeophyta. Aust. J. Bot. 15:189–270.

Womersley, H. B. S., and A. Bailey. 1970. Marine algae of the Solomon Islands. Phil. Trans. Royal Soc. London. B. Biological Sciences 259(830):257–352.

Yamada, Y. 1925. Studien ueber die Meeresalgen von der Insel Formosa. 2. Phaeophyceae. Bot. Mag. (Tokyo) 39:239–254.

Zollinger, H. 1854. Systematisches Verzeichnis der im indischen Archipel, in den Jahren 1842–1848 gesammelten sowie der aus Japan empfangenen Pflanzen. Zurich. xii+80 p.

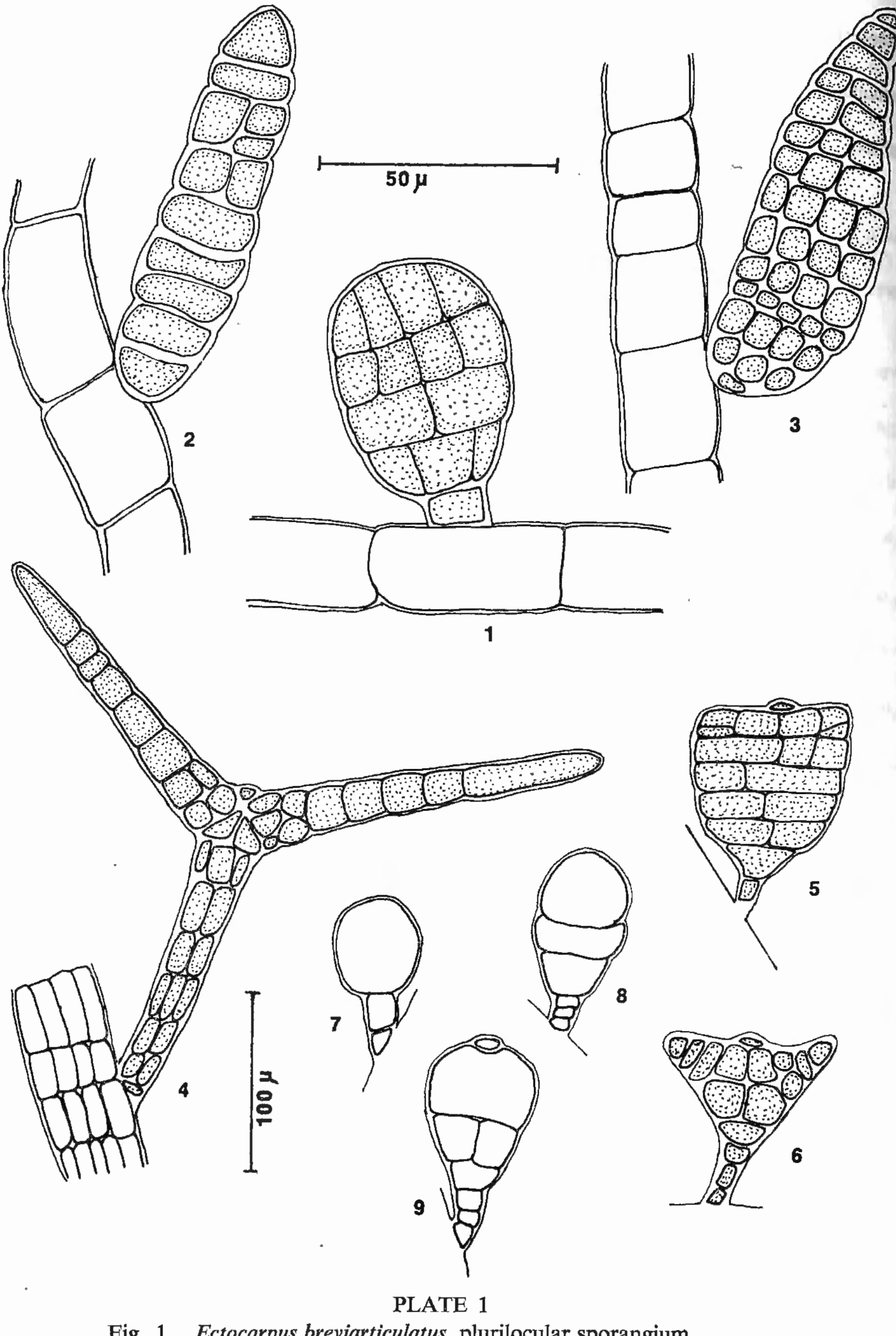

PLATE 1

Fig. 1. *Ectocarpus breviarticulatus*, plurilocular sporangium.
Fig. 2. *Feldmannia indica*, plurilocular sporangium.
Fig. 3. *Feldmannia irregularis*, plurilocular sporangium.
Fig. 4. *Sphacelaria furcigera*, propagula.
Fig. 5. *Sphacelaria novaehollandiae*, propagula.
Fig. 6. *Sphacelaria tribuloides*, propagula.
Fig. 7–9. *Sphacelaria tribuloides*, developmental stages of propagula.

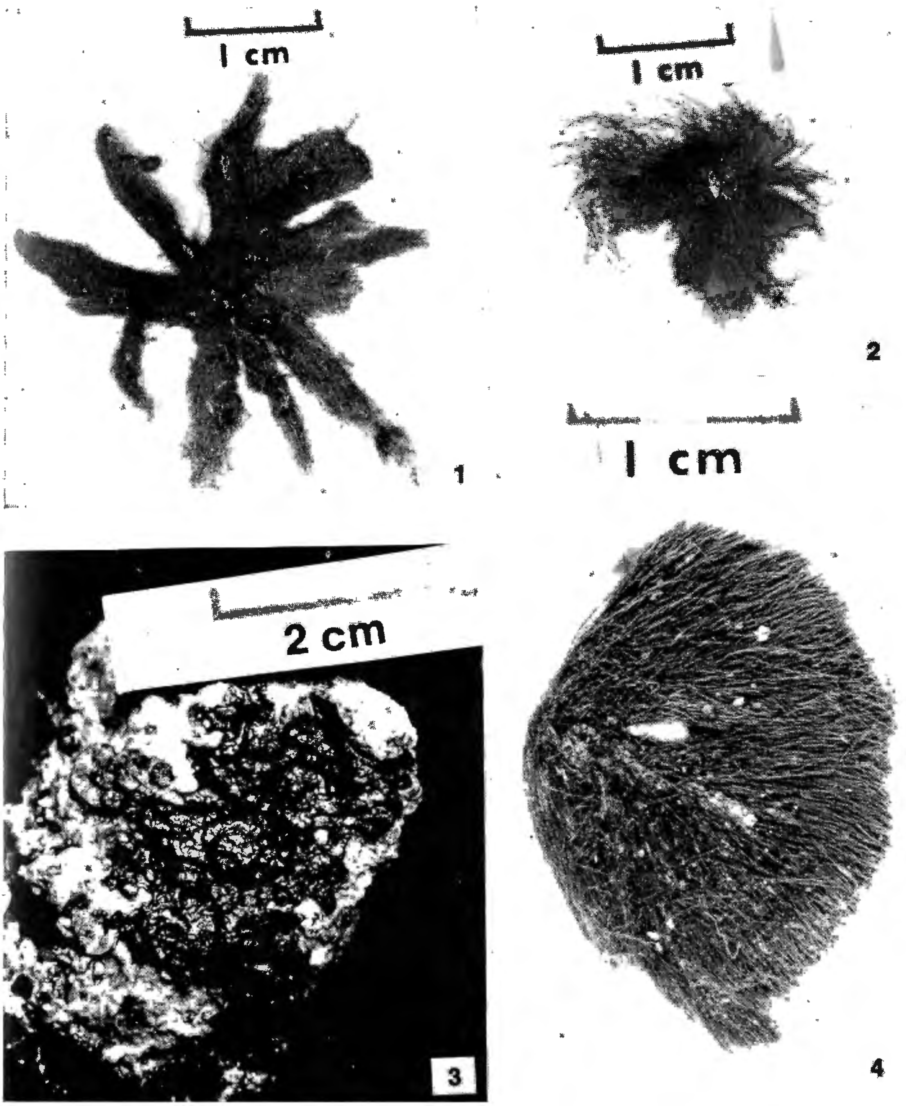

PLATE 2

Fig. 1. *Ectocarpus breviarticulatus*, habit showing intertwined filaments.

Fig. 2. *Feldmannia indica*, habit showing loose filaments.

Fig. 3. *Ralfsia pangoensis*, prostrate thallus on coral.

Fig. 4. *Sphacelaria tribuloides*, habit.

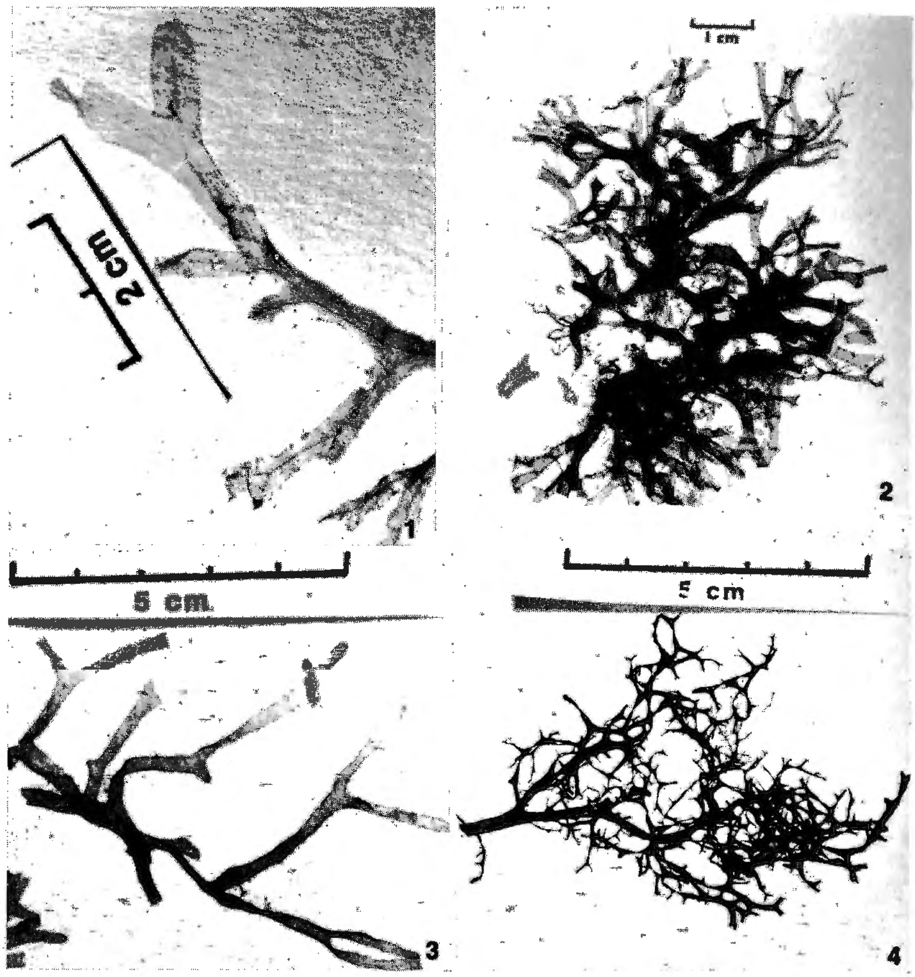

PLATE 3

Fig. 1. *Dictyopteris repens*, branches with distinct midrib.

Fig. 2. *Dictyota bartayresii*, clumps that inhabit inner reef flats.

Fig. 3. *Dictyota bartayresii*, deep water thalli.

Fig. 4. *Dictyota cervicornis*, thallus showing conspicuous twisting and widened basal branch.

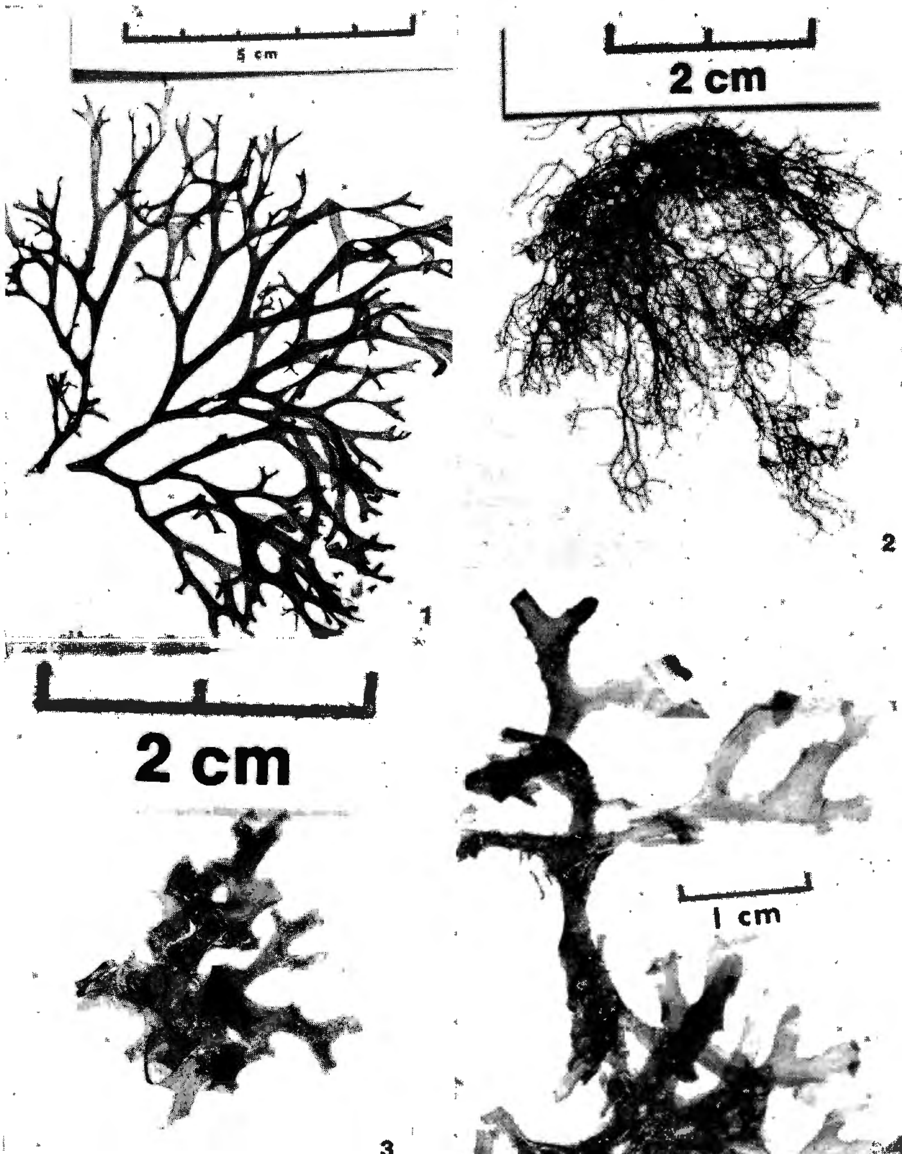

PLATE 4

Fig. 1. *Dictyota cervicornis*, thallus with dichotomous branches uniform in width.

Fig. 2. *Dictyota divaricata*, thalli with narrow branches.

Fig. 3. *Dictyota friabilis*, thallus with scattered tetrasporangia.

Fig. 4. *Dictyota patens*, thallus with dentitions (top) and thallus without dentitions (bottom).

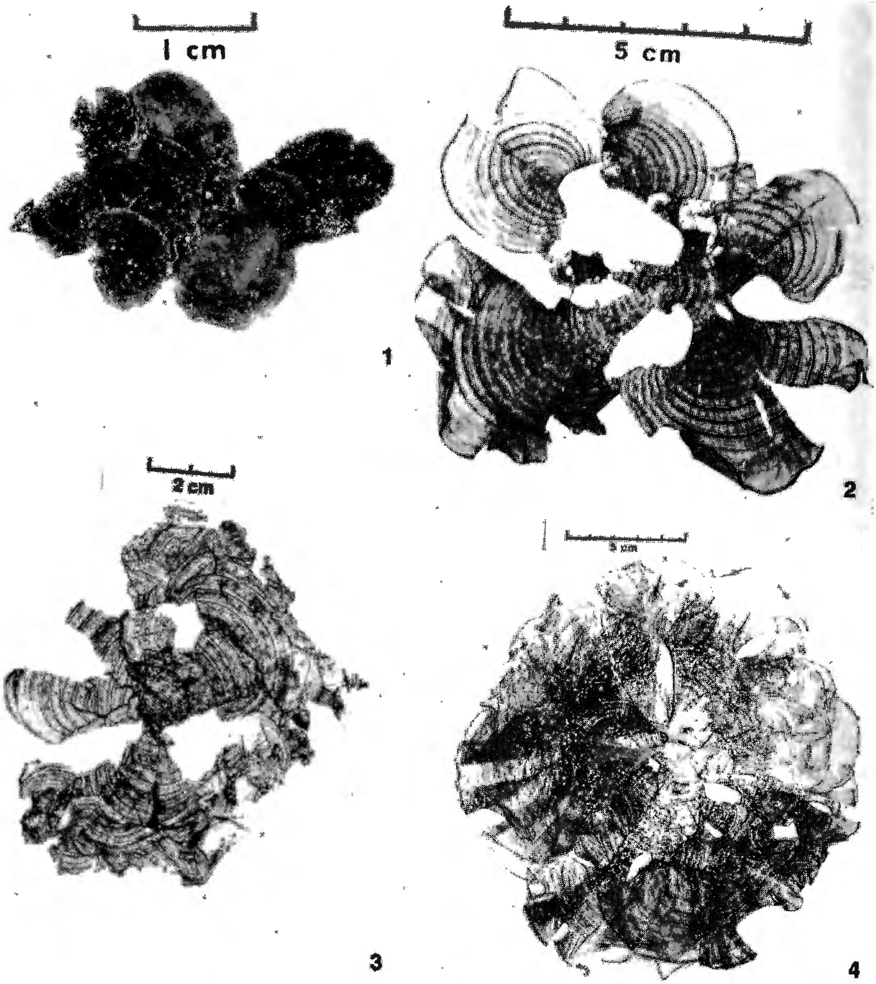

PLATE 5

Fig. 1. *Lobophora variegata*, habit showing overlapping prostrate thalli.

Fig. 2. *Padina minor*, thallus with concentric rows of tetrasporangia above every hair zone.

Fig. 3. *Padina jonesii* n. sp., thallus with concentric rows of tetrasporangia above every other hair zone. Part of Holotype.

Fig. 4. *Padina tenuis*, thallus with concentric rows of tetrasporangia above every other hair zone.

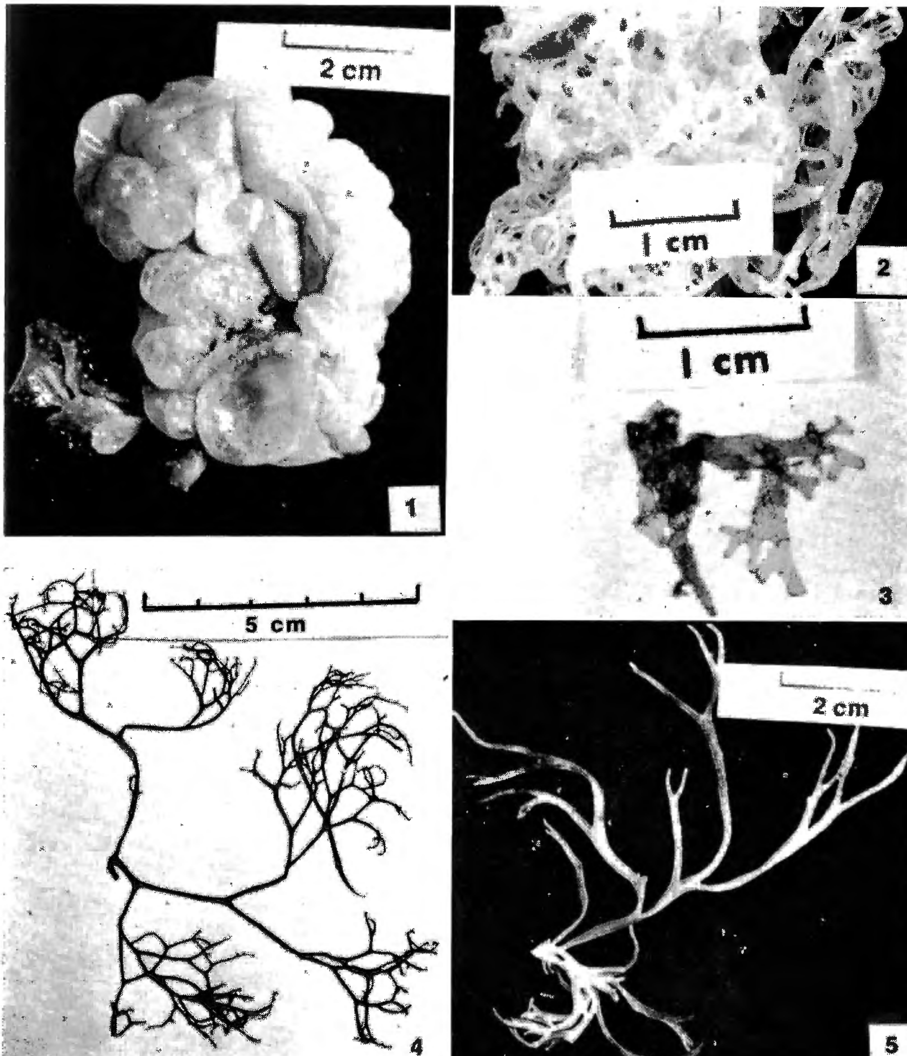

PLATE 6

Fig. 1. *Colpomenia sinuosa*, habit of mature thallus.

Fig. 2. *Hydroclathrus clathratus*, habit of mature thallus.

Fig. 3. *Rosenvingea intricata*, habit of immature thallus.

Fig. 4. *Chnoospora implexa*, habit showing cylindrical branches.

Fig. 5. *Chnoospora minima*, habit showing flattened branches.

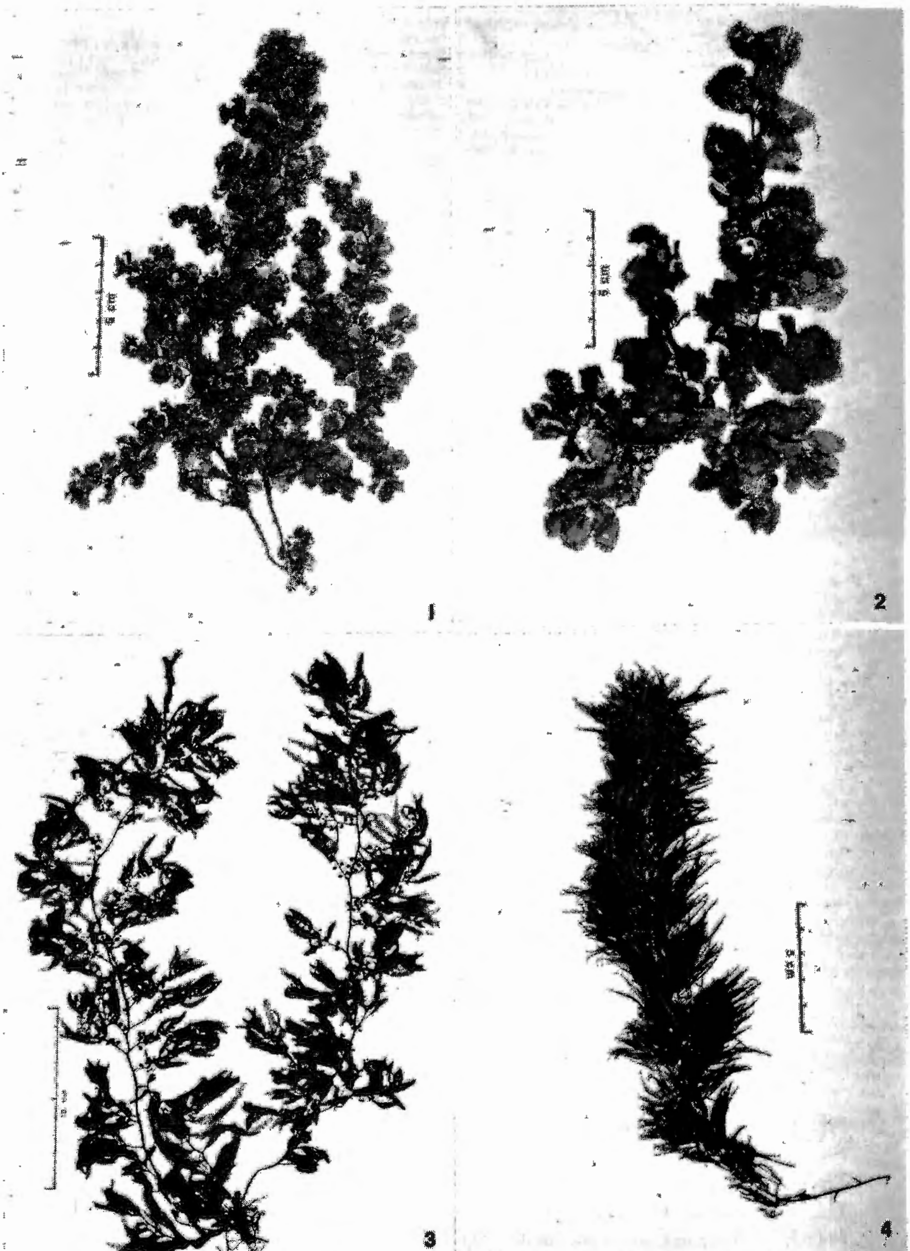

PLATE 7

Fig. 1. *Sargassum cristaefolium*, male thallus.

Fig. 2. *Sargassum cristaefolium*, female thallus.

Fig. 3. *Sargassum polycystum*, thallus with proliferations on branches.

Fig. 4. *Sargassum tenerrimum*, thallus showing radial arrangement of branches from central axis.

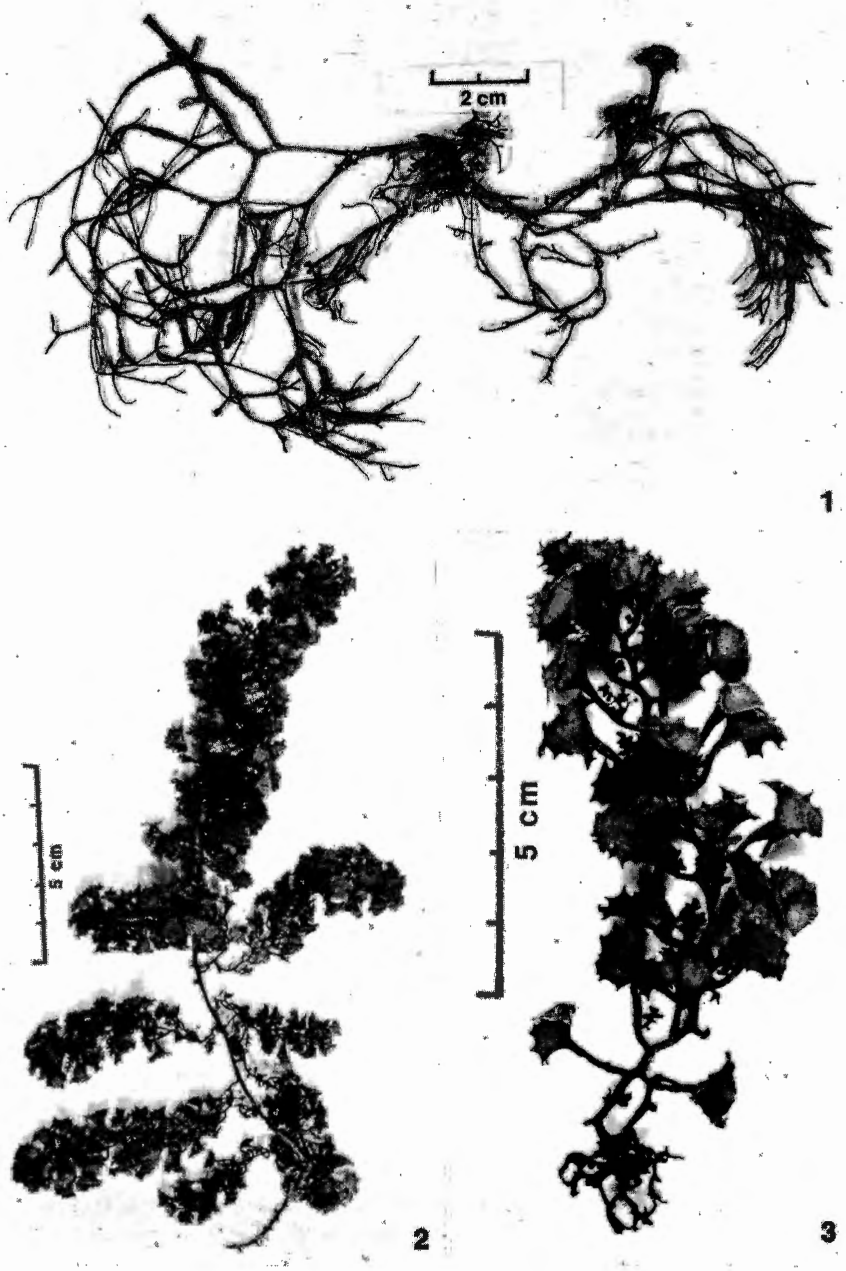

PLATE 8

Fig. 1. *Turbinaria ornata*, immature thallus.

Fig. 2. *Turbinaria ornata*, mature branched thallus inhabiting the calm inner reef flats.

Fig. 3. *Turbinaria ornata*, mature unbranched thallus inhabiting the turbulent reef margins.