MARINE ALGAE COLLECTED FROM PENGHU (PESCADORES)

by

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Penghu is composed of about 64 islets, situated between Taiwan and the Chinese mainland and is about 40 kilometers west of Taiwan.

With regard to the marine algae of this area, only about 20 species had been reported in some fragmentary notes made by some Japanese algalogists.

In the summer of 1960 the writer spent a few days on some of these islands collecting marine algae. The present study is based on the writer's own collection in those days. It contains 26 species, one variety and two forms, but it does not include a few species whose plants were too young to be identified.

All specimens referred to in this paper are deposited in the Algae Herbarium of the National Taiwan University.

The writer wishes to thank the Department of Botany, National Taiwan University for financial support during this trip.

SYSTEMATIC LIST OF ALGAE

Cyanophyta

Key to the genera of the Cyanophyta of Penghu

1. Thallus sub-spherical, hollow.....*Brachytrichia*
1. Thallus filamentous, often intricated into an irregular mass .....*Lyngbya*

Rivulariaceae

Brachytrichia

1. **Brachytrichia Quoyi** (C. Ag.) Born. et Flah., in Ann. de Sci. Nat. 1886, 373; Okamura 1915, 3:137, pl. 133, figs. 14–17; Shen and Fan 1950, 1 (2–4):320.

Plate 1a

The thallus is sub-spherical, hollow, very rigid, and about 1.5 to 3.5 cm. in diameter. The surface of the frond is very irregularly crisped and usually appears intestine like. The specimens were found cast ashore.

Collected at: Tungliang (732).

Distr. Japan, Ryukyu, Taiwan, Penghu, Borneo, Ceylon, Both coasts of North America.

Oscillatoriaceae

Lyngbya

Key to the species

1. Trichomes about 31 μ in diameter, sheath very thin ..... *L. majuscula*
1. Trichomes about 17.5 μ in diameter, sheath thick (about 4 μ thick)..... *L. confervoides*

1. **Lyngbya majuscula** Gomont, 1893, p. 151, pl. 3, figs. 3-4; Dawson 1954, 3:380, fig. 3d; Chiang 1960, p. 54, fig. 1A.

   Collected at: Chihpei (733).

   Distr. Taiwan, Penghu, Vietnam.

2. **Lyngbya confervoides** Gomont 1893, p. 156, pl. 3, figs. 5-6; Dawson 1954, 3:380, fig. 3b-c; Chiang 1960, p. 56, fig. 1B.

   Only a small mat of specimens was found mingled with *L. majuscula*. Trichomes are about 17.5 μ in diameter, sheath about 4 μ in thickness, color bluish-green.

   Collected at: Chihpei (734).

   Distr. Taiwan, Penghu, Vietnam.

Chlorophyta

Key to the genera of the Chlorophyta of Penghu

1. Thallus thickly calcified; flat ..... *Halimeda*
1. Thallus uncalcified..... 2.
2. Thallus expanded, membranous..... *Ulva*
2. Thallus filamentous or tubular ..... 3.
3. Thallus tubular, cell very large, nonseptate..... *Boergesenia*
3. Thallus filamentous ..... 4.
4. Filament composed of many cells..... 5.
4. Filament coenocytic..... 6.
5. Cells short united to each other to form a reticulum..... 7.
5. Cells not united to each other but intricated into an irregular mass ..... 8.
6. Thallus erect, almost pinnately branched ..... *Bryopsis*
6. Thalus with a rhizoid-bearing prostrate part and a branched erect part ..... *Caulerpa*
7. Thallus spongy..... *Boodlea*
7. Thallus flat..... *Microdictyon*
8. Filaments forming a surface layer of swollen utricles ..... *Codium*
8. Filaments in a mat-shape, cells very long..... *Cladophoropsis*

Ulvaceae

Ulva

1. **Ulva conglobata** Kjellm., Mar. Chlor. Jap. 1897, p. 10, pl. 2, figs. 1-3, pl. 3, figs. 9-14; Shen and Fan 1950, 1 (2-4):321; Chiang 1960, p. 57.

The specimens at hand are very similar to those collected from Northern Taiwan in every characteristic.

Collected at: Chihpei (735), Tungliang (729).

Distr. Japan, Taiwan, Penghu.

Siphonocladaceae

Boergesenia

1. **Boergesenia Forbesii** (Harv.) Feldmann, Rev. Gen. de Bot. 1938, p. 588, figs. 3–5; Yamada 1950, p. 174; Dawson 1954, 3:388, fig. 8d.

Valonia Forbesii Harv., Alg. Ceylon exsic. no. 75, Char. of new alg. etc. 1859, p. 333; Shen and Fan 1950, 1 (2–4):322.

Fig. I 1, 2

The plants were found growing on the sand covered rocks in the middle littoral belt.

Collected at: Hsiaomen (728).

Distr. Ryukyu, Taiwan, Penghu, New Guinea.

Boodleaceae

Boodlea

1. **Boodlea siamensis** Reinb. Bot. Tidsk 1901, p. 107; Okamura 1936, p. 38; Shen and Fan 1950, 1 (2–4):322.

With very large axis (sometimes reachcs 230 μ in diameter) and very irregular length of cells, our specimens are in close agreement with this species.

Collected at: Chihpei (736).

Distr. Ryukyu, Taiwan, Penghu, Malay Archipelago, Red Sea.

Cladophoropsis

1. **Cladophoropsis Zollingeri** (Kütz.) Börg., Cont. Connais. Gen. Siphonocladus 1905, p. 288; Yamada 1944, 3:11; Chiang 1960, p. 61, fig. 1F.

Cladophoropsis fasciculata Okam. (non Börg.) Icon. Jap. alg. 1921, 4:75, pl. 165, figs. 1–7; Yamada 1925, 39:85.

Collected at: Chihpei (738).

Distr. Japan, Ryukyu, Taiwan, Penghu, Malay Archipelago.

Anadyomenaceae

Microdictyon

1. **Microdictyon japonicum** Setch. Calif. Publ. Bot. 1929, 14:553; Okamura 1936, p. 40, fig. 19; Shen and Fan 1950, 1 (2–4):323.

Rhipidiphyllon reticulatum (non Heydr.) Okam. Illustr. Jap. alg. 1902, 1:91, pl. 30.

Fig. I 3, 4

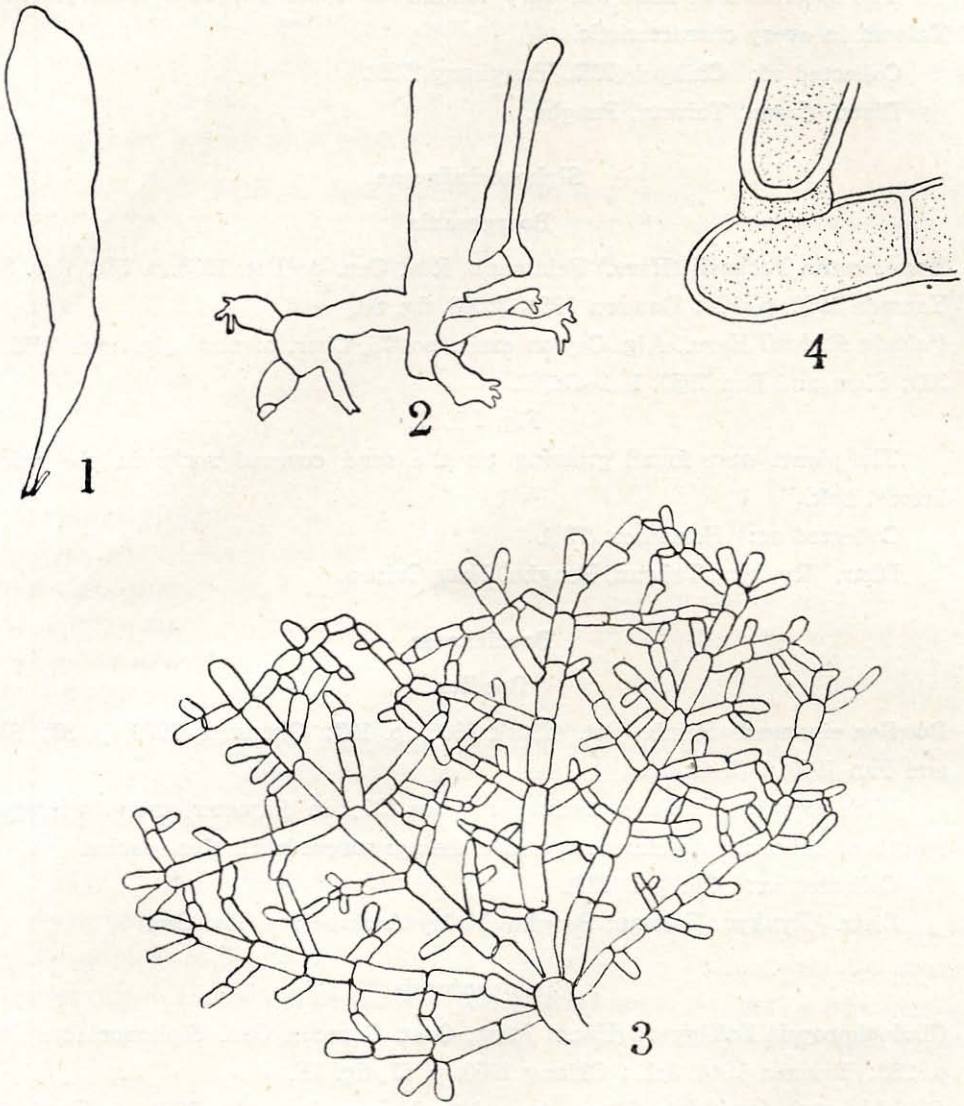

Fig. I. 1-2, *Boergesenia Forbesii* (Harv.) Feldmann: 1, Habit, ×2; 2. The rhizoidal base, ×30; 3-4, *Microdictyon japonicum* Setch.: 3, A portion of a thallus, ×48; 4, Detail of a hapteron, ×430.

Only a small specimen (about 1.5 cm. high) was found growing on a branch of *Galaxaura clavigera* Kjellm.

In habit, in length of the cell and the shape of hapteron, our specimen agrees with the description given by Okamura. But in our plant the diameter of the cells never exceeds 108 μ even in the lower portion of main axis.

Collected at: Chihpei (737).

Distr. Japan, Taiwan, Penghu.

Bryopsidaceae

Bryopsis

1. **Bryopsis indica** A. et E. S. Gepp., in Transac. Linn. Soc. London 1908, 7:169, pl. 22, figs. 10–11; Yamada 1934, p. 61, fig. 30; Chiang 1960, p. 65.

Though only a few specimens were collected, they agree with those collected from Northern Taiwan in many characteristics with the exception of smaller height (about 1 cm.) and that the branchlets sometimes divide again.

Collected at: Hsiaomen (724).

Distr. Ryukyu, Taiwan, Penghu, Malay Archipelago.

Caulerpaceae

Caulerpa

Key to the species

1. Ultimate branchlets peltate, with a flat tip.....*C. peltata* var. *typica*
1. Ultimate branchlets round.....*C. racemosa* var. *clavifera* f. *macrophysa*

1. **Caulerpa peltata** (Lam.) Web. v. Bos. var. **typica** Web. v. Bos., Monogr. des Caulerpa 1898, p. 375; Chiang 1960, p. 66.

A few young plants were found growing with other algae.

Collected at: Chihpei (741).

Distr. Widely distributed in most warm seas.

2 **Caulerpa racemosa** Web. V. Bos. var. **clavifera** f. **macrophysa** Web. v. Bos., Monogr. des Caulerpa 1898, p. 361, pl. 33, figs. 1–5; Okamura 1913, 3: 66, pl. 119, fig. 1; Okamura 1931, p. 102 Yamada 1934, p. 71.

Fucus clavifera Turner. Fuci. 1808, 1:126, pl. 57.

Caulerpa clavifera C. Agardh, Spec. alg., 1823, 1:437.

Fig. II 1

I found the present form in a shallow sandy bottom growing with other algae.

The diameter of the ultimate branchlets in our specimens is about 2–4 mm. wide, though Okamura reported that it as about 3–5 mm.

Collected at: Chihpei (740).

Distr. Ryukyu, Taiwan, Penghu, India Ocean, Red Sea, Java.

Codiaceae

Halimeda

1. **Halimeda Opuntia** Lam. f. **intermedia** Yamada, Mar. Chlorophy. Ryukyu 1934, p. 81, figs. 50–51.

Fig. II 2

Our specimens prove to be this form judging from the filaments in the central strand and the slightly cordate bases of some joints.

I found this species growing on a sandy bottom among rocks, near the middle littoral zone.

Collected at: Schaumen (725).

Distr. Ryukyu, Penghu.

Codium

Key to the species

1. Plant body compressed or flat ..... *C. adhaerens*
1. Plant body at least partly cylindrical, dichotomously branched..... *C. intricatum*

1. **Codium adhaerens** (Cabr.) C. Ag., Spec. Alg. 1882, 1:457; Okamura 1915, 3:140, pl. 134, figs. 1–3; Yamada 1934, p. 76, fig. 45; Chiang 1960, p. 66, fig. 2G.
Agardhia adhaerens Cabrera, in phys. Sällsk. Arsber.

The specimens at hand show the similarity of the plants from the Pescadores with our Taiwan specimens, except the former are fertile.

The plants adhere tightly to the surfy rocks on the sandy bottom and grows with *C. intricatum*.

Collected at: Schaumen (726).

Distr. Very widely distributed throughout the world.

2. **Codium intricatum** Okamura, Icon. Japan. alg., 1913, 3:74, pl. 120, figs. 9–13; Yamada 1934, p. 79, fig. 48.

Fig. II 3

Though our specimens show very close relations with this species by their habit and the shape of the utricles, I consider them as a form of *C. intricatum* Okam., as the utricles in our specimens are much smaller than those of Japanese and Ryukyu species described by Okamura and Yamada.

The largest utricles in our specimens measure about 170–240 μ in diameter and are 3 to 4 times as long as broad.

Collected at: Schaumen (727).

Distr. Japan, Ryukyu, Penghu.

Phaeophyta

Key to the genera of the Phaeophyta of Penghu

1. Thallus flat, membranous ..... *Padina*
1. Thallus clearly differentiated into stem, branches and leaf-like portions.....2.
2. Thallus with free vesicles, leaves flat ..... *Sargassum*
2. Thallus without free vesicles, leaves peltate. ..... *Turbinaria*

Dictyotaceae

Padina

Key to the species

1. Lower portion slightly covered with hairs, but hairs never borne on the middle portion; sporangia arising on every concentric line.....*P. minor*
1. Lower and middle portions usually thickly covered with hairs; sporangia arising on every other concentric line.....*P. australis*

1. **Padina minor** Yamada, in Bot. Mag. Tokyo 39:251, fig. 5, 1925; Shen and Fan 1950, 1 (2-4):328; Chiang 1960, p. 69.

Though only a few specimens were collected, they are in close agreement with our Taiwan specimens of this species in every characteristic.

Collected at: Chihpei (745).

Distr. Japan, Taiwan, Penghu.

2. **Padina australis** Hauck, in Hedwigia 1887, 26:44; Yamada 1925, 39:251; Okamura 1931, p. 103; Shen and Fan 1950, p. 328.

Plants are very large, about 7 to 6 cm. in height, from the lower portion up to the middle portion they are usually thickly covered with blackish brown hairs.

Plants grow abundantly and widely on the rocks or stones in the lower littoral belt.

Collected at: Chihpei (746), Makung (716).

Distr. Japan, Ryukyu, Taiwan, Penghu, Malay Archipelago, Australia.

Fucaceae

Turbinaria

Key to the species

1. Margin of the central cavity of the blade usually with rough teeth.....*T. ornata*
1. Margin of the central cavity of the blade not serrate .....*T. trialata*

1. **Turbinaria ornata** J. Ag., Sp. Alg. 1848, 1:266; Yamada 1925, 39:244; Shen and Fan 1950, 1 (2-4):329; Chiang 1960, p. 71.

Collected at: Makung (718), Chihpei (747).

Distr. Very widely distributed throughout the world.

2. **Turbinaria trialata** Kütz. ex Okamura Nippon Kaiso-si 1936, p. 313.

Plate 1b, Fig. II 4

Several fragments of dry specimens are at hand. They all appear to be abundantly branched, but some of the branches are broken off. Branches are about 5 to 14 cm. long. Leaves are small, about 3 to 6 and rarely up to 10 mm. in diameter, margins slightly or roughly serrate or rarely entire, petioles 3 to 8 mm. long, prism-like in shape, which usually develop up to the base of the leaf to form a vesicle.

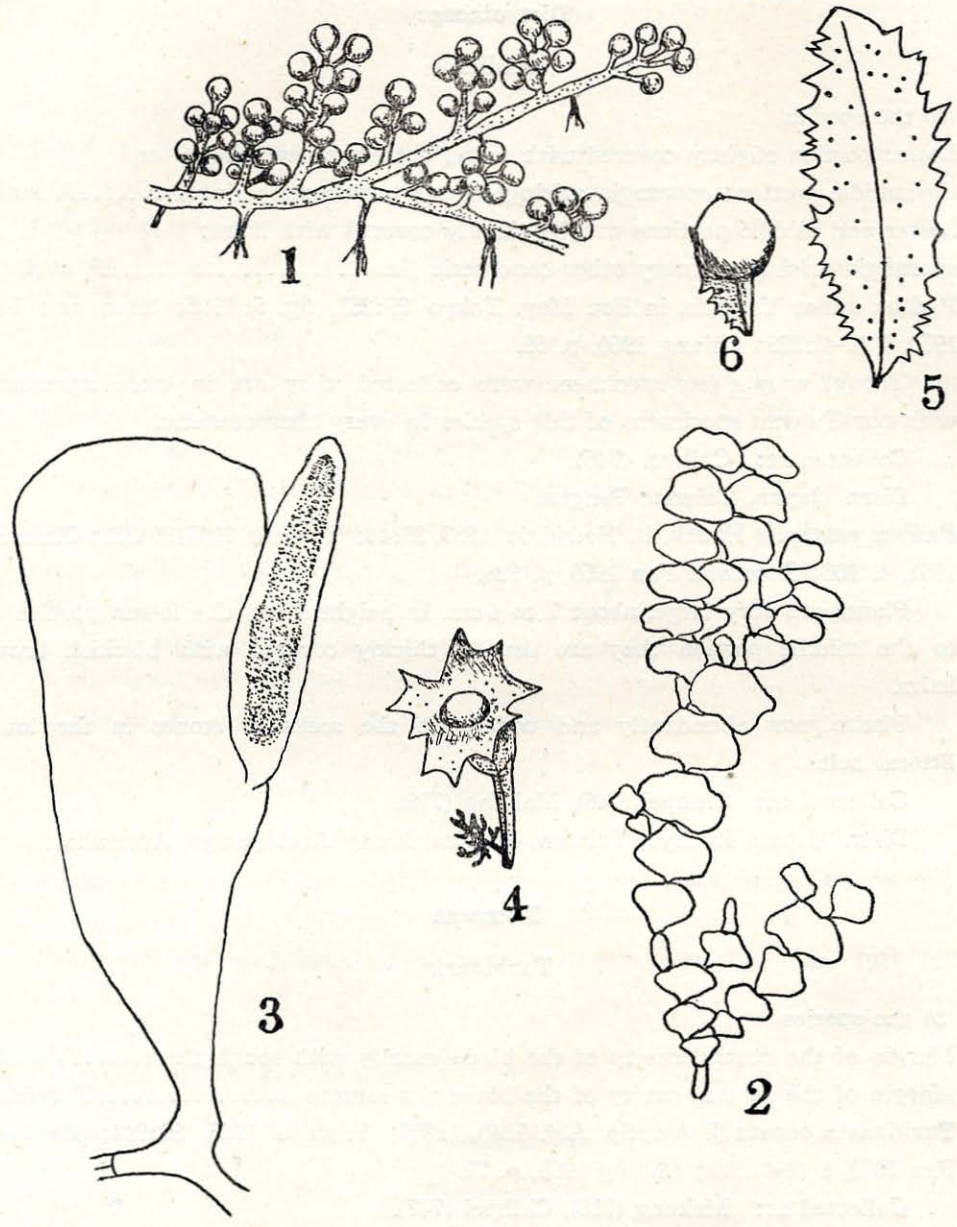

Fig. II. 1. *Caulerpa racemosa* Web. v. Bos. var. *clavifera* f. *macrophysa* Web. v. Bos.: Habit, ×1; 2, *Halimeda Opuntia* Lam. f. *intermedia* Yamada: A portion of a plant to show habit, ×1.5; 3, *Codium intricatum* Okam.: A utricle with a gametangium, ×180; 4, *Turbinaria trialata* Kütz.: A leaf with a receptacle, ×3; 5-6, *Sargassum* sp.: 5, Leaf, ×2; 6, Vesicle, ×1.5.

As mentioned above, our specimens are somewhat different from the descriptions of this species given by Okamura, in the habit of branches. So that more complete specimens and authentic specimens are needed for future study.

Collected at: Makung (719), Tungliang (731).

Distr. Ryukyu, Penghu, China Sea, Indian Ocean, Atlantic Ocean.

Sargassum

Key to the species

1. Branches cylindrical; vesicles round, small (1 to 3 mm. in diameter), with narrow stalk.....*S. crispifolium*
1. Branches flat; vesicles round, large (4 to 7 mm. in diameter), with broad and compressed stalk.....*S.* sp.

1. **Sargassum crispifolium** Yam., in Journ. Fac. Sci. Hokkaido Imp. Univ. 1931, 1 (2):72, pl. 20; Chiang 1960, p. 72, fig. 3D–F.

Sargassum Grevillei (non J. Ag.) Yendo, in Tokyo Bot. Mag. 1917, 31:195.

The specimens at hand agree well with our Taiwan specimens of this alga.

Collected at: Makung (717).

Distr. Japan, Taiwan, Penghu.

2. **Sargassum** sp.

Plate II, Fig. II 5, 6

These plants grow abundantly on rocks or shells in the littoral belt.

Collected at: Tungliang (730), Chihpei (749).

Rhodophyta

Key to the genera of the Rhodophyta of Penghu

1. Thallus completely or partially calcified.....2.
1. Thallus uncalcified.....4.
2. Thallus erect, jointed.....*Jania*
2. Thallus erect, at least in part, not jointed.....3.
3. Thallus erect, completely calcified .....*Galaxura*
3. Thallus has erect portion and flat portion, only the lower portion calcified.....*Peyssonnelia*
4. Thallus composed of cells throughout .....5.
4. Thallus composed of cells and rhizoidal filaments, cystocarps unilocular.....*Pterocladia*
5. Thallus erect .....6.
5. Thallus prostrate .....7.
6. Thallus flat, membranous.....*Martensia*
6. Thallus filamentous, dichotomously branched.....*Centroceras*
7. Thallus with clear indeterminate branches and determinate branches.....*Herposiphonia*
7. Determinate branches and indeterminate branches not clearly distinct; main axis bearing membranous, leaf like blades.....*Leveillea*

Chaetangiaceae

Galaxaura

Key to the species

1. Blade compressed; assimilating filaments long elliptical.....*G. clavigera*
1. Blade cylindrical; assimilating filaments wanting.....*G. fastigiata*

1. **Galaxaura clavigera** Kjellm., Floride-slaegtet Galaxaura 1900, p. 76, t. 13, t. 20, fig. 25; Tanaka 1936, 1:163, pl. 41, fig. 1, text-figs. 28–29; Shen and Fan 1950, 1 (2–4):333.

   Collected at: Makung (720).

   Distr. Japan, Ryukyu, Taiwan, Penghu, Indian Ocean, Malay Archipelago.

2. **Galaxaura fastigiata** Decaisne, Sur les Corallines 1842, p. 16; Tanaka 1936, 1: 157, pl. 37, fig. 2; Shen and Fan 1950, 1 (2–4):333.

   Our specimens agree well with the illustrations of this alga given by Tanaka, both in the external appearance and internal characters, of which the assimilating layer consists of loosely arranged moniliform cells and these are encrusted with lime.

   The plants grow on rocks in the lower littoral belt.

   Collected at: Chihpei (752).

   Distr. Japan, Ryukyu, Taiwan, Penghu, Philippine, Red Sea, Polynesia.

Gelidiaceae

Pterocladia

1. **Pterocladia tenuis** Okam., Gelid. Pterocl. Jap. 1934, p. 62, pl. 29, 30, fig. 3, pl. 33, figs. 1–3; Fan 1951, (2):18, pl. 5, fig. 3.

   Pterocladia capillacea Okam. (non Born. et Thur.), Icon. Jap. alg. 1913, 3:5, pl. 115.

   Collected at: Chihpei (753).

   Distr. Japan, Taiwan, Penghu.

Squamariaceae

Peyssonnelia

1. **Peyssonnelia distenta** (Harv.) Yam. Journ. Fac. Sci. Hokkaido Imp. Univ. 1930, 1:25, pl. 6; Shen and Fan 1950, 1 (2–4):335.

   Peyssonnelia involvens (non Zanard.) Okam., Icon. Jap. alg. 1907, 2:27, pl. 57, figs. 11–17.

   The specimens are sub-cylindrical and tubular, and irregularly and dichotomously branched.

   Collected at: Makung (721), Chihpei (750).

   Distr. Japan, Taiwan, Penghu.

Corallinaceae

Jania

1. **Jania adhaerens** Lamour., Polyp. Coral. 270; Okamura 1936, p. 529; Shen and Fan 1950, 1 (244):336.

Corallina adhaerens Kütz., Tab. Phyc. 8:t. 83.

Only a large mass of specimens was collected. Plants are irregularly and dichotomously branched, branches patent or sometimes acute, intricate and usually attached to each other with a disc. Internodes are 70 to 120 μ in diameter and about 3 to 6 times as long as diameter.

Collected at: Makung (722).

Distr. Japan, Ryukyu, Taiwan, Penghu, Red Sea, Medit. Sea.

Ceramiaceae

Centroceras

1. **Centroceras clavulatum** (Ag.) Mont., Explor. Sc. l'Algerie, Algues 1846, p. 140; Okamura 1936, p. 743, fig. 355; Shen and Fan 1950, 1 (2-4):342.

Some small sterile plants were found growing on the thallus of *Martensia flabelliformis*.

Collected at: Chihpei (754).

Distr. Japan, Korea, Taiwan, Penghu.

Delesseriaceae

Martensia

1. **Martensia flabelliformis** Harv., List Friendly Isl. Alg. no. 11; Shen and Fan 1950, 1 (2-4):342.

Many small (not exceeding 1 cm. in height), young plants grow on coral rocks or on other algae in the lower littoral belt. The plants have short stems with which they are attached on other things.

Collected at: Chihpei (743).

Distr. Ryukyu, Taiwan, Penghu.

Rhodomelaceae

Herposiphonia

1. **Herposiphonia** sp.

Some young plants were found growing on other algae in the lower littoral belt. In habit, they are very close to *H. secunda* (Ag.) Näg. They usually have one or two nodes between the first determinate branch and the second indeterminate branch, from which no branches are produced. But for want of authentic

specimens with which to compare ours. I think it best to await future study before giving a definite determination.

Collected at: Chihpei (755).

Leveillea

1. **Leveillea jungermannioides** (Mart. et Hering) Harv., Mar. Bot. West. Aust. 1855, p. 539; Okamura 1912, 2:148, pl. 92, figs. 18–27.

Polyzonia jungermanniolides Zanard. Alg. Mar. Rubr. 1858, p. 47.

In comparing our plant with the figures illustrated by Okamura the distance between two adjacent laminae seems farther apart in ours than in Okamura's plant.

The plant grows creeping on other algae.

Collected at: Chihpei (744).

Distr. Japan, Ryukyu, Taiwan, Penghu, Indian Ocean, Red Sea, Australia.

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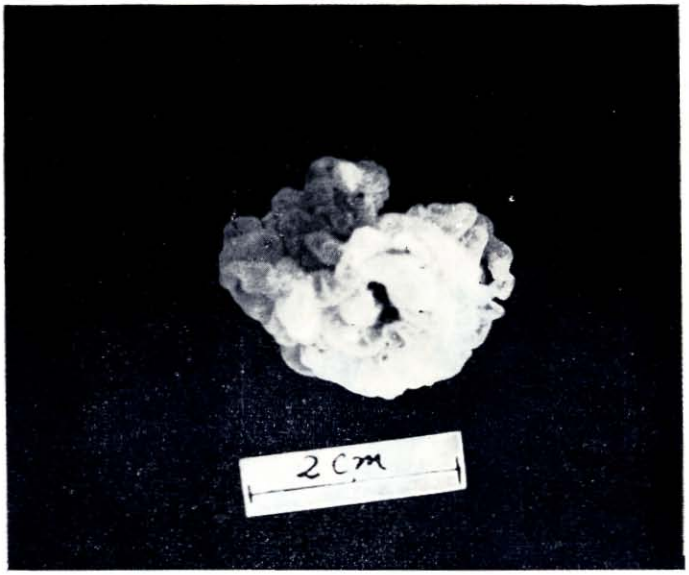

a. *Brachytrichia Quoyi* (C. Ag.) Born. et Flab.

b. *Turbinaria trialata* Kütz.

Sargassum sp.