The Marine Benthic Algae of the Caroline Islands, I. Introduction, Chlorophyta, and Cyanophyta[1]

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Introduction

The Caroline Islands are largely a group of atolls located between 131° and 164° East Longitude and 2° to 10° North Latitude. Most of the islands are low islands or coral atolls, but the islands of Kusaie, Ponape, Truk, and Palau are high islands of volcanic origin while Yap is of uplifted sedimentary origin. Those lying east of 148° East Longitude comprise the Eastern Caroline Islands, while those west of this meridian comprise the Western Caroline Islands. Together they constitute much of Micronesia.

The Caroline Islands (Pl. 1) form a chain roughly parallel to and just above the equator. The chain is flanked at its eastern end by the Marshall and Gilbert Islands, southward by several island groups comprising Melanesia, and westward by the Philippine Islands.

The earliest known records of the marine benthic algae from the Caroline Islands are those of Reinbold (1901) based on the materials collected by Dr. Volkens from the island of Yap. Except for those published by Schmidt in 1928, most of the records from 1904 to 1944 were contributed by Japanese phycologists.

The first Japanese phycologist to contribute to the knowledge of the algae of Micronesia was Okamura (1904), who enumerated 82 species from the Caroline Islands and Australia of which 26 species were from Palau and Yap Islands. The materials were collected and sent to him by S. Abe. In 1916 Okamura also reported on the algae of the Caroline Islands based on materials collected in 1914 and 1915 by several collectors from these five places in the Caroline Group, namely, Kusaie, Ponape, Truk, Yap, and Palau Islands.

In 1926 Y. Yamada surveyed and studied the coasts of Yap, Palau, and the Mariana Islands. The results of his studies were presented at the Third Pan-Pacific Science Congress. J. Tokida (1939) published a list of marine algae from Micronesia based on the materials he collected from Palau and on records assembled from the publications of previous authors. In the following year Kanda (1940) published his regeneration studies on *Halimeda macroloba*. Later in the same year he also published on three species of *Valonia* from Palau, i.e., *V. fastigiata*, *V. aegagropila* and *V. ventricosa*. Meanwhile Y. Yamada (1940), as Sachio Yamada, reported 15 species of *Caulerpa* from Micronesia, including two new species, *C.*

[1] A part of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the University of Hawaii, 1968.

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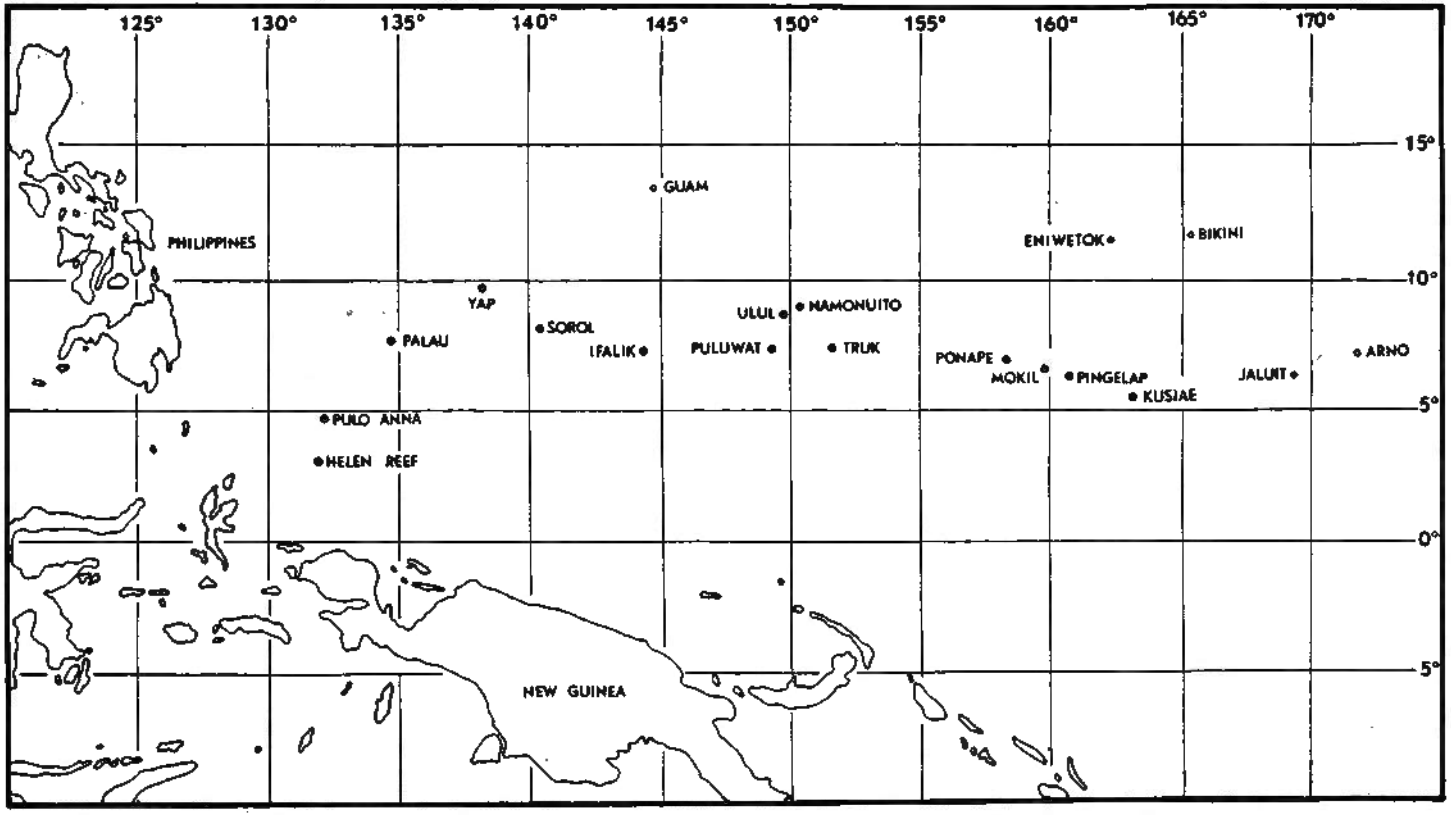


Plate 1. Map showing the general collecting stations in the Caroline Islands.

antoensis, and *C. matsueana*. In the following year he also reported seven species of *Halimeda* from Micronesia describing one of them, *H. micronesica*, as a new species. Later Yamada (1944a) validly published the above mentioned new species of *Caulerpa* and *Halimeda* from Micronesia with Latin descriptions. In so doing he added one new variety of *Caulerpa*, *C. lentillifera* var. *condensata* and two new varieties of *Halimeda*, *H. gracilis* var. *elegans* and *H. incrassata* var. *distorta*. In the same year he reported on the marine algae of the Atoll of Ant, describing two new species of Chlorophyta, *Dictyosphaeria mutica* and *Rhipilia micronesica*, and five new species of Rhodophyta, *Wrangelia anastomosans*, *Dasya adherens*, *Centroceras apiculatum*, *C. minutum*, and *Crouania minutissima*. He had earlier (1930) described a new species of *Udotea*, *U. geppii*, from the Palau Islands.

No report was published on the marine algae of the Caroline Islands from 1945 to 1960. In 1961, Abbott made a checklist of the marine algae of Ifaluk Atoll based on the collections made in 1960.

The availability of a large collection of marine benthic algae from the Caroline Islands in the University of Hawaii's Department of Botany provided the materials for this research. These materials were largely available as a result of the collections of Mr. E. G. Meñez who was sent to the Caroline Islands to obtain not only the algal materials but ecological information for a continuing project on the role of the algae in the Central Pacific. Significant collections were made from 14 major islands and atolls of the Caroline chain, extending from as far east as Kusaie Island to as far west as Helen Reef. In bulk and in number of species concerned the materials represent, to date, by far the most extensive collections ever made from this area.

The specimens cited in the following account are deposited in the Herbarium of the Department of Botany, University of Hawaii, Honolulu, Hawaii.

It should also be noted that the keys to the species are primarily designed for the benthic algae of the Caroline Islands and may not be applicable to the species from other regions.

Collecting Stations

The following is the complete list of the collecting stations as represented by the "Bag Numbers" together with their geographic location, date, and short notes on the type of substratum.

1. Ponape Group (Plate 2)

Bags 1–13. Collected from reef flat with a sandy-muddy substratum with rocks at eastern side of Peipalap Peak, Ponape Is., June 17, 1960. 6°59′45″ N. Lat.; 158°11′50″ E. Long.

Bags 14–16. Collected from reef with sandy-muddy substratum with rocks at Epwelkapw, Ponape Is., June 17, 1960. 6°59′30″ N. Lat.; 158°11′30″ E. Long.

Bag 17. Growing on mangrove bark on reef flat at eastern side of Peipalap Peak, Ponape Is., June 17, 1960. 6°59′45″ N. Lat.; 158°11′50″ E. Long.

Bag 18. Collected from reef flat with sandy-muddy substratum with rocks at eastern side of Peipalap Peak, Ponape Is., June 20, 1960. 6°59′25″ N. Lat.; 158°11′20″ E. Long.

Bags 19–20. Collected from outer reef with sandy-muddy substratum with numerous staghorn corals and limestone rocks facing Mantapeitak Is., June 20, 1960. 7°01′00° N. Lat.; 158°19′00″ E. Long.

PONAPE ISLANDS SHOWING COLLECTING STATIONS

Plate 2. Ponape Islands showing collecting stations.
Size: Ca. 17 miles across

Bags 21–29. Collected from reef with sandy-muddy substratum with numerous staghorn corals at eastern side of Mantapeitak Is., June 20, 1960. 70°00′15″ N. Lat.; 158°18′00″ E. Long.

Bags 30–33. Collected from reef with sandy-muddy substratum with limestone rocks at eastern side of Epwelkapw, Ponape Is., June 20, 1960. 6°59′30″ N. Lat.; 158°11′20″ E. Long.

Bags 34–55. All fresh water algae. Not treated.

Bags 56–62. Collected from reef flat with a wholly sandy-muddy substratum with eel grass near bridge between Kolonia and Sokehs (Jokai) Is., June 25, 1960. 6°58′04″ N. Lat.; 158°11′45″ E. Long.

Bag 63. Collected from drift log near pier at Kolonia Is., June 25, 1960. 6°58′04″ N. Lat.; 158°11′45″ E. Long.

Bags 64–115. All fresh water algae. Not treated.

Bags 215–227 were collected from Ponape on E. G. Menez's return from Kusaie, thus the following bag numbers are nonconsecutive.

Bags 215–220. Collected from reaf flat near boat pier with rocky substratum with little sand at Ponape Is., July 20, 1960. 6°59′20″ N. Lat.; 158°13′40″ E. Long.

Bags 221–226. Collected from reef flat with sandy-muddy substratum with few basalt rocks at Nanmatol Is., July 23, 1960. 6°59′00″ N. Lat.; 158°13′00″ E. Long.

Bag 227. Collected from basalt rocks on reef at entrance to ruins at Nanmatol Is., July 23, 1960. Location same as above.

2. Mokil Group (Plate 3)

Bags 116–120. Collected from thn lagoon side of the reef flat with sandy substratum with coral rocks at northwest tip of Mokil Is., June 19, 1960. 6°40′00″N. Lat.; 159°47′00″ E. Long.

Bags 121–124. Collected from the northern seaward reef flat with sandy substratum with

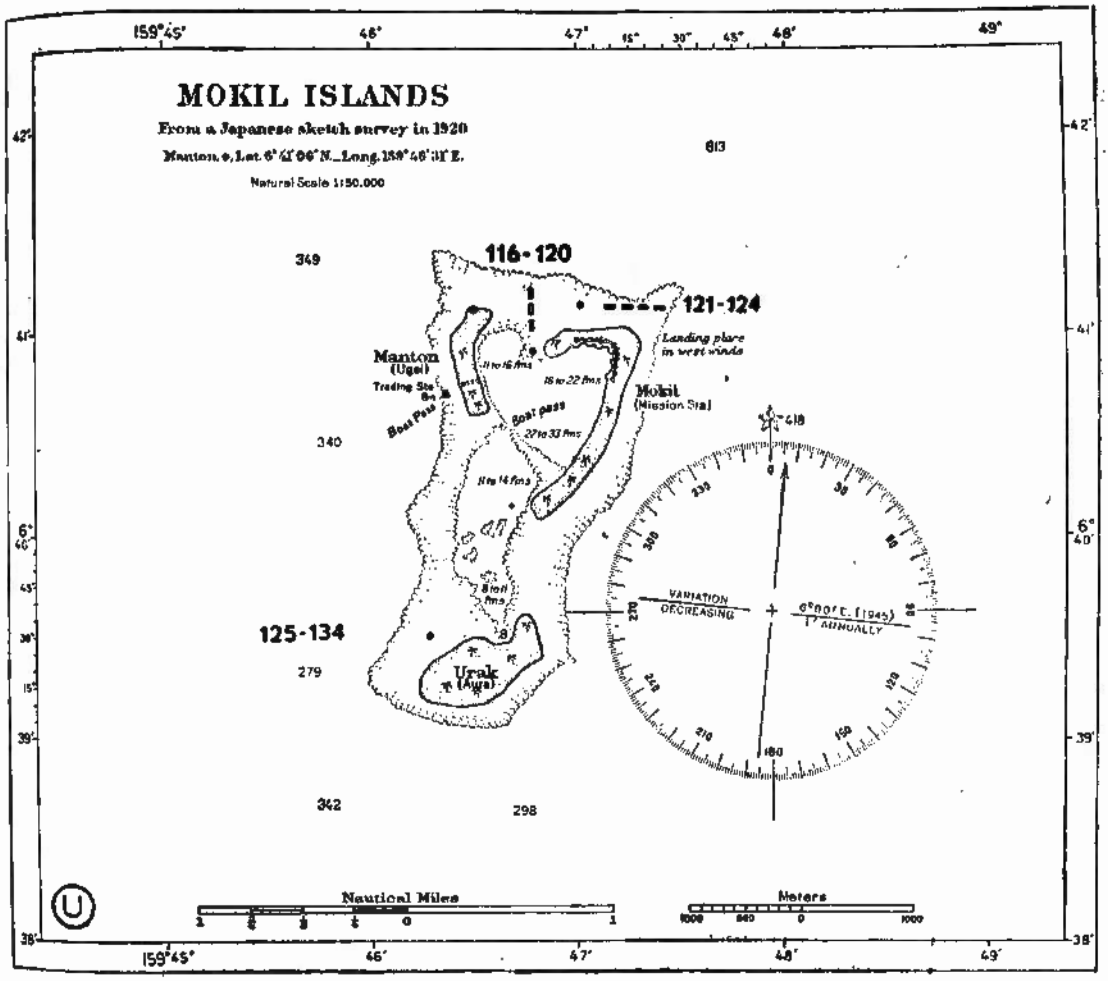


Plate 3. Mokil Islands showing collecting stations.

hard bottom at Mokil Is., June 29, 1960. Location same as above.

Bags 125–134. Collected from the western seaward reef flat of sandy substratum with hard bottom, coral heads and limerocks at Urak Is., June 29, 1960. 6°39′00″ N. Lat.; 159°46′00″ E. Long.

3. Pingelap Island (Plate 4)

Bags 135–141. Collected from the western seaward reef flat with sandy substratum heavy with lime rocks and eel grass at Pingelap Is., July 1, 1960. 6°12′00″ N. Lat.; 160°41′00″ E. Long.

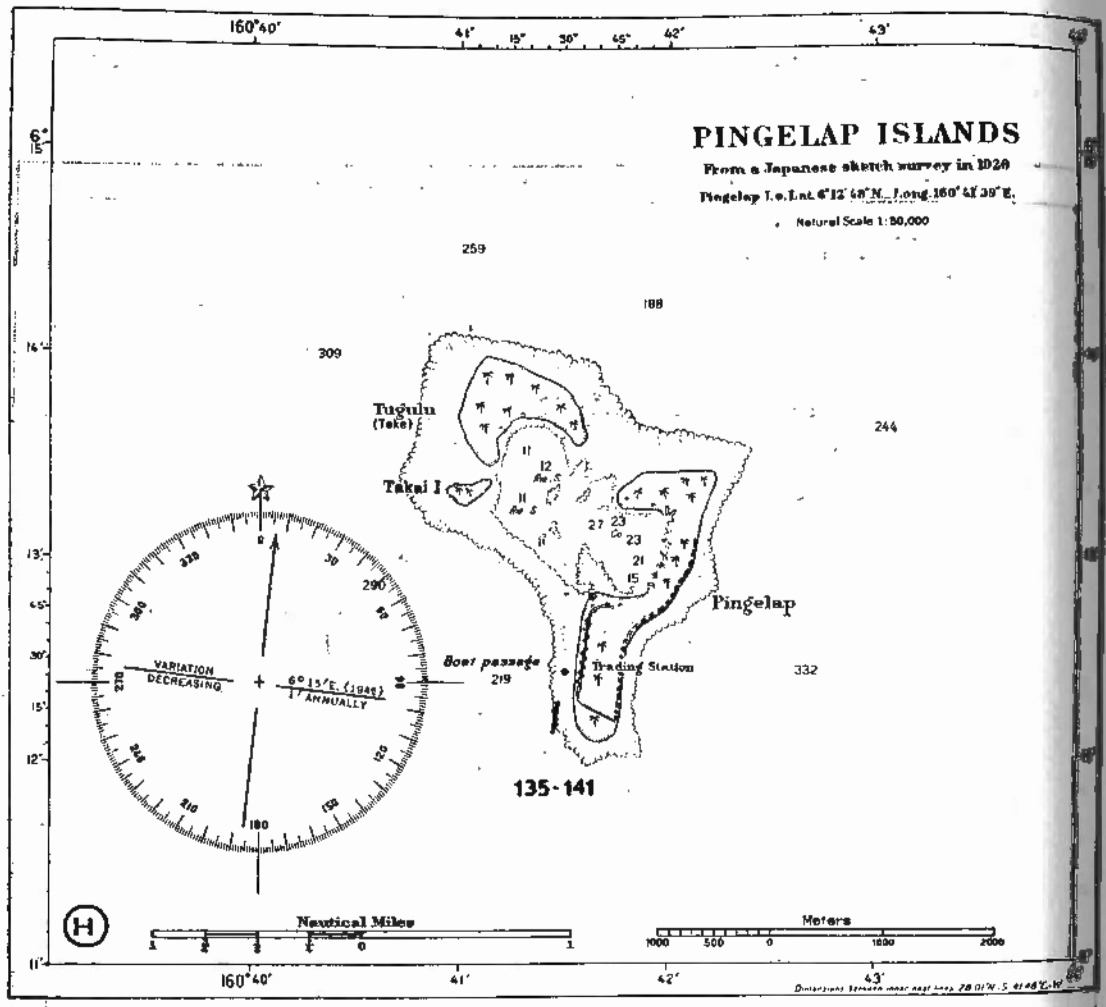


Plate 4. Pingelap Islands showing collecting stations.

4. Kusaie Group (Plate 5)

Bags 157–164. Collected from reef with sandy substratum near shore to solid bottom with thin layer of sand near the reef edge at Lele Harbor, Kusaie Is., July 15, 1960. 5°19′37″ N. Lat.; 163°01′54″ E. Long.

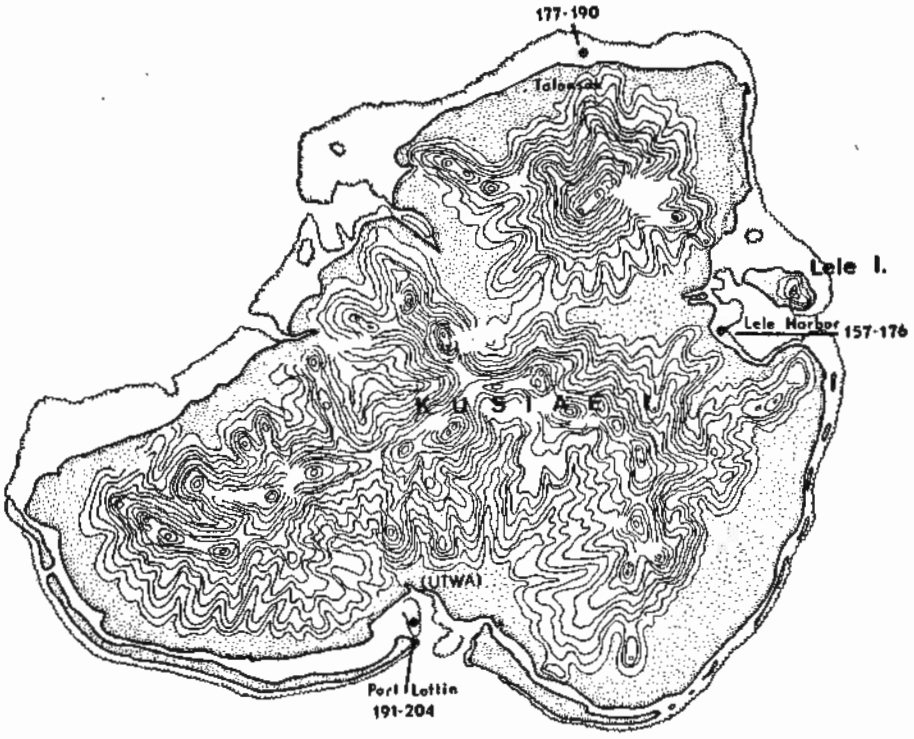


Plate 5. Kusaie Islands showing collecting stations.
Size: Ca. 8 miles across

Bags 165–176. Collected from reef with rocky substratum with abundance of corals near Lele Harbor, Kusaie Is., July 16, 1960. 5°19′37″ N. Lat.; 160°01′39″ E. Long.

Bags 177–190. Collected from reef with sandy to rocky substratum near Tafansak Village, Kusaie Is., July 16, 1960. 5°19′00″ N. Lat.; 163°01′00″ E. Long.

Bags 191–202. Collected from reef with rocky substratum with little sand at Utwa Is., July 17, 1960. 5°16′49″ N. Lat.; 162°57′46″ E. Long.

Bag 203. Collected from the base of mangrove at Utwa Is., July 17, 1960. Location the same as above.

Bag 204. Collected from reef with rocky substratum with little sand near shoreline at Utwa Village, Utwa Is., July 17, 1960. 5°16′19″ N. Lat.; 162°57′46″ E. Long.

Bags 205–214. All fresh water algae. Not treated.

5. Oroluk Island

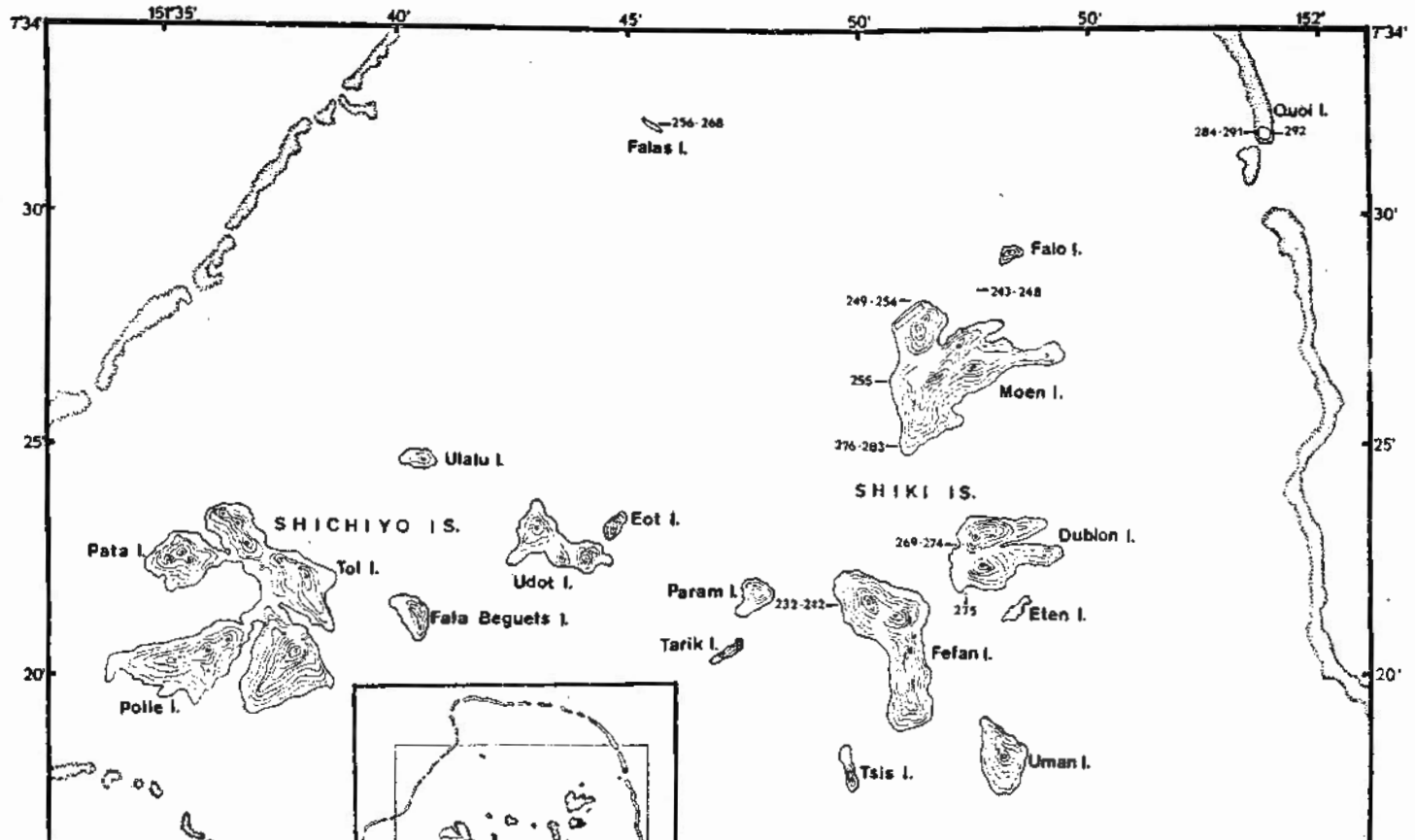
Bags 228–230. Collected from reef with sandy substratum with lots of rocks at Oroluk Is., July 26, 1960. 7°37′40″ N. Lat.; 155°09′45″ E. Long.

Bag 231. Fresh water algae. Not treated.

6. Truk Group (Plate 6)

Bags 232–242. Collected from reef flat with sandy-muddy substratum near the shore becoming sandy-rocky towards the reef edge at Fefan Is., July 28, 1960. 7°21′50″ N. Lat.; 151°49′24″ E. Long.

Bags 243–248. Collected from reef with a hard substratum with thin film of sand and lots



TRUK ISLANDS SHOWING COLLECTING STATIONS

Plate 6. Truk Islands showing collecting stations.
Natural size of inset: Ca. 35 miles across

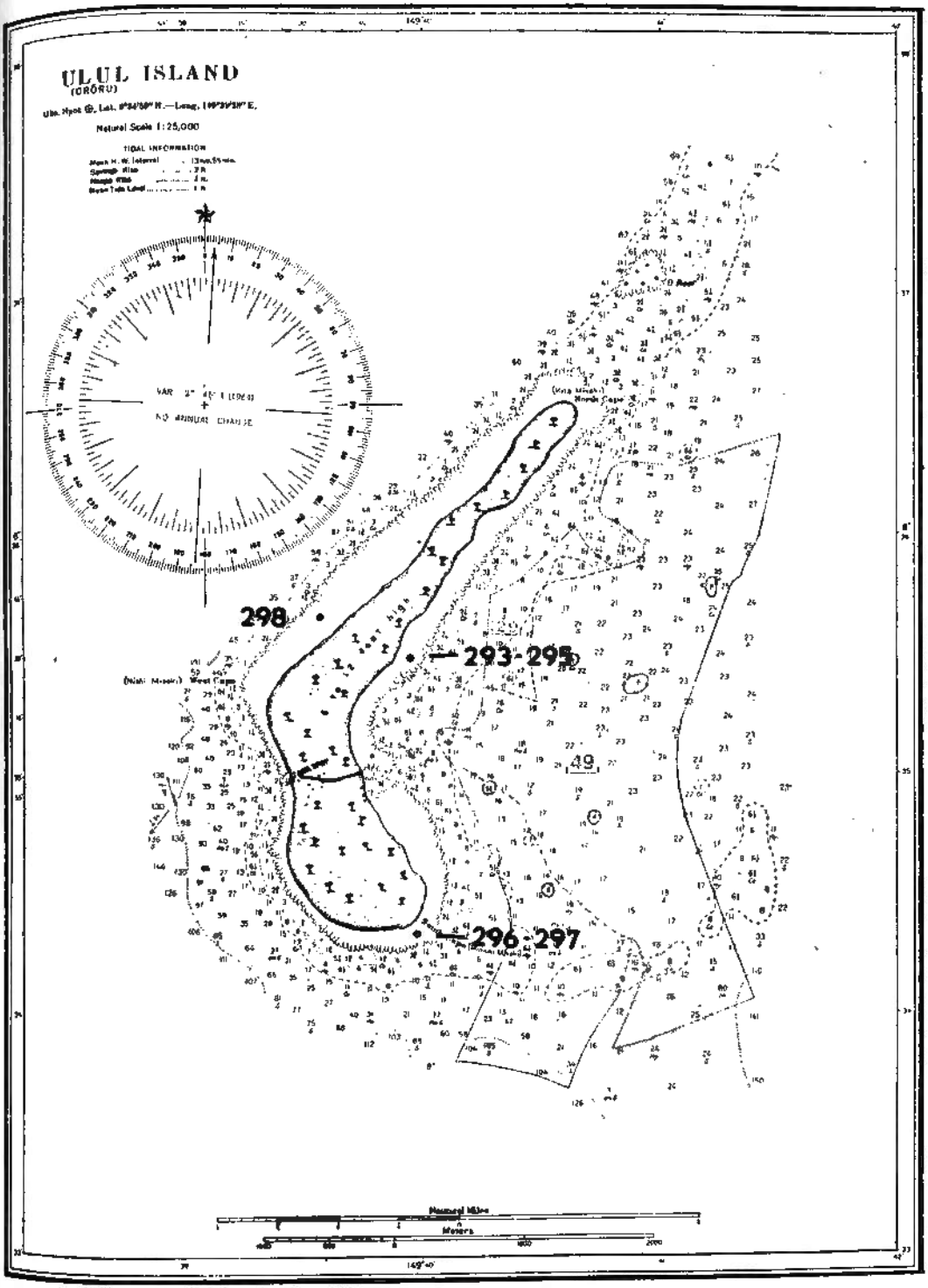


Plate 7. Ulul Island showing collecting stations.

of corals and sponges between Moen and Falo Is., July 29, 1960. 7°28′26″ N. Lat.; 151°52′12″ E. Long.

Bags 249–254. Collected from reef with sandy-muddy substratum with lots of corals and sponges near north end of the airport runway at Moen Is., July 29, 1960. 7°26′02″ N. Lat.; 151°51′00″ E. Long.

Bag 255. Collected from a man-made pool with muddy substratum with thin film of sand, Moen Island harbor, July 29, 1960. 7°26′02″ N. Lat.; 151°51′25″ E. Long.

Bags 256–268. Collected from reef with sandy substratum with rocks at the lagoon side of Falas Is., July 30, 1960. 7°32′06″ N. Lat.; 151°45′30″ E. Long.

Bags 269–274. Collected from reef with rocky substratum with little sand and lots of corals at Dublon Is., July 31, 1960. 7°23′19″ N. Lat.; 151°52′32″ E. Long.

Bag 275. Collected from roots of *Sonneratia sp.* in the mangrove section at Dublon at Dublon Is., July 31, 1960. Location the same as above.

Bags 276–283. Collected from mangrove section with muddy substratum with few rocks near south end of Moen Is., Aug. 1, 1960. 7°25′00″ N. Lat.; 151°59′38″ E. Long.

Bags 284–291. Collected from outer reef with rocky substratum with little sand and lots of corals, north of Northeast Pass at Quoi Is., Aug. 2, 1960. 7°31′48″ N. Lat.; 151°58′50″ E. Long.

Bag 292. Collected from reef with rocky substratum with lots of basalt and limerocks with thin layer of sand at Quoi Is., Aug. 2, 1960. 7°31′48″ N. Lat.; 151°58′50″ E. Long.

7. Ulul Island (Plate 7)

Bags 293–295. Collected from reef with sandy-rocky substratum at eastern side of Ulul Is., Aug. 6, 1960. 8°35′30″ N. Lat.; 149°39′45″ E. Long.

Bags 296–297. Collected from reef with sandy-rocky substratum at southern end of Ulul Is., Aug. 6, 1960. 8°34′20″ N. Lat.; 149°39′55″ E. Long.

Bag 298. Collected from reef with rocky substratum with little sand at western side of Ulul Is., Aug. 6, 1960. 8°35′30″ N. Lat.; 149°35′35″ E. Long.

8. Puluwat Island (Plate 8)

Bag 299. Collected from reef with sandy substratum with eel grass at Puluwat Is., Aug. 7, 1960. 7°21′22″ N. Lat.; 149°11′35″ E. Long.

Bags 300–304. Collected from reef with sandy-muddy substratum with eel grass at lagoon side at Puluwat Is. Aug. 7, 1960. 7°21′22″ N. Lat.; 149°11′45″ E. Long.

Bag 305. Collected from reef with rocky substratum with little sand near north end of Puluwat Is., Aug. 7, 1960. 7°22′05″ N. Lat.; 149°11′45″ E. Long.

9. Ifaluk Group (=Ifalik) (Plate 9)

Bag 306. Collected from reef with very sandy substratum with rocks at lagoon side of Ifaluk Is., Aug. 10, 1960. 7°15′20″ N. Lat.; 144°27′01″ E. Long.

Bags 307–309. Collected from reef with rocky substratum with little sand and abundance of foraminiferans at southeastern end of Ifaluk Is., Aug. 10, 1960. 7°15′00″ N. Lat.; 144°27′45″ E. Long.

Bag 310. Collected from reef with sandy muddy substratum at lagoon side near western end of Ella Is., Aug. 10, 1960. 7°14′35″ N. Lat.; 144°26′20″ E. Long.

Bag 311. Collected from reef with rocky substratum with little sand at lagoon side near eastern tip of Ella Is., Aug. 10, 1960.

Bags 312–313. Collected from reef with sandy substratum with lime rocks between Ifaluk and Flalap Is., Aug. 10, 1960. 7°14′55″ N. Lat.; 144°26′05″ E. Long.

Bag 314. Collected from seaward reef with rocky substratum with little sand near southern end of Ella Is., Aug. 10, 1960, 7°14′30″ N. Lat.; 144°26′30″ E. Long.

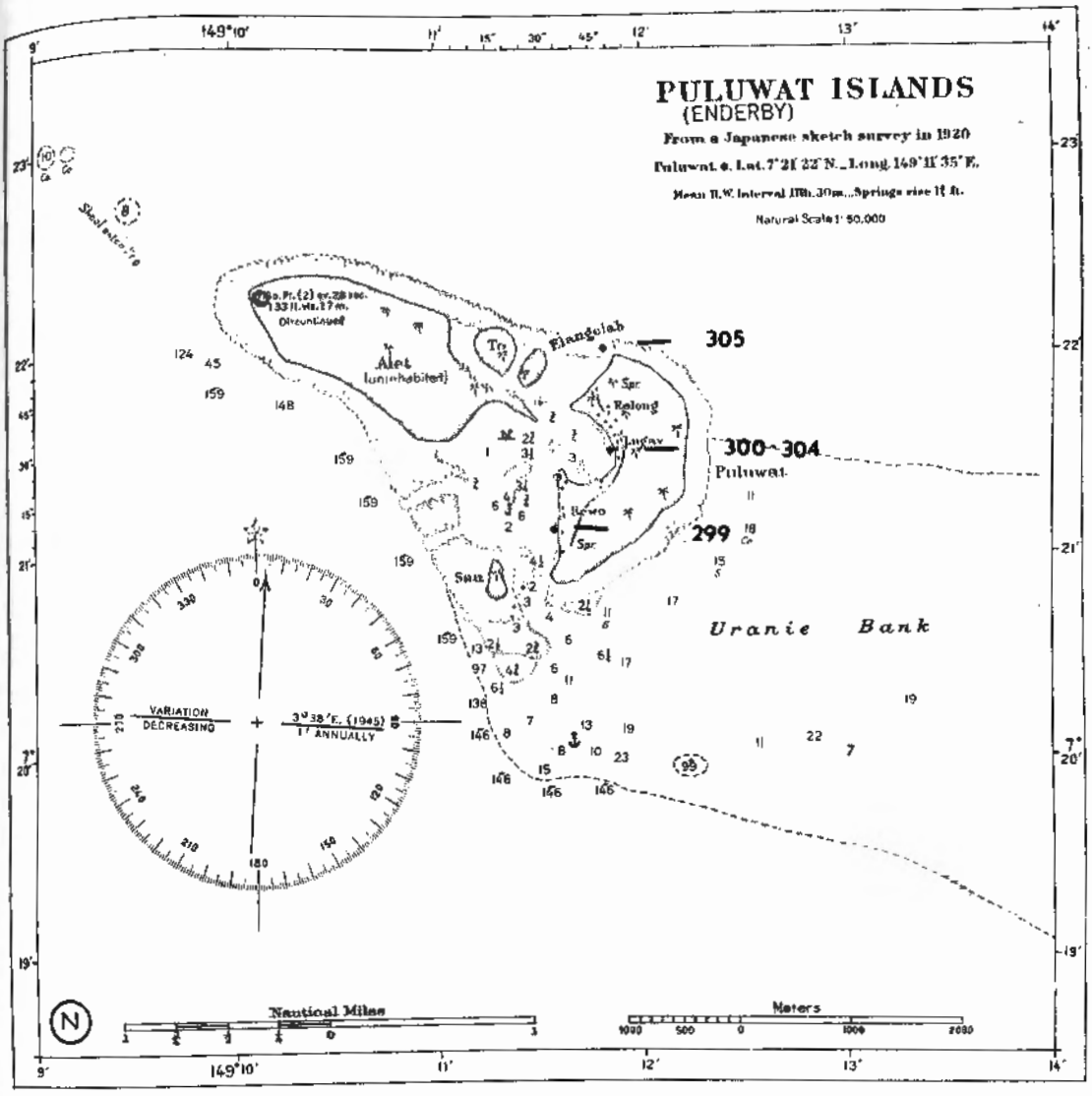


Plate 8. Puluwat Islands showing collecting stations.

10. Sorol Island (Plate 10)

Bags 315–319. Collected from reef with sandy-rocky substratum with coral heads at lagoon side of Sorol Is., Aug. 8, 1960. 8°07′40″ N. Lat.; 140°24′30″ E. Long.

Bag 320. Collected as beach drift on Sorol Is., Aug. 8, 1960. Location same as Bag 321.

Bag 321. Collected from seaward reef with rocky substratum with little sand at eastern side of Sorol Is., Aug. 8, 1960. 8°07′30″ N. Lat.; 140°24′55″ E. Long.

Bag 322. Collected from reef with sandy-rocky substratum with lots of foramniferans at southern end of Soral Is., Aug. 8, 1906. 8°07′08″ N. Lat.; 140°25′10″ E. Long.

11. Yap Island (Plate 11)

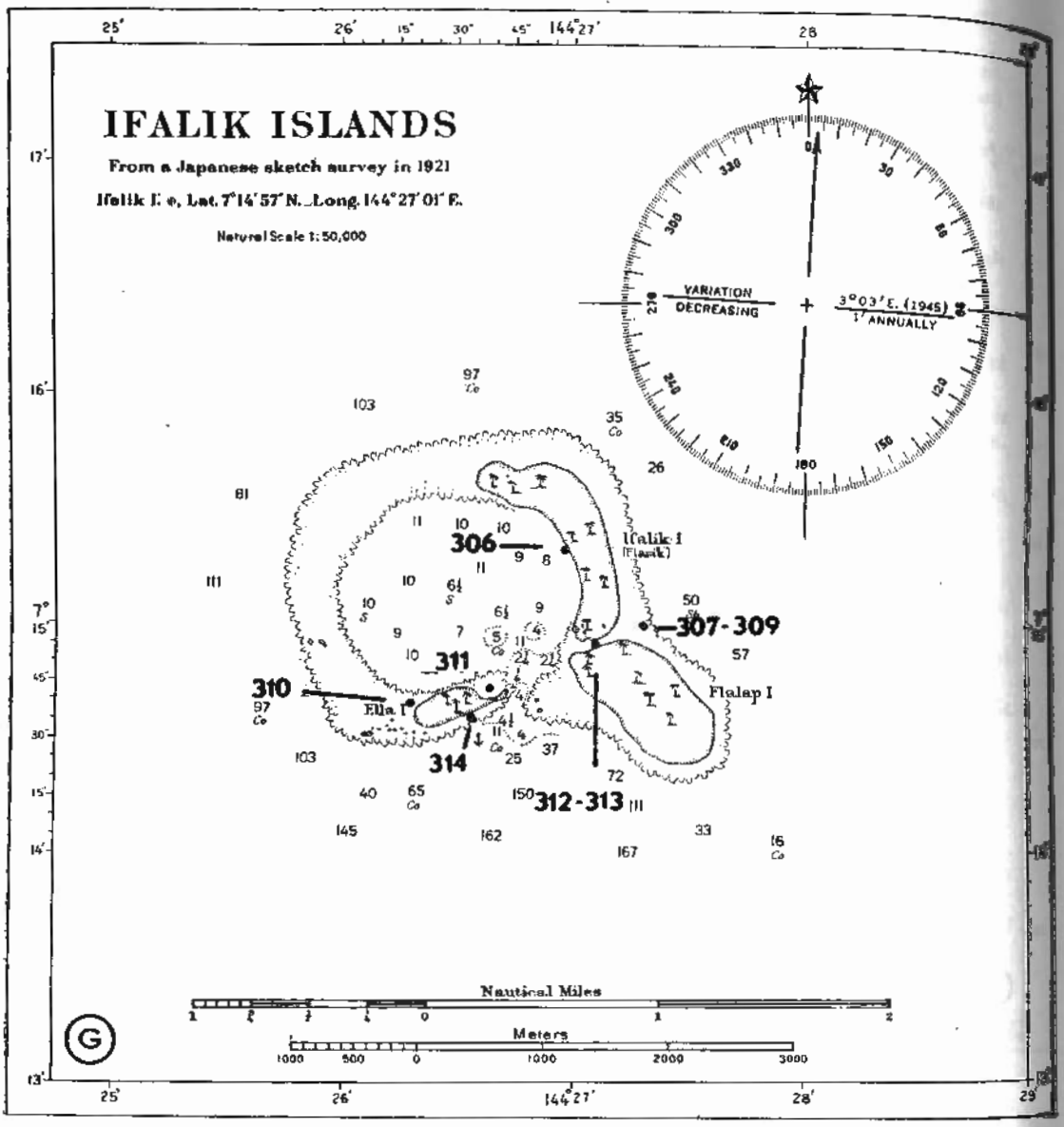


Plate 9. (Ifaluk) Islands showing collecting stations.

Bags 323–331. Collected from reef flat with sandy-rocky substratum north of channel near Yap Harbor, Aug. 18, 1960. 9°29′28″ N. Lat.; 138°08′40″ E. Long.

Bag 332. Collected from reef flat with sandy substratum north of channel near Yap Harbor, Aug. 18, 1960. Location same as Bag 323.

Bags 337–339. Collected from reef flat with sandy-muddy substratum north of channel near Yap Harbor, Aug. 19, 1960. Location the same as Bag 332.

Bag 340. Collected from reef flat with rocky substratum with plenty of staghorn corals north of channel near Yap Harbor, Aug. 18, 1960. Location the same as Bag 339.

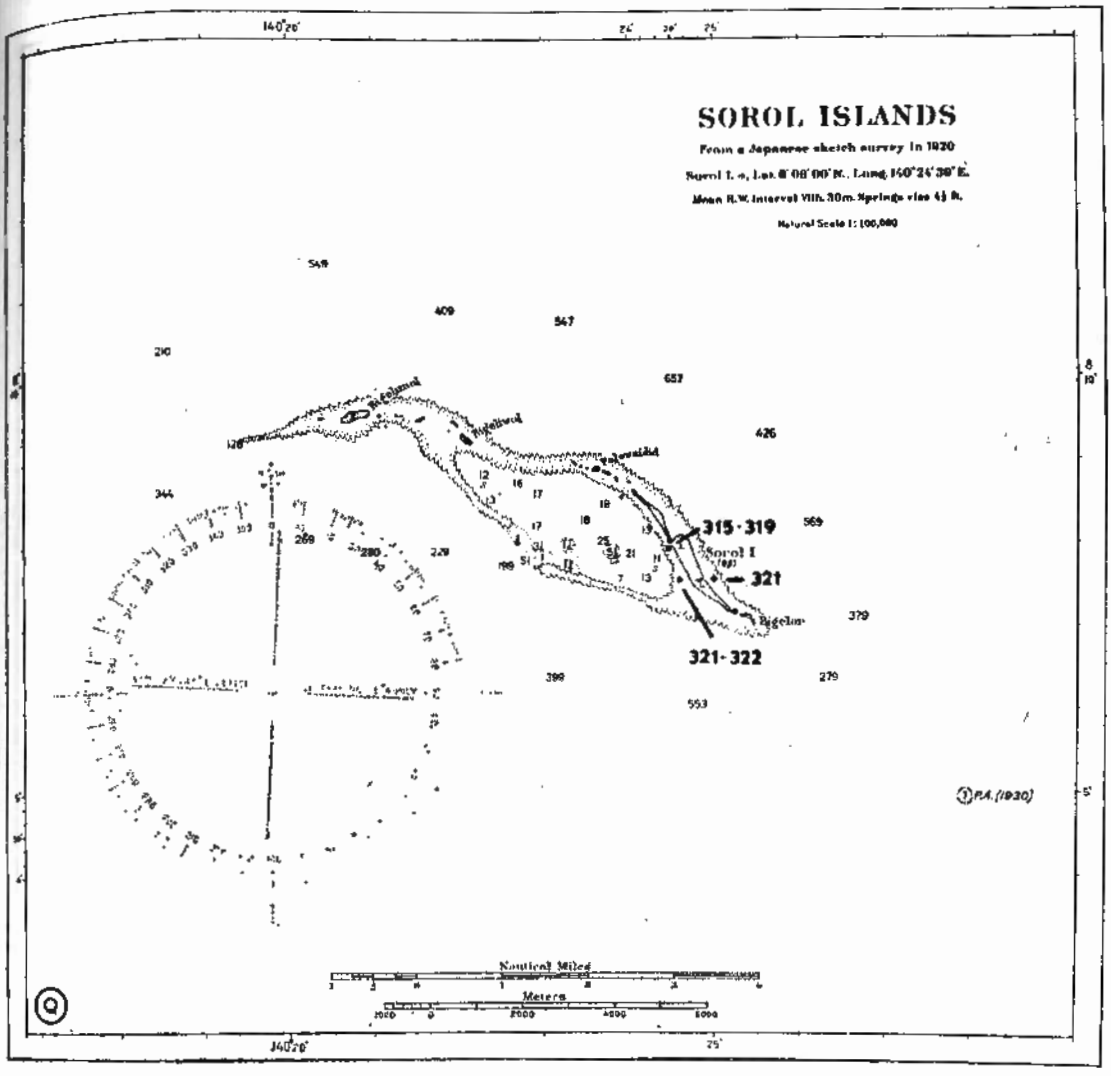


Plate 10. Sorol Islands showing collecting stations.

Bags 341–348. Collected from reef flat with sandy substratum with rocks and patches of eel grass south of channel near Yap Harbor, Aug. 19, 1960. 9°29′15″ N. Lat.; 138°07′50″ E. Long.

Bags 349–350. Collected from reef flat with rocky substratum with little sand south of the channel near Yap Harbor, Aug. 19, 1960. Location the same as Bag 341.

Bag 351. Collected from reef flat with sandy substratum with staghorn corals south of the channel near Yap Harbor, Aug. 18, 1960. Location the same as Bag 349.

12. Palau Group

Bags 352–384. Collected from reef flat with sandy-rocky substratum with lots of staghorn corals at Iwayama Bay, Palau Is., Aug. 22, 1960. A collection was also made from inside a cave with solid rock bottom with shallow water. 7°19′55″ N. Lat.; 134°31′05″ E. Long.

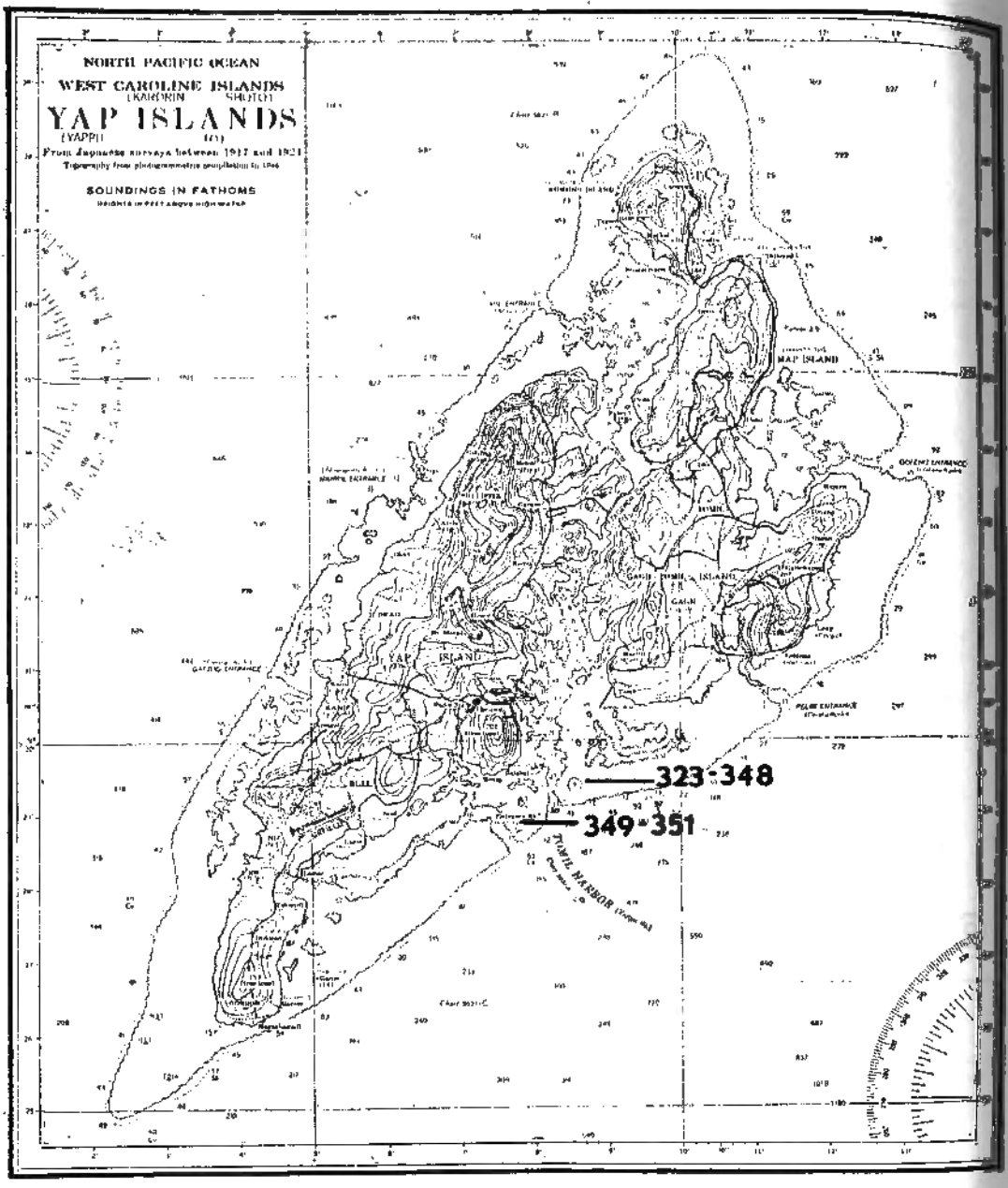


Plate 11. Yap Islands showing collecting stations.

Bags 435–461 were collected after E. G. Meñez came back from Pulo Anna thus the non-consecutive bag numbers for the Palau collection.

Bags 435–447. Collected from reef flat with sandy-muddy substratum with rocks and eel grass at Koror Is., Sept. 5, 1960. 7°19′55″ N. Lat.; 134°31′05″ E. Long.

Bags 451–456. Collected from reef with sandy-rocky substratum with animal corals at

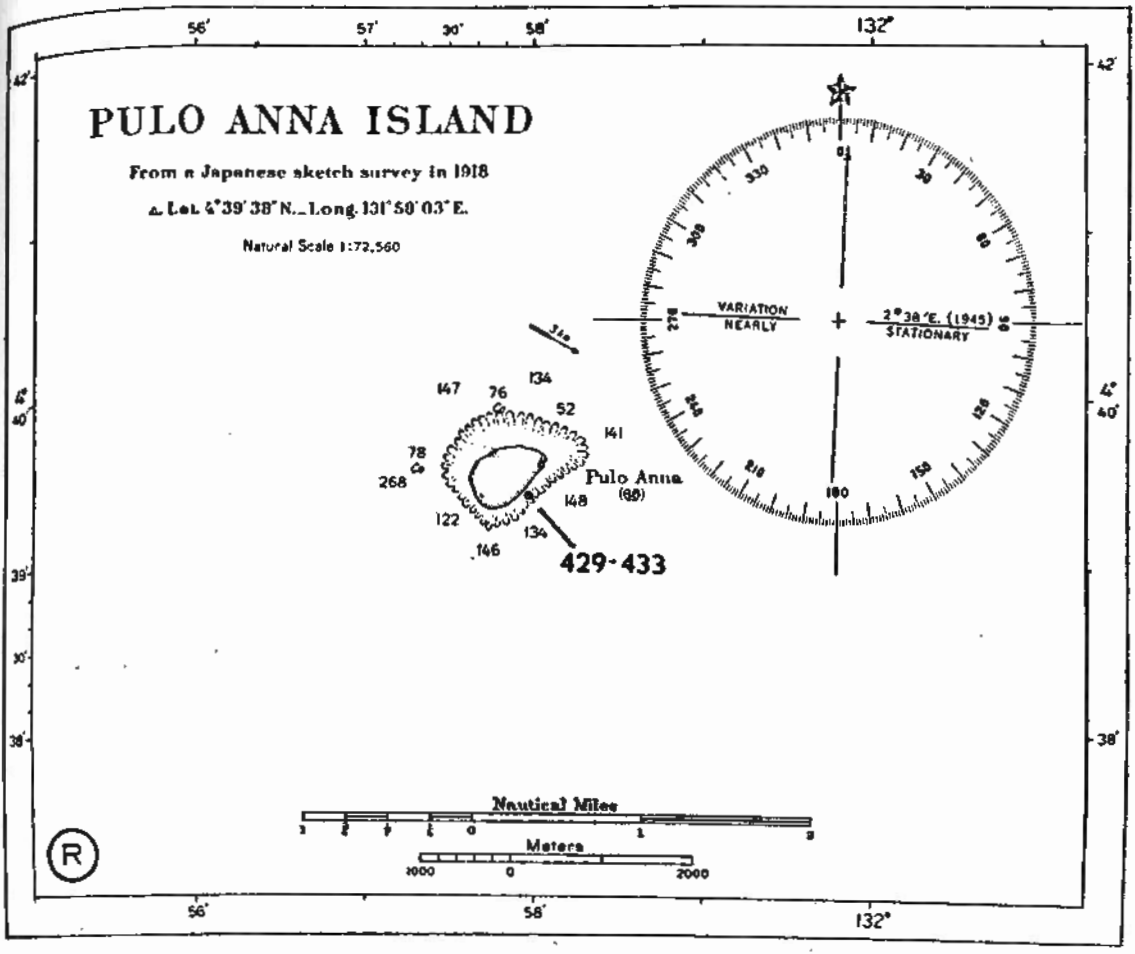


Plate 12. Pulo Anna Island showing collecting station.

Koror Is., Sept. 6, 1960. 7°19′20″ N. Lat.; 134°28′40″ E. Long.

Bags 457–461. Collected from reef with sandy-rocky substratum with lots of staghorn and other corals near Malakal Pass at Malakal Is., Sept. 6, 1960. Bag 458 was collected from inside a cave above water level. 7°19′00″ N. Lat.; 134°28′00″ E. Long.

13. Helen Reef

Bags 385–398. Collected from reef with sandy-rocky substratum at southeastern portion of Helen Reef, Aug. 28, 1960. This portion of the reef is never exposed during low tide. 2°49′36″ N. Lat.; 131°45′15″ E. Long.

Bags 399–404. Collected from reef with sandy-rocky substratum at lagoon side of Helen Is., Aug. 28, 1960. 2°49′52″ N. Lat.; 131°47′03″ E. Long.

Bags 405–411. Collected from reef with sandy substratum with few rocks at the northern side of Helen Is., Aug. 29, 1960. 2°58′34″ N. Lat.; 131°48′50″ E. Long.

Bags 412–421. Collected from reef with sandy-rocky substratum with lots of corals at western side of Helen Is., Aug. 30, 1960. 2°58′34″ N. Lat.; 131°48′50″ E. Long.

Bag 422. Collected from reef with very sandy substratum with few rocks at the southern

portion of Helen Is., Aug. 30, 1960. Location same as Bag 412.

Bags 423–428. All fresh water algae. Not treated.

14. Pulo Anna Island (Plate 12)

Bags 429–433. Collected from reef flat with sandy to rocky substratum at southeastern side of Pulo Anna Is., Sept. 3, 1960. 4°39′30″ N. Lat.; 131°57′50″ E. Long.

Bag 434. Collected from reef with rocky substratum with lots of basalt rocks at Pulo Anna Is., Sept. 3, 1960. Location the same as Bag 434.

Because of its bulk this manuscript is published into two parts, namely, Part I. *Chlorophyta* and *Cyanophyta* and Part II. *Phaeophyta* and *Rhodophyta*.

Part I. Chlorophyta and Cyanophyta

CHLOROPHYTA

Enteromorpha Link 1820

Key to species:

1. Thalli forming coarse tufts up to 3 cm or more tall, abundantly branched all over, or the branches restricted at the basal portions of the main axes 2
1. Thalli forming fine, entangled masses; filaments sparingly branched .... *E. salina* var. *polyclados*
   2. Branches abundant all over; ultimate branchlets fine and uniseriate .... *E. clathrata*
   2. Branches restricted to the basal portion of the thallus, ultimate branchlets generally multiseriate ..... *E. kylinii*

1. *Enteromorpha clathrata* (Roth) J. Agardh 1883: 153; Bliding 1944: 331, figs. 5–7; Dawson 1954: 384, fig. 6d–e.

   Conferva clathrata Roth 1806: 175.

Filaments 2–3 cm tall, cylindrical, irregularly branched all over, 100–280 μ in diameter, many cells broad; cells 16–20 μ wide, as long as wide, with 3–4 pyrenoids; cells fairly well arranged in longitudinal rows but not transversely. Ultimate lateral branches uniseriate. This particular material resembles the figure of Dawson (1954) for this species.

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

Materials examined: 21580, found only once, epiphytic on larger algae, on reef near Utwa Village, Utwa Is., Kusaie Group, VII–17–60.

2. *Enteromorpha salina* var. *polyclados* (Kütz.) Taylor 1960: 56; Taylor 1945: 39.

   Enteromorpha polyclados Kütz. 1845–1871, Vol. 6, tab. 36, p. 13.

Filaments very slender, about 30–40 μ in diameter, cylindrical, sparingly primarily branched, forming layers of entangled filaments. Main filaments 2–3 cells broad arranged in longitudinal rows but not transversely, with 1–2 pyrenoids, 8–12 μ wide, as long as wide.

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

Materials examined: 15382, 15335, 15338, on the northern side of Helen Is., Helen Reef, VIII–28–60; 15449, on the southeastern portion of Helen Reef, VIII–28–60.

3. *Enteromorpha kylinii* Bliding 1948: 1, figs. 1–3; Dawson 1954: 384, fig. 5.

Collected on drift-log forming tufts about 1–3 cm tall, mixed with blue-green

algae. Thalli branched at the basal portion only, cylindrical; the primary filament smaller in diameter than the simple and very much coarser branches. Simple branches thinner at the base, becoming enlarged and somewhat inflated towards the apices, which are slightly curved and slightly twisted occasionally.

Type: from the west coast of Sweden; present whereabouts not known to the writer.

Materials examined: 21729, on reef near Helen Is., Helen Reef, VIII-28-60.

Halicystis Areschoug 1850

Halicystis pyriformis Levring 1941:612, fig. 3L–P; Dawson 1954: 388, fig. 8a–c; Dawson 1956: 27.

Thalli small, composed of few vesicles, growing solitary or in clumps on coralline algae. Vesicles up to 2.5 mm tall; young vesicles pyriform to shortly clavate, swollen at the apices, tapered towards the base.

The single penetrating, thick walled rhizoid in both the young and matured vesicles are distinct. The specimens are identical to the figures of Dawson (1954) for this species.

Type: Levring specimen from Juan Fernandez Islands; present whereabouts not known to the writer.

Materials examined: 23644.1, on reef near Utwa Village, Kusaie Is., VII-17-60.

Cladophora Kützing 1843

Key to species:

1. Branching irregular, tips of branches commonly terminating in rhizoids .... *C. boodleoides*
1. Branching at the lower portions of the filaments commonly trichotomous; long unicellular rhizoids present at almost every cell on the basal portions of the main axes ..... *C. trichotoma*

1. *Cladophora boodleoides* Boergesen 1925: 56, figs. 19–22.

Filaments forming soft, low tufts or clumps, dark brown in color (pickled or dry). The size and form of the branching of the filaments and the common occurrence of branches which terminate into thin rhizoids with somewhat lobed to branched attachment organs fit very well the descriptions and figures of Boergesen (1925) for *C. boodleoides*. This name was interpreted by Van den Hoek (1963) as a synonym for a much earlier described species, *C. liebetruthii*. Boergesen, however, recognized these two entities as separate species. My material does not resemble the illustrations of Van den Hoek for *C. liebetruthii* but is in perfect agreement with Boergesen's descriptions and figures for *C. boodleoides*. Like Boergesen, I recognize this as a species distinct from *C. liebetruthii*.

The variable diameter of the filaments is well within the range of measurements for *C. boodleoides*, except for the longer cells, up to 7 diameters long, occasionally more than 10 times; the tips of the branches taper slightly but distinctly. This slight variation is well within the limits of the present species.

On rocks forming clumps mixed with *Rhipidiphyllon reticulatum* (Askenasy) Heydrich.

Type: from Orotava, Teneriffe, Canary Islands; present whereabouts not known to the writer.

Materials examined: 23057, on reef at northern end of Puluwat Is., VII-7-60; 23679, on reef at Oruluk Is., VII-26-60.

2. *Cladophora trichotoma* (Ag.) Kützing 1849: 414; Boergesen 1925: 50, figs. 15-16.
Conferva trichotoma Agardh, Syst. Alg.: 121.

Filaments forming tufts about 1 to 2 cm tall. The main filaments distinct 140-180 μ in diameter, those of the lesser branches become slightly but distinctly smaller towards the terminal branches. The branching may be irregular, secund, alternate or opposite, the last type very common along the main filaments, although occasionally three branches were found arising from the same cell. Long and slender rhizoids are found almost at every cell of the lower portions of the filament. The rhizoids are without cross walls and are tipped with lobed to branched attachment organs.

I have no doubt in assigning this material to *C. trichotoma*, but unlike that of Boergesen from the Canary Islands, the present material has abundant "trichotomies" which according to Boergesen, based on Kützing's descriptions, is the main character of this species.

Collected only once, forming soft tufts attached on rocks.

Type: "in stagnis Cochinchinae"; present whereabouts not known to the writer.

Materials examined: 23180, 21451, on reef near Utwa Village, Utwa Is., Kusaie Group, VII-17-60.

Boodleopsis A. and E. S. Gepp 1911

Boodleopsis sp.

Forming felted mass of matted filaments producing a greenish layer on the substratum. Examination of the matted filaments reveals a felted mass of colorless filaments below, and pigmented filaments on the upper surface.

The filaments, although forming a felted layer on the substratum, do not produce caespitose tufts. The rhizomatous main axis is very irregularly branched, concealed by the upper felted mass of filaments. Axis is about 60-80 μ in diameter, filled with colorless granules, presumably starch; the wall irregularly thickened and stratified. The main axis gives rise to more slender secondary branches, also irregular in diameter, the latter giving rise to the horizontal and semi-erect photosynthetic systems. Rhizoids are produced from the main axis without any arrangement.

The semi-erect system is made up of an irregularly branched basal portion becoming regularly dichotomous, sometimes trichotomous, towards the ultimate branches. Deep constrictions are present and equally placed above the dichotomies; diameter of the filaments 15-25 μ. Deep interdichotomal constrictions are also present. This more regularly branched portion of the thallus contains fewer chloroplasts than the horizontal photosynthetic system. Some filaments of the prostrate system are not constricted. These are a little thicker and densely filled with chloroplasts than those with constrictions, and are associated with a type of reproductive structure, presumed to be sporangia.

More striking than the above feature is the presence of horizontal dark green filaments densely filled with chloroplasts. These are very irregularly and sparsely branched, and may be dichotomous, alternate, or opposite, or the branches may

be restricted on one side of the filament for some length. The diameter of these filaments is 16–20 μ. Deep constrictions are at unequal distance above the dichotomies. Deep interdichotomal constrictions are also frequent.

Colorless filaments deep in the felted mass are very irregularly branched, the branches sometimes distinctly unilateral for a certain length of the main filament, but generally dichotomous or opposite. Diameter of the filament is 14–20 μ. Constrictions above the dichotomies, or at the base of the branches, are distinct. These filaments are devoid of chloroplasts or starch grains.

The presence of sporangia is easily noticeable with the dissecting microscope. These appear as dark rounded structures borne on or near the tips of the unconstricted portions of the semi-erect filaments. The dark appearance of the branch bearing these structures is due to the dense concentration of the chloroplasts in this portion. The sporangia are 110–130 μ in diameter and 160–175 μ long, subspherical to obovate and stalked. Cross walls separate the contents of the sporangia from the rest of the cytoplasm of the filament. Young sporangia are homogeneously filled with dense, small, spherical to ovate chloroplasts but in later stages the protoplast is partitioned into smaller segments about 30 μ thick.

Aside from the sporangia, smaller bodies about 40–45 μ were also observed. The relationships of these smaller bodies to the sporangia and to the filaments was first doubted since these smaller bodies were frequently found producing finer and rhizoid-like filaments which were in no way connected with the vegetative filaments. The structures remind one of a germinating pollen grain except that these contain chloroplasts. A thorough search, however, revealed that the filaments grow long without producing branches, the diameter increasing with growth and later giving rise to the vegetative filaments.

Materials examined: 23773, collected above tide level below an over-hanging ledge, near Malakal Pass, Malakal Is., Palau Group, Caroline Islands, IX-6-60. Now in M. S. Doty Herbarium, Dept. of Botany, University of Hawaii, Honolulu, Hawaii.

Valonia Ginnani 1757

Key to species:

1. Thallus solitary or in groups of two to a few individuals, each consisting of a single large cell attached to the substratum or to each other by small lenticular cells ..... *V. ventricosa*
1. Thallus branched or unbranched, made up of vegetative cells usually forming compact or loose clumps 2
   2. Vesicles large, 2-3 mm in diameter, up to 5 diameters long, cylindrical to clavate; length of the vesicles of the same age more or less uniform .. .. *V. fastigiata*
   2. Vesicles generally smaller, 1–2 mm in diameter, cylindrical or of various shapes and sizes, or forming a somewhat pseudoparenchymatous clumps 3
      3. Thallus erect forming compact clumps ..... *V. aegagropila*
      3. Thallus repent, spreading; vesicles of various shapes, cylindrical, arched or parenchyma-like ..... *V. utricularis*

1. *Valonia ventricosa* J. Agardh 1887: 96; Egerod 1952: 347, pl. 29a; Dawson 1954:

388, fig. 8e.

Thalli variable in size, ranging from 1 to 3 cm in diameter, spherical to obovate in shape. The lenticular cells at the base of the thallus which give rise to rhizoids are prominent.

Attached on rocks and dead corals.

Type: specimens collected by Oersted from St. Croix, Virgin Islands; present whereabout presumably in Agardh Herbarium, Lund, Sweden.

Materials examined: 15932, from lagoon, Puluwat Is., (Enderby Is.), VII-7-60; 21694, 23553, 23783, 23545, 21242, 21176, 21166, 21139, on reef flat at Iwayama Bay, Palau Is., VII-22-60; 23156, on reef at Yap Is., VII-19-60; 15811, on reef at eastern side of Ulul Is., VII-6-60; 15673, on reef flat at Epwelkapw, Ponape Is., IX-6-60; 15424, near Malakal Pass, Malakal Is., Palau Group, IX-6-60.

2. *Valonia aegagropila* C. Agardh 1822: 429; Egerod 1952: 348, pl. 29b; Dawson 1954: 388, fig. 8j; Dawson 1956: 28; Taylor 1950: 41.

Materials examined form clumps or mats of indefinite size. Vesicles are smaller in diameter than the measurement given by Egerod (1952) for *V. aegagropila*.

Type: from Venice, Italy; present whereabouts not known to the writer.

Materials examined: 15256, 23185, 15670, 23241, on reef at Kusaie Is., VII-15-60; 21562.1, on reef at Pulo Anna Is., IX-3-60.

3. *Valonia utricularis* (Roth) Agardh 1822: 431; Boergesen 1913-1920: 30, figs. 17-18; Weber van Bosse 1913: 60.

Conferva utricularis Roth 1806: 160, pl. 1, fig. 1.

Thalli examined may represent the two forms of this species, f. *typica* represented by collection numbers 15315, 15333, 15403, 15328, 15377, 21711, 15145, 15104, 21616.3 and f. *crustacea* represented by numbers 15265 and 15414. The notes were not sufficient to elaborate on the differences in habitats.

Growing on rocks, dead corals and coralline algae.

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

Materials examined: 15315, 15333, 15403, 15328, 15377, on south-eastern portion of Helen Reef, VII-28-60; 21711, 15145, on reef flat at Epwelkapw, Ponape Is., VI-20-60; 15104, on reef flat with sandy-rocky substratum at Iwayama Bay, Palau Is., VII-22-60; 15485, on reef with sandy-rocky substratum with plenty of corals near the western end of Helen Is., Helen Reef, VII-28-60; 21616.3, on reef flat with hard bottom with sand, Pulo Anna Is., IX-3-60; 15265, on reef at Tafansak Village, Kusaie Is., VII-16-60; 15414, on reef at south-eastern portion of Helen Reef, VII-28-60.

4. *Valonia fastigiata* Harvey ex. J. Agardh 1887: 101; Egerod 1952: 348; Kanda 1944: 749, fig. 9; Dawson 1957: 101, fig. 1; Gilbert 1959: 419; Taylor 1966: 347.

Among the *Valonia* materials from the Caroline Islands is a collection represented by five dried, mounted specimens. One very noticeable characteristic of this species is the large size of the vesicles, 2-3 mm in diameter and 5-10 mm long, about 2-5 diameters long in matured vesicles. The possibility that these materials could be a more robust form of *V. aegagropila* seems untenable when these are compared with the materials which I placed under this species; the vesicles are about 3-5 times larger than those which I call *V. aegagropila*.

Based on the size and form of branching the material could be a less regularly branched form of *V. fastigiata*. It resembles somewhat the figure 9 of Kanda (1944) for this species, though less regularly branched.

Type: from Ceylon, a part of Harvey's original collection issued as No. 74 of his Ceylon Algae; now in Farlow Herbarium.

Materials examined: 21395, 23314, on reef with sandy-muddy substratum, Nanmatol Is., Ponape Group, VII–23–60; 15674, 21711, on reef flat at Epwelkapw, Ponape Is., VI–20–60.

Valoniopsis Boergesen 1934

Valoniopsis pachynema (Martens) Boergesen 1934: 10, figs. 1, 2; Taylor 1950: 42; Dawson 1957: 102, fig. 2.

Bryopsis pachynema Martens 1866: 24, pl. 4, fig. 2.

Plants forming a loose, low tuft. The type of branching and the size of the filaments fit the descriptions and figures of Boergesen (1934) for *V. pachynema*, and Dawson's (1957) figure for the same species.

On rocks mixed with other algae.

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

Materials examined: 15243, 23417, on reef at Kusaie Is., VII–16–60; 23820, on reef at Lele Harbor, Kusaie Is., VII–15–60.

Boergesenia Feldmann 1938

Boergesenia forbesii (Harvey) Feldman 1938: 588, figs. 3–5; Yamada 1950: 174; Dawson 1954: 388, fig. 8d.

Valonia forbesii Harvey 1859a: 33.

Pl. 17, fig. 7

The thalli examined agree well with the descriptions and figures for *B. forbesii*. Several thalli were found growing on rocks in at least three collections.

Type: Harvey's specimen No. 75 from Ceylon; now in Botanical Museum at Copenhagen.

Materials examined: 21400, 23312, 21579, on reef at Nanmatol Is., Ponape Group, VII–23–60; 23149, in man-made pool dredged inside Moen Is. harbor, Truk Group, VII–29–60; 15937, in lagoon at Puluwat Is., (Enderby Is.), VII–8–60.

Dictyosphaeria Decaisne 1842

Key to species:

1. Thallus a hollow structure when young, becoming ruptured and convoluted at maturity; made up of a single layer of cells with non-trabeculate walls .. .. *D. cavernosa*
1. Thallus a solid pseudoparenchymatous structure 2
   2. Cell walls with trabeculae ..... *D. versluysii*
   2. Cell walls non-trabeculate ..... *D. mutica*

1. *Dictyosphaeria cavernosa* (Forskål) Boergesen 1932: 2, pl. 1, fig. 1; Taylor 1950: 43, pl. 27, fig. 2; Dawson 1954: 388, fig. 8i, Egerod 1952: 350, fig. 1, b–f, fig. 2, f and g.

   Ulva cavernosa Forskål 1775: 187.

   Young thalli hollow, made up of one layer of large non-trabeculate cells, be-

coming ruptured at maturity. This species was found to be widely distributed in the Caroline Islands and agrees well with the taxonomic treatments of the above cited authors.

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

Materials examined: 21319, 21385, 21281, on eastern seaward reef flat of Urak Is., Mokil Group, VI-29-60; 21719, 15604, on reef at Pulo Anna Is., IX-3-60; 15628, on northern seaward reef flat of Mokil Is., Mokil Group, VI-29-60; 23524, 15727, at south end of Helen Reef, VII-28-60; 15824, on reef at eastern side of Ulul Is., VII-6-60; 21933, 21932, 21924, on western seaward reef flat of Pingelap Is., VII-1-60; 23053, on eastern seaward reef between Ifaluk and Flalap Is., Ifaluk Group, VII-10-60; 23790, on reef flat with sandy-rocky substratum, Iwayama Bay, Palau Is., VIII-22-60; 23209, on reef at the southern tip of Sorol Is., VII-10-60; 15701, on northern seaward reef flat of Mokil Is., VI-29-60; 23350, on reef at eastern side of Sorol Is., VI-13-60; 23420, on reef at Kusaie Is., VII-15-60; 21613, on reef flat with hard botom with sand, Pulo Anna Is., VIII-18-60; 21562.3, on reef at Pulo Anna Is., IX-3-60; 21306, on reef at western side of Ella Is., Ifaluk Group, VII-10-60.

2. *Dictyosphaeria versluysii* Weber van Bosse 1905: 144; Dawson 1954: 388, fig. 8k, l; Egerod 1952: 1a; fig. 2, h-k.

The solid thallus and the presence of the trabeculae projecting from the walls of the cells characterize the specimens studied. Growing on rocks.

Type: from Indonesia; present whereabouts not known to the author, but probably with other Siboga materials in Indonesia.

Materials examined: 21277, on lagoon side of reef flat at northwest tip of Mokil Is., VI-29-60; 21557, 21616.4, on reef flat with hard bottom with sand at Pulo Anna Is., IX-3-60; 21521, on northern seaward reef at Mokil Is., VI-29-60; 23676, on reef at western end of Puluwat Is., VII-7-60.

3. *Dictyosphaeria mutica* Yamada 1944: 32.

Only one specimen was available for examination but the solid thallus and the absence of spinulose trabeculae fit the description of *D. mutica* by Yamada (1944) from the Atoll of Ant in the Caroline Islands.

Type: from Atoll of Ant, Caroline Islands; present whereabouts not known to the writer.

Material examined: 21351, on northern seaward reef flat of Mokil Is., VI-29-60.

Cladophoropsis Boergesen 1905

Key to species:

1. Filaments coarse, 400-600 μ in diameter with very thick walls; closely interwined, forming small clumps tightly appressed to the substratum ..... *Cladophoropsis sp.* 1
1. Filaments finer, thin walled, up to 300 μ in diameter, forming soft tufts... 2
   2. Filaments 250-300 μ in diameter, with few branches near the bases; diameter of the upper portion of the filaments distinctly larger than the base ..... *C. herpestica*
   2. Filaments finer than above, not more than 225 μ in diameter, abundantly branched 3

3. Filaments 150–225 μ in diameter, cells 4–10 diameters long..... ..... *C. membranacea*

3. Filaments fine, 95–140 μ in diameter; cells very variable in lingth, 4–50 diameters long ..... *Cladophoropsis sp.* 2

1. *Cladophoropsis membranacea* (Ag.) Boergesen 1905: 275, figs. 29–31; Boergesen 1913: 42, figs. 26–33; Dawson 1954: 390, fig. 8f; Egerod 1952: 356, fig. 3.
Conferva membranacea C. Agardh 1824: 120.

Filaments forming dense tufts on sandy-rocky substratum, attached by means of branched, basal rhizoids, provided with small tenacular cells at their tips; the end walls of the tenacular cells are modified into lobed or finger-like attachment structures.

Branching irregular, lax, and in all planes, alternate at the basal portions, secund, in short or long series near apical portions of the filaments. Cells 150–225 μ in diameter, variable in length, 4–10 diameters long in portions of the main filaments with branches, or many times longer in the unbranched portions. Tips of the main filaments may grow very long without producing branches. Occasionally tenacular cells are found at the tips of the decumbent main filament.

In one collection (21951.1) are specimens whose main filaments are only 110–140 μ in diameter, lesser branches only 75–80 μ in diameter. I have some doubts in assigning these materials to this species because of the smaller size of the filaments, yet other features recall that of *C. membranacea* described by Boergesen (1913) from the Danish West Indies.

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

Materials examined: 21027, on reef at Falas Is., Truk Group, VII–30–60; 21951.1, on reef near Utwa Village, Kusaie Is., VII–17–60.

2. *Cladophoropsis herpestica* (Mont.) Howe 1914; 31; Setchell 1926: 77, pl. 8, fig. 1; Dawson 1954: 390, fig. 8h.
Conferva herpestica Montagne 1842: 15.

One small clump was found which very much resembles this species. Thallus more or less consisting of decumbent filaments, the basal portions of which are much thinner than those above and are provided with rhizoids which are generally branched and segmented. Upper portion of the filament scarcely branched and distinctly larger in diameter than the basal portion, to about 250–300 μ. Walls in the older portions of the filaments thick, 20–35 μ, stratified, although thinner at younger portions.

The material closely resemble the figure 8h of Dawson (1954) for *C. herpestica* though smaller in diameter of the filament.

Type: from New Zealand; now in the Museum d'Histoire Naturelle, Paris.

Materials examined: 21714, on reef at Pulo Anna, IX–3–60.

3. *Cladophoropsis sp.* 1.

Filaments tightly intertwined forming small clumps growing appressed on dead corals and rocks as well as on coralline algae.

Main filaments 400–600 μ in diameter, twisted or curved, never straight. Branches cylindrical, although the cells of the main filaments found deeper in the mass are somewhat inflated and generally with bumps or short branches. Branches secund or sometimes somewhat alternate, without cross walls at the base. Portions of the main filaments located deeper in the clump do not produce

branches but portions exposed on the surface of the clump, or along the margins do.

Cells of the main filaments 2–4 times longer than wide, those of the branches up to 10 times or more. Branches simple, seldom producing secondary branches except in the old portions of the filaments. Cell walls thick, about 70–140 μ, stratified.

Base of the main filaments modified into rhizoid-like structures provided with small hapteroid cells. Hapteroid cells not limited to the basal portions of the filaments but are also present on the tips of the branches and along the sides when these are in contact with the substratum or with other filaments.

The hapteroid cells are hard to see due to their small size and the inability of the walls to take up stain. They are provided with tough, thin, hyaline end walls which are either lobed or finger-like.

The specimens resemble the genus *Cladophoropsis* with regards to their type of branching and the absence of cross walls at the base of the branches. The presence of numerous small hapteroid cells remind one of the genus *Dictyosphaeria*.

Materials examined: 15108, on reef flat with sandy-rocky substratum at Iwayama Bay, Palau Is., VIII–22–60; 15132, on eastern seaward reef flat, Urak Is., Mokil Group, VI–29–60; 15119, 15188, on seaward reef flat, Mokil Is., IV–29–60.

4. *Cladophoropsis sp.* 2.

Thalli forming soft, loose mats which are quite extensive, or mixed with other algae. Filaments found deeper in the mat are lighter in color than those exposed at the surface. The latter are crispy and robust in appearance.

Main filaments 95–140 μ in diameter; walls thin. Branching irregular, secund, alternate to subopposite. The last type of branching is only found in the main branches. Branches slightly but distinctly tapering towards the apices.

The most interesting character of this species is the extremely variable length of the cells. The main filament may give rise to a branch which grows very long, up to 50 times its diameter without producing cross walls, then interrupted by very much shorter cells, 4–10 times diameter long which give rise to branches; a branch from the main filament may grow and develop like those described above, and produce branchlets which are quite distant from the main filament; or the tips of the same branch system may develop into a very long non-septate tube; or the branch may produce two or a series of secondary lateral branches one of which may grow and produce short and non-septate branchlets; or the branch may produce long, non-septate secondary lateral branches without developing ultimate branchlets.

The filaments are attached to the substrate, or to each other by means of short 2(3) celled branch, the tip cell modified into a holdfast cell with lobed or branched tips, the protoplast of which is connected to the mother cell; the latter may be modified into a thin rhizoid-like structure. These were found to develop in pairs only at the proximal ends of the old main filaments.

Materials examined: 23616, on reef near Utwa Village, Kusaie Is., VII–17–60; 21027, on reef at Falas Is., Truk Group, VII–30–60.

Boodlea Murray et De Toni 1890

Key to species:

1. Main filaments about 350–500 μ in diameter, distinctly coarser than the minor branches ..... *B. siamensis*
1. Main filaments not more than 300 μ in diameter, not distinctly larger than the minor branches 2
   2. Filaments 80–110 μ in diameter, shiny and somewhat crispy in appearance (both dried and pickled materials), cells 2–15 diameters long; two types of attachment cells present ..... *Boodlea sp.*
   2. Filaments coarser, 150–300 μ in diameter 3
      3. Basal portions of the filaments with many rhizoidal filaments ..... *B. vanbosseae*
      3. Basal portions of the filaments without rhizoidal filaments ..... *B. composita*

1. *Boodlea composita* (Harvey) Brand 1904: 187; Boergesen 1940: 21, fig. 6; Egerod 1952: 362, pl. 32a, fig. 6, a; Dawson 1954: 390, fig. 9c–d; Taylor 1960: 119. *Cladophora composita* Harvey 1834: 157.

Filaments forming cushions of irregular size. Identical with the specimens from Hawaii annotated by W. J. Gilbert.

Type: from Mauritius collected by Telfair; now in Kew Herbarium.

Materials examined: 21519, on northern seaward reef flat of Mokil Is., VI–29–60; 21079, on south end of Helen Reef, VIII–28–60; 23660, on reef at Falas Is., Truk Group, VII–30–60.

2. *Boodlea vanbosseae* Reinbold 1905: 148; Reinbold, *In* Weber von Bosse 1913: 70, fig. 12; Dawson 1956: 29, fig. 6.

Branching very irregular, opposite or alternate, proliferous. Filaments 250–300 μ in diameter attached to each other by means of hapteroid cells. Rhizoidal filaments numerous. Materials identical to figures and notes of Dawson (1957) for *B. vanbosseae*. Included under this species are materials 21616 and 15606 which somewhat resemble this species but which differ from the typical materials in having fewer rhizoidal filaments. Forming soft cushions mixed with other algae growing on rocks.

Type: from Lucipara Is., Indonesia; present whereabouts not known to the writer.

Materials examined: 21559, 21562.6, on reef at Pulo Anna Is., IX–3–60; 21781, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 15429, on reef near Tafansak Village, Kusaie Is., VII–16–60; 23550.4, on reef at Iwayama Bay, Palau Is., VIII–22–60; 23505.2, on reef at Oruluk Is., VII–29–60; 21930, 21448, on western seaward reef flat of Pingelap Is., VII–1–60.

3. *Boodlea siamensis* Reinbold 1901: 107; Weber van Bosse 1913: 68, fig. 11; Taylor 1950: 44.

Main filaments distinct, very coarse, 350–500 μ in diameter, and easily separated from one another, cells about 5 diameters long. Branching more or less regular along the main filament, opposite but becoming irregular among the finer secondary branches where branching is in all planes.

The small clumps of wet preserved materials from two collections were in such a battered condition that a thorough study did not ascertain their identity

beyond doubt. Further study with dried materials, however, revealed the presence of the very distinct main filament and the irregular branching in all planes among the secondary branches which resembles Weber van Bosse (1913) Figure 11 for *B. siamensis*.

Type; from Koh Chang, Gulf of Thailand; in Dublin Herbarium.

Materials examined: 15654.6, 15658.2 on reef in Koror Is,, Palau Group, VII-5-60; 211469.2, on reef flat at Iwayama Bay, Palau Is., VIII-22-60.

4. *Boodlea sp.*

Thalli soft, forming yellowish-green, firm mat less than a centimeter tall consisting of sub-erect main filaments from which prostrate and erect branches arise. The basal portions of the main filaments are attached to the substratum by small hapteroid cells. The tips of the prostrate branches are modified into small hapteroid cells and become attached to other filaments or to the substratum, producing a firm mat.

Main axis 80–110 μ thick, tapering slightly to about 70 μ in the branches; length of the cells variable, 2–15 diameters long, short in portions bearing branches. The tips of the prostrate filaments tend to curve to the substratum, producing one or two hapteroid cells at their ends. Branches of the prostrate filaments also curved in the same direction, producing the characteristic habit found in the genus *Boodlea*.

Under the dissecting microscope the filaments appear to be shiny and crispy. Branching irregular in all planes but commonly secund on prostrate filaments. Branches with cross walls at their bases although these are sometimes absent in younger ones. Older branches usually produce hapteroid cells at their tips.

Two forms of hapteroid cells were observed. These may be small and short or they may be long, slender, and rhizoid-like in appearance.

Materials examined: 23458.2, on reef between Falo and Moen Is., Truk Group, VII-29-60.

Struvea Sonder 1845

Struvea anastomosans (Harvey) Piccone and Grunow, ex. Piccone 1884: 20; Egerod 1952: 359, pl. 31; fig. 4a–h; Dawson 1954: 390, fig. 8g; Boergesen 1913: 54, fig. 39.

Cladophora anastomosans Harvey 1859b, pl. 101.

Materials are quite small, up to 1.5 cm tall. The size reminds one of *S. tenuis* but tripinnate to quadripinnate branching is definitely that of *S. anastomosans*.

Materials examined lack the characteristic corrugations in the stipes. Several long stipitate fronds were found arising from a stoloniferous base, although individual specimens with rhizoids at the base of the stipes were found. Plants fit fairly well with the descriptions and figures for *S. anastomosans*. Growing on rocks.

Type: from Fremantle, West Australia; present whereabouts not known to the writer.

Material examined: 23458.1, on reef between Falo and Moen Is., Truk Group, VII-29-60.

Rhipidiphyllon Heydrich 1894

Rhipidiphyllon reticulatum (Askenasy) Heydrich 1894: 281, pl. 15, fig. 1; Taylor 1950:

45; Boergesen 1924: 251, figs. 3–4; Dawson 1956: 32, fig. 10.

Anadyomene reticulata Askenasy 1888: 5, pl. 2, fig. 7.

Filaments forming clumps mixed with other specimens. The materials fit the descriptions of Taylor (1950) and Dawson's (1956) Figure 10 for *R. reticulatum*.

On rocks and dead coral.

Type: from Dirk Harteg Is., West Australia; present whereabouts not known to the writer.

Materials examined: 23681, 23505.1, on reef at Oruluk Is., VII–26–60; 23057.1, on reef at northern end of Puluwat Is., VIII–7–60.

Microdictyon Decaisne 1839

Key to species:

1. Blades small, meshes very close, appearing pseudoparenchymatous; main segments stellate ..... *Microdictyon sp.*
1. Blades large, meshes large, not appearing pseudoparenchymatous; main segments not stellate ..... *M. okamurai*

1. *Microdictyon okamurai* Setchell 1929: 553, figs. 76–84; Taylor 1950: 46, pl. 27, fig. 1; Dawson 1956: 32, fig. 11a.

Pl. 15, fig. 6

Main filaments 375–450 μ in diameter, segments 625–750 μ long. Anastomosing segments slightly tapered towards the tips, provided with crenulate fibulae. Meshes 1.0–1.8 mm broad.

The materials examined fit the figures and descriptions for this species, except for the thicker walls up to 8 μ in older portions of the mesh and also the slightly smaller size of the mesh.

Type: holotype, Okamura's specimen from the Ryukyu Island; now in the University of California Herbarium, No. 341251.

Materials examined: 21283, 21345, on western seaward reef flat of Urak Is., Mokil Group, VI–29–60; 21261, 21276, 21303, 21304, 21112, 21730, on lagoon side of reef flat at northwest tip of Mokil Is., VI–29–60; 23210, 23171, near southern tip of Sorol Is., VII–13–60; 23116, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, VIII–10–60; 21361, 21252, 21320, 15974, 21229, on eastern seaward reef flat at Urak Is., Mokil Group, VI–29–60; 23674a, on western end of Puluwat Is., VII–7–60; 23231, on reef at lagoon side of Ella Is., Ifaluk Group, VII–10–60; 21350, 15695, 21524, 21753, on northern seaward reef of Mokil Is., VI–29–60; 23034, on reef between Ifaluk and Flalap Is., Ifaluk Group, VIII–10–60; 21445, 21927, on western seaward reef flat of Pingelap Is., VI–1–60; 21276, on lagoon side of reef flat at northwestern tip of Mokil Is., VI–29–60; 23107, on reef at western side of Ella Is., Ifaluk Group, VIII–10–60; 23757 on lagoon side of reef flat at northeastern tip of Mokil Is., VI–29–60; 15106, on a reef flat with a sandy to rocky substratum of Iwayama Bay, Palau Is., VIII–22–60; 21001, on reef at Quoi Is., Truk Group, VIII–2–60; 21291, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60; 23504, Oruluk Is., VII–26–60.

2. *Microdictyon sp.*

Materials examined consist of small blades (8) about 1 cm across. The main filament is not prominent but easily recognizable, 360–420 μ in diameter, 1/3 to 2 times longer than wide.

The blades are characterized by a distinct stellate branching of the segments, and the meshes formed by the segments develop so close to each other that the blade appears to be pseudoparenchymatous. Walls thick, to 10–12 μ.

Ultimate segments 280–300 μ in diameter, provided at the tips with fimbriate extensions of the walls; short, not tapered, with blunt ends. Rhizoids produced at the basal portion of the blade, and not infrequently, at the margin near the base of the blade.

Materials examined: 15183, attached on rocks, collected from the northern seaward reef flat of Mokil Is., VI–6–60.

Chaetomorpha Kützing 1845

Chaetomorpha crassa (C. Agardh) Kütz. 1845; 204; Okamura 1931: 97; Dawson 1954: 386, fig. 6k; Taylor 1960: 72.

Filaments entangled with other specimens. The size of the cylindrical filaments ranges from 450–650 μ in diameter; cells 1–3 times longer than broad. The absence of the basal cell agrees with the description of *C. crassa*. Although quite variable in the size of the filaments, these are all within the size range for this species.

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

Materials examined: 21957, 21870, 15780, on reef at Tafansak Village, Kusiae Is., VII–16–60; 23013, on reef flat at eastern side of Peipalap Peak, Ponape Is., VI–17–60; 21736, on reef flat facing Mantapeitak Is., Ponape Group, VI–20–60; 21315, on western reef flat of Pingelap Is., VII–1–60; 21619, 21393, on reef at Nanmatol Is., Ponape Group, VII–23–60.

Rhizoclonium Kützing 1843

Rhizoclonium samoense Setchell 1924: 177, fig. 42; Dawson 1956: 33, fig. 13a.

Filaments forming entangled masses attached to decaying branch by few, short rhizoids at or near the bases. Diameter of the filaments irregular, about 69–90 μ; cells 1.5–3 diameters long. The cell walls are thick and stratified.

The specimens resemble those that were described by Setchell from Samoa.

Type: from Tutuila, Samoa; whereabouts presumably in the Carnegie Institute in Washington.

Materials examined: 21028, on reef at Falas Is., Truk Group, VII–30–60.

Derbesia Solier 1847

Derbesia sp.

Filaments minute, about 1.5 mm tall, found epiphytic on *Padina*. Composed of siphonaceous horizontal and erect filaments; the horizontal filaments very variable in diameter, very laxly tortuous, commonly from 15 to 40 μ in diameter; sometimes a short portion of the horizontal axis may become knob-like. The erect filaments are very much attenuated from a thick base, about 50–60 μ thick to very thin ultimate branches, 6–8 μ in diameter. The lower portion of an erect filament is unbranched for a distance of about 280 to 450 μ from the base, the upper portion 2 to 3 times dichotomously branched with very narrow angles. The erect arborescent filaments may be solitary, or in series along the long horizontal creeping axis. When in series, erect filaments are about 650 to 1800 μ from each other.

Materials examined: 15576.1, 15645.1, 15548.1, 15586.1, on *Padina sp.*, at Koror Is., Palau Group, IX-5-60; 21472.1, on *Padina sp.*, on reef at Iwayama Bay, Palau Group, VIII-22-60; now in M. S. Doty, Herbarium, Dept. of Botany, University of Hawaii, Honolulu, Hawaii.

Caulerpa Lamouroux 1809

Key to species:

1. Thallus not differentiated into distinct horizontal stolon and erect foliar branches ..... *C. fastigiata*
1. Thallus differentiated into a distinct horizontal stolon and erect foliar branches 2
2. Horizontal stolon and erect branches covered with whorls of determinate, branched, bifurcate branchlets ..... *C. pickeringii*
2. Horizontal stolons naked, not as above 3
3. Erect fronds flattened blades, simple or sparingly branched, toothed or cleft; or flattened, narrow uniform bands, toothed and commonly spirally twisted with teeth disposed at the outer margin of the spiral 4
3. Erect fronds not flattened blades, variously branched, filiform or massive 8
4. Erect fronds simple, or sparingly branched; broadly flattened blades with finely toothed margins ..... *C. brachypus*
4. Erect fronds not as above, simple or sparingly branched blades with cleft margins, or, narrow, flattened, uniform bands commonly spirally twisted, toothed 5
5. Blades cleft, branchlets or pinnules evently pinnate, cylindrical or compressed 6
5. Blades even, narrow, flattened bands, margins toothed; often conspicuously spirally twisted, the teeth uniseriate at the outer margin of the spiral ..... *C. serrulata*
6. Branchlets or pinnules strongly compressed, regularly and oppositely pinnate, upcurved, sickle-shaped, contracted at the base, tapered towards the mucronate tips ..... *C. taxifolia*
6. Branchlets or pinnules cylindrical and evenly pinnate, not contracted at the base, upcurved 7
7. Plants small, forming dense mats of entangled stoloniferous and rhizoidal portions with sand particles; pinnules commonly pinnate, though may be irregular at the basal portion of the small blades, upcurved with apiculate tips ..... *C. antoensis*
7. Plants large; branchlets or pinnules always regularly and oppositely pinnate, upcurved with mucronate tips ..... *C. sertularioides*
8. Erect branches or axes with cylindrical branchlets or pinnules, verticillately arranged at regular intervals; or, normally with rows of short imbricate branchlets or teeth, or long and densely crowded; branchlets not differentiated into pedicels and swollen, spherical, or peltate apices 9
8. Erect branches with branchlets differentiated into pedicels and swollen, spherical or peltate apices 12

9. Branchlets distinctly verticillate at regular intervals along the erect axes, dichotomously subdivided, the ultimate subdivisions with bimucronate apices ..... *C. verticillata*
9. Branchlets or teeth not arranged as above, imbricate, multiseriate, or irregularly and densely crowded 10
10. Branchlets cylindrical, slightly contracted at the base, crowded along the entire length of the erect axes, or nearly so, twice or longer than the diameter of the main axes, upcurved with mucronate tips ... *C. cupressoides* var. *lycopodium*
10. Branchlets or teeth short, multiseriate, broad at the base abruptly tapering to the mucronate tips; or generally with three rows of short, imbricate, typically cylindrical branchlets with slight contracted bases 11
11. Teeth short, normally densely multiseriate, broad at the base, and abruptly tapered to the mucronate tips .... *C. urvilliana*
11. Branchlets cylindrical, commonly in three imbricate rows, slightly contracted at the base, or sometimes in compressed portions of the upper axes biseriate .... *C. cupressoides*
12. Branchlets with distinct stalks and peltate apices .... *C. peltata*
12. Branchlets not as above, clavate, or with globose or spherical apices 13
13. Branchlets constricted between the tips of the stalks and the globose apices ..... *C. lentillifera*
13. Branchlets not constricted between the tip of the stalks and the globose apices ..... *C. racemosa*

1. *Caulerpa antoensis* Yamada 1944: 27, pl. 1, fig. 1; Dawson 1956: 36, fig. 20.
Caulerpa arenicola Taylor 1950: 55, pl. 28, fig. 2.

Pl. 15, fig. 7

Thalli examined possess well-developed, fine cylindrical horizontal branches covered with rhizoids among which sand particles are entangled. From these horizontal axes arise many erect branches bearing short, slightly and upwardly curved ramuli which are cylindrical, arranged irregularly, and provided with acute apices or appearing distichous along the upper portion of the erect axes. My specimens differ, however, from Yamada's (1944) description of *C. antoensis* by having ramuli not always arranged in a pinnate manner, and are more like Dawson's (1956) figure 20 for *C. antoensis*. The ramuli are short, 0.5–1.5 mm long. This species resembles, and may be confused with, *C. arenicola* described by Taylor (1950) from Bikini. I am inclined to believe, based on its description and figure, that Taylor's species may be the same as *C. antoensis*.

On sandy substratum.

Type: from the Atoll of Ant, near Island of Ponape, Caroline Islands; present whereabouts not known to the writer.

Materials examined: 23074, on reef at eastern side of the lagoon at Puluwat Is., VIII-7-60; 21383, 21344, 21362, on eastern seaward reef flat at Urak Is., Mokil

Group, VI-29-60; 21926, 21338, on western seawards reef flat at Pingelap Is., VII-1-60; 23066, 23355, 23132, 23074, 23236.1, on reef at western (lagoon) side at Puluwat Is., VIII-7-60; 23102, on reef between Ifaluk and Flalap Is., Ifaluk Group, VIII-10-60; 23748, on reef at Urak Is., Mokil Group, VI-29-60; 15935-b, from lagoon, Puluwat Is., (Enderby Is.), VIII-7-60; 23055, 23118, on reef at eastern side between Ifaluk and Flalap Is., Ifaluk Group, VIII-10-60; 23232, on reef at lagoon side of Ella Is., Ifaluk Group, VIII-10-60.

2. *Caulerpa verticillata* J. Agardh 1847: 6; Dawson 1954: 392, fig. 10b; Taylor 1950: 54; Taylor 1960: 138, pl. 10, fig. 1, 2; Boergesen 1913: 121, figs. 95-98.

Pl. 14, fig. 4

Only two collections comprising several small specimens were available for study but are definitely *C. verticillata*. The verticillate arrangement of the ramuli at regular intervals along the erect axes and their bimucronate tips are distinctive.

Found growing on sandy-muddy substratum.

Type: from Atlantic coast of Mexico; present whereabouts not known to the writer.

Materials examined: 23409, on outer reef facing Mantapeitak Is., Ponape Group, VI-20-60; 21108, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI-25-60.

3. *Caulerpa fastigiata* Montagne 1845: 262, pl. 2, fig. 3; Boergesen 1913: 118, fig. 93; Taylor 1960: 136, pl. 10, fig. 12; Weber van Bosse 1898: 262, pl. 20, figs. 1-20.

Pl. 15, fig. 8

Materials examined fit very well the descriptions and figures for this species. Morphologically the horizontal stolons do not differ from the erect branches and can only be recognized by their lighter color and the presence of the rhizoids. The stolon is slightly bigger in average diameter than the erect branches, the former 170-200 μ in diameter while the latter is 120-160 μ. The erect branches are irregularly branched, alternate, opposite, or dichotomous. The terminal portion of the branches gradually taper to a blunt apex. Numerous trabeculae are present.

Materials were found growing on a sandy-muddy substratum where they form considerable mat-like colonies. The materials show a more vigorous growth and proliferous branches than that shown by Figure 93 of Boergesen (1913).

Found growing on sandy-muddy to sandy-rocky substratum.

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

Materials examined: 23002, 21981, near Tafansak Village, near river outlet, Kusaie Is., VII-16-60; 21955, on reef at Tafansak Village, Kusaie Is., VII-16-60; 23714, on reef near Utwa Village, Utwa Is., Kusaie Group, VII-17-60.

4. *Caulerpa pickeringii* Harvey and Bailey 1851: 373; Weber van Bosse 1898: 272; pl. 11, figs. 7-8.

Pl. 15, fig. 5

One sample constitutes the collection for this species. The tallest erect branch is about 2 cm., arising from a well-developed horizontal stolon. Both the erect branches and the stolon, except for the rhizoids, are covered with whorls of determinate branches (ramuli). The type of branching of the ramuli is the same as *C. Webbiana* var. *pickeringii* (Harvey and Bailey) Eubank, except that there are

only 3 ramuli in each whorl. The presence of ramuli or branchlets on the horizontal stolon is a distinctive character of this species. I am therefore retaining the name *C. pickeringii* for the present material.

Growing on sandy-rocky substratum.

Type: from Wilson Is., Paumoto Group; in Harvey Herbarium, Dublin, Ireland.

Material examined: 23780, on reef at northern end of Yap Is., VIII–19–60.

5. *Caulerpa taxifolia* (Vahl) C. Agardh 1822: 435; Weber van Bosse 1898: 292, Eubank 1946: 417; Yamada 1934: 67, figs. 36–37; Dawson 1956: 35, fig. 17. *Fucus taxifolia* Vahl 1799: 36.

Pl. 15, fig. 1

Materials examined fit very well the descriptions for *C. taxifolia*, also Figure 17 of Dawson (1956). The strongly compressed, sickle-shaped branchlets which are regularly and oppositely pinnate tapered towards the mucronate tips are distinctive.

On sandy-rocky substratum.

Type: from West Indies; presumably in Lund Herbarium.

Materials examined: 21897, on reef flat at Yap Is., VIII–18–60; 23307, on reef at Quoi Is., Truk Group, VIII–2–60.

6. *Caulerpa sertularioides* (Gmelin) Howe 1905b: 576; Boergesen 1913: 133; Dawson 1956: 38, fig. 22; Eubank 1946: 417; Taylor 1960: 144, pl. 13, figs. 2, 3, 6, 7. *Fucus sertularioides* Gmelin 1768: 151, pl. 15, fig. 4.

Pl. 16, fig. 5

Materials examined showed some degree of variation especially in the size and the height of the frond which ranges from 1 to 10 cm but all conform to the characters of *C. sertularioides*.

On sandy-rocky substratum.

Type: origin of type not specified but "Americae" listed as type locality; present whereabouts not known to the writer.

Materials examined: 23539, on reef at north end of Yap Is., VIII–6–60; 15861, on reef at south end of Ulul Is., Namonuito Group, VIII–6–60; 23202, 23082, 23028, on reef at Fefan Is., Truk Group, VII–28–60; 21158, 21272, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 15587, on reef at Koror Is., Palau Group, IX–5–60; 21469, 23017, on reef near Utwa Village, Utwa Is., Kusaie Group, VII–17–60; 21105, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60; 21914, on reef at southern end of Ulul Is., Namonuito Group, VIII–6–60; 15646, 15579, on reef at Koror Is., Sept. 3, 1960.

7. *Caulerpa brachypus* Harvey 1859: 332; Weber von Bosse 1898: 280, pl. 22, fig. 2; Gilbert 1942: 9, figs. 1–3; Yamada 1944: 34; Taylor 1950: 56, pl. 29, fig. 2.

Pl. 15, fig. 2

Thalli with well-developed horizontal stolons from which arise stipitate fronds. The latter may be simple blades or may be branched, with finely serrated margins.

On sandy-rocky substratum.

Type: from Japan; supposedly in Harvey Herbarium in Dublin, Ireland.

Materials examined: 23064, 23071, on reef at western, lagoon side of Puluwat Is., VIII–7–60; 21989, 21489, on reef flat at Yap Is., VIII–19–60; 23454, on reef at

Fefan Is., Truk Group, July 28, 1960.

8. *Caulerpa peltata* Lamouroux 1809: 145; Weber van Bosse, 1898: 373, pl. 31, figs. 9-11; Reinbold 1901: 350; Gilbert 1942: 22; Taylor 1960: 155, pl. 17, fig. 2; pl. 18, fig. 1.

Pl. 14, fig. 3

Materials examined show the characteristic alternate, stalked, peltate ramuli.

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

Materials examined: 21059, from south end of Moen Is., Truk Group, VII-29-60; 15675, on reef flat at Epwelkapw, Ponape Is., VI-20-60; 23383, on reef between Falo and Moen Is., Truk Group, VII-29-60; 23693, at north end of airport runway at Moen Is., Truk Group, VII-29-60; 15102a, on a reef flat with a sandy to rocky substratum at Iwayama Bay, Palau Is., VIII-22-60; 21542, on reef flat near bridge between Kolonia and Kokaj Is., Ponape Group, VI-25-60.

9. *Caulerpa lentillifera* J. Agardh 1837: 173; Weber van Bosse 1898: 380, pl. 34, figs. 1-2; Eubank 1946: 418, fig. 2, k-l; Gilbert 1942: 23.

Pl. 19, fig. 6

Thalli small; erect branches 1 to 3 cm tall beset with globose, short-stalked ramuli, the constriction between the tip of the ramular stalk and the globose species evident.

On sandy-rocky substratum.

Type: from Red Sea; now in Agardh Herbarium, Lund, Sweden.

Materials examined: 23027, 23334, on reef at Fefan Is., Truk Group, VII-28-60.

10. *Caulerpa serrulata* (Forskål) J. Agardh emend. Boergesen 1932: 5, pl. 1, fig. 2; Gilbert 1942: 14; Dawson 1954: 393; Taylor 1950: 57, pl. 31, figs. 1-2; pl. 32, fig. 1; pl. 30, fig. 1; Taylor 1960: 145, pl. 14, fig. 5.

Pl. 14, figs. 1-2; pl. 16, figs. 4, 8; pl. 17, fig. 9

This species is well represented in the materials studied. This is one of the most common and abundant species.

The specimens are quite variable both in stature and the degree of the twisting of the uniform, narrow bands (blades). In flat untwisted forms the teeth are somewhat irregularly disposed at the margins, those in the twisted forms the teeth are uniseriate at the outer margin of the spiral blade.

Although several varieties are recognizable, the field notes accompanying each collection are not complete to give one a clear picture of the habitat, thus not sufficient to enable one to elaborate on their local ecology.

On sandy-rocky substratum.

Type: from Red Sea; in Forskål Herbarium in Botanical Museum of the University of Copenhagen.

Materials examined: 15839, 15851, 15762, on reef at Kusaie Is., VII-15-60; 21002-21014, on reef at Quoi Is., Truk Group, VIII-2-60; 21862, 21855, on reef flat at Yap Is., VIII-19-60; 23692, 15885, near north end of airport runway at Moen Is., Truk Group, VII-29-60; 21678, 21543, on reef at eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 23093, on reef at Yap Is., VIII-19-60; 15926, south end of Moen Is., Truk Group, VII-29-60; 21577, 21396, 23311, on reef at Nanmato Is., Ponape Group, VII-23-60; 21318, 21302, on eastern seaward reef flat with sandy-hard bottom at Urak and Mokil Is., VI-29-60; 15638, 15640, 21219, 21129, on reef flat of Epwelkapw, Ponape Is., VI-17-60; 15862, on reef at southern por-

tion of Ulul Is., VIII-6-60; 21453, 21314, on western seaward reef flat of Pinegelap Is., Pingelap Group, VII-1-60; 21556, on reef at Pulo Anna Is., IX-3-60; 21306, on lagoon side of reef flat at northwest tip of Mokil Is., Mokil Group, VI-29-60; 21518a, on northern seaward reef flat of Mokil Is., VI-29-60; 23347, on reef at western side of Sorol Is., Sorol Group, VIII-13-60; 23111, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, VIII-10-60.

11. *Caulerpa cupressoides* (Vahl) C. Agardh 1822: 441; Weber van Bosse 1898: 323, pl. 27-28; Boergesen 1913: 135; Gilbert 1942; 16; Taylor 1960: 146.
Fucus cupressoides Vahl 1802: 29.

Pl. 14, fig. 8; pl. 15, fig. 3

This species is well represented in the collections from the Caroline Islands and when found mixed with *C. urvilliana* can readily be confused with it. Before Dr. Wm. R. Taylor came to the Department of Botany, University of Hawaii to work on the species of *Caulerpa* found in Dr. M. S. Doty's collections, I had included the materials representing this species with *C. urvilliana*. With the help of Dr. Taylor, I was able to separate these two entities, but not without some difficulty. The variations in these two species are quite overlapping. Some varieties of *C. cupressoides* which closely resemble *C. urvilliana* can be distinguished from the latter by having cylindrical branchlets, or, if these are short and tooth-like, their bases are slightly contracted. The difficulty is more pronounced when one works with dried and pressed materials. The teeth in *C. urvilliana* are broad at the base, which are by no means contracted, tapering quite abruptly to the mucronate apices, while in *C. cupressoides* the branchlets are not cylindrical and if short they are contracted at the base and not abruptly tapering to the mucronate apices. This is by no means conclusive when one works with numerous materials of these two species in which the variability in the form of the branchlets or teeth seems so overlapping.

Type: from St. Croix, Danish West Indies; according to Weber van Bosse (1898) these are found in several Herbaria, including the British Museum, Agardh Herbarium, and the Harvey Herbarium.

Materials examined: 15415, at southeastern portion of Helen reef, VIII-28-60; 15883, on reef at southern portion of Ulul Is., VIII-6-60; 15894, on reef at Quoi Is., Truk Group, VIII-1-60; 15901, from mangrove area with muddy bottom at south end of Moen Is., Truk Group, VIII-1-60; 21015, 21016, on reef with sandy-rocky bottom at Quoi Is., Truk Group, VIII-2-60; 21312, 21935, on western seaward reef flat of Pingelap Is., VII-1-60; 21572, 23776, at north end of Yap Is., VIII-19-60; 21856, 21864, 23092, 23144, on reef flat at Yap Is., VIII-18-60; 23044, 23049, 23162, on reef at western side of Sorol Is., VIII-13-60; 23081, on reef at Fefan Is., Truk Group, VII-28-60; 23126, 23225, on lagoon side (western) of Ifaluk Is., VIII-10-60; 23131, on reef at western side of lagoon, Puluwat Is., VIII-7-60; 23191, 23401, at western side of Quoi Is., Truk Group, VIII-2-60; 23235, on reef at lagoon side of Puluwat Is., with sandy, muddy bottom, VIII-7-60; 23248, on reef around Utwa Village, Kusaie, Is., VII-17-60; 23513, 23663, on reef at Falas Is., Truk Group, VII-30-60; 23407, on reef at Tafansak Village, Kusaie Is., VII-16-60.

12. *Caulerpa urvilliana* Montagne 1845: 21; Weber van Bosse 1898: 318, pl. 26, figs. 7-11; Taylor 1950: 60, pl. 31, fig. 1; pl. 32, fig. 1; Dawson 1956: 37, fig. 21.

Pl. 14, fig. 5–7

Many specimens of this species are included in the collections from the Caroline Islands and are distinguished from *C. cupressoides* by their normally short teeth, broad at the base and tapering quite abruptly towards the mucronate apices. The teeth are by no means contracted at the base, and are usually multiseriate.

Growing on sandy-muddy to rocky substratum.

Type: from Toud Is., Torres Straits; now in the Herbarium, Paris Museum.

Materials examined: 15852, on reef at Kusaie Is., VII–15–60; 15693, 21518, on northern seaward reef flat of Mokil Is., VI–29–60; 15817, 21567, 21429, 21893, 23704, 21488, on reef at north of Yap Is., VIII–19–60; 15544, 15472, 15525, 15514, 15519, 15537, on reef at Helen Is., VIII–30–60; 15725, 15739, 15390, 23532, south region of Helen Reef, VIII–28–60; 15401, at southeast region of Helen Reef, VIII–28–60; 21002–21003, on western side of Quoi Is., Truk Group, VIII–2–60; 23115, 23111, 23033, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, VIII–10–60; 23347, on reef at western side of Sorol Is., VIII–13–60; 23029, on reef at Fefan Is., Truk Group, VII–28–60; 23702, at south end of Helen Reef, VIII–28–60; 21988, on reef flat with sandy-rocky bottom at north end of Yap Is., VIII–19–60; 21406, 21896, on reef at Yap Is., VIII–18–60; 15480, 15519, on Helen Reef near western end of Helen Is., VIII–28–60; 21282, 21285, 21360, 21318, 21227, on eastern seaward reef flat of Urak Is., Mokil Group, VI–29–60; 15863, 21912, 15862, 23720, on reef near south end of Ulul Is., Namonuito Group, VIII–6–60; 21279, 21306, on lagoon side of reef flat at northwest tip of Mokil Is., VI–29–60; 23095, 23230, on reef at lagoon side of Ella Is., Ifaluk Group, VIII–10–60; 23677, on reef at western lagoon side of Puluwat Is., VIII–7–60; 21105, 21602, on reef at Quoi Is., Truk Group, VIII–2–60; 21925, 21454, 21314, 21339, on western seaward reef flat of Pingelap Is., VII–1–60.

13. *Caulerpa racemosa* (Forskål) J. Agardh 1872: 35; Weber van Bosse 1898: 357, pl. 31, figs. 5–8; pl. 32, figs. 1–7, 33, figs. 1–23; Taylor, 1928: 101, pl. 12, fig. 3, 5–6, 8, 14; pl. 13, figs. 3, 8–11; Taylor 1960: 151, pl. 17, figs. 1, 3, 4, 6, 7; pl. 18, figs. 2–5, 7; Eubank 1946: 419.

Fucus racemosus Forskål 1775: 191.

Pl. 14, fig. 9; pl. 16, fig. 7

Like *C. urvilliana* and *C. serrulata*, *C. racemosa* is one of the common species of *Caulerpa* collected from the Caroline Islands. It is also one of the most variable, the characters are so overlapping that their varietal entities are difficult to determine. Specimen number 23579 shows extreme variability characterized by the possession of a branch with globose ramuli and another branch bearing flat strap-shaped branches instead of the globose ramuli. For this reason and the fact that the field notes are also incomplete I deem it more practical to lump all these only to species level.

On sandy-muddy to sandy-rocky substratum.

Type: from Red Sea; in Forskål Herbarium in the Botanical Museum in the University of Copenhagen.

Materials examined: 21854, 21863, 21405, 23362.1, 23145, 21895, on reef flat at Yap Is., VIII–18–60; 15708, 21150, 21138, 21010, 21074, 21056, 15102, on reef flat with sandy-rocky bottom at Iwayama Bay, Palau Is., VIII–22–60; 21545, 21546, 21680, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 21978,

23026, 23196, 23330, 23395, 23336, 23080, on reef at Fefan Is., Truk Group, VII-28-60; 21494, on reef flat at Iwayama Bay, Palau Is., VIII-29-60; 15769, 21311, on western seaward reef flat of Pingelap Is., VII-1-60; 15348, at western end, lagoon side of Helen Is., Helen Reef, VIII-29-60; 21720, 15625, on reef flat at Pulo Anna Is., IX-31-60; 15585, 15573, 15611. 15590, on reef flat with sandy-mud substratum with rocks, Koror Is., Palau Group, IX-5-60; 23579, 23220, on reef at Dublon Is., Truk Group, VII-31-60; 15818, 21428, 21885, 21486, 21566, 23538, 23705, 21648, 23538, 21985, on reef flat at Yap Is., VIII-19-60; 15927, 15917, near south end of Moen Is., Truk Group, VIII-1-60; 21555, 21721, 21612, on reef with sandy-muddy substratum at Pulo Anna Is., IX-3-60; 15761, 15837, 15838, 15853, 23421, 15750, 15224, on reef at Kusaie Is., VII-16-60, 15555, Koror Is., Palau Group, IX-5-60; 23303, on reef at Quoi Is., Truk Group, VIII-2-60; 21581, 21827, 23178, 23619, 23247, 23671, on reef around Utwa Village, Kusaie Is., VII-17-60, 21607, 23404, on reef at Tafansak Village, Kusaie Is., VII-16-60; 21745, on reef at Mantapeitak Is., Ponape Group, VI-20-60; 21620, on reef at Nanmatol Is., Ponape Group, VII-23-60; 15380, on north side of Helen Is., VIII-28-60; 15639, 21365, on reef flat of Epwelkapw, Ponape Group, VII-17-60; 23764, on reef at Iwayama Bay, Palau Is., IX-5-60; 23743, on reef at Iwayama Bay, Palau Is., VIII-29-60.

Chlorodesmis Harvey et Bailey 1851

Key to species:

1. Species with large, prostrate, rhizomatous main filaments .... *Chlorodesmis sp.*
1. Species not as above 2
   2. Dichotomal constrictions unequal, interdichotomal constrictions absent .. .. *C. comosa*
   2. Dichotomal constrictions equal, interdichotomal constrictions present .... *C. hildebrandtii*

1. *Chlorodesmis comosa* Harvey et Bailey 1851: 373; A. and E. S. Gepp 1911: 14, pl. 8, figs. 69–73.

Materials examined agree fairly well with the descriptions and figures of *C. comosa* as described by A. and E. S. Gepp (1911). The unequal distance of the constrictions above the dichotomies and the irregularly branched, moniliform and colorless creeping filaments are distinct. Diameter of the filaments quite variable, 55–85 μ. The terminal branches are slightly enlarged at the tips, and frequently small reddish bodies are found inside the filaments. Presence of trichotomies not infrequent.

On rocks and dead corals.

Type; from Fiji Islands, collected by the U.S. Exploring Expedition of 1838–42 under Captain Wilkes; present whereabouts not known to the writer.

Materials examined: 15696, 21520, 21755, on northern seaward reef flat at Mokil Is., VI-29-60; 15752, 15713, 21234, 21528, 21174, 15980, on reef at Iwayama Bay, Palau Is., VIII-22-60; 21310, on lagoon side of reef flat at northwestern tip of Mokil Is., VI-29-60; 21382, on eastern seaward reef flat at Urak Is., Mokil Group, VI-29-60; 23305, on reef at Quoi Is., Truk Group, VIII-2-60; 21524.2, on northern seaward reef flat of Mokil Is., VI-29-60; 21386, on reef flat of Epwelkapw, Ponape Is., VI-16-60.

2. *Chlorodesmis hildebrandtii* A. and E. S. Gepp 1911: 16, figs. 74–75; Egerod 1952: 377, pl. 34a, fig. 9 a, b, d.

Pl. 13, figs. 1–3

Materials examined fit fairly well with the descriptions and figures of A. and E. S. Gepp (1911) for *C. hildebrandtii* although these differ slightly from *C. hildebrandtii* reported by Egerod (1952) from Hawaii. Although the interdichotomal constrictions are present yet these are not as numerous as those found in specimens from Hawaii. On rocks and dead corals.

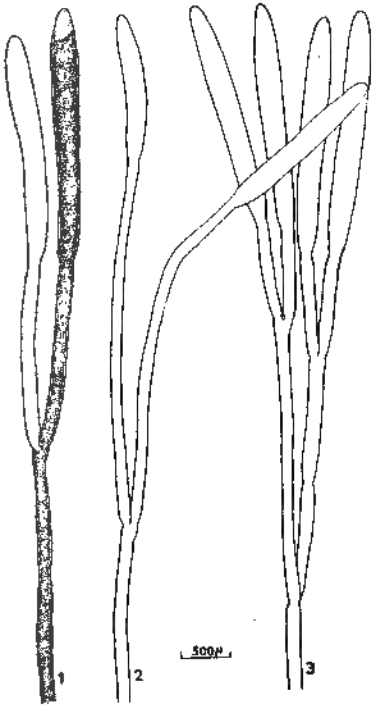


Plate 13. *Chlorodesmis hildebrandtii*.
Figs. 1–3. Tips of fertile filaments showing sporangia.

Fertile specimens of this species were found (15774). Although only pickled materials were available for study, yet the development of the sporangia can readily be observed by studying the different stages. Before the sporangia are formed the upper portion of the filaments become dark green in color. It seems as if the chloroplasts in the basal portion of the filaments migrate towards the upper and ultimate branches. This is shown by the fact that starting at this stage up to the time when the sporangia are mature, the lower portion of the plants seem to be devoid of chloroplasts while the upper portion become increasingly dark green. The chloroplasts are numerous and concentrated in ultimate branches and downwards up to the 4th dichotomy from the apices.

The apical portion of the ultimate segments become enlarged progressively towards the base while the green bodies become more compacted inside the de-

veloping sporangia. Up to about 2/3 of the ultimate segment may be transformed into a sporangium. In matured sporangia dark bodies appear to be larger than the ordinary chloroplasts in the vegetative filaments and I assume them to be zoospores. Empty sporangia were seen although pores or analogous structures through which the sporangial contents were released were not seen.

The sporangia are cylindrical, about 275 to 330 μ in diameter by 1500 to 3300 μ long and slightly tapered from the upper one third portion towards the blunt tips.

As far as the writer is aware, this is the first report on the asexual reproductive structure of this species.

Type: from Indonesia, Comoren; present whereabouts not known to the writer.

Materials examined: 15774, on reef at Yap Is., VIII-19-60.

3. *Chlorodesmis sp.*

Filaments are up to 5 cm tall forming soft green tufts, consisting of a thick, postrate, rhizomatous portion at rhe apical portion of which many erect filaments arise. The rhizomatous filament is well developed, thick walled, irregular in diameter, to about 300 μ at its thickest portion, slightly moniliform, covered with densely packed rhizoidal, branched filaments. The rhizoids are moniliform near their bases to cylindrical especially at or near their apices. Both the rhizomatous and rhizoidal portions are densely packed with chloroplasts.

Branching of the main rhizomatous filament is irregular, giving rise to secondary branches which are similarly irregularly branched and moniliform, and strongly constricted at the dichotomies. The upper erect filaments are cylindrical, about 60-80 μ thick, dichotomous to trichotomously branched in alternate planes; deeply and equally constricted above the dichotomies. Internodal constrictions present especially at the lower portion. Dichotomies and trichotomies abundant below and fewer above.

Materials examined: 21023, on reef at Falas Is., Truk Group, VII-30-60.

Avrainvillea Decaisne 1842

Key to species:

1. Blades sessile or substipitate, each with well developed rhizoidal holdfast ... . *A. erecta*
1. Blades stipitate, one or more blades on a well developed rhizomatous or bulbous rhizoidal holdfast 2
   2. Blades irregularly zonate, with smaller proliferations on both the margin and as well as on the surface of the blade ..... *Avrainvillea sp.*
   2. Blades simple, not zonate 3
      3. Blades small, thin, firm, light brown in color ..... *A. lacerata*
      3. Blades large, thick, spongy, dark brown in color ..... *A. nigricans*

1. *Avrainvillea erecta* (Berk.) A. and E. S. Gepp 1911: 29, figs. 84–89; Dawson 1954: 395, fig. 13a; Boergesen 1940: 53.
   Dichonema erecta Berkeley 1842: 157, pl. 7, fig. 11.
   Pl. 19, fig. 9

Thalli large, dark brown, up to 15 cm tall including the large massive holdfast formed by the rhizoidal filaments together with sand particles. Fronds simple, sessile to sub-stipitate, solitary or sometimes clumped together in two's or in three's

but each has a distinct and well developed simple holdfast.

On sandy-muddy substratum.

Type: specimen collected by Cuming from the Philippines and first described by Berkeley as a fungus *Dichonema erecta* now in the Herbarium, Royal Gardens Kew.

Materials examined: 21289, reef flat near bridge, between Kolonia and Jokaj Is., Ponape Group, VI-25-60.

2. *Avrainvillea lacerata* Harvey ex. J. Agardh 1887: 54; A. and E. S. Gepp 1911: 38, figs. 105–109; Taylor 1950: 70.

Udotea lacerata Harvey 1855 (Exsicc., Friendly Islands, No. 86).

Pl. 19, fig. 8

Thalli up to 10 cm tall. Blades thin, upon drying with lacerate to entire margins. As many as eight stipitate flabella were found arising from a simple to branched rhizome. Stipes short, 1 to 2(3) cm long, 1 to 2 cm thick.

Main filaments cylindrical, 20–26 μ in diameter; constrictions above their dichotomies long-necked, tapering to thin colorless terminal filaments which are somewhat irregularly torulose a short distance from the tips. Identification of the specimens was based on the study of dried speciments but fit fairly well with the descriptions and figures of A. and E. S. Gepp (1911) for *A. lacerata*. However, specimens 15984 and 21164 differ from Gepps' (1911) Figures 106 or 109 for *A. lacerata* in that terminal filaments are more tortuous. It was also noted that the walls of the secondary and terminal filaments have slightly thicker walls and retain its shape even in dried condition.

The materials differ from *A. amadelpha* in the nature of the terminal filaments which are tapered to about 6–8 μ at the apices and are never twisted, curved or torulose, or unilaterally and interruptedly swollen (Gepps 1911, figures 112 and 113). Like *A. amadelpha* the terminal filaments form a loose pseudo-cortex.

On sandy-muddy substratum.

Type: Harvey Exsicc. No. 86 from Friendly Islands, Pacific; now in Herbarium British Museum and Kew Herbarium.

Materials examined: 21164, 21097, 21533, 15984, 21675, on reef flat at Iwayama Bay, Palau Is., VII-22-60.

3. *Avrainvillea nigricans* Decaisne 1842: 108; A. and E. S. Gepp 1911: 23, figs. 78–81; Taylor 1950: 69, pl. 34, fig. 2; Dawson 1956: 39.

Pl. 19, figs. 2, 4–5

Thalli examined were very variable in habit and size. The large materials reach a height of 20 cm including the massive underground holdfast or rhizomes (as in 15931 and 23067). The blades are spongy and thick, obovate-cuneate, the margins irregularly cut. The stipes are thick, 5–8 mm in diameter, up to 6 cm long. The older flabella turn greyish brown in color upon drying.

The intermediate forms are smaller up to 15 cm tall including the holdfast but the stipes and blades are thinner. Examples are 21327, 21343, 21380, and 15973.

The "young specimens" (23110, 23052, 23095, 23101) show a large variation in the development of their blades. Some show a habit like that of *A. rawsonii* although less branched. Although the habit of the specimens is variable, their anatomy resembles that of *A. nigricans*. The filaments of these specimens differ

from *A. rawsonii* by having thick walls, 2-3 μ; surface filaments which are torulose although brownish coagulated plugs were found at the constriction above the dichotomies like those described by A. and E. S. Gepp (1911) for *A. rawsonii*. Specimen number 23072 differed slightly from other materials in its thicker blades which I assume to be due to age. Dr. William R. Taylor annotated one of the specimens and suggested it might be *A. obscura* because of the scantily developed though somewhat torulose surface filaments. Further examination revealed, however, the presence of definitely well developed surface filaments which are distinctly torulose, although in old blades, the surface filaments are somewhat denuded. It is interesting to note that although the surface filaments of the blades can easily be teased, the central filaments of both the dried and pickled specimens are so well packed together that it is difficult to tease these apart without breaking the filaments.

On sandy-muddy substratum.

Type: specimen collected by d'Arainville in Iles des Saintes, Guadaloupe; now in Herbarium, Museum de Paris.

Materials examined: 21317, 21343, 21380, 21286, 21280, 15973, on eastern seaward reef flat at Urak Is., Mokil Group, VI–29–60; 21458, on reef at Nanmatol Is., Ponape Group, VII–23–60; 15931, 15934, from lagoon at Puluwat Is. (Enderby Is.), VIII–7–60; 23067, 23072, on reef at western side (lagoon side) at Puluwat Is., VIII–7–60; 23110, 23052, 23117, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, VII–10–60; 23096 on reef at southern side of Ella Is., Ifaluk Group, VIII–10–60; 23101, 23037, on reef between Ifaluk and Flalap Is., Ifaluk Group, VII–10–60; 15860, on reef at southern portion of Ulul Is., VIII–6–60.

4. *Avrainvillea sp.*

Only one specimen was available. Thallus is brownish ash-grey after drying; 9 cm tall; stipitate from a bulbous rhizoidal holdfast; stipe cylindrical, 10–20 cm long, 3–5 mm thick. Frond consists of a thin main blade from which secondary proliferations arise either from the margin or from the flat side of the blade.

When viewed macroscopically, the blade appears to be irregularly zonate, composed of irregular, alternating brown and greyish bands. The blade is made up of strongly interwoven filaments. The main filaments are 12–14 μ in diameter, irregularly and slightly moniliform, yellowish brown, filled with brownish-green chromatophores. The filaments are conspicuously constricted above the dichotomies, the constrictions somewhat unequal, one of which is long-necked. The surface filaments of the blade distinctly finer than the inner filaments, 4–5 μ in diameter, colorless, and not markedly constricted above the dichotomies, cylindrical, tortuous with blunt ends, and compacted together into a pseudo-cortex.

The surface filaments of the stipe are very compact and hard to tease. The inner filaments are slightly larger than those of the blade, 15–18 μ in diameter, but more tortuous.

The inner filaments of the rhizome are very much larger than those of the blade and the stipe, up to 70 μ in diameter, yellowish-brown and filled with starch grains; they are irregularly but distinctly torulose, averaging 55 μ in diameter. The secondary filaments about 40–55 μ in diameter, giving rise to the surface filaments which are torulose to sub-moniliform but becoming cylindrical and very tortuous towards the apices which are 8–10 μ in diameter.

Materials examined: 23123, on sandy-rocky substratum on reef at eastern side of Ifaluk Is., Ifaluk Group, VIII-10-60.

Rhipilia Kützing 1858

Rhipilia orientalis A. and E. S. Gepp 1911: 57, pl. 16, figs. 134–136; Taylor 1950: 72, pl. 36, fig. 1.

Pl. 19, fig. 1

Materials studied agree with both the descriptions and figures of Taylor (1950) and A. and E. S. Gepp (1911) for this species except that the flabella are quite thick and can hardly be described as translucent. At least one specimen showed several stipitate flabella arising from a horizontal rhizome, a character that both of the above authors have never mentioned in their papers.

On sandy-muddy substratum.

Type: specimens collected by Weber van Bosse, Siboga Expedition, on mudy reef and up to a depth of 34 meters at Pulu Sebangkatau, Borneo Bank; present whereabouts not known to the writer.

Materials examined: 15848, found only once, represented by several plants, collected from a reef at Falas Is., Truk Group, VII-30-60.

Halimeda Lamouroux 1812

The genus *Halimeda* is one of the green algae richly represented among the generous collections from the Caroline Islands. The writer, being aware of the wide variability among the different species, corresponded with Dr. L. W. H. Colinvaux who verified the writer's own determinations and annotated the materials of the different species. Of the 40 dried materials 12 species of *Halimeda* were varified by her, excluding numbers 23031, 23062, 21299, 15798, 23022, 21460, 15553, 21375, 21570, and 15400 which according to her were quite aberrant and "at least at the moment I do not wish to attach any name at present." These materials are at present in her possession in conjunction with her study of the *Halimeda* from the Indian Ocean.

Key to species:

1. Thallus with large, well developed and generally massive rhizoidal holdfast, rarely less than 1 cm long; medullary filaments uniting as a single group at the nodes, the adjacent filaments communicating by pores; often growing on sandy-muddy substrate 9
1. Thallus with small, generally inconspicuous rhizoidal holdfast rarely exceeding 1 cm long, (or sometimes spreading, not elongate, i.e., in some specimens of *H. discoidea*); medullary filaments free, or united in groups of twos, threes, or sometimes in fours at the nodes; often growing on stones and rocks, or forming massive beds 2
   2. Thallus commonly forming extensive patches; holdfast region not restricted to the initial area; branching in more than one plane ..... *H. opuntia*
   2. Thallus not forming extensive patches; holdfast single and conspicuous branching essentially in one plane 3
      3. Habit very lax and flaccid, up to 25 cm long ..... *H. gracilis*
      3. Habit erect or prostrate but not flaccid, generally compact in appearance 4

4. Basal segment very conspicuous, flabellate, supporting numerous branches ..... *H. micronesica*
4. Basal segments not specialized 5
5. Surface utricles large, exceeding 120 μ in surface diameter; surface of the segments appearing pitted under lower magnification; segments very friable on drying ..... *H. macrophysa*
5. Surface utricles less than 120 μ in surface diameter; surface of segments not appearing pitted under lower magnification 6
6. Surface utricles separating with slight pressure on decalcification; segments very fragile on drying ..... *H. fragilis*
6. Surface utricles remaining fused after decalcification 7
7. Secondary utricles conspicuously inflated, generally exceeding 90 μ in diameter ..... *H. discoidea*
7. Secondary utricles not conspicuously inflated, less than 90 μ in diameter 8
8. Segments on drying flat and generally broad, to about 20 mm tall, and 35 mm broad, and 0.5–0.8 thick; reniform in shape, the upper margins commonly undulate or folded ..... *H. tuna*
8. Segments becoming concave on drying, to about 12 mm tall, 15 mm broad, and 1–1.5 mm thick; subcuneate to somewhat reniform in shape ..... *H. taenicola*
9. Segments large, flat and broad, about 10–20 mm tall, 15–30 mm broad ..... *H. macroloba*
9. Segments small, flat or cylindrical, never attaining the above dimensions (except for the occasional large basal supporting segments in *H. cylindracea*) 10
10. Thallus elongate, up to 15 cm tall excluding the holdfast; cylindrical segments conspicuously decreasing in diameter from the base to the apical portion as much as 4 times finer than those at the base, generally 4 to 5 diameters long ..... *H. cylindracea*
10. Thallus smaller, segments flat or cylindrical; if cylindrical the length is rarely more than two diameters long; not conspicuously decreasing in diameter from the base to the apical portion 11
11. Thallus appearing thick-set; segments subcuneate to cylindrical, about 2 mm thick, becoming somewhat moniliform towards the apex ..... *H. stuposa*
11. Thallus not appearing thick-set; segments subcuneate to reniform, rarely more than 1 mm thick ... *H. incrassata*

1. *Halimeda opuntia* (Linnaeus) Lamouroux; Reinbold 1901: 350; Hillis 1959: 359, pl. 2, figs. 7–8; pl. 5, figs. 3–4; pl. 6, fig. 6; pl. 7, fig. 3; pl. 10; Taylor 1950: 80, pl. 50, fig. 1; Collins 1909–18: 400, pl. 17, fig. 156; Taylor 1928: 82; Egerod 1952: 397, pl. 37, fig. 19, a, e, f.
Corallina opuntia Linnaeus 1758: 805 p.p.
Halimeda opuntia Lamouroux 1812: 186.
Halimeda opuntia Barton 1901: 18 pl. 2, figs. 19–27.

Pl. 18, figs. 1–4

This is the most common among the different species of *Halimeda* studied, comprising more than half of the materials for this genus.

Thalli often forming extensive mats; compact, or sometimes loose, attached to the substratum by means of many small inconspicuous rhizoidal holdfasts found at intervals in the lower portions of the thalli. Branching generally trichotomous and in more than one plane; color on drying whitish, cream, golden to greenish, the surface of the segments dull or glossy; calcification moderate to heavy.

The segments variable, flattened and generally reniform with auriculate base and with entire or undulate upper margins, or, the upper margins distinctly trilobed, and commonly ribbed.

Many forms are recognizeable, but no attempt was made to identify them below the species rank.

Type: L. Hillis (1959) cited two types for the two varieties she recognized, namely, v. *opuntia* from Jamaica and v. *hederacea* collected by the Siboga Expedition to Indonesia; present whereabouts not known to the writer, but probably among other Siboga materials in Indonesia.

Materials examined: 21687, 21691, 21674, 21699, 23549, 21154, 21235, 21173, 21190, 21072, 21471, 21527, on reef flat with a sandy to rocky substratum at Iwayama Bay, Palau Is., VIII-22-60; 21746, 15620, 21327, 15634, on reef on eastern side of Mantapeitak Is., Truk Group, VI-20-60; 21627, 21656, 21907, 21257, 21474, on reef near boat pier, Jokaj Is., Ponape Group, VII-20-60; 21599, 21600, 15921, 15922, 15893, 15919, 23190, 23300, 23189, 23399, 23750, on reef at Quoi Is., Truk Group, VIII-2-60; 21390, 21391, 23392, 23388, 23370, 21979, 23025, 23335, 23326, 23199, 23456, 23591, 21907, on reef at Fefan Is., Truk Group, VII-28-60; 21508, 21426, 21898, 21414.1, 23089, 23158, 23368, 23141, 21991, 21865, 21853, 21407, on reef at Yap Is.; VIII-18-60; 21476, 23310, 23311.1, 21456, 23476, on reef at Nanmatol Is., Ponape Group, VII-23-60; 21641, 15773, 21887, 15820, 21983, 21890, on reef at Yap Is., VIII-19-60; 21721, 21111, 21110, 21333, 21334, 23004, 21278, 21260, 21115, on lagoon side of reef flat at northwestern tip of Mokil Is., Mokil Group, VI-29-60; 21586, 21442, 23672, 23006, 21441, 21950, 21902, 21449, 21465, 21481, 21826, on reef around Utwa Village, Kusaie Is., VII-17-60; 21292, 21295, 21297, 21300, 21363, 21228, 15731, 21287, 21208, 21251, 21359, 21363, 21284, on eastern seaward reef flat of Urak Is., Mokil Group, VI-29-60; 15612, 15749, 15734, 15743, 15856, 23410, on reef at Kusaie Is., VII-15-60; 23268, 23277, 23396, 23204, 15995, on reef at Dublon Is., Truk Group, VII-31-60; 23255, 15900, in mangrove at south end of Moen Is., Truk Group, VIII-1-60; 15523, 15473, 15615, 15542, 15535, 15511, 15518, on reef at Helen Is., Helen Reef, VIII-30-60; 15623, 15378, on north side of Helen Is., Helen Reef, VIII-28-60; 15365, at Helen Is., Helen Reef, with very sandy substratum with few rock and not much algae, VIII-29-60; 15946, 15962, 15971, 15797, near north end of airport runway at Moen Is., Truk Group, VII-29-60; 15915, 21042, on reef at south end of Moen Is., Truk Group, VIII-1-60; 15479, on reef with sandy, rocky substrate with plenty of animal coral near the western end of Helen Is., VIII-28-60; 15671, 21768, 15678, 21214, on reef flat at Epwelkapw Is., Ponape Group, VI-20-60; 15792, 15825, 15812, 15829, on reef on eastern side of Ulul Is., Namonuito Group, VIII-6-60; 15367, 15723, 15737, 15399, 15320, 23528, 23526, 23652, at southeastern region of Helen Reef, VIII-28-60; 21606, 15745, 15714,

15684, 21946, 23134, 24606, 23609, 23402, 23406, 21905, 21866, 21511, 21871, on reef at Tafansak Village, Kusaie Is., VII–16–60; 21715, 21563, on reef at Pulo Anna Is., IX–3–60; 15649, 15681, 15546.2, 15554, 15572, 15546.3, 15577, 15588, on reef at Koror Is., Palau Group, IX–3–60; 15613, 21298, 21313, 23007, 21452, 21314, 21446, on western seaward reef flat of Pingelap Is., VII–1–60; 21742, 21959, on reef facing Mantapeitak Is., Ponape Group, VI–20–60; 23542, 21164, 21173, 15757, 23563, 21208, 21132, on reef at Iwayama Bay, Palau Is., VIII–22–60; 23266, 21323, 15834, 15845, 23373, 23279, 23514, 23279, 21322, 23316, 15968, 21064, on reef at Falas Is., Truk Group, VII–20–60; 23098, on reef between Ifaluk and Flalap Is., Ifaluk Group, VIII–10–60; 21230, 21290, 21120, 21101, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60; 21568, at Yap Is., with a rocky, hard bottom with little sand, VIII–19–60; 15631, 21972, 21376, 21368, 21788, 21771, 21839, 21794, 15623, 15592, 21802, on reef flat on eastern side of Peipalap peak, Ponape Is., VI–19–60; 15797, 15788, 15924, on reef between Moen and Falo Is., Truk Group, VII–29–60; 23130, 23356, 23065, 23069, 23233, 23293, 23073, on reef at western lagoon side of Puluwat Is., VIII–7–60; 23103, 23094, on reef at western side of Ella Is., Ifaluk Is., VIII–10–60; 23108, 23098, 23054, 23124, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Is., VIII–10–60; 23227, on reef at lagoon side of Ella Is., Ifaluk Is., VIII–10–60; 23023, on reef between Falo Is. and Moen Is., Truk Group, VII–29–60; 23292.1, 23238.1, on reef at western side of Sorol Is., VIII–13–60; 21334, 21517a, on northern seaward reef flat of Mokil Is., VI–29–60; 21065, 21593, collected from southwestern side of Puluwat Is. (Enderby Is.), VIII–7–60; 23151, in man-made pool dredged inside Moen Is. harbor, VII–29–60, 23700, at south end of Helen Reef, VIII–28–60; 23760, on lagoon side of reef flat at northeast tip of Mokil Is., VI–29–60.

2. *Halimeda incrassata* (Ellis) Lamouroux; Hillis 1959: 365, pl. 4, figs. 1–2; pl. 5, fig. 21; pl. 6, figs. 21–24; pl. 12.

Corallina incrassata Ellis 1767: pl. 17, figs. 20–27; Ellis and Solander 1786: 111, pl. 20, figs. D1–6, d, d1–3.

Corallina tridens Ellis and Solander 1786: 109, pl. 20, fig. a.

Halimeda incrassata Lamouroux 1812: 186; Lamouroux 1816: 307; Barton 1901: 25, pl. 5, figs. 39, 41–51.

Halimeda tridens Lamouroux 1812: 186; Lamouroux 1816: 308; Collins 1909–18: 398; Taylor 1928: 84, pl. 10, fig. 14; Taylor 1950: 92.

Pl. 18, fig. 8

Thallus lax or compact, attached to the substratum by a well developed rhizoidal holdfast, up to about 4 cm long. The erect thalli up to 10 cm tall; color on drying whitish-cream to greenish; surface of the segments rough, heavily calcified at the basal portions of the thallus.

Basal segments generally subcuneate, supporting other segments which may become fused laterally forming a fan-shaped structure, but sometimes becoming massive and stipe-like.

Segments variable in shape, generally subcuneate to discoid, or reniform, or those which do not support other segments compressed to cylindrical. Branch segments slightly or deeply lobed at the upper margins, surface plane or ribbed.

Specimens sent to Dr. L. W. H. Colinvaux and verified by her as *H. incrassata* were compared to those which I provisionally call *H. simulans*. A sample of the

latter which was also sent to her and upon which she commented in her letter as probably *H. simulans*, but which she later crossed out of the list and noted as one of the aberrant specimens. The wide variation in the form of the segments and the habit of the specimens seem to overlap so much that even microscopic examination of the diameter of the surface vesicles in both groups of specimens failed to distinguish the former from the latter species, both groups having surface vesicles which fall below 50 μ at their greatest surface diameter. The only difference observable was the slight difference in the shape of the peripheral vesicles as seen from the surface view. Those of *H. incrassata* were tightly fused laterally with sharp corners, while those which I provisionally call as *H. simulans* somewhat rounded but also remaining fused.

Although the size of the surface vesicles seems to be small for *H. incrassata*, other morphological characters have influenced my decision to lump these materials under this species until more studies could be made to justify separation of the materials under the two names.

Common on reef with sandy-rocky substratum.

Type: Ellis' specimen from Jamaica, which according to Barton (1901) was lost.

Materials examined: 23522, 23651, 15483, 15477, 21075, at south end of the Helen Reef, VIII-28-60; 23224, on lagoon side (western) of Ifaluk Is., VIII-10-60; 23038, on reef at western side of Sorol Is., VIII-13-60; 23008, 15614, 21299, 21929, on western seaward reef of Pingelap Is., VII-1-60; 15791, on reef on eastern side of Ulul Is., Namonuito Group, VIII-6-60; 15471, 15504, 15521, 15465, 15460, 15512, 15533, 15539, 15517, on reef at Helen Is., VIII-20-60; 15351, 15736, on the southeast portion of Helen Is., VIII-28-60; 15301, on reef flat at Fefan Is., Truk Group, VII-28-60; 15966, on reef at northeastern side of Falas Is., Truk Group, VII-20-60; 21296, 21293, on eastern seaward reef flat of Urak Is., Mokil Group, VI-29-60; 21984, on reef flat at north end of Yap Is., VIII-19-60.

3. *Halimeda cylindracea* Decaisne 1842: 103; Hillis 1959: 373, pl. 4, fig. 19; pl. 7, fig. 13; pl. 12.

Pl. 16, figs. 6, 9

Thalli tall, generally slender, up to 15 cm high excluding the well developed holdfasts which are up to 4 cm long; distinctly attenuate from the base to the apex of the branches, the ultimate segments 4 or sometimes 5 times thinner than those of the cylindrical segments at the basal portion. Calcification moderate although heavier near the base; color on drying whitish, or greenish, the surface slightly glossy.

The basal segments shortly barrel-shaped, 4-6 mm tall, 7-17 mm broad, forming a subcylindrical stipe. The segments arising from it may become laterally fused together forming a fan-shaped structure, or may become somewhat folded and massive. Branch segments subcuneate, trilobed at their upper margins, the lobes cylindrical; segments not supporting branches cylindrical. The upper segments cylindrical, about 3-4, or sometimes 5 diameters long.

Some of the specimens resemble *H. incrassata* but possess surface vesicles ranging from 15-25 μ in surface diameter which is diagnostic of *H. cylindracea*.

On reef with sandy-rocky bottom.

Type: from Madagascar, Nossi-Bé, Pervillé (PC); whereabouts not known to the writer.

Materials examined: 23601, 23379, on reef at Dublon Is., Truk Group, VII-31-60; 23288, on reef at western side of Sorol Is., VIII-13-60; 23371, 23389, 21831, on reef at Fefan Is., Truk Group, VII-28-60; 23258, 23262, 23374, 23280, 23363, 23265, 21321, 15909, 15902, on reef at Falas Is., Truk Group, VII-30-60; 23529, at south end of Helen Reef, VIII-28-60; 21066, southwestern side of Puluwat Is. (Enderby Is.), VIII-7-60; 15516, 15368, 15513, 15370, on reef at Helen Is., VIII-30-60; 15947, 15887, near north end of airport runway at Moen Is., Truk Group, VII-29-60; 15950, on reef at northeastern side of Tolus Is., Truk Group, VII-20-60; 15117, on a reef flat with a sandy to rocky substratum at Iwayama Bay, Palau Is., VIII-22-60.

4. *Halimeda taenicola* Taylor 1950: 86, pl. 46, fig. 1; Dawson 1956: 109; Hillis 1959: 354, pl. 2, fig. 6; pl. 5, fig. 12; pl. 6, fig. 14; pl. 11.

Pl. 16, fig. 3

This is also one of the common species amply represented among the collections. Thalli compact, to about 13 cm tall, attached to the substratum by means of small rhizoidal holdfast. Basal segments subcuneate, or in robust specimens stipe-like in appearance. Color on drying whitish, cream, pale golden or greenish. Segments moderately calcified, glossy, variable in shape but commonly subcuneate to reniform, less commonly discoid, thick, and becoming concave on drying, about 12 mm tall, 15 mm broad. Branching sometimes frequent, up to 5 arising on one segment.

This species is quite easily recognizeable macroscopically and is characterized by its thick glossy segments which become concave on drying.

On reef with sandy-rocky substratum.

Type: Taylor 46-551 from the Marshall Islands, Rongerik Atoll, Enyvertok Island, June 29, 1946; now in the Herbarium of the University of Michigan.

Materials examined: 15987, 15386, 23523, 15388, 15373, southern region of Helen Reef, VIII-28-60; 15634, 15700, 21275, 21336, 21348, on northern seaward reef flat of Mokil Is., VI-29-60; 15828, on reef at eastern side of Ulul Is., VIII-6-60; 15733, 21294, on eastern seaward reef flat at Urak Is., Mokil Group, VI-29-60; 15865, on reef at southern end of Ulul Is., VIII-6-60; 15832, 21256, on reef at Quoi Is., Truk Group, VIII-1-60; 21337, on western seaward reef flat of Pingelap Is., VII-1-60; 21305, 21116, on lagoon side of reef flat at northwestern tip of Mokil Is., VI-29-60; 23228, on reef at lagoon side of Ella Is., Ifaluk Group, VIII-10-60; 23099, on reef between Ifaluk and Flalap Is., VIII-10-60.

5. *Halimeda tuna* (Ellis and Solander) Lamouroux 1812: 186; Lamouroux 1816: 309, pl. 11, fig. 8; Barton 1901: 11, pl. 1, figs. 1-6; Collins 1909-18: 400; Taylor 1928: 85; Hamel 1931: 407, fig. 26; Hillis 1959: 342, pl. 1, figs. 4-5; pl. 5, fig. 9; pl. 6, fig. 7; pl. 9.

   Corallina tuna Ellis and Solander 1786: 111, pl. 20, fig. e.

   Halimeda tuna f. *platydisca* (Decaisne) Barton 1901: 14, pl. 1, fig. 2; Gilbert 1947: 124.

   Halimeda platydisca Decaisne 1842: 102.

   Halimeda tuna v. *platydisca* Boergesen 1911: 134; Boergesen 1913: 106; Collins 1909-18: 102; Taylor 1928: 85, pl. 10, fig. 13.

Pl. 16, fig. 2

Thalli either forming compact cushions, or spreading, up to about 15 cm tall,

attached to the substratum by means of small holdfasts, about 1 cm long. Color on drying cream, or light rusty brown to greenish in color. Basal segments subcuneate to subcylindrical, the latter stipe-like. Upper segments variable in size. The thalli with compact habit generally having smaller segments, while those having a spreading habit large, up to 25 mm tall, 35 mm broad, plane but sometimes slightly ribbed; segments slightly calcified with glossy surface, the margins undulate to somewhat folded and thicker than the other portions of the segments. Shape of the segments commonly reniform, or somewhat discoid to subcuneate.

The materials resemble *H. gigas* in habit and large size of the segments but the surface vesicles are very much smaller in diameter, about 75–90 μ in surface diameter.

Type: from the Mediterranean Sea; present whereabouts not known to the writer. This species is the type for the genus.

Materials examined: 15770, 21886, on reef at Yap Is., VIII–19–60; 15951, 23259, on reef at northeast side of Falas Is., Truk Group, VII–30–60; 21899, 21857, 21408, 21992, 21421, on reef flat at Yap Is., VIII–18–60; 21366, 21218, on reef flat at Epwelkapw, Ponape Is., VI–20–60.

6. *Halimeda stuposa* Taylor 1950: 90, pl. 43, fig. 1; pl. 49; pl. 50, fig. 2; Dawson 1956: 41; Dawson 1957: 109; Hillis 1959: 374, pl. 3, fig. 5; pl. 5, fig. 25; pl. 6, fig. 18; pl. 7, fig. 11; pl. 11.

Pl. 18, fig. 7

Thalli thick-set in appearance, erect, up to 6 cm tall, attached to the substratum by means of very well developed, massive rhizoidal holdfast, which attain a length of up to 10 cm, beset with sand and shell fragments.

Color on drying cream to golden, or geenish. Thallus moderately calcified with smooth surface. Basal segments subcuneate to cylindrical, forming a short stipe, or the segments borne on the basal segment may fuse laterally to form a short stem. Branching mostly trichotomous; main segments slightly ribbed, averaging about 2 mm thick, flattened, and sometimes shallowly trilobed at the upper margins. Upper segments generally smaller, cylindrical to sometimes spherical.

This species can easily be distinguished from the other members of the *H. incrassata* complex by being short and thickly set and by the presence of subcylindrical to cylindrical segments which are seldom more than two diameters long.

On reef with sandy-rocky substratum.

Type: Taylor 46–591 from Rongelap Atoll, Naen Island, Marshall Islands, July 17, 1946; in the Herbarium of the University of Michigan.

Materials examined: 15881, 15864, 15827, 15829, 23717, on reef at southern portion of Ulul Is., VIII–6–60; 23056, on reef at northern portion of Puluwat Is., VIII–7–60, 23125, on reef at lagoon side of Ifaluk Is., VIII–10–60; 23104, on reef at western side of Ella Is., Ifaluk Group, VIII–10–60; 23112, on reef between Ifaluk and Flalap Is., VIII–10–60; 21911, on reef at southern end of Ulul Is., VIII–6–60.

7. *Halimeda discoidea* Decaisne 1842: 91; Howe 1907: 495, pl. 25, figs. 11–20; pl. 26; Setchell and Gardner 1920: 177, pl. 13, fig. 3; Taylor 1928: 82, pl. 10, fig. 17; pl. 11, fig. 23; Taylor 1950: 85, pl. 45, figs. 1–2; Egerod 1952: 398, pl. 38, fig. 19b–d; Hillis 1959: 352, pl. 2, fig. 5; pl. 5, fig. 11; pl. 6, fig. 11; pl. 7, figs. 9–10; pl. 8, figs. 5–8; pl. 11.

Halimeda discoidea v. *platyloba* Boergesen 1913: 107, fig. 86.
Halimeda discoidea f. *intermedia* Gilbert 1947: 126.
Halimeda discoidea f. *subdigitata* Gilbert 1947: 125.
Halimeda cuneata f. *digitata* Barton 1901: 16, pl. fig. 9.

Pl. 17, figs. 1-3

This species is one of the most variable in the genus *Halimeda*. Although the specimens all show the *H. discoidea* anatomy, they show a wide variability in habit and in the form of the segments. One form is represented by materials with compact and cushion-like habit, arising from a well developed, spreading rhizoidal holdfast, the segments of which are small, discoid to subcuneate, generally broader than long. The other form is represented by materials showing the f. *subdigitata* habit and form of segments. The thallus is attached to the substratum by means of a small holdfast about 1 cm long. The basal segments may be stipe-like, commonly broadly cuneate, supporting a row of digitately arranged branches. The upper segments are narrowly subcuneate to cylindrical. Intermediate forms are also present.

Type: Hillis (1959) expresses doubt as to the type locality but cites Kamtschatka as the place of collection. She observed in a photograph of this species taken by Professor Taylor that the type was supposedly collected from Kamtschatka during the voyage of the "Venus." Now in the Museum National d'Histoire Naturelle in Paris.

Materials examined: 15632.1, 15618.1, on reef on eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 15671b, 15674a, 15672, 21128, on reef flat at Epwelkapw, Ponape Is., VI-20-60; 15804, on reef at Falas Is., Truk Group, VII-30-60; 15928, 21062, collected from south end of Moen Is., Truk Group, VIII-1-60; 15960, 15783, 15800, 15941, 15888, collected near north end of airport runway at Moen Is., Truk Group, VII-29-60; 15368.1, at southeast region of Helen Reef, VIII-28-60; 21908, 21909, 23337, on reef at Fefan Is., Truk Group, VII-28-60; 21073, 21497, on reef at Iwayama Bay, Palau Is., VIII-22-60; 21504, 21421.1, on reef at Yap Is., VIII-18-60; 23257, in mangrove at south end of Moen Is., Truk Group, VIII-1-60; 23229.1, on reef at lagoon side of Ella Is., Ifaluk Group, VIII-10-60; 15379, on north side of Helen Is., Helen Reef, VIII-28-60.

8. *Halimeda macrophysa* Askenasy 1888: 14, pl. 4, figs. 1-4; Barton 1901: 17, pl. 2, figs. 15-18; Hillis 1959: 359, pl. 2, fig. 3; pl. 5, fig. 16; pl. 6, fig. 8; pl. 11; Dawson 1957: 108, fig. 12.

Pl. 18, figs. 5-6

Thalli up to 8 cm tall, compact, attached to the substratum by means of a small holdfast. Segments moderately calcified, fragile; color on drying whitish-rusty to pale-greenish. The surface of the segments appear pitted under low magnification due to the exceptionally large diameter of the peripheral vesicles, separated from each other by a layer of calcium carbonate.

Basal segments small, subcylindrical or cuneate, others generally reniform, to about 11 mm tall, and 20 mm broad. Branching complanate, di-trichotomous but sometimes up to 4 branches are borne on a segment. Upper margins of the segments entire.

This species is characterized by its very friable segments and their pitted appearance under low magnification due to the large surface diameter of the peri-

pheral vesicles and the nature of calcification.

On reef with rocky bottom and plenty of corals and little sand.

Type: from Matuku, Fiji Is., South Pacific; present whereabouts not known to the writer.

Materials examined: 15787, 15957, 21549, on reef between Moen and Falo Is., VII-29-60; 15619, 15618, 15632, on reef eastern side of Mantapeitak Is., Truk Group, VI-20-60; 15908, 15844, 15801, 23317, 23391, on reef at Falas Is., Truk Group, VII-30-60; 15807, 15963, 15945, collected near north end of airport runway at Moen Is., Truk Group, VII-29-60; 21134, 21099, on reef flat at Iwayama Bay, Palau Is., VIII-22-60; 21910, on reef at Fefan Is., Truk Is., VII-28-60.

9. *Halimeda fragilis* Taylor 1950: 88, pl. 48, fig. 2; Hillis 1959: 363, pl. 3, fig. 2; pl. 5, fig. 10; pl. 6, fig. 1; pl. 7, fig. 1; pl. 8, fig. 1; pl. 9.

Pl. 16, fig. 1

Thalli up to 5 cm tall, compact, cushion-shape, attached to the substratum by means of small holdfast; color on drying cream to greyish; segments heavily calcified. Basal segment inconspicuous, cylindrical. Branching in more than one plane.

Upper segments reniform or sometimes cuneate, flattened, up to 8 mm tall, to 12 mm broad, and 0.5-1.0 mm thick. Upper margins entire to slightly undulate. Segments brittle on drying.

On reef with rocky bottom with little sand.

Type: from the Marshall Is., Eniwetok Atoll. Taylor No. 46-394, June 2, 1946; present whereabouts probably in the Herbarium, University of Michigan, Ann Arbor, Michigan.

Materials examined: 23114, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, Aug. 10, 1960; 15866, 15867, on reef at south portion of Ulul Is., Aug. 6, 1960.

10. *Halimeda macroloba* Decaisne 1841: 118; Decaisne 1842: 91; Barton 1901: 24, pl. 3, figs. 33-38; Reinbold 1901: 350; Hillis 1959: 375, pl. 3, fig. 3; pl. 5, figs. 19-20; pl. 6, fig. 17; pl. 12.

Halimeda macroloba var. *ecalcarea* Weber van Bosse 1926: 88.

Pl. 17, figs. 4-5

Thalli large, erect, flattened up to about 20 cm tall, attached to the substratum by means of well developed, massive rhizoidal holdfasts which are up to 6 cm long, loaded with sand, shell, and small stones caught among the filaments.

The basal segments commonly flattened to subcylindrical, supporting 2 or more segments which may be free, partly or entirely united at their lateral margins, to form a flabellate to massive basal structure, which in well developed somewhat bushy thalli may be somewhat folded. Branching di-trichotomous, the surface of the segments dull, whitish to copper, or dull green on drying.

Segments commonly reniform, discoid, or somewhat cuneate, their margins entire or undulate, seldom slightly lobed, flat or slightly ribbed, and about 1 mm thick. Segments are generally broader than long, about 10-20 mm long, 15-30 mm broad.

Mature fruiting materials were seen. The sporangia form dark, dense clumps on both the surface and margins of the segments; color of the fertile material whitish and more chalky than the sterile ones.

On reef with sandy-rocky substratum.

Type: Schimper 871, 1837, from the Red Sea; isotype materials now in several herbaria including the British Museum of Natural History and the New York Botanical Garden.

Materials examined: 21860, 23141.1, 23090, 21852, 23142, on reef flat at Yap Is., VIII–18–60; 23600, 23252, on reef at Dublon Is., Truk Group; VII–31–60; 15796, on reef between Moen and Falo Is., Truk Group, VII–29–60; 21840, 21377, 21325, on reef flat on eastern side of Peipalap Peak, Ponape Is., VI–17–60; 23005, 21464, 21450, 21585, 23018, 23142, 21591, 21825, 21444, on reef around Utwa Village, Kusaie Is., VII–17–60; 21231, 21103, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60; 21485, 21569, on reef at north end of Yap Is., VIII–19–60; 21258, on reef near boat pier at Jokaj Is., VII–20–60; 21958, on outer reef flat facing Mantapeitak Is., VI–20–60; 23372, 23323, 21830, on reef at Fefan Is., Truk Group, VII–28–60; 21473, on reef near Boat Pier, Ponape Is., VII–20–60; 21037, collected from pool inside Moen Is. harbor, Truk Group, VII–29–60; 21205.1, 21142.1, 15704, on reef flat at Iwayama Bay, Palau Is., VIII–22–60; 21121, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI–25–60; 15944, 15948, 15970, collected near north end of airport runway at Moen Is., Truk Group, VII–29–60; 15918, collected from south end of Moen Is., Truk Group, VIII–1–60; 15952, on reef at northeast side of Falas Is., Truk Group, VII–30–60; 15747.1, on reef at Kusaie Is., VII–15–60; 15575.1, 15545, on reef at Koror Is., Palau Group, IX–5–60; 15538, on reef at Helen Is., VIII–30–60.

11. *Halimeda micronesica* Yamada 1941: 121, fig. 15; Yamada 1944a: 29, pl. 5; Taylor 1950: 89, pl. 46, fig. 2; pl. 47; Hillis 1959: 364, pl. 3, fig. 1; pl. 5, figs. 12–14; pl. 6, fig. 2; pl. 9.
Halimeda orientalis Gilbert 1947: 126, fig. 1.

Pl. 17, fig. 6

Thalli up to 9 cm tall attached by means of small rhizoidal holdfasts; color on drying steel-grey. The comparatively large, basal segments bearing numerous branches are distinctive. Branching, except at the basal segment, sometimes dichotomous, more often trichotomous. Upper segments usually cuneate to discoid, about 3–5 mm tall, trilobed at the upper margins, or cuneate to reniform, sometimes broader than long with slightly lobed upper margins.

On sand in reef pools and lagoons.

Type: Yamada's specimen from Atoll of Ant, near Ponape Is.; its whereabouts not known to the writer.

Materials examined: 15826, on reef at eastern side of Ulul Is., Namonuits Group, VIII–6–60; 15620.1, on reef at eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 15793, 15826, on reef on eastern side of Ulul Is., Namonuits Group, VIII–6–60; 15703, on reef at Iwayama Bay, Palau Is., VIII–22–60; 23229, on reef at lagoon side of Ella Is., Ifaluk Group, VIII–10–60; 15599.1, 15633, 15620.1, on reef on eastern side of Mantapeitak Is., Ponape Group, VI–20–60; 21913, on reef at southern end of Ulul Is., Namonuits Group, VIII–6–60; 23113, on reef at eastern side of Ifaluk and Flalap Is., Ifaluk Group, VIII–10–60.

12. *Halimeda gracilis* Harvey ex. J. Agardh 1887: 82; Harvey's Ceylon Algae No. 72; Barton 1901: 22, pl. 3, figs. 28–32; Collins 1909–18: 399; Yamada 1944b: 37.
Halimeda gracilis v. *elegans* Yamada 1944a: 28, pl. 3.

Halimeda gracilis v. *opuntioides* Boergesen 1913: 108, fig. 87.
Halimeda gracilis v. *laxa* (Barton) Barton 1900: 479, pl. 18, figs. 1–3.

Pl. 18, fig. 9

Thalli very loose and lax and straggly in habit, to about 25 cm long. Basal portion not seen. Branching sparse, di-trichotomous, although sometimes up to 5 branches arising from a segment. Segments flattened, moderately calcified, slightly ribbed commonly cuneate in shape but here and there are cylindrical segments. The upper margins of the segments commonly trilobed but may be entire or slightly undulate. Color on drying whitish to light green.

Type: Harvey's Ceylon Algae No. 72 from Ceylon; according to Hillis Colinvaux isotypes are found in several herbaria including the British Museum of Natural History and the New York Botanical Garden.

Materials examined: 21004, 21264, on reef at Iwayama Bay, Palau Is., VIII-22-60; 15366, 23536, at southeast region of Helen Reef, VIII-28-60.

Udotea Lamouroux 1812

Key to species:

1. Thallus up to 10 mm tall, stipe monosiphonous; blade monostromatic .... *U. javensis*
1. Thallus more than 2 cm tall, stipe polysiphonous, blade polystromatic 2
   2. Thallus to 6 cm tall, stipe bearing a single blade-like frond .... *U. indica*
   2. Thallus large to 18 cm tall, stipe bearing a frond composed of many flabellate segments 3
      3. Frond-filaments 22–25 μ, occasionally to 40 μ in diameter, lateral branchlets 2–4 times dichotomous with the dichotomies of unequal length; ultimate branchlets bearing finger-like tips compacted so as to form a pseudo-cortex covering the blade ..... *U. geppii*
      3. Frond-filaments large, 40–55 μ in diameter; lateral branchlets simple, more or less of equal length, simple to lobed, or with somewhat flattened heads abutting with each other and forming a pseudo-cortex over the surface of the blade ..... *U. argentea*

1. *Udotea javensis* (Montagne) A. and E. S. Gepp 1904: 363, fig. 38a–c; Taylor 1950: 73; Egerod 1952: 379, fig. 10a–g; Dawson 1954: 395, fig. 13b–c; Dawson 1956: 40.

   Rhipidosiphon javensis Montagne 1842: 15.

The specimens are characterized by a simple monosiphonaceous stipe supporting a small monostromatic flabellum formed by repeated dichotomy of the filaments which are laterally coherent by calcification.

On rocks and dead corals.

Type: specimens collected by Hombron at Leyden, Batavia; present whereabouts not known to the writer. Materials examined agree very well with the figures and descriptions of A. and E. S. Gepp (1911) and Egerod (1952).

Materials examined: 21183, Iwayama Bay, Palau Is., VIII–22–60.

2. *Udotea indica* A. and E. S. Gepp 1911: 121, figs. 13a, 14, 52a–b; Taylor 1950: 74.

Pl. 19, fig. 3

Thalli examined variable both in the shape of the fronds and the form of the

lateral appendages of the frond filaments. The worker is convinced that the specimens examined belong to *U. indica* but convinced only after an exhaustive study of the materials. The shape and the form of the lateral appendages of the frond-filaments differ from Figure 13a–c of *U. indica* as described by A. and E. S. Gepp (1911) by being, for the most part, simple, short and blunt or conical and "never being peltate or .... papillae." Only after a thorough search did I find frond filaments whose lateral appendages are truncate or with slightly flattened to concave apices. The form and the shape of the lateral appendages of most of my specimens resemble in part the figures of Dawson (1956) for *U. palmetta* var. *marshallensis*.

A. and E. S. Gepp (1911) described the anatomy of the stipe of *U. palmetta* as follows: "Filaments of the stipes bearing lateral appendages, 2–4 times dichotomous and terminated by dactyloid, tapering acute apices which are approximated together to form the cortex of the stipe" (Gepps' Figure 54a–b). The stipe filament of my specimens differ distinctly from those of the above descriptions by not ending in dactyloid, tapering acute apices but they agree with the Gepps' Figure 14 for *U. indica*. Furthermore Boergesen (1940: 59) described the base of *U. palmetta* as "consisting of thin filaments to which much sand adheres, forming a root mass about 2 cm high and 1.5 cm broad." The base of my specimens never attain this size.

Dawson (1956: 40, fig. 28a–c; 1957: 108) said nothing about the anatomy of the stipe. Assuming that the stipes of Dawson's *U. palmetta* var. *marshallensis* have the same anatomical features as the stipes of *U. palmetta* as described by A. and E. S. Gepp (1911), my specimens are undoubtedly *U. indica*.

On sandy-rocky substratum.

Type: specimens collected by J. A. Murray in 1880–83 at Kurrachee, Sindh near the mouth of the Indus River; now in the herbarium of the British Museum.

Materials examined: 15913, on reef, Quoi Is., Truk Group, IX–2–60; 15694, on north seaward reef flat, Mokil Is., Mokil Group, VI–29–60; 15933, lagoon at Puluwat Is., IX–7–60; 21349, seaward reef flat at Mokil Is., Mokil Group, VI–29–60; 21342, 21381, eastern seaward reef flat, Urak Is., Mokil Group, VI–29–60; 15869, on reef, south portion of Ulul Is., VIII–9–60; 21750, on north seaward reef flat, Mokil Is., VI–29–60.

3. *Udotea geppii* Yamada 1930: 139, figs. 1–3; Kanda 1944: 754, fig. 15.

Pl. 19, fig. 7

The thalli examined agree very well with the descriptions and figures given by Yamada (1930) although the diameter of the frond-filaments are quite variable and smaller in size, ranging from 22–40 μ thick. Like Yamada's, my specimens were also collected from Palau and Helen Reef, the former is type locality for *U. geppii* Yamada.

On sandy-rocky substratum.

Type: Yamada's specimens from Palau, Caroline Islands; presumably in Yamada's herbarium in Japan and in the herbarium of the British Museum of Natural History in London.

Materials examined: 15503, 15510, 15538, 15470, 15515, 15524, 15531, on reef near Helen Is., Helen Reef, IX–3–60; 15458, 15463, western portion of Helen Reef, IX–30–60; 21238, 21698, 23541, on reef flat at Iwayama Bay, Palau Is., IX–22–60;

15476, on reef with sand substrate with plenty of animal coral near the western portion of Helen Is., VII-28-60.

4. *Udotea argentea* Zanardini 1858: 290; A. and E. S. Gepp 1911: 125, figs. 15, 21, 22; Abbott 1961: 21.

Pl. 15, fig. 9

Thalli steel-grey in color, up to 15 cm tall. Holdfast composed of rhizoids mixed with sand particles forming an elongated, bulbous root mass. Stipes short and simple (occasionally subsessile fronds), 1–5 mm long, 2–3 mm thick.

The frond-filaments are unequally constricted above the dichotomies, and bear lateral appendages which are slightly constricted near the base of the stalk. The apical ends of the appendages vary from being inflated heads to being 2–4 slightly and irregularly lobed capitula. The size, form and arrangement of the appendages fit the Gepps' (1911) descriptions and figures.

Some of my specimens differ from the habit described for *U. argentea* as shown by Gepps' (1911) Figure 15. While their figure shows a flat main basal segment giving rise to proliferations developing more or less in the same plane with the basal segment, my specimens (23322, 15925, 15884) have conspicuous radially plicate basal segments giving rise to many secondary segments that do not develop in the same plane with the basal segment. The result is a bushy, proliferous frond. There is no doubt, however, that my specimens belong to *U. argentea*.

On sandy to rocky substratum.

Type: Zanardini's specimen from the Red Sea; present whereabouts not known to the writer.

Materials examined: 23375, on reef Dublon Is., Truk Group, VII-31-60; 23322, 23573, 23024, 23075, on reef Fefan Is., Truk Group, VII-28-60; 23380, on reef between Falo and Moen Is., Truk Group, VII-29-60; 21832, 23201, on reef flat, Fefan Is., Truk Group, VII-28-60; 15925, 21045, south end of Moen Is., Truk Group, IX-1-60; 15782, 15884, 23696, near north end of airport runway, Moen Is., Truk Group, VII-29-60; 15974, eastern seaward reef, Urak Is., Mokil Group, VII-29-60; 23306, on reef at Quoi Is., Truk Group, IX-2-60; 15805, on reef at Falas Is., Truk Group, VII-30-60; 23719, on reef at south end of Ulul Is., Namonuito Group, VIII-6-60.

TYDEMANIA Weber van Bosse 1911

1. *Tydemania expeditionis* Weber van Bosse 1901: 139; A. and E. S. Gepp 1911: 66, pl. 18, figs. 153–154; Taylor 1950: 73, pl. 38, fig. 1; Dawson 1956: 41; Gilmartin 1966: 100, figs. 3–6.

Pl. 17, fig. 8

Thalli examined agree fairly well with the descriptions and figures of A. and E. S. Gepp for *T. expeditionis*, except for 15850 which in my opinion represents only the flabellar portion of this species, and 21086 and 21677, which were very much smaller in size than the other thalli I had examined. The glumeruli of these two plants are generally composed of 5 verticillately arranged branchlets arising from the main filament. Also, further examination of the thalli did not reveal the presence of the flabellar portion.

On sandy-rocky substratum in deeper water.

Type: specimen collected by Weber van Bosse from the Malay Archipelago

during the Siboga Expedition; probably in Indonesia together with other Siboga materials.

Materials examined: 23381, 21031, on reef between Falo and Moen Is., Truk Group, VII-29-60; 21900, on reef flat at Yap Is., VII-18-60; 21976, on reef at the eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 15850, on reef at Falas Is., Truk Group, VII-3-60; 21086, 21677, on reef flat at Iwayama Bay, Palau Is., VII-22-60.

Codium Stackhouse 1797

Key to species:

Thallus cylindrical, dichotomously to subdichotomously branched, the branches occasionally attached to each other ..... *C. edule*

Thallus applanate, firmly attached on the surface of the substratum, producing excrescenses ..... *C. arabicum*

1. *Codium edule* Silva 1952, *In* Egerod (1952) An Analysis of the Siphonaceous Chlorophycophyta with Special Reference to the Siphonocladales, Siphonales, and Dasycladales of Hawaii, U. of California Publications in Botany 25 (5): 392, pl. 35b, fig. 18a-d.

Pl. 17, fig. 10

Thalli irregularly branched, subdichotomous or dichotomous. Branches 2 to 3 mm thick, connected to each other by means of secondary attachments. The size and form of the utricles are within the range of measurements for *C. edule*.

Attached on rocks and decaying branch.

Type: Papenfuss 10803, on reef in front of Elk's Club, Waikiki, Oahu, Hawaiian Islands, collected November 17, 1940; now at University of California, Berkeley (925225).

Materials examined: 23506, 23597, 23318, near mangrove at southern end of Moen Is., Truk Group, VIII-1-60; 15597, on reef at eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 21048, 15903, 15904, at southern end of Moen Is., Truk Group, VIII-1-60; 15101, 21131, 21189, 21540, 21530, 21701, 15986, 21054, on reef flat with sandy-rocky substratum at Iwayama Bay, Palau Is., VIII-22-60; 21880, 23285, 23667, on reef at eastern lagoon side at Falas Is., Truk Group, VII-30-60; 23348, on reef at eastern side of Sorol Is., VIII-13-60.

2. *Codium arabicum* Kütz. 1856: 35, pl. 100, fig. 2; Silva 1952, *In* Egerod (1952) An Analysis of the Siphonaceous Chlorophycophyta with Special Reference to the Siphonocladales, Siphonales, and Dasycladales of Hawaii, U. of California Publications in Botany 25 (5): 382, pl. 34b, Text Figs. 11-13.
Codium coronatum Setchell 1926: 82, pl. 10, figs. 2-5, pl. 11, figs. 2-3; pl. 12, figs. 1 and 50.

Pl. 15, fig. 4

The unbranched, applanate habit of the thallus with excrescences is definitely referable to *C. arabicum*. The shape and size of the utricles are quite variable but still within the dimension of this species as described by Silva (1952). The apical walls of the utricles are clearly alveolate.

The utricles of 23507 are sub-cylindrical to clavate, without any alveolation in the wall at the apex of the utricles. The thalli of 15598 are fertile, the utricles with alveolate walls at the apices; the gametangia are large, 160-280 μ long,

60–100 μ wide. These were identical to Figures 13a–d of Silva (1952) for *C. arabicum*.

Type: from Tor, Sinai Peninsula, Gulf of Suez, Egypt; present whereabouts not known to the writer.

Materials examined: 21410, washed ashore, Sorol Is., VIII-13-60; 15598, 21734, 21554, 21681, on reef at eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 15902, 21049, from south end of Moen Is., Truk Group, VIII-1-60; 23507, near mangrove at south end of Moen Is., Truk Group, VIII-1-60; 23161, 23340, 23046, 23043, on reef at western side of Sorol Is., VIII-13-60.

Neomeris Lamouroux 1816

Neomeris van-bosseae Howe 1909: 80, figs. 17–19; Egerod 1952: 405, pl. 41, fig. 22b; Gilbert 1943: 17.

Materials examined composed of fertile thalli which do not appear annulate, and the gametangia although strongly calcified, are free from each other. Thalli 1-2 cm tall and 2-3 mm thick. These characters fit those of the above species.

Type: Weber van Bosse 1196 from Sikka, Flores, Indonesia; now in the Herbarium New York Botanical Garden and the Herbarium of Madame Weber van Bosse in Eerbeek, Holland.

Materials examined: 21765, on outer reef flat at Epwelkapw, Ponape Is., VI-20-60; 21966, on outer reef flat facing Mantapeitak Is., Ponape Group, VI-20-60; 23554, 21197, on reef flat at Iwayama Bay, Palau Is., VIII-22-60; 21974, on reef flat at eastern side of Peipalap Peak, Ponape Group, VI-17-60; 21107, on reef flat near bridge between Kolonia and Jokaj Is., Ponape Group, VI-25-60.

Bornetella Munier-Chalmas 1877

Key to species:

Thallus spherical ..... *B. sphaerica*
Thallus clavate ..... *B. nitida*

1. *Bornetella sphaerica* (Zanard.) Solms-Laubauch 1893: 92, pl. 9, fig. 8; Gilbert 1943: 22; Egerod 1952: 407, pl. 42, fig. 22d–g.
   Neomeris sphaerica Zanardini 1878: 38.
   Bornetella ovalis Yamada 1934: 51, figs. 14–15.

Thalli attached on rocks and dead corals. The anatomy of the materials studied fits the figures and descriptions of the above cited authors for this species.

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

Materials examined: 15707, 21673, 23793, 23550, 23763, 21534, 21270, 21246, 21151, 21705, 21690, 21196, 21178, 21145, on reef flat at Iwayama Bay, Palau Is., VIII-22-60; 23547, on reef at Yap Is., VII-29-60.

2. *Bornetella nitida* (Harvey) Munier-Chalmas 1877; Gilbert 1943: 25, fig. 1e–f.
   Neomeris nitida Harvey 1857, List of Friendly Islands Algae, No. 83.

Thallus cylindrical to clavate, 2–3 cm long, 2–6 mm in diameter. Since the single collection is in dried state, the nature of the gametangial cysts can not be ascertained. The only basis I used for determining the species is the thickness of the radial wall in the capitate branches which are coherent and calcified, forming the cortex of the thallus. The thickness of the radial wall is 16–20 μ in contrast to a much thicker wall in *B. oligospora*. Collected attached on rocks.

Type: isotype from the Friendly Island (Harvey, Friendly Island Algae, No.

83); now at the New York Botanical Garden.

Materials examined: 21152, consisting of four thalli, on reef flat at Iwayama Bay, Palau Is., VIII–22–60.

Acetabularia Lamouroux 1816

Key to species:

1. Gametangial rays coherent with each other, forming a disc ..... *A. moebii*
1. Gametangial rays not coherent with each other, free 2
   2. Gametangial rays clavate to obovate, the apices blunt or rounded ..... *A. clavata*
   2. Gametangial rays somewhat pyriform with mucronate apices ... *A. exigua*

1. *Acetabularia clavata* Yamada 1934: 57, figs. 24–25; Egerod 1952: 413, fig. 23j–k.

Thalli very small, 1–2 mm tall. The gametangial rays vary from 6–9 in number. The materials studied fit the description and figures by the above cited authors for this species. Growing on rocks and dead corals.

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

Materials examined: 23182.1, on reef near Utwa Village, Utwa Is., Kusaie Group, VII–17–60; 23350.1, on reef at eastern side of Sorol Is., VIII–13–60.

2. *Acetabularia exigua* Solms-Laubach 1895: 28, pl. 2, fig. 1; Dawson 1956: 42, fig. 31.

Two small thalli were found in two collections growing mixed with *A. clavata*. The size and the shape of the gametangial rays fit those described for *A. exigua*, although differing slightly from Figure 31 of Dawson (1956) for this species in that the shape of the distal end of the gametangial rays of my specimens are somewhat mammilate.

Type: from tropical eastern Asia, Macassar, Celebes; present whereabouts of the type not known to the writher.

Materials examined: 23182.2, growing on dead coral on reef near Utwa Village, Utwa Is., Kusaie Group, VII–17–60; 23550.2, on reef at eastern side of Sorol Is., VIII–13–60.

3. *Acetabularia moebii* Solms-Laubach 1895: 30, pl. 4, fig. 1; Egerod 1952: 411, fig. 23i.

Only one small thallus was found in one collection but it fits fairly well with the descriptions and figures of the above authors for this species. Thallus is about 4 mm tall and the gametangial disc is composed of 17 gametangial rays. Growing on dead coral with other smaller algae.

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

Materials examined: 23253.2, on reef at Dublon Is., Truk Group, VII–31–60.

CYANOPHYTA

The following list includes species that are conspicuous components of the marine benthic flora of the Caroline Islands. Mention is also made of other species found as epiphytes or mixed in small quantities with other algae.

ANACYSTIS Meneghini 1837

Anacystis montana (Lightf.) Drouet and Daily 1956: 45, figs. 16–99.

Forming soft gelatinous mass coating the under surface of an overhanging rock.

Type: from Scotland (?); present whereabouts not known to the writer.

Materials examined: 21725, Koror Is., Palau Group, IX–6–60.

LYNGBYA C. Agadh 1824

Key to species:

1. Apical cell of the trichome capitate ..... *L. aestuarii*
1. Apical cell of the trichome not capitate 2
   2. Tips of trichomes slightly tapered, apical cells rotund; transverse walls often granulate; diameter of the trichomes 10–20 μ ..... *L. confervoides*
   2. Tips of trichomes not tapered; apical cells rotund; transverse walls not granulate; diameter of the trichomes 15–60 μ ..... *L. majuscula*

1. *Lyngbya majuscula* Gomont 1892: 131; Dawson 1954: 380, fig. 3d; Taylor 1950: 111; Dawson 1957: 128; Tilden 1910: 123, pl. 5, fig. 42.

Filaments forming entangled masses or tufts up to 8 cm or more long.

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

Materials examined: 15930, 15905, on reef at southern end of Moen Is., Truk Group, VIII–1–60; 15765, 15157, 15289, 23139, on reef at Tafansak Village, Kusaie Is., VII–16–60; 15846, 15909, 21026, 23661, on reef at Falas Is., Truk Group, VII–30–60; 15776, 21670, on reef north of channel near Yap harbor, Yap Is., VIII–19–60; 15858, 15842, 15243a, 21706, on reef at Kusaie Is., VII–15–60; 15712, 21539, 21211, 21267, 23561, on reef at Iwayama Bay, Palau Is., VIII–22–60; 15655, on reef at Koror Is., Palau Group, IX–5–60; 21439, 23642, on reef near boat pier at Ponape Is., VII–20–60; 21126, 21708, 21217, on reef at Epwelkapw, Ponape Is., VI–20–60; 21417, 23157, on reef at Yap Is., VIII–18–60; 21773, 21816, 21780, on eastern reef flat at Peipalap Peak, Ponape Is., VI–17–60; 21595, on reef at Puluwat Is., VIII–7–60; 23294, on reef at western lagoon side of Puluwat Is., VIII–17–60; 21068, on reef at southeastern portion of Puluwat Is., VIII–17–60; 21397, on reef at Nanmatol Is., Ponape Group, VII–23–60; 21653, 21443, 21467, 23265, 23673, 23249, 21951, on reef at Utwa Village, Kusaie Is., VII–17–60; 23215, on reef at Dublon Is., Truk Group, VII–31–60; 21757, on reef at Urak Is., Mokil Group, VI–29–60; 23412, 21967, on reef at Mantapeitak Is., Ponape Group, VI–20–60; 23239, on reef at Kusaie Is., VII–15–60; 23152, in man-made pool dredged inside Moen Is., Truk Group, VII–29–60; 21882, on reef at Falas Is., Truk Group, VII–30–60; 23583, on reef at Dublon Is., Truk Group, VII–31–60.

2. *Lyngbya confervoides* Gomont 1892: 136, pl. 3, figs. 5–6; Dawson 1954: 380, fig. 3b, c.

Forming soft, slimy layer on substratum.

Type: from Cadiz, Spain; present whereabouts of the type not known to the writer.

Materials examined: 15425, on reef near Malakal Pass, Palau Is., IX–6–60; 15347, on reef near Helen Is., Helen Reef, VIII–29–60; 15004, on reef at eastern side of

Peipalap Peak, Ponape Is., VI-17-60; 15123, on reef at Tafansak Village, Kusaie Is., VI-17-60; 15218, on reef at Kusaie Is., VII-15-60; 15198, on mangrove, Kiti, Ponape Is., VII-6-60.

3. *Lyngbya aestuarii* Gomont 1892: 127, pl. 3, figs. 1-2; Tilden 1910: 120, pl. 5, figs. 40-41; Dawson 1954: 380, fig. 3a.

Forming silky, fine entangled tufts of filaments.

Type: from Jever, Oldenburg, Germany; present whereabouts of the type not known to the writer.

Materials examined: 21928, 21931, 21316, 21340, on reef flat at Pingelap Is., VII-1-60; 21738, on reef at eastern side of Mantapeitak Is., Ponape Group, VI-20-60; 21346, on eastern seaward reef flat at Urak Is., Mokil Group, VI-29-60; 21354, 21522, on northern seaward reef flat at Mokil Is., VI-29-60; 15144, on reef at Epwelkapw, Ponape Is., VI-20-60; 23169, 23211, on reef at southern tip of Sorol Is., VIII-13-60; 23678, 23680, on reef at western end of Puluwat Is., VIII-7-60; 21195, 21268, 21245, 21159, 21171, on reef flat at Iwayama Bay, Palau Is., VIII-22-60; 21309, on reef at lagoon side of Mokil Is., VI-29-60; 23160, 21604, on reef at western side of Quoi Is., Truk Group, VIII-2-60; 21513, on reef at Kusaie Is., VII-15-60; 15350, on reef at Helen Is., Helen Reef, VIII-29-60; 15358, 15420, on reef near Malakal Pass, Palau Is., IX-6-60; 15177, on reef at Tafansak Village, Kusaie Is., VII-16-60; 21029, on reef at Falas Is., Truk Group, VII-30-60; 15698, on reef at Mokil Is., VI-29-60; 15954, 15953, 23520a (mixed with *Cladophora*), on reef at Falas Is., Truk Group, VII-30-60; 23059 (mixed with *Cladophora*), on reef at Puluwat Is., VIII-7-60; 15910, on reef at Falas Is., Truk Group, VIII-30-60; 15999, on reef at Quoi Is., Truk Group, VIII-2-60.

Symploca Kütz. 1843

Symploca hydnoides Gomont 1892: 127, pl. 2, figs. 1-4; Dawson 1954: 380, fig. 30p.

Forming dense fasiculate tufts to about 3 cm high.

Type: from Appin, Scotland; present whereabouts of the type not known to the writer.

Materials examined: 15223, on reef at Kusaie Is., VII-15-60; 15426, on reef near Malakal Pass, Palau Is., IX-6-60.

Hormothamnion Grunow 1867

Hormothamnion enteromorphoides Born. and Flah. 1888: 260; Tilden 1910: 205, pl. 10, fig. 13; Dawson 1954: 379, fig. 3n.

Filaments usually forming soft, slimy and extended fasicles or strands.

Type: from Tongabu, Polynesia; present whereabouts of the type not known to the writer.

Materials examined: 15846a, mixed with *Lyngbya majuscula*, on reef at Falas Is., Truk Group, VII-30-60; 23641, on reef near boat pier, Ponape Is., VII-20-60.

Schizothrix Kütz. 1843

Schizothrix calcicola Gomont 1892: 307, pl. 8, figs. 1-3; Drouet 1963: 261-281, figs. 1-56.

Filaments forming thin sheaths on substratum or forming botton-like gelatinous masses which become calcified with age.

Type: from Sweden; now in Agardh Herbarium, Hund.

Materials examined: 21609, on reef at Tafansak Village, Kusaie Is., VII–16–60; 21646, on reef at Yap Is., VIII–19–60; 23187, 15715, on reef at eastern side of Mantapeitak Is., Ponape Group, VII–20–60; 23061, on reef at western lagoon side of Puluwat Is., VIII–7–60; 23120a, on reef at eastern side of Flalap Is., Ifaluk Group, VIII–10–60; 21017, on reef at Quoi Is., Truk Group, VIII–2–60; 21288, on eastern seaward reef flat at Urak Is., Mokil Group, VI–29–60; 21944, 21404, 21945, on reef at Tafansak Village, Kusaie Is., VII–16–60; 23188, on reef at western side of Quoi Is., VIII–2–60; 23222, on reef at lagoon side of Ifaluk Is., VIII–10–60; 21127, 21127, on reef flat at Epwelkapw, Ponape Is., VI–20–60.

Hydrocoleum Kütz. 1843

Hydrocoleum lyngbyaceum Gomont 1892: 337, pl. 12, figs. 8–10; Dawson 1957: 129.

Forming slimy mat or caespitose tufts.

Type: probably from Cherbourg, France, according to Dawson (1954); present whereabouts of the type not known to the writer.

Materials examined: 23083a, on reef at Fefan Is., Truk Group, VII–28–60; 21883, 21026a, on reef at Falas Is., Truk Group, VII–30–60.

Hydrocolum comoides Gomont 1892: 335, pl. 12, fig. 3–5; Dawson 1957: 129, fig. 31u.

Filaments forming caespitose, slimy cushion tufts.

Type: from Australia, whereabouts of the type not known to the writer.

Materials examined: 23084, on reef at Fefan Is., Truk Group, VII–28–60; 15847, on reef at Falas Is., Truk Group, VII–30–60.

Microcoleus Desmazierés 1823

Microcoleus chthonoplastes Gomont 1892: 353, pl. 14, figs. 5–8; Drouet 1964: 315, figs. 1–17.

Filaments forming dark green coat on *Rhizophora sp.*

Type: from the Baltic Sea (?); presumably in Thuret Herbarium.

Materials examined: 23173, in mangrove at Utwa Village, Kusaie Is., VII–17–60; 23458, on reef between Falo and Moen Is., Truk Group, VII–29–60.

Calothrix Agardh 1824

Calothrix pilosa Bornet and Flahault 1886: 363; Dawson 1954: 379, fig. 3e.

Forming brownish to very dark layer on surface of rocks or coral pebbles.

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

Materials examined: 23650, Oruluk Is., VII–26–60; 23611, on coral rocks near shore at Utwa Is., Kusaie Group, VII–17–60.

Other species of *Cyanophyta* recorded by the writer from the Caroline Islands:

Phormidium crosbyanum Tilden
Calothrix crustacea (Thuret) Fan
C. confervicola (Roth) Agardh
Entophysalis deusta (Meneghini) Drouet and Daily
Spirulina subsalsa Gomont
Oscilatoria sp.

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Explanation of Plates

Plate 14. 1–2. *Caulerpa serrulata-* showing variation in habit. 3. *C. peltata-* a portion of a branch. 4. *C. verticillata-* habit. 5–4. *C. urvilliana-* showing variation in habit. 8. *C. cupressoides-* habit. 9. *C. racemosa-* habit.

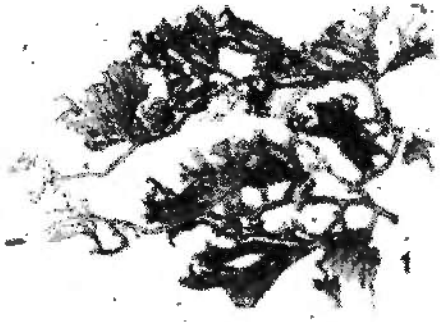
Plate 15. 1. *Caulerpa taxifolia-* habit. 2. *C. brachypus*: habit. 3. *C. cupressoides-* habit. 4. *Codium arabicum-* habit. 5. *Caulerpa pickeringii-* habit. 6. *Microdictyon okamurai-* habit. 7. *Caulerpa antoensis-* habit. 8. *C. fastigiata-* habit. 9. *Udotea argentea-* habit.

Plate 16. 1. *Halimeda fragilis-* habit. 2. *H. tuna-* habit. 3. *H. taenicola-* habit. 4 & 8. *Caulerpa serrulata-* showing variation in habit. 5. *C. sertularioides-* habit. 6 & 9. *Halimeda cylindracea-* showing variation in habit. 7. *Caulerpa racemosa-* habit.

Plate 17. 1. *Halimeda discoidea-* fertile thallus. 2–3. *H. discoidea-* showing variation in habit. 4. *H. macroloba-* fertile thallus. 5. *H. macroloba-* habit. 6. *H. micronesica-* habit. 7. *Boergesenia forbesii-* habit. 8. *Tydemania expeditionis-* habit. 9. *Caulerpa serrulata-* habit. 10. *Cadium edule-* habit.

Plate 18. 1–4. *Halimeda opuntia-* showing variations in habit. 5–6. *H. macrophysa-* showing variation in habit. 7. *H. stuposa-* habit. 8. *H. incrassata-* habit. 9. *H. gracilis-* habit.

Plate 19. 1. *Rhipilia orientalis-* habit. 2, 4, 5. *Avrainvillea nigricans-* habit. 3. *Udotea indica-* habit. 6. *Caulerpa lentillifera-* habit. 7. *Udotea geppii-* habit. 8. *Avrainvillea lacerata-* habit. 9. *A. erecta-* habit.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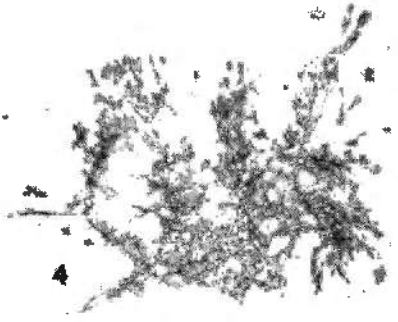
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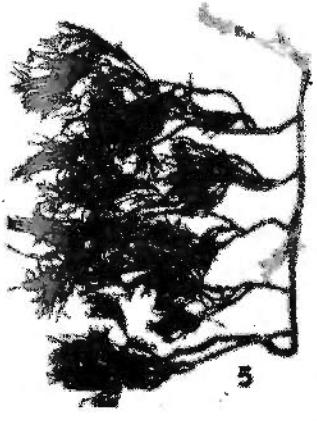
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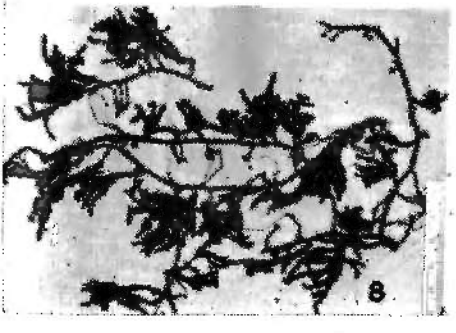
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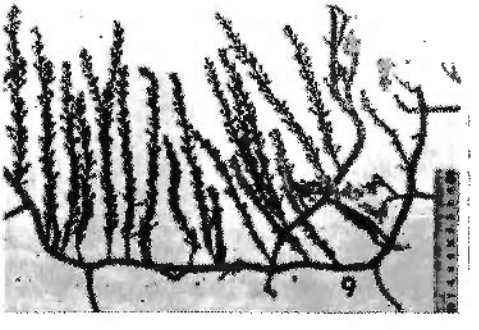
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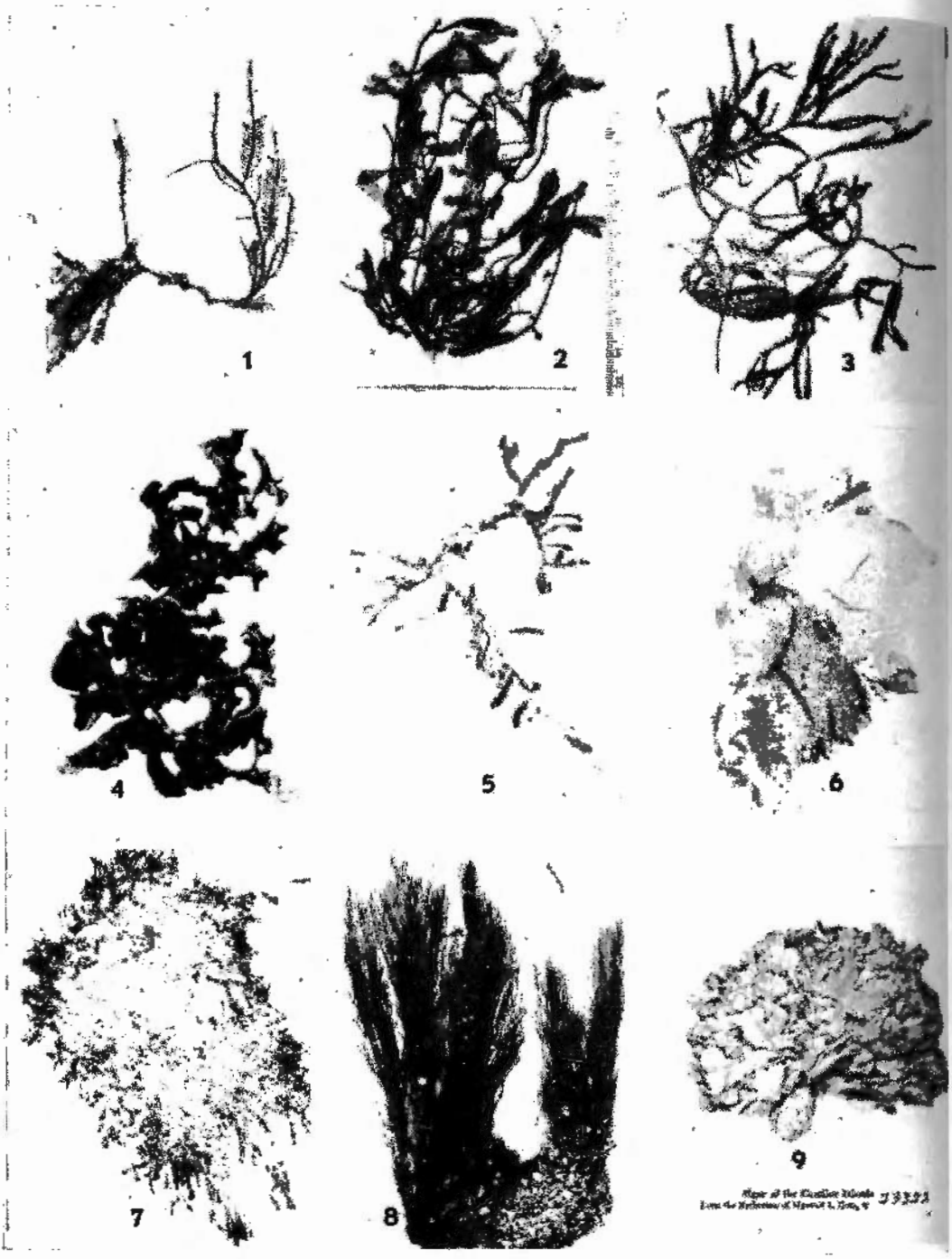
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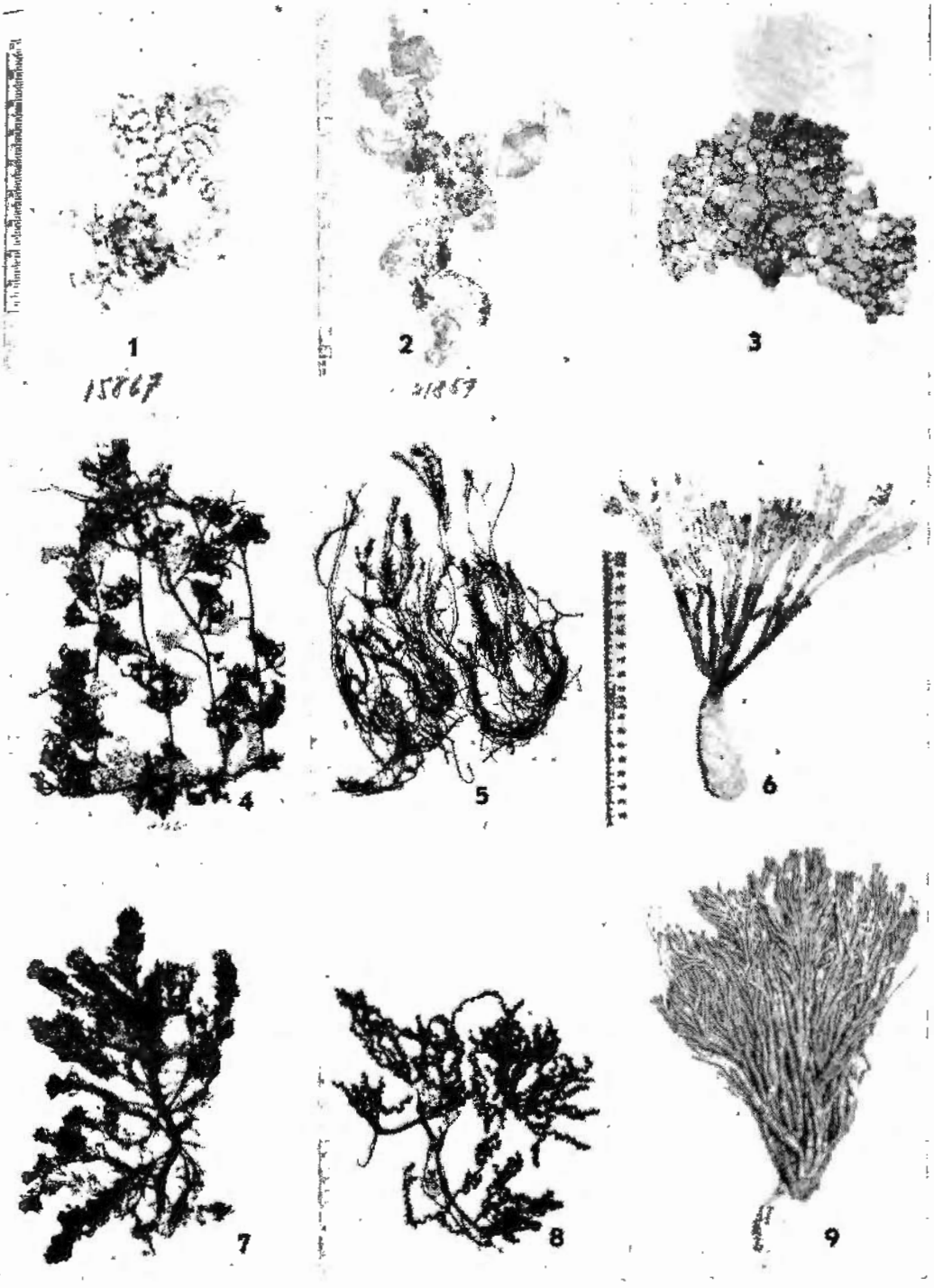
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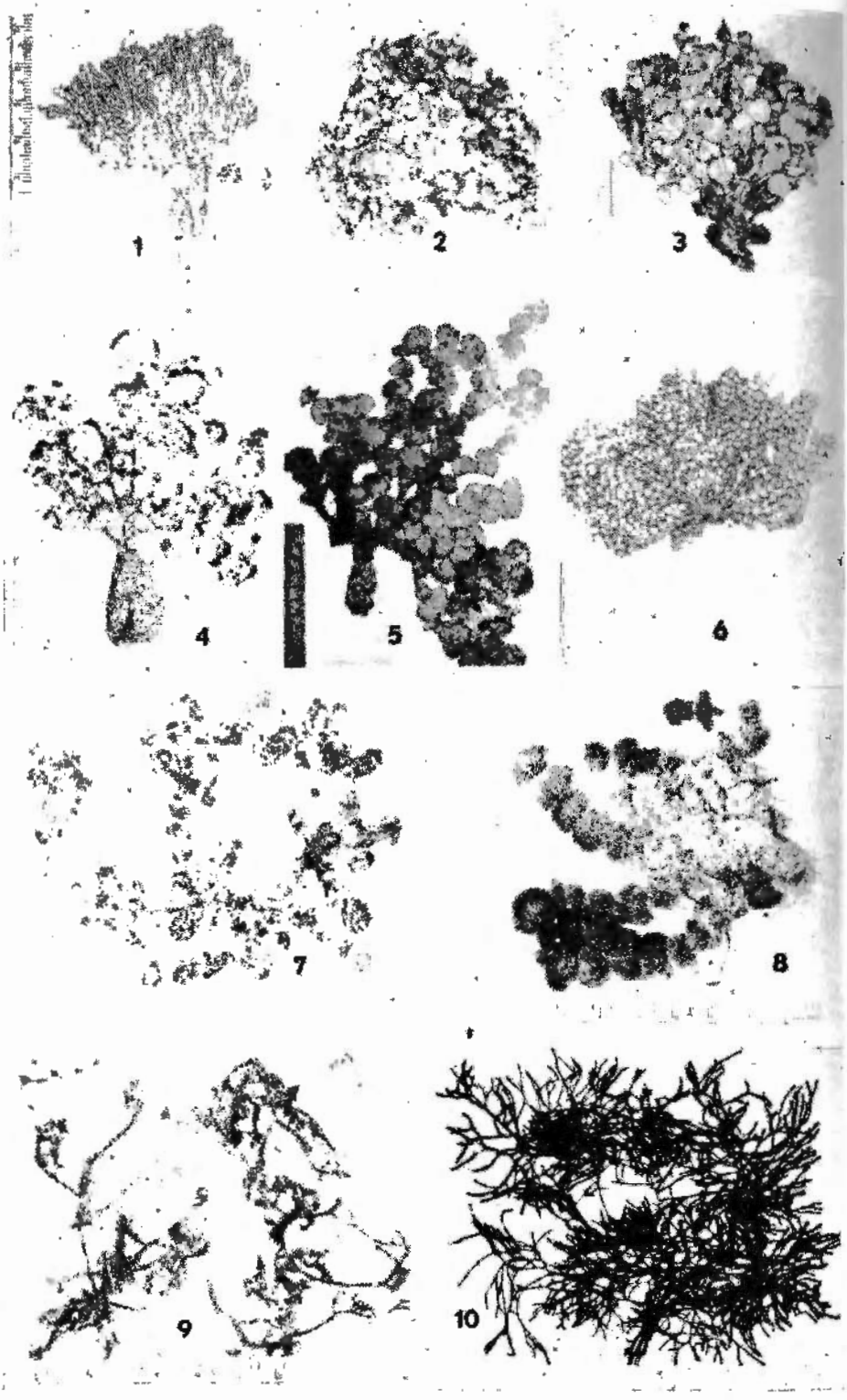
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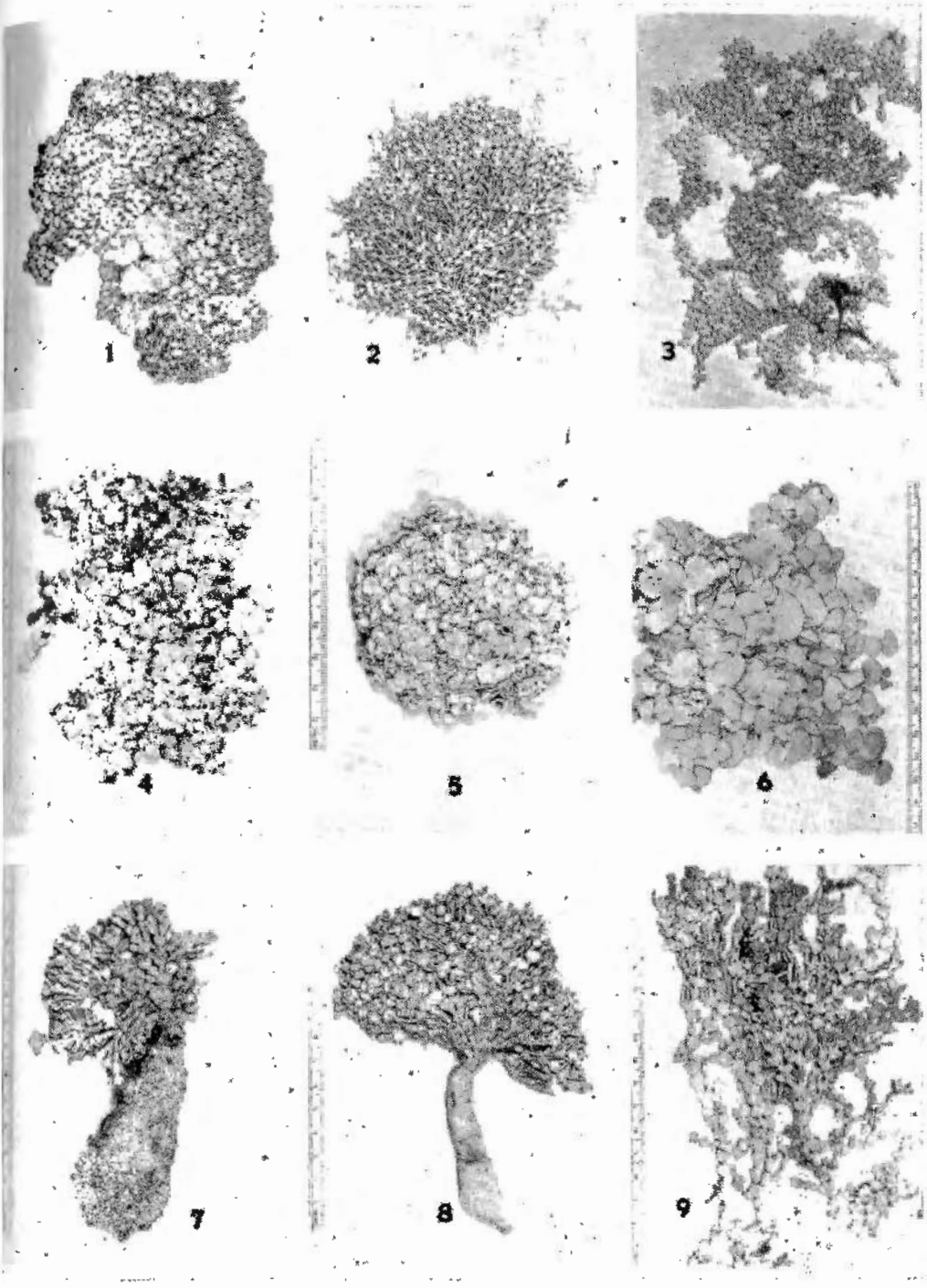
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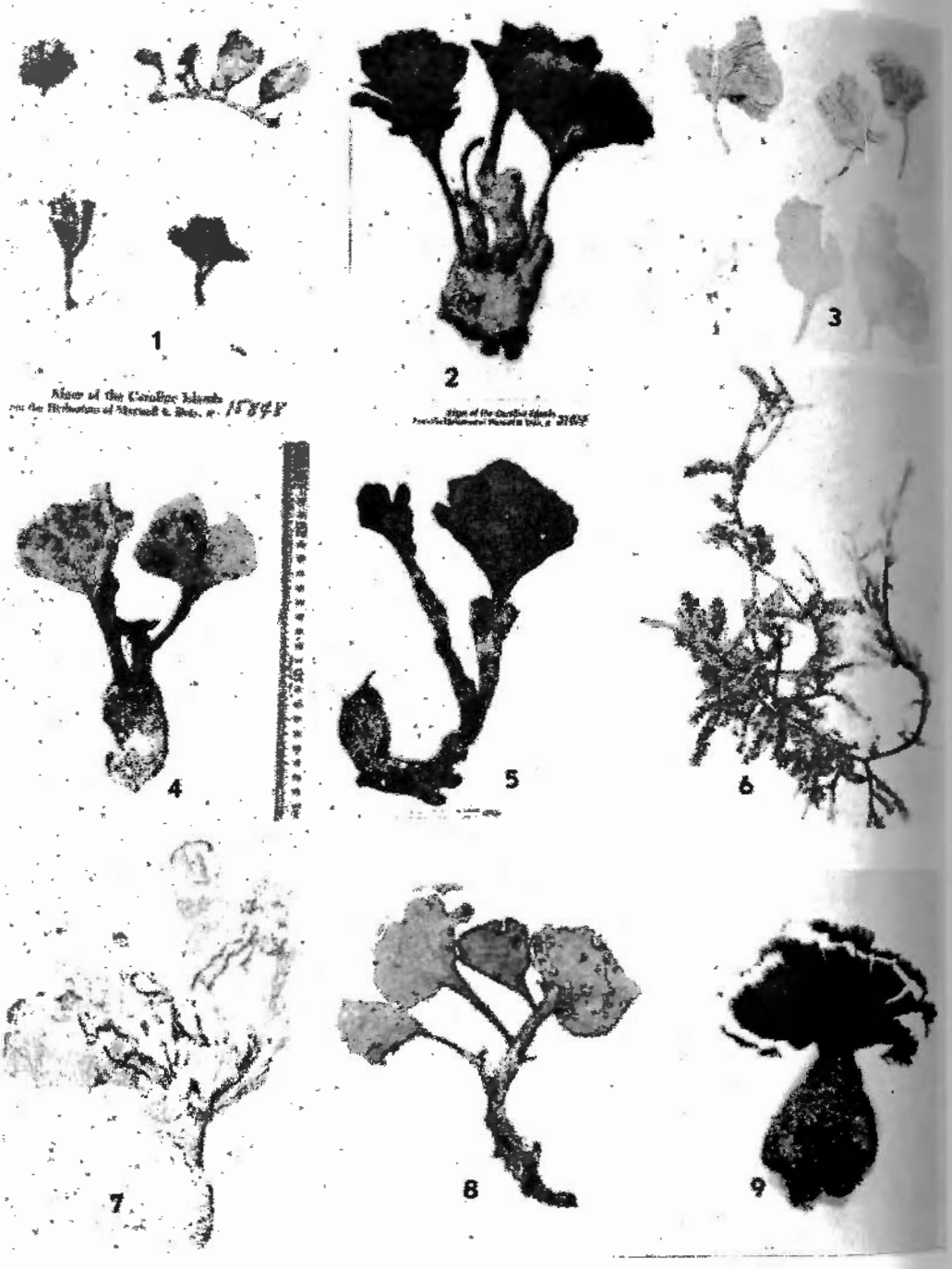
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