MARINE ALGAE OF THE KURILE ISLANDS. II

By

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RHODOPHYCEAE

Subclass I. BANGIALES

Family 1. *Bangiaceae*

Key to the genera

I. Fronds filamentous, consisting of a row of cells, arranged immersed within the tender gelatinous matrix, without any typical rhizoidal cells as holdfast ..... *Goniotrichum* (1)

II. Fronds expanded, membranaceous or rarely subcoriaceous, consisting of 1 or 2 layers of cells (mono- or distromatic), arranged immersed within the stiff, lamellose, gelatinous matrix with a bundle of rhizoidal cells, arising from the basal part of frond as holdfast ..... *Porphyra* (2)

Subfamily 1. *Goniotrichieae*

1. *Goniotrichum* KÜTZING, 1843

Goniotrichum Alsidii (ZANARDINI) HOWE

(Pl. IV, figs. 1, 2)

Mar. Alg. Peru, (1914), p. 75—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 12, fig. 5—TSENG, Mar. Alg. fr. Amoy, p. 32, pl. IV, fig. 15—OKAMURA, Mar. Alg Jap. p. 369, fig. 175—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 215, pl. XXVIII, fig. 1–4.

Bangia elegans CHAUVIN, in Mem. Soc. Linn. Norm. VI, (1838), p. 13—HARVEY, Phyc. Brit. III, pl. CCXLVI—ZANARDINI, Plant. in Mari Rubro, p. 87 (nomen nud.).

B. Alsidii ZANARDINI, Bibl. Ital. 96, (1839), p. 136.

Coniotrichum elegans ZANARDINI, Not. Cell. Mar. (1847), p. 69—HAUCK, Meeresalg. p. 518, fig. 233—ROSENVINGE, Mar. Alg. Denmark, I, p. 75, fig. 15, 16—DE TONI, Syll. Alg. V, p. 687.

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Fronds filamentous, attaching by elementary disc on other algae; ca. 3 mm. high, subdichotomously much branched, 30–45 μ thick in the lower branches and 15–24 μ in the upper ones; cells arranged in a row in the gelatinous matrix of the filaments, suboblong to short disc-shaped, 6–9 μ wide, 7.5–9 μ long or 10.5–12 μ wide, 3–4.5 μ long, containing star-shaped chromatophore and a central pyrenoid within it, lilac, sometimes faded to a feebly yellowish or gray color.

The specimens at hand appear to resemble more closely the Danish plant than the Peruvian in the height of the frond and its luxuriant branching.

Habitat and localities. Epiphytic on the fronds of other algae, e.g., *Chaetomorpha area, Rhodomela Larix,* etc.

S. Kuriles. Kunasiri Isl.—Tohutu, Tomari.

Distrib. Atlantic Ocean, Red Sea, S. America (Peru), China and Japan (Hokkaido and the Kuriles).

Subfamily 2. *Bangieae*

2. *Porphyra* AGARDH, 1824

Key to the species

I. Fronds monostromatic.
  A. Fronds membranaceous, less than 60 μ thick.
    1. Vegetative cells, in surface view of the frond, squarish with round angles ..... *P. umbilicalis* (1)
    2. Vegetative cells, in surface view of the frond, angular .... *P. pseudolinearis* (2)
  B. Fronds membranaceous, more than 60 μ thick .....*P. ochotensis* (3)

II. Fronds distromatic.
  A. Fronds plane.
    1. Fronds membranaceous.
      a. Fronds dioecious.
        i. Antheridial fronds, only, known; antheridia formed within the yellowish zone on the margin of frond..*P. occidentalis* (4)
        ii. Sporocarpic fronds, only, known; sporocarps scattered on the whole frond in variegate appearance.....*P. variegata* (5)
      b. Fronds monoecious or dioecious .....*P. amplissima* (6)
    2. Fronds subcoriaceous ..... *P. Tasa* (7)
  B. Fronds usually with an inflated, hollow portion.....*P. bulbopes* (8)

Subgenus 1. Euporphyra

1. *Porphyra umbilicalis* (L.) J. AGARDH

Till. Alg. Syst. VI, (1883), p. 66, Tab. II, fig. 61—BØRGESEN, Mar. Alg. Faeröes, p. 348—ROSENVINGE, Mar. Alg. Denmark, I, p. 60, pl. I, fig. 1–3—UEDA, Porphyra of Japan, p. 31, pl. I, fig. 10, 11, 15, pl. VII, fig. 6–16, pl. VIII, fig. 1 —NAGAI, Meeresalg. a. Kamtschatka, p. 17—TOKIDA, Mar. Alg. Robben Isl., (Suppl. Rept.), p. 18, pl. II—YAMADA, Mar. Alg. Urup, p. 21 pl. VII—OKAMURA, Mar. Alg. Jap. p. 388—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 207.

Ulva umbilicalis LINNAEUS, Sp. Plant. ed. 2, (1753), p. 1633.

Porphyra laciniata var. *umbilicalis* AGARDH, Icon. Alg. Eur. (1828–35), Tab. XXVI.

P. laciniata THURET, in LE JOLIS Liste Alg. Mar. Cherbourg, (1863), p. 99.

Wildemania umbilicalis DE TONI, Syll. Alg. IV, 1, (1897), p. 20.

P. laciniata HUS, West Coast Porphyras, (1900), p. 62; Account Porphyra Pacific Coast N. Amer. p. 196.

Jap. name. Tisima-kuronori.

Key to the forms

I. Frond linear ..... f. *linearis*
II. Frond lanceolate, oblong-lanceolate or oblong.....f. *vulgaris*
III. Frond round or oblong-obovate when young, becoming expanded broadly above and much lobed into laciniae at maturity.....f. *laciniata*

f. *linearis* (GREVILLE) HARVEY

Phyc. Brit. II, (1849), pl. CCXI, fig. 2, 3—THURET, l.c. p. 99—ROSENVINGE, l.c. p. 60, pl. II, fig. 1–3—UEDA, l.c. p. 33, pl. XXI, fig. 1, 2.

Porphyra linearis GREVILLE, Alg. Brit. (1830), p. 170, Tab. XVIII—KÜTZING, Tab. Phyc. XIX, Tab. 79, fig. g–i.

Wildemania linearis DE TONI, l.c. (1897), p. 22.

f. *vulgaris* (AGARDH) THURET

in LE JOLIS Liste Alg. Mar. Cherbourg, (1863), p. 99—ROSENVINGE, l.c. p. 60.

Porphyra vulgaris AGARDH, Icon. Alg. Eur. (1828–35), Tab. XXVIII—GREVILLE, l.c. p. 169—HARVEY, l.c. pl. CCXI, fig. 1—KÜTZING, l.c. Tab. 82, fig. a, b.

Frond lanceolate, oblong-lanceolate or oblong, 15–38 cm. long, 4.5–17 cm. wide.

f. *laciniata* (LIGHTFOOT) THURET

in LE JOLIS Liste Alg. Mar. Cherbourg, (1863), p. 99—ROSENVINGE, l.c. p. 61, pl. I, fig. 2—UEDA, l.c. p. 33, pl. XX, fig. 1–3—TOKIDA, l.c. p. 19, pl. II—OKADA, Kaiso-zuhu, p. 87, pl. LXXXIV, fig. 2.

Ulva laciniata LIGHTFOOT, in Fl. Scotia, (1777), p. 974, Tab. XXXIII.

Porphyra laciniata AGARDH, Syst. Alg. (1824), p. 190; Icon. Alg. Eur. Tab. XXVII—GREVILLE, l.c. p. 168—HARVEY, l.c. pl. XCII—KÜTZING, l.c. Tab. 82, fig. c–e—HUS, Account of Porphyra, p. 196 (p.p.)—YENDO, Notes Alg. New to Jap. p. 127—OKAMURA, Nippon Sorui Meii, ed. 2, p. 8—SINOVA, Alg. Kamtschatka, p. 29.

P. laciniata f. *typica* KJELLMAN, Alg. Arct. Sea, (1883), p. 190.

Wildemania laciniata DE TONI, l.c. (1897), p. 20.

Up to the present, f. *vulgaris* has not been reported from Japan. However, in the writer's collection, there are some specimens that accord well with the descriptions of *Porphyra vulgaris* in general appearance. Most of the specimens, referable to the present form, are sterile, but some bear antheridia. In the latter specimens, the antheridia are formed within narrow, yellowish zones on the margin of the middle to upper part of the frond. However the antheridia do not become mature. They are divided into 128 antherozoids according to the formula, $128\left(\frac{a}{4},\frac{b}{4},\frac{c}{8}\right)$, as ascertained respectively by HUS and by UEDA. In other specimens, however, the fronds are divided by a longitudinal limiting line into two parts, distinguishing thereby the one half yellowish, and the another purple or purplish red color. From microscopical observations, the former yellowish part is known to be the antheridial area and the latter deep colored part the sporocarpic one. Such specimens are monoecious without doubt.

The specimens referable to f. *laciniata*, are round, ovate or sometimes oblong-obovate, being not laciniate when young. When matured, they expand broadly above, often becoming asymmetrical, in the monoecious plant, as the antheridial area becomes broken away sooner than the sporocarpic part. Such an appearance is also observed on this form and f. *linearis* by ROSENVINGE (Cfr. l.c. 1909, pl. I, fig. 1, pl. II, fig. 1) and on the latter form by UEDA (Cfr. l.c. 1932, pl. XXI, fig. b). The present alga becomes much undulate and folded on the surface of the frond by irregular development and sometimes is divided into several laciniae above. The base of the frond, though rounded when young, becomes cordate or even um-

bilicate at maturity. As to the reproductive bodies, ROSENVINGE and UEDA describe them respectively in detail. The sporocarps, in the writer's specimens, are observed to be divided into 32 carpospores according to the formula, $32\left(\frac{a}{4},\frac{b}{2},\frac{c}{4}\right)$, as ascertained by UEDA in his plant. As to the antherozoids, he described them as 128 or 256 in number, according to the formula, $128\left(\frac{a}{4},\frac{b}{4},\frac{c}{8}\right)$ or $256\left(\frac{a}{4},\frac{b}{4},\frac{c}{16}\right)$. In the writer's specimens, however, only 128 antherozoids are counted in an antheridium.

Habitat and localities. Forma *linearis* and f. *vulgaris* growing on rocks gregariously in the highest part of the sublittoral zone, facing to the surf.

f. *linearis*.

M. Kuriles. Usisiru Isl.—Minamizima. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Tosirari, Sibetoro. Kunasiri Isl.—Tinomizi.

f. *vulgaris*.

N. Kuriles. Paramusiru Isl.—Kakumabetu.

M. Kuriles. Usisiru Isl.—Minamizima. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Tokotan, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Iriribusi, Sibetoro, Rubetu, Kamuikotan. Sikotan Isl.—Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Tohutu.

Forma *laciniata* growing on rocks, stones or sometimes on the fronds of other algae in the littoral zone.

N. Kuriles. Araido Isl.—Minami-ura. Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Titose-wan, Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Misima, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Iriribusi, Sibetoro, Arimoe, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan, Anama, Aimizaki, Notoro. Kunasiri Isl. —Tohutu.

Distrib. *Sp.*—North Atlantic Ocean, Arctic Ocean, Alaska, Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles); f. *linearis*—Atlantic Ocean and Japan (Hokkaido, Saghalien and the Kuriles); f. *vulgaris*—Atlantic Ocean and Japan (the Kuriles); f. *laciniata*—Atlantic Ocean, Arctic Ocean, Alaska, Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Porphyra pseudolinearis* UEDA

Porphyra of Japan, (1932), p. 29, pl. I, fig. 6, pl. VI, fig. 17, 18, pl. VII, fig. 1–5, pl. XIX—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 15—YAMADA, Mar. Alg. Urup, p. 20—OKAMURA, Mar. Alg. Jap. p. 387—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 207.

Jap. name. Uppurui-nori.

The present writer has obtained some specimens, referable to the present species. These specimens resemble well *P. umbilicalis* f. *linearis* HARV. in its linear frond, but they differ from the latter in having angular and irregularly arranged cells in surface view. The frond of the present species is also more lustrous than that of the latter species, as far as the writer's observations show.

Habitat and localities. Growing on rocks in the lower littoral zone, exposed to surf.

M. Kuriles. Uruppu Isl.—Iema (YAMADA).
S. Kuriles. Etorohu Isl.—Moyoro, Tikohai. Sikotan Isl.—Tiboi, Aimizaki.

Distrib. Japan (Korea, Honsyu, Hokkaido and the Kuriles).

3. *Porphyra ochotensis* NAGAI, sp. nov.

(Pl. IV, figs. 3–8; pl. VI, figs. 1, 2)

Porphyra perforata UEDA (not J. AGARDH), Porphyra of Japan, (1932), p. 26, pl. V, fig. 15–17, pl. XVII, fig. 3, 4—TOKIDA, Mar. Alg. Robben Isl. p. 11, fig. 3—YAMADA, Mar. Alg. N. Kuriles, p. 347; Mar. Alg. Urup, p. 21—OKAMURA, Mar. Alg. Jap. p. 386—KAWABATA, List Mar Alg. Isl. Shikotan, p. 207.

Jap. name. Ana-amanori.

Planta rupicola, dioica vel raro monoica; fronde membranacea, monostromatica, nonnunquam perforata, breve stipitata, linearivel ovato-lanceolata, non raro in 2–5 lobatas laciniata, marginibus undulatis, fere 60–100 μ crassa, 20–40–70 cm., raro usque 115 cm. longa, 10–40 cm., raro usque 50 cm. lata, rubripurpurea, saepe ex parte olivacea, sensim basi juvenili rotunda et mature cordata vel umbilicata; cellis vegetativis a facie visis subquadratis vel ellipticis, plus minus regulariter dispositis, in sectione thalli transversa oblongis; parte gelatinosa sub superficie frondis 1/4–1/6 totius crassitudinis; antheridiis ad margine frondis in plus minus irregulares luteolos pannos extendentibus; spermatiis a facie visis quaternis quadrigeminatis, in sectione transversa octonis quadriplicatis;

sporocarpiis ad margine frondis in irregulares rubripurpureos pannos extendentibus, carposporis a facie visis rotundato-quadratis duabus quadrigeminatis, in sectione transversa quaternis duplicatis.

The present species is linear-lanceolate to ovate-lanceolate, and in the latter case often laciniate into two to five lobes. The fronds are monostromatic, perforate, deeply folded from the median line toward both sides and very undulate on the margins. They are rounded at the base when young, becoming later cordate or even umbilicate. They measure mostly 60 to 100 μ thick, mostly 20 to 70 cm. long and 10 to 40 cm. wide. The largest specimen that the present writer has obtained, attained to 115 cm. in length and 50 cm. in breadth at its broadest part. This specimen was collected in Paramusiru Isl. The fronds are reddish purple, sometimes also becoming partly olive brown when old.

The vegetative cells of the frond are quadrate with round angles or elliptic, and disposed in subregular order in surface view. The contents of the cells are oblong and 2 to 2.5 times as high as the breadth in cross section. The surface jelly of the frond is 1/4 to 1/6 as thick as the thickness of the frond. The present species is as a rule dioecious. According to TOKIDA, however, it is monoecious rarely. In the dioecious thallus, the antheridia are found within the yellowish irregular patches on the marginal region of the upper and middle part of the frond. Antheridium mother cells are at first divided by cruciate division perpendicular to the surface of the frond, followed continuously three times by the parallel and the second perpendicular divisions. An antheridium contains 128 antherozoids, arranged in four tiers of four each in surface view. The formula of the division corresponds to $128\left(\frac{a}{4},\frac{b}{4},\frac{c}{8}\right)$.

Sporocarpic patches are found on the marginal region of the different thalli. The patches are also irregular in outline as in the antheridial thallus, but usually larger than those in the latter case. Two divisions take place first at the same time or consecutively on the sporocarps. They happen cruciately with each other and perpendicularly to the surface. Subsequently the other divisions parallel to the surface, take place two times on these segments. Finally two divisions more, which are parallel to each other, take place in the direction perpendicular to the surface. There are sometimes observed such irregular divisions, that a part of the segments

are divided perpendicularly, and others parallelly or even obliquely to the surface, or there may be some changes in the order of the divisions. In the Kurile specimens, it is not rare that carpospores are found which have not yet completed the final parallel (to each other) and perpendicular divisions. In this case, the carpospores count 16 in number. On the completion, the carpospores are observed arranged in two tiers of four each in cross section, and in four tiers of two each in surface view. The formula of the division corresponds to $32\left(\frac{a}{2},\frac{b}{4},\frac{c}{4}\right)$.

The first record of the present species is that by TOKIDA in his "Marine Algae of Robben Island" under the name of *Porphyra linearis* which was later revised by the same author as *P. perforata* in accordance with the opinion of UEDA. UEDA, in his "Porphyra of Japan", determined TOKIDA's specimens as *P. perforata* J. AGARDH. YAMADA agreed with UEDA in determination of the specimens from the islands of Paramusiru and Uruppu in the Kuriles, without debate. It seems, however, very highly probable that the present alga occurring in the Kuriles and Saghalien, is not identifiable with *P. perforata* J. AG., because of the frequent occurrence of the dioecious thallus and the difference of the division mode of carpospores. As to the dioecism or monoecism, TOKIDA describes his plant to be usually dioecious and rarely monoecious. As the present writer asked him for information on this point, TOKIDA replied that he had found only once a monoecious plant which possesses a small antheridial patch among the sporocarpic area. YAMADA and UEDA respectively describe their plant as dioecious. As far as the writer's observations show, the specimens at hand are all dioecious. HUS studied minutely on the Californian specimens of *P. perforata* J. AG., of which the type locality is that coast. According to HUS, the sporocarps of *P. perforata* J. AG. are divided into 32 carpospores according to the formula, $32\left(\frac{a}{4},\frac{b}{4},\frac{c}{2}\right)$, but those of the writer's specimens are divided according to the formula, $32\left(\frac{a}{2},\frac{b}{4},\frac{c}{4}\right)$. Such a difference in the formula of division has already been pointed out by UEDA. As to this discrepancy, UEDA thinks that it might be caused in all probability by the unripened carpospores in HUS' specimens. Comparing with HUS' descriptions, the writer's specimens differ also from *P. perforata* f. *segregata* SETCH. et HUS in the dioecism and the

size of the fronds, as well as from the other form, f. *lanceolata* SETCH. et HUS in the shape of the fronds. Two specimens of *P. perforata* have been deposited in our Herbarium—one of them, the type form, collected by Prof. YAMADA in California; the another, f. *lanceolata* which was contributed from FARLOW's Herbarium to Prof. Emer. MIYABE. After careful examination of these specimens, the sporocarps of the Californian specimens became known to be divided after all according to the formula given by HUS. The present writer has come to the conclusion that the present alga should better be treated as a new species which is closely related to *P. perforata* J. AG.

Habitat and localities. Growing on rocks in the littoral zone.

N. Kuriles. Simusyu Isl.—Kataoka-wan, Numaziri (YAMADA). Paramusiru Isl.—Murakami-wan, Kurosaki, Kakumabetu.

M. Kuriles. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Misima, Tokotan, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Rubetsu. Sikotan Isl.—Aimizaki, Syakotan (KAWABATA).

Distrib. Japan (Saghalien and the Kuriles).

Subgenus 2. Diploderma

4. *Porphyra occidentalis* SETCHELL et HUS

(Pl. IV, figs. 9–12; pl. VI, fig. 3)

in HUS, Prelim. Notes West Coast Porphyras, (1900), p. 69; Account Porphyra Pacific Coast N. Amer. p. 228, pl. XXI, fig. 15a–17b—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 207.

Wildemania occidentalis DE TONI, Syll. Alg. VI, (1924), p. 13.

Jap. name. Kiiro-tasa.

Frond membranaceous, distromatic, lanceolate, slightly or sometimes much crenate on the margin, rarely slightly lobed, with cuneate base, shortly stipitate, 10–38 cm. long, 3–7 cm. wide, 48–63 μ thick in the vegetative part, slightly thicker (e.g. 84, 93 μ) in the antheridial part, light cerise, slightly lustrous; vegetative cells, subsquarish with round angles in surface view and also in cross section; surface jelly not very thick; dioecious; antheridia formed within yellowish narrow marginal zone of the upper part of the frond, containing

64 antherozoids after having divided according to the formula, $64\left(\frac{a}{4},\frac{b}{4},\frac{c}{4}\right)$; sporocarps unknown.

Several specimens from Simusyu Isl. are referable to the present species by their accordance with SETCHELL and HUS' description and illustrations in the external and internal features. In the South Kuriles, KAWABATA reported the present species from Sikotan Isl.

Habitat and localities. Growing on the fronds of *Corallina pilulifera,* in the littoral zone.

N. Kuriles. Simusyu Isl.—Tenzin-iwa.
S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. California and Japan (the Kuriles).

5. *Porphyra variegata* KJELLMAN

in HUS, Prelim. Notes West Coast Porphyras, (1900), p. 69; Account Pacific Coast N. Amer. p. 225, pl. XXI, fig. 18—UEDA, Porphyra of Japan, p. 38, pl. I, fig. 9, pl. IX, fig. 7, pl. X, fig. 1–3, pl. XXIII, fig. 2, pl. XXIV, fig. 1—OKAMURA, Mar. Alg. Jap. p. 391—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 207.

Diploderma variegatum KJELLMAN, Beringhafv. Algfl. (1889), p. 33, pl. II, fig. 1–4.

Wildemania variegata DE TONI, Syll. Alg. IV, 1, (1897), p. 23; VI, (1924), p. 13.

Jap. name. Huiri-tasa.

Frond membranaceous, distromatic, oblong-ovate to broad-lanceolate and unilaterally recurved, with rounded or cordate base, sessile, areolate, 9–18 cm. long, 3.5–8 cm. wide, ca. 100–220 μ thick, variegate, gloomy red; vegetative cells, in surface view angular with round corners, more or less regularly arranged, in cross section quadrate with round angles or slightly higher than broad; surface jelly thick; dioecious; sporocarps scattered over the whole frond, intermixed with vegetative cells, containing 16 carpospores each after having divided according to the formula, $16\left(\frac{a}{2},\frac{b}{2},\frac{c}{4}\right)$; antheridia unknown.

The specimens that the present writer has referred to the present species, are unilaterally recurved to take a large comma-shape, with rounded bases. They are often faded from their gloomy

red color in the upper outer part of the frond as a result of the collapse of the vegetative cells. In the young frond, there are found sometimes more or less larger, round cells which are intermingled among the small vegetative ones. These large cells are divided later, cruciately in surface view of the frond, dividing each then into four parts by divisions parallel to the surface. Thus there are observed sixteen carpospores in mature sporocarps. The maturation of the sporocarps does not proceed from a certain side evenly toward the opposite or inward, but occurs in every portion at random over the whole frond. Thus the sporocarps are formed intermixed among the vegetative cells. Such specimens take variegate appearance. The antheridial thallus has not been collected in the Kuriles by the writer. The occurrence of the present species in Hokkaido was ascertained by UEDA and it has also been obtained by the present writer in Aniwa Bay of Saghalien.

Habitat and localities. Epiphytic on the thallus of other plants, e.g., *Phyllospadix* sp., *Tichocarpus crinitus, Odonthalia corymbifera, Ptilota pectinata, Chondrus pinnulatus, Corallina pilulifera,* etc.

S. Kuriles. Sikotan Isl. (KAWABATA). Kunasiri Isl.—Rebun-iso, Tohutu.

Distrib. Bering Isl., Washington, California and Japan (Hokkaido, Saghalien and the Kuriles).

6. *Porphyra amplissima* (KJELLMAN) SETCHELL et HUS

in HUS, Prelim. Notes West Coast Porphyra, (1900), p. 67; Account Porphyras Pacific Coast N. Amer. p. 215, pl. XX, fig. 13a, 13b—UEDA, Porphyra of Japan, p. 40, pl. I, fig. 4, 9, pl. X, fig. 6, 7, pl. XI, fig. 1, 5, pl. XXIV, fig. 3—YAMADA, Mar. Alg. N. Kuriles, p. 347—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 19—OKAMURA, Mar. Alg. Jap. p. 392—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 207.

Diploderma amplissimum KJELLMAN, Alg. Arct. Sea, (1883), p. 188, pl. XVII, fig. 1–3, pl. XVIII, fig. 1–8.

D. amplissima f. *typica* FOSLIE, Contr. Mar. Alg. Norway, I, (1890), p. 56.

Wildemania amplissima FOSLIE, Contr. Mar. Alg. Norway, II, (1891), p. 14—DE TONI, Syll. Alg. IV, 1, p. 24; VI, p. 13.

Porphyra miniata f. *amplissima* ROSENVINGE, Grønl. Havalg. (1893), p. 827—BØRGESEN, Mar. Alg. Faeröes, p. 347.

Jap. name. Beni-tasa (UEDA), Akatasa or Benitasa (local name in Etorohu Isl.).

Frond membranaceous, distromatic, elliptic to ovate or ovate- to oblong-lanceolate, with broad-cuneate to round or cordate base, 60–152 μ thick, crimsonlake; vegetative cells, in surface view angular with round corners, in cross section squarish with round angles or slightly higher than broad; surface jelly rather thick; dioecious or monoecious; sporocarps and antheridia respectively intermixed with the vegetative cells on the whole frond, beginning to ripen at the marginal area, proceeding inward, sporocarps containing 8 carpospores each after having divided according to the formula, $8\left(\frac{a}{2},\frac{b}{2},\frac{c}{2}\right)$, antheridia containing 16 antherozoids each after having divided according to the formula, $16\left(\frac{a}{2},\frac{b}{2},\frac{c}{4}\right)$.

Key to the forms

I. Frond mostly 60–100 μ thick, rarely up to 120 μ.
  A. Frond elliptic to ovate ..... f. *elliptica*
  B. Frond ovate- to oblong-lanceolate ..... f. *lanceolata*
II. Frond 145–152 μ thick ..... f. *crassa*

f. *elliptica* NAGAI, f. nov.

Fronde elliptica, ovata, ad basin cordata vel rotunda, crebre et profunde undulato-plicata, 31–35 cm. longa, 25–35 cm. lata, 60–120 μ crassa.

f. *lanceolata* NAGAI, f. nov.

Fronde ovato-lanceolata vel oblongo-lanceolata, ad basin late cuneata, raro rotundata vel cordata, crebre et profunde undulato-plicata, 45–115 cm. longa, 15–26 cm. lata, 60–120μ crassa.

f. *crassa* KAWABATA

l.c. (1936), p. 208.

The present species is easily identifiable by the comparatively large, membranaceous, distromatic, red-purplish fronds and their internal features in the reproductive part. In the Kuriles, the present species was often found floating on the surface of the water, as stated by KJELLMAN and FOSLIE, but once was collected on the

rocks in a depth of about 3 to 5 feet at low tide at Aimizaki, Sikotan Isl. KJELLMAN describes the frond as being ovate-cordate, oblong-ovate or oblong-lanceolate. These variations in the shape are also observed in the Kurile specimens. The frond is inclined at its extremity on one side to become elliptic and on the other oblong-lanceolate. In both of the forms, *elliptica* and *lanceolata*, the frond is more or less densely undulate-plicate toward the median line. As to the thickness of the frond as well as the structure of the vegetative and reproductive cells, there are no differences between these forms. The thickness of the frond is mostly 60 to 100 μ, sometimes more than 100 μ, but rarely attaining 123 μ. Besides the above, there has been reported a thicker form, f. *crassa* by KAWABATA in Sikotan Isl. This form is described as having a frond, measuring 145 to 152 μ in thickness. The vegetative cells, in the writer's forms, are 18 to 36 μ diam. in the surface view of the frond and 27 to 33μ high, 15 to 21 μ wide in the cross section. The species is dioecious or monoecious. On the monoecious plant, the antheridia and sporocarps are observed being scattered by intermixing with each other over the whole frond, beginning to ripen at margin proceeding inward, as mentioned by KJELLMAN. The masses of the reproductive cells, thus scattered, are easily observable by means of the magnifying loupe, because they are more rich in purplish red color than the vegetative cells. The antherozoids count 16 in each antheridium and the carpospores 8 in each sporocarp.

Habitat and localities. Growing gregariously on rocks in the sublittoral zone.

N. Kuriles. Araido Isl.—Kuzira-wan. Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Titose-wan—Kurosaki, Kakumabetu (YAMADA).

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Uruppu Isl.—Misima.

S. Kuriles. Etorohu Isl.—Moyoro, Iriribusi, Tosirari, Sibetoro, Rubetu, Kamuikotan. Sikotan Isl.—Anama, Aimizaki, Tiboi. Kunasiri Isl.—Rebun-iso, Kuraoi.

f. *elliptica.*

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Uruppu Isl.—Misima.

S. Kuriles. Etorohu Isl.—Moyoro, Sibetoro, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan.

f. *lanceolata.*

N. Kuriles. Paramusiru Isl.—Suribati-wan, Titose-wan, Kurosaki.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Uruppu Isl.—Misima.

S. Kuriles. Etorohu Isl.—Iriribusi. Sikotan Isl.—Syakotan, Anama, Aimizaki, Tiboi.

f. *crassa.*

S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. *sp.*—Arctic Ocean, Alaska, Washington and Japan (Saghalien and the Kuriles); f. *elliptica*, f. *lanceolata* and f. *crassa*—endemic (the Kuriles).

7. *Porphyra Tasa* (YENDO) UEDA

(Pl. IV, figs. 13-20)

Porphyra of Japan, (1932), p. 35, pl. I, fig. 10, 16, pl. VIII, fig. 11, pl. IX, fig. 1-6, pl. XXII—YAMADA, Mar. Alg. N. Kuriles, p. 347; Mar. Alg. Urup, p. 21—OKAMURA, Mar. Alg. Jap. p. 390.

Wildemania Tasa YENDO, Nov. Alg. Jap. (1920), p. 3.

Jap. name. Tasa or Tasa-nori.

In the writer's collection, there is a number of specimens of a Porphyra—called 'Tasa or tasa-nori' by the inhabitants of Etorohu—which grows abundantly on the rocks in the upper littoral zone from the eastern coast of Etorohu northward to the North Kuriles. The alga is characteristic in having distromatic, rather thick, coriaceo-pergameous fronds. The fronds are sessile, simple, commonly longer than broad and slightly irregular in outline when young, becoming later expanded rather vigorously toward both lateral sides rather than upward. They are often divided deeply into irregular lobes and very perforate in the lower portion. As far as the writer's observation shows, the present species is dioecious. Antheridia and sporocarps are both formed respectively within distinct, narrow, marginal zones of the different thalli. The antheridial patches are yellowish, and the sporocarpic ones as a rule brownish red or dark purple, but rarely taking yellow hue added here and there with pink. Antheridium mother cells are at first divided into four parts by a cruciate division perpendicular to the surface of the frond. Subsequently divisions parallel to the surface take place thrice, followed twice by other perpendicular ones. After completion of the divisions, antherozoids, in cross section of the frond, are arranged in four tiers of eight each, and in surface view, in four tiers of four each.

The formula of the division corresponds to $128\left(\frac{a}{4},\frac{b}{4},\frac{c}{8}\right)$. Sporocarps are divided only by a cruciate division, perpendicular to the surface of the frond into four carpospores. The formula of the division corresponds to $4\left(\frac{a}{2},\frac{b}{2},\frac{c}{1}\right)$. Development of the carpospores in various stages was observed with interest. The carpospores, in cross section, are at immaturity oblong in shape and arranged in pairs. As the spores become mature, they germinate at their outer ends, and develop further proliferating through the surface jelly to lengths of 9 to 24 μ. The tubes measure about 9.5 μ diam. They are straight or sometimes curved, turned then slightly parallel to the surface of the frond. Although the present writer has not really seen the fertilization of carpospores with antherozoids, the observations on the later stages, lead him to the conclusion that these proliferated tubes may probably act as trichogynes. In some of the specimens at hand, carpospores are observed that might have already ended their fertilization. In these carpospores, the contents are present partly within the tubes while the greater part remains within the basal cells, taking oblong shape. In other cases, the external portion of the tubes is broken away from the frond, leaving the internal part within. The contents of these cells are stained pink on the outer half, and are not regularly arranged in pairs, but more or less singly in rows.

The specimens at hand, accord well with the descriptions of the present species, given respectively by YENDO and by UEDA in the essential characters except the dioecism. As to the structure of the antheridia, YENDO describes it: "antheridiis subflavis in margine frondis a carpogoniis atropurpureis introrsum pallescentibus limpidissime definientibus". UEDA gives nearly the same description as YENDO concerning it. The present writer failed to obtain any monoecious plant, but observed the internal features, in some specimens, somewhat similar to monoecious appearance. In such specimens, there are arranged many pairs of oblong cells in two rows. The cells are similar to the carpospores, but lacking in trichogyne-like tubes. They are commonly narrower than the carpospores with trichogyne-like tubes. Such cells, just mentioned, are often observed, partly intermixed with the antheridia near the yellowish antheridial zone. The writer is not able to decide at present whether these cell rows are young carpospores or antheridia that have just ended their

first cruciate division. The present species is sometimes harvested for food by the inhabitants of Etorohu Isl.

Habitat and localities. Growing abundantly on rocks in the upper littoral zone; in Kuraoi, Kunasiri Isl. cast ashore.

N. Kuriles. Araido Isl.—Sekinezaki, Minami-ura. Simusyu Isl.—Kataoka-wan, Tenzin-iwa. Paramusiru Isl.—Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Odomari, Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Musiru Islet. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima, Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan. Uruppu Isl.—Kobune, Misima, Tokotan, Zizonoma, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Hitokappu-wan, Wenbetu, Iriribusi. Sikotan Isl.—Aimizaki. Kunasiri Isl.—Kuraoi.

Distrib. Endemic (the Kuriles).

8. *Porphyra bulbopes* (YENDO) OKAMURA

(Pl. VI, fig. 4)

Nippon Sorui Meii, ed. 2, (1916), p. 7; Mar. Alg. Jap. p. 390—UEDA, Porphyra of Japan, p. 36, pl. XXIII, fig. 1.

Porphyra umbilicata var. *vulgaris α* RUPRECHT, Tange Och. Meeres, (1851), p. 394.

Wildemania bulbopes YENDO, Some New Alg. fr. Japan, (1913), p. 276, pl. XIII, fig. 1–9—DE TONI, Syll. Alg. VI, p. 13.

Jap. name. Hukuro-tasa.

Frond membranaceous, distromatic, simple, obovate or elliptic-ovate, usually having a single, round or ovate, inflated, hollow portion, with round base, shortly and broadly stipitate, reddish-purple, 1.5–7.2 cm. long, 1–4.8 cm. wide, ca. 70–80 μ thick; vegetative cells, in surface view elliptic or squarish with round angles, in cross section oblong with round angles; surface jelly thin; neither sporocarps nor antheridia found in the writer's specimens.

Although no reproductive organs were found, the writer's specimens were easily identified with the present species without doubt by the accordance of the external and internal features, especially by the presence of the peculiar inflation of the frond. YENDO describes the inflated part as being present at the basal portion of the frond. However in the writer's specimens, the part in question is observed not only in the base, but also in the center, margin or even in the apical portion of the frond. It appears

usually singly on each frond, measuring ca. 6 to 10 mm. diam. The stipe is short, rather wide and thick for the size of the frond, and cushion-shaped at the base.

Habitat and localities. Growing on stones in the upper sublittoral zone in Sikotan Isl.

N. Kuriles. Simusyu Isl. (YENDO).
M. Kuriles. Rasyuwa Isl.—Sonraku-wan. Ketoi Isl.—Minami-ura.
S. Kuriles. Sikotan Isl.—Aimizaki.

Distrib. Bering Isl. and Japan (the Kuriles).

Subclass II. FLORIDEAE

Order I. Nemalionales

Family 2. *Chantransiaceae*

3. *Rhodochorton* (NÄGELI, 1861) DREW, 1928

Key to the species

I. Plant having unicellular base; cells of the filaments swollen, doliiform.. ..... *R. moniliforme* (1)
II. Plant having multicellular base; cells of the filaments cylindrical .... *R. kurilense* (2)

1. *Rhodochorton moniliforme* (ROSENVINGE) DREW

(Pl. IV, figs. 21, 22)

Chantransia, Rhodochorton, and Acrochaetium, (1928), p. 164.

Chantransia moniliformis ROSENVINGE, Mar. Alg. Denmark, I, (1909), p. 99, fig. 28, 29—COLLINS, Mar. Alg. Vancouver Isl. p. 113—HOWE, Mar. Alg. Peru. p. 85—DE TONI, Syll. Alg. VI, p. 39.

Acrochaetium moniliforme BØRGESEN, Mar. Alg. Dan. West Indies, II, (1915), p. 22; Mar. Alg. Easter Isl. p. 271, fig. 17a—HAMEL, Floridees de France, V, p. 111; Acrochaetium et Rhodochorton, p. 174—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 227.

Plant minute, epiphytic, caespitose, 54–180 μ long; basal cell single, subglobose, giving rise to 2–3 or more erect or decumbent and ascending filaments; erect filaments simple, rarely branched; cells as long, to twice as long as broad, subglobose or doliiform, or wider in the upper half, 12–13.5 μ long, 9–12 μ wide; chromatophore stellate, with a single pyrenoid; hairs originally terminal, later pseudolateral,

27–54 μ long; monosporangia sessile, rarely pedicellate, terminal, lateral or often secund, occasionally opposite, oval, 10.5–12×7.5–9 μ.

The present species was easily identified by its small epiphytic thallus, of which the erect part is grown up from a single basal cell and consists of a row of swollen, doliiform cells. From the basal cell, there are observed sometimes some short filaments which are decumbent. The present species is related to *Acrochaetium crassipes* BØRG. but it differs from the latter in the slightly larger dimensions of the filament cells and also of the monosporangia.

Habitat and locality. Epiphytic on the fronds of *Sphacelaria subfusca* and *Chaetomorpha aerea.*

S. Kuriles. Kunasiri Isl.—Tomari.

Distrib. Atlantic Ocean, West Indies, S. America (Peru), Vancouver Isl: and Japan (the Kuriles).

2. *Rhodochorton kurilense* NAGAI, sp. nov.

(Pl. IV, figs. 23–28)

Planta epiphytica, ex filamentis erectis et filamentis repentibus constructa; filamentis erectis 165–450 μ altis, leviter ramosis, superne 4.5–6 μ, inferne 7.5–9 μ latis, ramulis brevibus, secundis vel lateralibus; cellulis cylindricis, 1.6–2.8-plo diametro longioribus; pilis longis hyalinis initio terminalibus, dein pseudolateralibus, 21–33 μ longis, ca. 2 μ latis; chromatophoris parietalibus, aliquando partim fenestratis, pyrenoidibus singularibus; sporangiis terminalibus, secundis vel raro oppositis, sessilibus vel pedicellatis, 1–2 sporalibus; monosporis ovatis 10.5–12×7–7.5 μ, bisporis oblongo-ovatis 13.5–22.5×7.5–9 μ.

The base of the plant consists of creeping filaments, forming a unistratose, somewhat irregular disc, on which erect filaments are caespitosely grown up. The filaments are originally developed from the two daughter cells of a somewhat large spore. The erect filaments are slightly branched, 4.5 to 6 μ wide in the upper parts, and 7.5 to 9 μ near the bases. The tips of the filaments are blunt, showing nearly as wide as the lower, continuing cells, but are converted occasionally into sporangia or rarely into hairs. The hairs are hyaline, and later formed pseudolaterally in the subapical portions of the erect filaments. They measure 21 to 33 μ long, and about 2 μ wide. The cells of the filaments are cylindrical and 1.6 to 2.8 times as

long as the diameter. The chromatophore is parietal, sometimes partly fenestrate, and contains a pyrenoid. The sporangia are formed terminally or secundly or rarely oppositely on the upper parts of the filaments. They are sessile or occasionally pedicellate. They are mostly monosporangia, but occasionally some of them are divided by a transverse wall into two spores. The monosporangia are oval, and measure 10.5 to 12 μ long, 7 to 7.5 μ wide. The sporangia, containing two spores, are oval or ovate-oblong or rarely slightly constricted at the middle part. They are 13.5 to 22.5 μ long, 7.5 to 9 μ wide. As is mentioned by DREW in *R. arcuatum* DREW and *R. densum* DREW, cells adjacent to the sporangia resembling sporangia both in shape and in the cell contents are also occasionally found in the species under consideration. He thinks that these are probably second sporangia which mature after the spores have been liberated from the upper ones.

The alga in question appears to be closely related to *Acrochaetium canariense* BØRG. in having an epiphytic thallus which is originally developed from the spore, consisting of two daughter cells. These species both have hairs. According to BØRGESEN, the latter species has many tetrasporangia, which are divided cruciately and also zonately. Unripened, two-celled ones are also recorded. In the writer's specimens, no tetrasporangia are found, but only two-celled sporangia occur. They appear to suggest the unripened stage of the tetrasporangia. In other respects, however, the present species differs from BØRGESEN's species in the terete shape of the cells of the erect filaments and in the somewhat larger and less broad sporangia. In determining the present species, the writer is much obliged to Mr. Y. NAKAMURA who is expert on the genus Rhodochorton and its allies in Japan.

Habitat and locality. Epiphytic on the fronds of *Chaetomorpha aerea*, in company with *R. moniliforme*.

S. Kuriles. Kunasiri Isl.—Tomari.

Distrib. Endemic (the Kuriles).

Order II. Cryptonemiales

Family 3. *Dumontiaceae*

Key to the genera

I. Fronds cylindrical or flattened, branched or unbranched, without differentiation into axils and blades.

A. Fronds cylindrical, slightly branched, hollow, partly compressed..... ..... *Dumontia* (4)

B. Fronds compressed.

1. Fronds narrow, much branched; branching lateral....*Farlowia* (5)
2. Fronds expanded, oblong-obovate with cuneate base, fleshy .... *Dilsea* (6)

II. Fronds differentiated into axils and blades; axil cylindrical, subdichotomously branched; blade orbicular, later splitting radially, connected with another by the axil in the center by proliferation.....*Constantinea* (7)

4. *Dumontia* (LAMOUROUX, 1813) J. AGARDH, 1852

Dumontia filiformis (FL. DAN.) GREVILLE

Alg. Brit. (1830), p. 165, Tab. XVII—HARVEY, Phyc. Brit. I, pl. LIX—KÜTZING, Sp. Alg. p. 718; Tab. Phyc. XVI, Tab. 81, fig. a–c—J. AGARDH, Sp. Alg. II, 2, p. 349; III, 1, (Epicr.), p. 257—KJELLMAN, Alg. Arct. Sea, p. 157; Beringhafv. Algfl. p. 30—OKAMURA, Nippon Sorui Meii, ed. 1, p. 92, ed. 2, p. 113; Icon. Jap. Alg. I, 4, p. 65, pl. XVI, fig. 1–8; Mar. Alg. Jap. p. 475, fig. 219—BØRGESEN, Mar. Alg. Faeröes Isl. p. 397—SETCHELL & GARDNER, Alg. N. W. Amer. p. 352—DE TONI, Syll. Alg. IV, 4, p. 1621; VI, p. 557—SETCHELL, *Dumontia filiformis*. pp. 33–37—SINOVA, Alg. Mer Ochtsk. p. 121; Alg. Kamtschatka, p. 39—INAGAKI, Red Mar. Alg. Osyoro Bay, Hokkaido, p. 26—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 20—YAMADA, Mar. Alg. Urup, p. 21—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 208.

Conferva filiformis FL. DAN. I, Tab. 1480, fig. 2.

Halymenia filiformis AGARDH, Sp. Alg. I, 2, (1822), p. 214.

Dumontia contorta RUPRECHT, Tange Och. Meeres, (1851), p. 295.

Jap. name. Ryumonso.

As far as the present writer's observation has shown, the tetrasporic plant is more delicate and slender than the cytocarpic one. In the former plant, the fronds are 0.6 to 4 mm., mostly 1 to 2 mm. in diameter, while in the latter plant they are 2 to 7 mm. in diamter in the main axis and 1.5 to 5 mm. in the branches. The present species is rather widely distributed in North Japan, being common in Hokkaido, Saghalien and the Kuriles.

Habitat and localities. Growing gregariously on rocks in sheltered places in tide-pools in the littoral zone.

N. Kuriles. Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kurosaki, Kakumabetu.

M. Kuriles. Harumukotan Isl.—Harumukotan-byoti. Musiru Islet. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Tokotan, Iema (KODAMA; YAMADA).

S. Kuriles. Etorohu Isl.—Iriribusi, Tosirari, Sibetoro, Rubetu. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Sibetoro, Nisiura.

Distrib. North Atlantic, Alaska, Bering Sea (Port Clarence ?), Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

5. *Farlowia* J. AGARDH, 1876

Key to the species

I. Frond rather regularly much disticho-pinnately branched.... *F. mollis* (1)
II. Frond dichotomously or irregularly or tri- to polychotomously branched, usually with fasciculate branchlets in the upper portions..*F. irregularia* (2)

1. *Farlowia mollis* (BAILEY et HARVEY) FARLOW et SETCHELL

COLLINS, HOLDEN & SETCHELL, Phyc. Bor.-Amer. Nos. 898, 1150—SETCHELL & GARDNER, Alg. N. W. Amer. p. 354—DE TONI, Syll. Alg. IV, 4, p. 1633; VI, p. 562—COLLINS, Mar. Alg. Vancouver Isl. p. 128—YENDO, Notes Alg. New to Jap. III, p. 115—OKAMURA, Nippon Sorui Meii, ed. 2, p. 114.

Gigartina mollis BAILEY et HARVEY, in Bot. Expl. Exped.—HARVEY, Ner. Bor.-Amer. II, p. 175—J. AGARDH, Sp. Alg. III, 1, (Epicr.), p. 191.

Jap. name. Kusiba-nisekarekigusa (n.n.).

Frond arising from a small disc, subterete near the base, becoming compressed and disticho-pinnately much branched above, 5–10 cm. high, 0.6 mm. wide in the narrow part, ca. 3 mm. in the broadest one; branches tapering at the base, becoming broader above, sometimes again narrowed; upper branchlets similar to the branches in shape, very small, spine-like, ca. 2 mm. long, dark red; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 3–4 or more rows of small, ellipsoidal cells, arranged closely with their longer axis perpendicular to the surface; subcortical layer consisting of 2 parts, outer and inner, the outer layer of 2 or 3, more or less irregular rows of somewhat larger, round to ovate cells, arranged more loosely toward the inside, the inner layer of 2 or 3 rows of larger flattened cells, joining with the neighbouring cells by plasmic threads; medulla of abundant, very slender, rhizoidal cells, arranged closely by anastomosing with each other, surrounding a comparatively large, round cell in the center, which may be a cross section of the axial cell running lengthwise in the frond; neither cystocarps nor tetrasporangia found in the writer's specimens.

There have been deposited two sets of authentic specimens in our Herbarium, which were kindly contributed from the Department

of Botany, University of California. The one is a rather slender and small specimen, measuring 11 cm. high, about 0.3 mm. wide in the narrow part and 2.5 mm. in the broadest; the other a large one, measuring 14.5 cm. high, about 0.6 mm. wide in the narrow part and about 5 mm. in the broadest. These specimens are both sterile. The writer's specimens more closely resemble the former specimen in external appearance.

The present writer identified his specimens with the present species by the resemblance of the external appearance as well as the accordance of the internal feature.

Habitat and locality. Growing on rocks in the upper sublittoral zone.

M. Kuriles. Uruppu Isl.—Kobune.

Distrib. Washington, California and Japan (Hokkaido and the Kuriles).

2. *Farlowia irregularis* YAMADA

Notes on Some Jap. Alg. V, (1933), p. 280, pl. XI—OKAMURA, Mar. Alg. Jap. p. 482, fig. 224.

Jap. name. Nisekarekigusa.

Prof. YAMADA reported the present species as growing abundantly at Akkesi, Hokkaido. He found it also in OKADA's collection of the marine algae from Kunasiri Isl. The present writer failed, however, to find any specimen referable to the present species.

Habitat and locality. Growing on rocks in the littoral zone (at Akkesi), according to YAMADA.

S. Kuriles. Kunasiri Isl.—Eastern coast? (YAMADA).

Distrib. Japan (Hokkaido, Saghalien and the Kuriles).

6. *Dilsea* STACKHOUSE, 1809

Dilsea edulis STACKHOUSE

in Mém. Soc. Mosc. II, (1809), pp. 55, 71—DE TONI, Syll. Alg. IV, 4, p. 1635; VI, p. 565—YENDO, Notes Alg. New to Jap. p. 133; Kaisan-Syokubutugaku, p. 739, fig. 207—OKAMURA, Nippon Sorui Meii, ed. 2, p. 114; Icon. Jap. Alg. IV, 6, p. 115, pl. CLXXX; Mar. Alg. Jap. p. 483, fig. 225—ROSENVINGE, Mar. Alg. Denmark, II, p. 160, fig. 76, 77—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 28—OKADA, Kaiso-zuhu, p. 159, pl. CLVI, fig. 2—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 208.

Fucus edulis STACKHOUSE, Ner. Brit. Fasc. I, (1795), p. 57, pl. XII—TURNER, Fuci, II, p. 112, pl. 114.

Halymenia edulis AGARDH, Sp. Alg. I, 2, (1822), p. 202; System. Alg. p. 242.

Iridaea edulis BORY, in Dict. Class. d'Hist. Nat. IX, (1826), p. 15—GREVILLE, Alg. Brit. p. 158, Tab. XVII—HARVEY, Phyc. Brit. I. pl. XCVII—KÜTZING, Sp. Alg. p. 724; Tab. Phyc. XVII, Tab. 3, fig. a–c.

Schizymenia edulis J. AGARDH, Sp. Alg. II, 1, (1851), p. 172—KJELLMAN, Spetzberg. Thall. I, p. 23.

Sarcophyllis edulis J. AGARDH, Sp. Alg. III, 1, (Epicr.), (1876), p. 265—GOBI, Algenfl. Weiss. Meeres, p. 39—KJELLMAN, Alg. Arct. Sea, p. 152.

Jap. name. Akaba.

Only a few specimens were referred to the present species on the basis of the accordance of the external and internal features. This is a widely distributed species in northern Japan, from Northeastern Honshyu northward to the Kuriles, through Hokkaido. In Hokkaido this is a familiar species.

Habitat and localities. Growing on rocks in the upper sublittoral zone, preferring somewhat sheltered place.

M. Kuriles. Uruppu Isl. (OKAMURA).

S. Kuriles. Etorohu Isl.—Iriribusi. Sikotan Isl.—Tiboi, Notoro, Aimizaki. Kunasiri Isl.—Hurukamappu.

Distrib. Atlantic Ocean, Arctic Ocean and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles).

7. *Constantinea* (POSTELS et RUPRECHT, 1840) SETCHELL, 1906

Key to the species

I. Proliferous bud in the center of the uppermost blade small, rosulate; blade not ample, less than 10 cm. diam. ..... *C. rosa-marina* (1)

II. Proliferous bud in the center of the uppermost blade rather long, subuliform; blade ample, mostly more than 10 cm., attaining to 21 cm. diam. ..... *C. subulifera* (2)

1. *Constantinea rosa-marina* (GMELIN) POSTELS et RUPRECHT

Ill. Alg. (1840), p. 17, Tab. XXX, Tab. XL, fig. 84–87—J. AGARDH, Sp. Alg. II, 1, p. 295—KJELLMAN, Beringhafv. Algfl. p. 30—DE TONI, Syll. Alg. IV, 4, p. 1637; VI, p. 566—OKAMURA, Nippon Sorui Meii, ed. 1, p. 93, ed. 2, p. 115; Icon. Jap. Alg. II, 6, p. 91, pl. LXXVII, pl. LXXVIII, fig. 8–13; Mar.

Alg. Jap. p. 485, fig. 226—SETCHELL & GARDNER, Alg. N. W. Amer. p. 355—SETCHELL, Rev. Genus Constantinea, p. 9—YENDO, Kaisan-Syokubutugaku, fig. 73—NAGAI, *Constantinea rosa-marina* & *C. subulifera*, pp. 780–783, fig. 1.

Fucus rosa marina GMELIN, Hist. Fuc. (1768), p. 102, Tab. V, fig. 2, 2a—AGARDH, Sp. Alg. I, 2, p. 190 (sub *Delesseria*).

Constantinea Sitchensis POSTELS et RUPRECHT, III. Alg. (1840), p. 17, pl. XL, fig. 88—KÜTZING, Sp. Alg. p. 744—J. AGARDH, Sp. Alg. II, 1, p. 295—DE TONI, Syll. Alg. IV, 4, p. 1638.

Kallymenia rosa marina ENDLICHER, Gen. Plant. Suppl. III, (1843), p. 40.

Neurocaulon rosa marina KÜTZING, Sp. Alg. (1849), p. 744; Tab. Phyc. XVII, Tab. 83, fig. d.

Jap. name. Okitubara.

Until recent years, there has been known only a single species, viz. the present one, in Japan. This species was reported by OKAMURA, YENDO and other Japanese phycologists. OKAMURA described and delineated the present species in his "Icones of Japanese Algae, vol. II.". As far as the present writer has studied, however, there occur two species in Japan, belonging to the present genus, viz., *C. rosa-marina* and *C. subulifera*.. The latter is described next below.

Habitat and localities. Found cast ashore; once found growing solitarily on rock in a sheltered place in the upper sublittoral zone, at Kakumabetu, Paramusiru Isl.

N. Kuriles. Araido Isl.—Uomizaki. Simusyu Isl.—Kataoka-wan (OKAMURA). Paramusiru Isl.—Suribati-wan, Musasi-wan (OKAMURA), Titose-wan.

M. Kuriles. Onnekotan Isl.—Odomari, Nemo-wan. Harumukotan Isl.—Harumukotan-byoti.

S. Kuriles. Etorohu Isl.—Iriribusi.

Distrib. Alaska, Pribilof Isl., Bering Isl., Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Constantinea subulifera* SETCHELL

Rev. Genus Constantinea, (1906), p. 11—DE TONI, Syll. Alg. VI, p. 567—NAGAI, *Constantinea rosa-marina* & *C. subulifera*, p. 780–783, fig. 2, 3—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 208.

Constantinea Sitchensis HARVEY, Coll. Alg. Vancouver Island, (1862), p. 172, (excl. synonymy).

C. Sitchensis FREEMAN, Observ. on Constantinea, (1899), p. 178.

C. Sitchensis SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 356, pl. XVIII, fig. 18.

C. rosa-marina OKADA, Kaiso-zuhu, (1934), pl. 157.

Jap. name. Oba-okitubara.

Plant 5–12 cm. high, arising from a scutate disc, 1–5 times, mostly 2–3 times subdichotomously branched, yellowish red to dark red; primary stipe short, ca. 7 mm. long, ca. 1.5 mm. diam., later elongated, annulate with scars of fallen baldes; scars comparatively nearer to the neighbouring ones on the lower portion (internodes 1–2 diam. long), becoming more distant upward (internodes ca. 5–6 diam. long); blade orbicular, fleshy, entire in juvenile stage, later splitting radially into 4–11 segments, 7–27 cm., mostly 12–17 cm. diam.; proliferous bud subuliform; tetrasporangia formed among slender, more or less clavate, unicellular paraphyses within the nemathecia on the under surface of the blade, tetraspores oblong-obovate, zonate; cystocarps unknown.

Several specimens from the Kuriles accord well with the original description and the authentic specimen of *C. subulifera* SETCH. In the writer's specimens, there are sometimes observed zonate tetrasporangia within masses of abundant unicellular paraphyses in sori. The sori are formed as comparatively large or small, distinctly defined spots of nemathecia on the under surface of the balde.

Habitat and localities. Found cast ashore; once found growing solitarily on rocks in a sheltered place in the upper sublittoral zone, at Aimizaki, Sikotan Isl.

M. Kurilss. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Minamizima.

S. Kurilss. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Idasibenai, Kuraoi, Seseki near Wennai, Tohutu.

Distrib. Washington and Japan (Hokkaido and the Kuriles).

Family 4. *Squamariaceae*

Key to the genera

I. Tetrasporangia scattered immersed within the sori upon the frond; tetraspores cruciate ..... *Rhododermis* (8)

II. Tetrasporangia gathered within the conceptacles; tetraspores irregularly cruciate or zonate ..... *Hildenbrandtia* (9)

8. *Rhododermis* CROUAN, 1852

Rhododermis parasitica BATTERS

(Pl. IV, fig. 29)

Alg. Berwick-on-Tweed, (1889), p. 92, Tab. XI, fig. 2, A, B—KUCKUCK, Beitr. z. Kenntn. d. Meeresalg. p. 5, pl. VII, VIII—DE TONI, Syll. Alg. IV, 4, p. 1711; VI. p. 597—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 253.

Jap. name. Kobunohana (n. n.).

Thalli consisting of small, thin crusts which are roundish, sometimes connecting with each other, resulting in irregular outline as a whole, brownish red, 2–10 mm. diam., 100–270 μ thick; vegetative part consisting of regularly arranged vertical rows of small cuboidal cells, giving rise outside to filamentous part; cells of the vegetative part wider than long or nearly as long as broad, arranged rather firmly and 3, 4 or more in number in a row; filamentous part consisting of numerous paraphyses and tetrasporangia; paraphyses uniseriate, of 5–11 elongate cells, slender, rounded at apices, 90–180 μ long, 6–9 μ wide; tetrasporangia clavate or oblong-ovate, somewhat thickened at apices, 39–57 μ long, 15–24 μ wide, with long pedicels, tetraspores cruciate; cystocarps unknown.

As far as the present writer is aware, there are known three species and two varieties in the genus. They are *R. parasitica*, *R. elegans* and its var. *polystromatica*, and *R. Georgii* and its var. *fucicola*. Among them, *R. elegans* is characteristic in having hyaline hairs between paraphyses or in sterile part and *R. Georgii* and its var. *fucicola* in having inflated portions in frond. As to *R. elegans* var. *polystromatica*, ROSENVINGE has an opinion that there is no reason to maintain the establishment of the variety. In the writer's specimens, there are found neither hairs nor inflated portions. Therefore they are not referable either to *R. elegans* or to *R. Georgii*. Comparing with descriptions of *R. parasitica*, the specimens at hand accord relatively well except for a few discrepancies in measurement.

Habitat and localities. Epiphytic on the stipe, rarely on the holdfast of various species of the Laminariaceae, e.g., *Laminaria platymeris*, *Thalassiophyllum Clathrus*, *Arthrothamnus kurilensis*, *Alaria dolichorhachis*, etc., and on the frond of *Halosaccion saccatum*.

N. Kuriles. Paramusiru Isl.—Kurosaki.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Musiru Islet. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Minamizima. Ketoi Isl.—Minami-ura. Uruppu Isl.—Kobune.

S. Kuriles. Etorohu Isl.—Wenbetu.

Distrib. Atlantic Ocean and Japan (the Kuriles).

9. *Hildenbrandtia* NARDO, 1834

Hildenbrandtia prototypus NARDO

(Pl. IV, fig. 30)

in Oken's Isis, (1843), p. 675—HAUCK, Meeresalg. p. 38, fig. 9—DE TONI, Syll. Alg. IV, 4, p. 1714; VI, p. 598—ROSENVINGE, Mar. Alg. Denmark, II, p. 202, fig. 121–125—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 257, pl. XXXVI, fig. 9, 10.

Hildenbrandtia rosea KÜTZING, Phyc. Gen. (1843), p. 384; Tab. Phyc. XIX, Tab. 91, fig. c–e—J. AGARDH, Sp. Alg. II, 2, p. 495; III, 1, (Epicr.), p. 379.

Jap. name. Benimadara.

Thalli consisting of thin crusts, suborbicular in juvenile stage, later becoming spread over the surface of rocks or stones, blood-red or brownish red, 120–330 μ thick; tissue composed of regularly arranged vertical rows of cuboidal cells; cells 4.5–7.5 μ long, ca. 4 μ wide; conceptacles scattered singly or sometimes connected in groups, sub-spherical or a little depressed, 60–90 μ diam., or 60–105 μ high, 60–180 μ wide; tetrasporangia formed within the conceptacles, ovoid, obovoid or sometimes more or less elongated, irregularly cruciate or zonate, 19.5–27 μ long, 8–12 μ wide; paraphyses linear.

ROSENVINGE described minutely and delineated this species in Denmark, with which description and figures the writer's specimens accord very well. The present species is found rather widely distributed in the Kuriles.

Habitat and localities. Growing on rocks and stones, forming crusts, in the littoral zone.

M. Kuriles. Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Uruppu Isl.—Kobune, Misima, Tokotan.

S. Kuriles. Etorohu Isl.—Naibo. Sikotan Isl.—Notoro, Aimizaki. Kunasiri Isl.—Tohutu, Rurui, Kotankesi.

Distrib. Atlantic Ocean, Arctic Ocean, Bering Sea (Konyam Bay and Port Clarence), Washington and Japan (the Kuriles).

Family 5. *Corallinaceae*

Key to the genera

I. Frond expanded, without genicula ..... *Phymatolithon* (10)
II. Frond branched, with geniculae.

A. Mother-cells of propagating cells generated in the cortex; genicula unizonal or multizonal ..... *Amphiroa* (11)
B. Mother-cells of propagating cells generated in the medulla; genicula unizonal ..... *Corallina* (12)

Subfamily 1. *Melobesiae*

10. *Phymatolithon* FOSLIE, 1898

Phymatolithon (*Clathromorphum*) *loculosum* (KJELLMAN) FOSLIE

Rev. Syst. Surv. Melob. (1900), p. 10; Rem. on North. Lithothamnia, p. 93—DE TONI, Syll. Alg. IV, 4, p. 1727—YENDO, in OKAMURA's Nippon Sorui Meii, ed. 2, p. 124—OKAMURA, Mar. Alg. Jap. p. 505.

Lithothamnion loculosum KJELLMAN, Beringhafv. Algfl. (1889), p. 21, Tab. I, fig. 1, 2.

Key to the forms

I. Conceptacles not closely arranged, 250–300μ diam..... f. *typica*
II. Conceptacles closely arranged, 300–500μ diam..... f. *evanida*

f. *typica* FOSLIE

Contr. Monogr. Lithothamnia, (1929), pl. XLI, fig. 17–19.

f. *evanida* FOSLIE

Rem. on North. Lithothamnia, (1905), p. 93; Contr. pl. XLI, fig. 16—YENDO, l. c. p. 124—OKAMURA, l. c. fig. 235.

YENDO reported the present species as growing in the Kuriles in OKAMURA's Nippon Sorui Meii, ed. 2.

Habitat and localities. Growing on stones and pebbles.

f. *typica*.
N. Kuriles. Simusyu Isl. (YENDO).

f. *evanida*.
S. Kurilcs. Etorohu Isl.—Rubetu (YENDO).

Distrib. *Sp.*—Alaska, Bering Sea and Japan (the Kuriles); f. *evanida*—endemic (the Kuriles).

Subfamily 2. *Corallineae*

11. *Amphiroa* LAMOUROUX, 1812

Amphiroa cretacea ENDLICHER

Gen. Plant. Suppl. III, (1843), p. 49—KÜTZING, Sp. Alg. p. 701; Tab. Phyc. VIII. Tab. 45—ARESCHOUG, in J. AGARDH Sp. Alg. II, 2, p. 533—HARVEY, Ner. Bor.-Amer. II, p. 86—YENDO, Corall. Verae Jap. p. 7, pl. I, fig. 4, pl. IV, fig. 2; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 135—DE TONI, Syll. Alg. IV, 4, p. 1811—SINOVA, Alg. Kamtschatka, p. 39—OKAMURA, Mar. Alg. Jap. p. 521.

Corallina cretacea POSTELS et RUPRECHT, Ill. Alg. (1840), p. 20. Taf. XL, fig. 104.

Jap. name. Isokiri.

Key to the forms

I. Articuli cylindrical throughout except in ramiferous portion.....f. *typica*
II. Articuli globular, arranged in rosariform..... f. *rosariformis*

f. *typica* NAGAI, f. nov.

Ramis ramulisque divaricato-deflexis; articulis cylindricis, 2–5 mm. longis, 0.8–2 mm. diam.

f. *rosariformis* YENDO

l.c. (1902), pl. IV, fig. 3—OKAMURA, Mar. Alg. Jap. p. 521.

The specimens at hand are easily identifiable with the present species by the stout and robust fronds. In f. *typica*, the articuli are cylindrical throughout except in the ramiferous portion, while in f. *rosariformis* some or most of the articuli are short and globular, arranged in rosariform. Forma *rosariformis* was occasionally found in company with f. *typica* in the Kuriles. This is a rather widely distributed species in northern Japan from Northeastern Honsyu northward to the Kuriles through Hokkaido.

Habitat and localities. Growing on rocks and pebbles in the littoral zone.

f. *typica*.

N. Kuriles. Paramusiru Isl.—Suribati-wan, Titose-wan.

M. Kuriles. Uruppu Isl.—Iwayadomari.

S. Kuriles. Etorohu Isl.—Iriribusi. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Tohutu, Sokobetu, Kotankesi.

f. *rosariformis*.

M. Kuriles. Uruppu Isl.—Iwayadomari.

S. Kuriles. Etorohu Isl.—Iriribusi.

Distrib. *Sp.*—Alaska, Aleutian Isl., Bering Sea (Port Clarence, St. Lawrence Isl. and Bering Isl.), Kamchatka and Japan (Honsyu, Hokkaido and the Kuriles); f. *rosariformis*—Japan (Honsyu and the Kuriles).

12. *Corallina* LAMOUROUX, 1815

Corallina pilulifera POSTELS et RUPRECHT

Ill. Alg. (1840), p. 20, Taf. XL, fig. 101—RUPRECHT, Tange Och. Meeres, p. 344—ARESCHOUG, in J. AGARDH, Sp. Alg. II, 2, p. 563—YENDO, Corall. Verae Jap. p. 30, pl. III, fig. 14–16, pl. VII, fig. 14–16; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 139—DE TONI Syll. Alg. IV, 4, p. 1843—SINOVA, Alg. Mer Ochotsk, p. 122—YAMADA, Mar. Alg. N. Kuriles, p. 348—TSENG, Mar. Alg. fr. Amoy, p. 39, pl. IV, fig. 20, 22—OKAMURA, Mar. Alg. Jap. p. 527.

Corallina officinalis f. *pilulifera* SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 366.

Jap. name. Pirihiba.

Key to the forms

I. Articuli of the main axis with projecting shoulders ..... f. *sororia*
II. Articuli of the main axis without projecting shoulders.
  A. Conceptacles with long pedicels ..... f. *filiformis*
  B. Conceptacles with short pedicels ..... f. *intermedia*

f. *sororia* RUPRECHT

Tange Och. Meeres, (1851), p. 344—YENDO, Corall. Verae Jap. p. 30, pl. III, fig. 15, pl. VII, fig. 15; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 139—OKAMURA, Mar. Alg. Jap. p. 527.

Fronds relatively robust, decumbent; articuli of the main axis highly elevated on one side while on the other remaining flat, often with projecting shoulders, broad-cuneate with truncate ends.

f. *filiformis* RUPRECHT

l.c. (1851), p. 345—YENDO, Corall. p. 30, pl. III, fig. 14, pl. VII, fig. 14; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 139—OKAMURA, Mar. Alg. Jap. p. 527.

Fronds very slender; articuli of the main axis without projecting shoulders, narrow-cuneate with truncate ends, sometimes at the apices of some branches broad and laciniate; conceptacles with long pedicels.

f. *intermedia* YENDO

l.c. (1902), p. 30, pl. III, fig. 16, pl. VII, fig. 16; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 139—OKAMURA, Mar. Alg. Jap. p. 527.

Fronds intermediate between the above forms; articuli of the main axis without projecting shoulders; conceptacles with short pedicels.

The present species is found widely in the Kuriles from the north to the south islands. Most of the specimens at hand, are referable to f. *filiformis* and a few to f. *sororia* and f. *intermedia*.

Habitat and localities. Growing at low tide mark, forming dense tufts on rocks, as well as in tide-pools in the littoral zone.

N. Kuriles. Araido Isl.—Sekinezaki. Paramusiru Isl.—Arakawa (YAMADA), Kakumabetu.

M. Kuriles. Uruppu Isl.—Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tosimoe, Wenbetu, Iriribusi, Tosirari, Sibetoro, Syamanbe, Bettobu, Arimoe, Rubetu. Sikotan Isl.—Syakotan, Aimizaki, Tiboi. Kunasiri Isl.—Atoiya, Idasibenai, Pontomari, Hurukamappu, Tohutu, Sokobetu, Odatomi, Rurui, Kotankesi.

f. *sororia*.

S. Kuriles. Etorohu Isl.—Arimoe.

f. *filiformis*.

N. Kuriles. Araido Isl.—Sekinezaki.

M. Kuriles. Uruppu Isl.—Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tosimoe, Wenbetu, Iriribusi, Tosirari, Bettobu, Syamanbe. Sikotan Isl.—Tiboi, Aimizaki, Syakotan. Kunasiri Isl.—Atoiya, Hurukamappu, Tohutu, Sokobetu, Odatomi, Kotankesi.

f. *intermedia*.

S. Kuriles. Kunasiri Isl.—Idasibenai.

Distrib. *Sp.*—Alaska, Okhotsk Sea, China and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles); f. *sororia*—Okhotsk Sea and Japan (Honsyu, Hokkaido and the Kuriles); f. *filiformis*—Okhotsk Sea and Japan (Honsyu, Hokkaido and the Kuriles); f. *intermedia*—Japan (Hokkaido and the Kuriles).

Family 6. *Endocladiaceae*

13. *Gloiopeltis* J. AGARDH, 1842

Gloiopeltis furcata (POSTELS et RUPRECHT) J. AGARDH

Sp. Alg. II, 1, (1851), p. 235; III, 1, (Epicr.), p. 275—HARVEY, Ner. Bor.-Amer. II, p. 183—KJELLMAN, Beringhafv. Algfl. p. 28—OKAMURA, Nippon Sorui Meii, ed. 1, p. 84, ed. 2, p. 102; Icon. Jap. Alg. V, 9, p. 164, pl. CCXLIV; Mar. Alg. Jap p. 562, fig. 264—SETCHELL & GARDNER, Alg. N. W. Amer. p. 348—DE TONI, Syll. Alg. IV, 4, p. 1534; VI, p. 533—YENDO, Kaisan-Syokubutugaku, p. 712, fig. 200—YAMADA, Mar. Alg. N. Kuriles, p. 347, fig. 2—TSENG, Mar. Alg. fr. Amoy, p. 39—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 208.

Dumontia furcata POSTELS et RUPRECHT, Ill. Alg. (1840), p. 19—KÜTZING, Sp. Alg. p. 719—RUPRECHT, Tange Och. Meeres, p. 310.

Jap. name. Hukuro-hunori, Hunori.

f. *coliformis* OKAMURA

Icon. V, 9, p. 166; Mar. Alg. Jap. p. 563.

Gloiopeltis coliformis HARVEY, Char. New Alg. (1859), p. 332—SURINGAR, Alg. Jap. p. 32, Tab. XIX—DE TONI, Syll. Alg. VI, p. 533.

G. furcata var. *coliformis* J. AGARDH, Sp. Alg. III, 1, (Epicr.), (1876), p. 275—DE TONI, Syll. Alg. IV, 4, p. 1534—OKAMURA, Nippon Sorui Meii, ed. 1, p. 84, ed. 2, p. 102.

Jap. name. Kita-hunori.

In Japan, there are known two forms of the present species, viz., f. *coliformis* OKAM. and f. *intricata* OKAM., the former being distributed in the northern region and the latter in the southern. The specimens at hand are all referable to the former form. As far as the writer's observation shows, the cystocarpic plant is usually smaller and more slender than the tetrasporic one, measuring only 0.6 to 2.5 cm. high and 0.5 to 1 mm. wide.

Habitat and localities of f. *coliformis*. Growing gregariously on rocks in the upper littoral zone.

N. Kuriles. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kurosaki, Kakumabetu.

M. Kuriles. Ketoi Isl.—Minami-ura. Simusiru Isl.—Nakadomari. Uruppu Isl.—Yosinohama, Misima, Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, wenbetu, Iriribusi, Tosirari, Sibetoro, Bettobu, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan. Kunasiri Isl.—Sokobetu, Tosyoro.

Distrib. *Sp.*—Washington, Alaska, Bering Isl., Kamchatka, China and Japan (Kyusyu, Honsyu, Hokkaido and the Kuriles); f. *coliformis*—Japan (Honsyu, Hokkaido and the Kuriles).

Family 7. *Tichocarpaceae*

14. *Tichacarpus* RUPRECHT, 1851

Tichocarpus crinitus (GMELIN) RUPRECHT

Tange Och. Meeres, (1851), p. 320, Tab. XVII—J. AGARDH, Sp. Alg. III, 1, (Epicr.), p. 284—SCHMITZ u. HAUPTFLEISCH, in ENGLER u. PRANTL Natürl. Pflanzenfam. I, 1, p. 381—DE TONI, Syll. Alg. IV, 1, p. 385; VI, p. 239—OKAMURA, Nippon Sorui Meii, ed. 1, p. 35, ed. 2, p. 39; Icon. Jap. Alg. III, 5, p. 79, pl. CXXI, CXXII, pl. CXXIII, fig. 1-8; Mar. Alg. Jap. p. 565, fig. 265—SINOVA, Alg. Mer Ochotsk, p. 111—TOKIDA, Mar. Alg. Robben Isl. p. 20—KYLIN, Florideenordn. Gigartinales, p. 69, fig. 22—YAMADA, Mar. Alg. N. Kuriles, p. 349—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210.

Fucus crinatus GMELIN, Hist. Fuc. (1768), p. 160.

F. crinitus GMELIN, Hist. Fuc. (1768), Tab. XVIII, fig. 2—TURNER, Fuci, II, p. 136, pl. CXXIII.

Sphaerococcus crinitus AGARDH, Sp. Alg. 1, 2, (1822), p. 275—POSTELS et RUPRECHT, Ill. Alg. p. 17.

Gelidium crinitum KÜTZING, Sp. Alg. (1849), p. 766; Tab. Phyc. XVIII, Tab. 45, fig. c-f.

Prionitis? crinitas J. AGARDH, Sp. Alg. II, 1, (1851), p. 191.

Jap. name. Karekigusa.

Key to the forms

I. Upper branches and branchlets narrow ..... f. *linearis*
II. Upper branches and branchlets complanate ..... f. *complanatus*

f. *linearis* NAGAI, f. nov.

Ramis et ramulis superne angustis crassis, 1/3–1/2 mm. diam.

f. *complanatus* NAGAI, f. nov.

Ramis et ramulis superne complanatis, 1–3 mm. latis.

The present species has been known only from the Okhotsk Sea and Korea up to the present. Although the present writer has really found neither cystocarpic nor tetrasporic plants, he was able to identify his specimens with the present species without hesitation. The specimens at hand accord well with the original description and figures of RUPRECHT. OKAMURA described and also delineated this species minutely in his "Icones of Japanese Algae, III". As far as the present writer studied, the specimens at hand are divided into two forms, the one having narrow, slightly thickened branches and branchlets, the another having somewhat wide, complanate ones. There are, however, no essential differences between them in the internal features except in the thickness of the tissue layers. The medulla of f. *complanatus* is only about two-thirds as thick as the other layers, while that of f. *linearis* is about two times.

Habitat and localities. Growing on rocks between the lower littoral zone and the upper sublittoral zone.

f. *linearis*.

M. Kuriles. Uruppu Isl.—Tokotan.

S. Kuriles. Etorohu Isl.—Iriribusi, Tosirari, Bettobu, Arimoe, Rubetu. Sikotan Isl.—Syakotan. Kunasiri Isl.—Atoiya, Rebun-iso, Tinomizi, Hurukamappu, Tohutu, Sokobetu, Sibetoro, Tosyoro, Ponkotan, Nisiura.

f. *complanatus*.

N. Kuriles. Araido Isl.—Minami-ura. Simusyu Isl.—Kataoka-wan, Tenzin-iwa. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Ketoi Isl.—Minami-ura.

S. Kuriles. Etorohu Isl.—Wenbetu, Iriribusi.

Distrib. *Sp.*—Okhotsk Sea. Kamchatka and Japan (Korea, Hokkaido, Saghalien and the Kuriles); f. *linearis* and f. *complanatus* —endemic (the Kuriles).

Family 8. *Callymeniaceae*

Key to the genera

I. Frond membranaceous, several times palmately or subdichotomously divided ..... *Callophyllis* (15)

II. Frond carnoso-membranaceous.

A. Frond regularly branched.

1. Frond simple in juvenile stage, then lobed di- or polychotomously, or subpalmately and repeatedly branched above, and becoming stem-like by decaying away of membranaceaus alae ..... *Erythrophyllum* (16)

2. Frond linear-complanate, repeatedly and dichotomo-pinnately branched ..... *Euthora* (17)

B. Frond simple, expaned, sometimes irregularly or palmately divided.. ..... *Callymenia* (18)

15. *Callophyllis* KÜTZING, 1843

Callophyllis rhynchocarpa RUPRECHT

Tange Och. Meeres, (1851), p. 260, Tab. XIII—MARTENS, Tange Ost-Asien, p. 118—A. AGARDH, Sp. Alg. III, 1, (Epicr.), p. 236—KJELLMAN, Beringhafv. Algfl. p. 30—DE TONI, Syll. Alg. IV, 1, p. 284; VI, p. 212—OKAMURA, Nippon Sorui Meii, ed. 1, p. 31, ed. 2, p. 34; Mar. Alg. Jap. p. 571—SINOVA, Alg. Mer Ochotsk. p. 109; Alg. Kamtschatkas, p. 32—TOKIDA, Mar. Alg. Robben Isl. p. 15.

Jap. name. Hime-tosakamodoki.

Frond membranaceous, arising from a small scutate disc, 3–10 times palmately or subdichotomously divided, tapering cuneately toward the base, obtuse or laciniate into slender fragments above, more or less irregularly crenulate on margin, 5–12 cm. high, scarlet to yellowish red; segments narrow or wide, usually wider beneath the branching part; tissue composed of 3 layers, cortical, subcortical and meduallary; cortex of 1 or partly 2 rows of small, cuboidal cells;

subcortical layer of 1 or partly 2 rows of larger, ovoid or slightly flattened cells; medulla of 2 or 3 rows of exceedingly large, flattened cells; tetrasporangia scattered, immersed within the cortex, ovoid, ca. 30×12–15 μ; tetraspores cruciate; cystocarps unknown.

Key to the forms

I. Upper segments narrow, often much laciniate into small fragments at apices ..... f. *obtusiloba*
II. Upper segments wide, obtuse or sometimes laciniate at apices ..... f. *subsimplex*

f. *obtusiloba* RUPRECHT

Tange Och. Meeres, Tab. XIII, fig. b, bd, bda.

Frond 6–10 times divided, branching dichotomous or subdichotomous; upper segments narrow, 2/3–2 mm. wide, much laciniate into small fragments at apices.

f. *subsimplex* NAGAI, f. nov.

Fronde 3–8-plo palmata vel dichotoma, segmentis superne 3–10 mm. latis, apicibus obtusis vel laciniatis.

The frond is 3 to 8 times palmately or dichotomously divided. The upper segments are 3 to 10 mm. wide, and obtuse or laciniate at apices.

In the plant from the Okhotsk, RUPRECHT reported two forms, viz., f. *acutiloba* and f. *obtusiloba*, under this species. He enumerated also other forms, f. *cristata* and f. *incisa* from other regions of the North Pacific. In the Kuriles, the present writer has obtained two forms, the one identifiable with f. *obtusiloba* and the other new to science. In the new form, f. *subsimplex*, the frond is rather simple, being not so much branched as in f. *acutiloba* or f. *obtusiloba* in the upper segments. The segments are 3 to 10 mm., mostly 5 to 10 mm. wide, and much wider than those of RUPRECHT's two forms, above mentioned. The forma in question has some resemblances with *C. crispata* OKAM. at a glance, but it differs from the latter by having the frond margin more crenulate but not fimbriate, with minute processes. In the specimens at hand, there are found many tetrasporangia scattered on the frond, though cystocarps are absent. In the cross section of these specimens, the tetrasporangia are disposed rather sparsely within the cortex. There are no essential differences between this new form and f. *obtusiloba* in the internal features.

Habitat and localities. Found cast ashore, epiphytic on the fronds of *Ptilota pectinata.*

f. *obtusiloba.*

N. Kuriles. Paramusiru Isl.—Suribati-wan.
S. Kuriles. Kunasiri Isl.—Atoiya, Kuraoi.

f. *subsimplex.*

S. Kuriles. Etorohu Isl.—Wenbetu.

Distrib. *Sp.*—Alaska, Bering Isl., Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles); f. *obtusiloba*—Okhotsk Sea and Japan (the Kuriles); f. *subsimplex*—endemic (the Kuriles).

16. *Erythrophyllum* J. AGARDH, 1872

Erythrophyllum Gmelini (GRUNOW) YENDO

Erythrophyllum Gmelini, (1915), pp. 230–237, fig. 1–3—OKAMURA, Icon. Jap. Alg. IV, 5, p. 90, pl. CLXXII; Nippon Sorui Meii, ed. 2, p. 311; Mar. Alg. Jap. p. 573, fig. 268—DE TONI, Syll. Alg. VI, p. 193—YAMADA, Mar. Alg. N. Kuriles, p. 348.

Fucus palmetta GMELIN, Hist. Fuc. (1768), p. 183, Tab. XXII, fig. 3, Tab. XXIII.

Kallymenia Gmelini GRUNOW, Alg. Novara, (1870), p. 72—SETCHELL & GARDNER, Alg. N. W. Amer. p. 307.

Jap. name. Ezotosaka.

Although the present writer carefully examined the specimens at hand, no reproductive organs have been found. In the specimens from Harumukotan Isl., there are found many dotted thalli of an endophytic alga, *Chlorochytrium inclusum* KJELLM., scattered over the whole frond.

Habitat and localities. Epiphytic on the holdfast of various species of the Laminariaceae, e.g., *Alaria fistulosa, Thalassiophyllum Clathrus, Laminaria ochotensis,* etc.; not common on the western coast of Kunasiri Isl.

N. Kuriles. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Titose-wan, Noda-wan (YAMADA).

M. Kuriles. Onnekotan Isl.—Odomari, Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan.

S. Kuriles. Etorohu Isl.—Wenbetu, Iriribusi. Sikotan Isl.—Tiboi, Aimizaki. Kunasiri Isl.—Seoi, Seseki near Wennai, Wennai, Hurukamappu, Syarikinmoe, Kotankesi.

Distrib. Alaska and Japan (Hokkaido and the Kuriles).

17. *Euthora* J. AGARDH 1851

Euthora fruticulosa (RUPRECHT) J. AGARDH

Sp. Alg. II, 2, (1852), p. 705; III, 1, (Epicr.), p. 360—DE TONI, Syll. Alg. IV, 1, p. 335; VI, p. 232—SETCHELL & GARDNER, Alg. N. W. Amer. p. 311—KYLIN, Mar. Red Alg. Friday Harb. p. 39—TOKIDA, Mar. Alg. Robben Isl. p. 15, fig. 4, pl. II, fig. c, d, pl. VI, fig. b, c—OKAMURA, Alg. fr. Alaska, p. 90; Mar. Alg. Jap. p. 575, fig. 269—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210.

Nereidea fruticulosa RUPRECHT, Tange Och. Meeres, (1851), p. 255.

Jap. name. Yusora.

There are no specimens referable to the present species in the writer's collection. However KAWABATA reported the present species in Sikotan Isl.

Habitat and locality. According to KAWABATA, found on the frond of *Agarum cribrosum*.

S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. Washington, Bering Sea, Kamchatka, Okhotsk Sea and Japan (Saghalien and the Kuriles).

18. *Callymenia* J. AGARDH, 1842

Key to the species

I. Frond ovate in juvenile stage, becoming expanded and palmately divided.. ..... *C. ornata* (1)

II. Frond obovate, cuneate or subreniform, irregularly and deeply divided, with cuneate base ..... *C. reniformis* var. *cuneata* (2)

1. *Callymenia ornata* (POSTELS et RUPRECHT) J. AGARDH

Sp. Alg. I, 1, (1851), p. 290; III, 1, (Epicr.), p. 223—KJELLMAN, Beringhafv. Algfl. p. 30—DE TONI, Syll. Alg. IV, 1, p. 303—SETCHELL & GARDNER, Alg. N. W. Amer. p 307—SINOVA, Alg. Mer Ochotsk, p. 111; Alg. Kamtschatka, p. 32—YAMADA, Mar. Alg. Urup, p. 21, pl. VIII—OKAMURA, Mar. Alg. Jap. p. 578.

Iridaea ornata POSTELS et RUPRECHT, Ill. Alg. (1840), p. 17, pl. XXXI—KÜTZING, Sp. Alg. (1849), p. 725.

Jap. name. Kita-tukasanori.

Frond carnoso-membranaceous, arising from a small irregular disc, in juvenile stage ovate with round base, becoming expanded widely, rather wider than long, then divided palmately into several lobes, scarlet- or dull-red, 11–28 cm. high; stipe short, complanate, 2–10 mm. long, becoming somewhat longer later; lobes 3–9 cm. wide, cuneate or attenuate below, sometimes stem-like at the base, slightly perforate, often lacerate on upper margins; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 1–2 rows of small, cuboidal cells, arranged closely with their longer axis perpendicular to the surface; subcortical layer of 2 or 3 rows of rather small, ovoid cells; medulla of larger, irregularly ovoid to elongate cells with granular contents, arranged rather in parallel to the surface, and joining with the neighbouring cells by plasmic threads, and accompanied by rod-shaped, yellowish, homogenous, translucent substances, occupying the greater part of the thickness of the frond; neither cystocarps nor tetrasporangia found in the writer's specimens.

YAMADA reported endophytic bodies in his Uruppu specimens, suggesting them to be a parasitic alga, Chlorochytrium. In the writer's specimens also, similar bodies are found within the frond. They are pear-shaped with thickened apices, measuring 84 to 150 μ by 80 to 144 μ, and filled with yellowish green contents. Comparing with KJELLMAN's description and figures, they were identified with the endophytic green alga, *Chlorochytrium inclusum* Kjellm. as previously stated under that species.

Habitat and localities. Found cast ashore.

N. Kuriles. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Onnekotan Isl.—Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Minamizima. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune, Tokotan, Iema (YAMADA).

S. Kuriles. Sikotan Isl.—Syakotan, Aimizaki.

Distrib. Alaska, Bering Isl., Kamchatka, Okhotsk Sea and Japan (the Kuriles).

2. *Callymenia reniformis* J. AGARDH

Sp. Alg. III, 1, (Epicr.), (1876), p. 221—DE TONI, Syll. Alg. IV, 1, p. 297; VI, p. 221—SINOVA, Alg. Mer Ochotsk, p. 110.

? var. *cuneata* J. AGARDH

l.c. (1876), p. 221—SETCHELL & GARDNER, Alg. N. W. Amer. p. 307—YENDO, Notes Alg. New to Jap. V, p. 257—TOKIDA, Mar. Alg. Robben Isl. p. 14, pl. II, fig. b, pl. VI, fig. a—YAMADA, Mar. Alg. N. Kuriles, p. 348—OKAMURA, Mar. Alg. Jap. p. 579.

Prof. YAMADA reported the present species as occurring in the North Kuriles with query in the above account. TOKIDA observed it also in South Saghalien.

Locality.

N. Kuriles. Island and locality unknown (YAMADA).

Distrib. *Sp.*—Atlantic Ocean, British Columbia, Okhotsk Sea; var. *cuneata*—Atlantic Ocean, Alaska and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles).

Order III. Gigartinales

Family 9. *Nemastomaceae*

19. *Schizymenia* J. AGARDH 1851

Schizymenia Dubyi (CHAUVIN) J. AGARDH

Sp. Alg. II, 1, (1851), p. 171; III, 1, (Epicr.), p. 123—DE TONI, Syll. Alg. IV, 4, p. 1648; VI, p. 571—YENDO, Notes Alg. New to Jap. VI, p. 93—YAMADA, Mar. Alg. Mutsu Bay, II, p. 532, fig. 24—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 38, fig. 18—OKAMURA, Icon. Jap. Alg. VII, 2, p. 10, pl. CCCVII, fig. 1–5, pl. CCCVIII, fig. 12; Mar. Alg. Jap. p. 587, fig. 275.

Halymenia Dubyi CHAUVIN, in DUBY Bot. Gall. p. 944.

var. *palmata* YAMADA

Mar. Alg. Urup, (1935), p. 23, pl. IX—OKAMURA, Mar. Alg. Jap. p. 588.

Jap. name. Sake-benisunago, Ebirako (Tosimoe, Etorohu Isl.).

Frond carnoso-membranaceous, somewhat rough to the touch, subsessile, elliptic or elliptic-ovate with broad cuneate base in juvenile stage, becoming expanded later, often divided into 3–5 lobes, sometimes repeatedly into more, at last often cuculate with these separate lobes, rounded, cordate or even umbilicate at the base, dark yellowish-red, 10–30 cm. high, 100–450 μ thick; lobes ovate, oblong-ovate or irregular; tissue composed of 3 layers, cortical, subcortical and

medullary; cortex of 2–3 rows of small, ellipsoid cells, arranged closely with their longer axes perpendicular to the surface of the frond; subcortical layer of slightly larger, roundish or nearly round cells which are arranged in anticlinal order; medulla of abundant, slender, rhizoidal cells, anastomosing with each other; no glandular cells found in the writer's specimens; cystocarps spherical, immersed within the frond between the subcortical layer and the medulla, carpospores ovoid, oblong, 11.5–15×15–27 μ; tetrasporangia oblong, ovoid, subglobose, tetraspores cruciate or somewhat irregular in division, 30–51×18–27 μ.

Prof. YAMADA separated the present alga from *Schizymenia pacifica* KYLIN and *S. Dubyi* J. AG. by the palmate frond and not usual presence of glandular cells, treating it as a variety of the latter species. It is found rather widely in the Kuriles from the northern islands to the southern.

Habitat and localities of var. *palmata*. Growing on rocks in sheltered places in the upper sublittoral zone.

N. Kuriles. Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Titose-wan, Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Tikohai, Wenbetu, Iriribusi. Kunasiri Isl.—Rubun-iso.

Distrib. *Sp.*—Atlantic Ocean, Mediterranean Sea and Japan (Kyusyu, Sikoku, Honsyu, Hokkaido); var. *palmata*—endemic (the Kuriles).

Family 10. *Solieriaceae*

20. *Turnerella* SCHMITZ, 1889

Turnerella Mertensiana (POSTELS et RUPRECHT) SCHMITZ

Syst. Uebers. Florid. (1889), p. 7—DE TONI, Syll. Alg. IV, 1, p. 323; VI, p. 228—OKAMURA, Nippon Sorui Meii, ed. 1, p. 34, ed. 2, p. 37; Icon. Jap. Alg. III, 5, p. 83, pl. CXXIII, fig. 9, 10; Mar. Jap. Alg. p. 597, fig. 280—SETCHELL & GARDNER, Alg. N. W. Amer. p. 309—SINOVA, Alg. Kamtschatka, p. 32—TOKIDA, Mar. Alg. Robben Isl. p. 18—YAMADA, Mar. Alg. N. Kuriles, p. 349; Mar. Alg. Urup, p. 22—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210.

Iridaea Mertensiana POSTELS et RUPRECHT, Ill. Alg. (1840), p. 18, pl. XXXIII—KÜTZING, Sp. Alg. p. 727.

Schizymenia Mertensiana J. AGARDH, Sp. Alg. II, 1, (1851), p. 174; III, 1, (Epicr.), p. 121—KJELLMAN, Beringhafv. Algfl. p. 32.

Jap. name. Yezonamesi.

Frond subcoriaceous, broadly expanded, not much but irregularly lobed, undulato-plicate, sometimes somewhat perforate, with often round, sometimes lacerate margin above, umbilicate at the base, sessile, deep blood-red, becoming darker and not adhering to paper upon drying, 6–19 cm. high, 9–32 cm. wide; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 4–5 rows of small, oblong-ovoid cells, arranged rather closely with their longer axis perpendicular to the surface of the frond; subcortical layer of ovoid or subovoid cells with granular contents, arranged in anticlinal order, ca. 1.5–2 times as thick as the cortex; medulla of abundant, filamentous cells with granular contents, anastomosing with each other and often accompanied by ellipsoid or ovoid cells within the transition region to the subcortical layer; glandular cells numerous, ellipsoid, oblong, or bottle-shaped, usually setting narrower tip upwards, with yellowish, lustrous substance, 54–87 μ long, 18–51 μ wide at the broadest part; cystocarps scattered in dotted appearances on the upper part of the frond, being immersed, making both surfaces of the frond slightly elevated, ca. 1/2–2/3 mm. diam., almost always immature in the writer's specimens; tetrasporangia unknown.

The present species has deep blood-red, subcoriaceous and broadly expanded fronds, of which the internal features are characteristic in having usually numerous distinct glandular cells within the cortex. This is known widely in the Kuriles and also from the eastern coast of Hokkaido and South Saghalien.

Habitat and localities. Found cast ashore.

N. Kuriles. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Titose-wan, Noda-wan (YAMADA).

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Rasyuwa Isl. Usisiru Isl.—Minamizima. Uruppu Isl.—Kobune, Tokotan (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Tosirari, Sibetoro. Sikotan Isl.—Tiboi, Notoro. Kunasiri Isl.—Idasibenai, Rebun-iso, Tinomizi, Kuraoi, Tokaisen, Wennai.

Distrib. Alaska, Washington, Bering Isl., Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

Family 11. *Rhodophyllidaceae*

21. *Rhodophyllis* KÜTZING, 1847

Rhodophyllis capillaris TOKIDA

(Pl. V, figs. 1–3)

Rhodophyllis capillaris sp. nov. and Some Other Red-Algae, etc. (1932), p. 13, fig. 1, 2, pl. I, fig. 1–6—OKAMURA, Mar. Alg. Jap. p. 603.

Fronds caespitose, filiform, terete, subdichotomously and laterally much branched, 7–9 cm. high, ca. 0.5 mm. diam. below; branchlets not constricted at the base, subulate toward the tips; tissue composed of 2 layers, cortical and subcortical; cortex of a row of small ovoidal cells, arranged rather loosely and areolately in the middle portion of the frond; subcortical layer of several, irregular rows of larger, thick-walled cells around a row of the central axial cells; cystocarps hemispherical, lateral on the branches and branchlets, usually with a few protruded appendages, 240–510 μ diam., carpospores obovoid, subglobose, 21–36×18–24 μ, or 22–27 μ diam.; tetrasporangia abundant, formed within the cortex of the branches and branchlets, tetraspores ellipsoidal oblong, ovoid, zonate, 39–45× 24–30 μ; spermatangia not found in the writer's specimens.

The present species was first recorded by TOKIDA based upon specimens from Muroran and Sibotu Isl., Prov. Nemuro in Hokkaido. He determined this alga as new to science because of the cylindrical filiform frond, of which the cortical cells are rather loosely and areolately arranged, and because of the characteristic features of the reproductive organs as well. The writer's specimens were identified by him with the present species.

Habitat and locality. Epiphytic on the fronds of *Ptilota Asplenioides.*

N. Kuriles. Paramusiru Isl.—Suribati-wan.

Distrib. Japan (Hokkaido and the Kuriles).

Family 12. *Gracilariaceae*

22. *Gracilaria* GREVILLE, 1830

Gracilaria confervoides (L.) GREVILLE

Alg. Brit. (1830), p. 123—HARVEY, Phyc. Brit. I, pl. LXV; Ner. Bor.-Amer. II, p. 108—J. AGARDH, Sp. Alg. II, 2, p. 587; III, 1, (Epicr.), p. 413—HAUCK.

Meeresalg. p. 182, fig. 77—DE TONI, Syll. Alg. IV, 2, p. 431; VI, p. 250—OKAMURA, Nippon Sorui Meii, ed. 1, p. 37, ed. 2, p. 42; Icon. Jap. Alg. IV, 1, p. 1, pl. CLI; Mar. Alg. Jap. p. 628, fig. 298—SETCHELL & GARDNER, Alg. N. W. Amer. p. 312—YENDO, Kaisan-Syokubutugaku, p. 637—COTTON, Some Chinese Mar. Alg. p. 112—HOWE, Chinese Mar. Alg. p. 139—KYLIN, Mar. Red Alg. Friday Harb. p. 39—ROSENVINGE, Mar. Alg. Denmark, IV, p. 602, fig. 605–610—TOKIDA, Mar. Alg. Robben Isl. p. 21—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 35, fig. 10, 11—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 219—TSENG, Mar. Alg. fr. Amoy, p. 46—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 293, pl. XXXVIII, fig. 1.

Fucus confervoides LINNAEUS, Sp. Plant. ed. 2, (1763), p. 1629—TURNER, Fuci, II, p. 32, pl. 84.

Sphaerococcus confervoides AGARDH, Sp. Alg. I, 2, (1822), p. 303 (excl. var.); Syst. Alg. p. 232 (excl. var.)—KÜTZING, Sp. Alg. p. 772; Tab. Phyc. XVIII, Tab. 72, fig. a, b—SURINGAR, Alg. Jap. p. 35.

Jap. name. Ogonori.

The present species is known to be distributed widely in the southern and middle regions of Japan. In the Icones of Japanese Algae, IV, p. 3 and the Marine Algae of Japan, p. 629, OKAMURA states it as growing widely from Formosa northward to Simusyu Isl., Kuriles in Japan. However the present writer failed actually to find this species in the Kuriles except on the western and southwestern coasts of Kunasiri and Sikotan Isl.

Habitat and localities. Growing on gravels in the sandy bottom of the lower littoral zone in calm cove.

S. Kuriles. Sikotan Isl.—Notoro (KAWABATA). Kunasiri Isl.—Kotankesi, Tomari.

Distrib. Atlantic Ocean, West Indies, Mediterranean Sea, Cape of Good Hope, Philippine Isl., Washington, California, China and Japan (Formosa, Kyusyu, Honsyu, Korea, Hokkaido, Saghalien and the Kuriles).

Family 13. *Phyllophoraceae*

23. *Ahnfeltia* FRIES, 1835

Ahnfeltia plicata (HUDSON) FRIES

Flora Scanica, (1835), p. 310—J. AGARDH, Sp. Alg. II, 1, p. 311; III, 1, (Epicr.), p. 206—HARVEY, Ner. Bor.-Amer. II, p. 168—KJELLMAN, Alg. Arct. Sea, p. 166; Beringhafv. Algfl. p. 30—DE TONI, Syll. Alg. IV, 1, p. 254; VI,

p. 201—SETCHELL & GARDNER, Alg. N. W. Amer. p. 305—COTTON, Mar. Alg. fr. Corea, p. 369—SINOVA, Alg. Mer Ochotsk, p. 108—ROSENVINGE, Mar. Alg. Denmark, IV, p. 554—OKAMURA, Mar. Alg. Jap. p. 646—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 295, pl. XXXVII, fig. 1, pl. XL, fig. 6.

Fucus plicatus HUDSON, Fl. Anglica, ed. alt. (1762), p. 589.

var. *tobuchiensis* KANNO et MATUBARA

Studies on *Ahnfeltia plicata* var. *Tobuchiensis*. I, (1932), p. 97–132, pl. I, II—OKAMURA, l.c. p. 646.

Jap. name. Itanigusa.

Plant forming a ball, consisting of luxuriant, rather loosely assembled slender branches which are branched by dichotomous, partly lateral ramification and anastomosing with each other, 11–20 cm. diam., lurid- to brownish-violet; branches subcylindrical throughout almost whole length, in cross section circular or a little oblong, ca. 200–300 μ diam.; tissue composed of 2 layers, cortical and medullary; cortex of small, subsquarish with slight round angled cells, 3–4.5×2–3 μ in longitudinal section, 3–4.5×1.5–3 μ in cross section, arranged rather loosely in 4 or 5 rows in radial directions, ca. 1/9 as thick as the medulla; medulla of cylindrical cells which bear rigid refractive cell-walls, 21–42×4.5–6 μ in longitudinal section, 4.5–13.5 μ diam. in cross section.

KANNO and MATUBARA reported the presence of nemathecia on the Saghalien specimens all the year round, but the present writer failed to find them in the Kurile specimens, collected in August. The people of Tomari, Kunasiri Isl., harvest the present alga for manufacturing agar-agar in recent times.

Habitat and locality of var. *tobuchiensis*. Growing abundantly on the sandy bottom, forming thick layers in the depths of 2–6 fathoms in the sublittoral zone.

S. Kuriles. Kunasiri Isl.—Tomari.

Distrib. *Sp.*—Atlantic Ocean, Arctic Ocean, Bering Sea (St. Lawrence Isl., Konyam Bay, Port Clarence), Alaska, Washington, Okhotsk Sea and Japan (Korea, Saghalien, Hokkaido and the Kuriles); var. *tobuchiensis*—Japan (Saghalien and the Kuriles).

Family 14. *Gigartinaceae*

Key to the genera

I. Cystocarps formed within the papillate processes on the margin or on the surface of frond ..... *Gigartina* (24)

II. Cystocarps formed within the frond, being scattered as spots.

A. Frond more or less complanate, broad-linear, broad-cuneate, and dichotomously branched; cystocarps scattered mostly on the upper part of the frond, making one surface elevated ..... *Chondrus* (25)

B. Frond complanate, narrow-cuneate below, abruptly expanded above, entire or 1–8 times repeatedly and dichotomously divided; cystocarps scattered on the whole frond except basal parts, making both surfaces hemispherically elevated.

1. Tetrasporangial sori formed deeply within the medulla .... *Iridophycus* (26)

2. Tetrasporangial sori formed within the subcortical layer .... *Rhodoglossum* (27)

24. *Gigartina* STACKHOUSE, 1809

Key to the species

I. Frond having papillate processes not only on the marginal portions but also on both surfaces ..... 1. *G. unalaschcensis*

II. Frond having papillate processes (sometimes lobules) only on the terminal and upper lateral margins ..... 2. *G. ochotensis*

1. *Gigartina unalaschcensis* (RUPRECHT) RUPRECHT

(Pl. IV, figs. 31, 32)

in litt. Herb Acad. Petropol.—DE TONI, Syll. Alg. IV, 1, p. 228; VI, p. 177—YENDO, Notes Alg. New to Jap. IV, p. 54, fig. 2—SINOVA, Alg. Mer Ochotsk, p. 107—INAGAKI, Mar. Red. Alg. Osyoro Bay, Hokkaido, p. 33—SETCHELL & GARDNER, Gigartina, p. 282, pl. LIX—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 20—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 209—OKAMURA, Mar. Alg. Jap. p. 652, fig. 310.

Chondrus mamillosus var. *unalaschcensis* RUPRECHT, Tange Och. Meeres, (1851), p. 318.

Jap. name. Ibonori.

Fronds gregarious, arising from a callous disc, subcoriaceous, once or twice, rarely up to 5 times dichotomously divided, slightly curved inwardly and crispate at the apices, narrow-cuneate at the bases, commonly fan-shaped or reniform in expansion, dark reddish

purple, 3–7 cm. high, 300–600 μ thick, usually with numerous, simple or rarely elongated and irregularly branched papillate processes on the terminal and lateral margin and also with a few processes on both surfaces; segments broad-cuneate with wide roundish sini, 0.5–4.5 cm. wide at the broadest part; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 7–9 rows of small, ellipsoidal cells, arranged closely with their longer axis perpendicular to the surface of the frond; subcortical layer of somewhat larger subglobose, ovoid or irregular cells, rather loosely arranged, joined with the neighbouring cells by plasmic threads, 1.5–2 times as thick as the cortex; medulla of slender anastomosing rhizoidal cells, joined with the neighbouring cells by plasmic threads, nearly as thick as the subcortical layer; cystocarps formed immersed within the papillate processes, 1 or 2 in each process, carpospores subglobose, ovoid, ellipsoid, oblong or polygonal, 15–21×9–10.5 μ or 12–14 μ diam.; tetrasporangia not found in the writer's specimens.

Key to the forms

I. Marginal processes short, papillate.
  A. Segments narrow, 7–12 mm. wide at the broadest part ..... f. *typica*
  B. Segments wide, 2.5–4.5 cm. wide at the broadest part....f. *grandifolia*
II. Marginal processes elongated and irregularly branched ..... f. *irregularis*

f. *typica* NAGAI, f. nov.

(Pl. IV, fig. 32)

Fronde 3–6 cm. alta; segmentis 5–12 mm. in latitudine maxima; papillis marginis multis minutis.

f. *grandifolia* NAGAI, f. nov.

(Pl. IV, fig. 31)

Gigartina pacifica KJELLMAN, Beringhafv. Algfl. (1889), p. 31, Tab. I, fig. 21, 22—DE TONI, Syll. Alg. IV, 1, p. 217—OKAMURA, Icon. Jap. Alg. I, 7, p. 165, pl. XXXIV, fig. 1–8; Nippon Sorui Meii, ed. 2, p. 31—YENDO, Kaisan-Syokubutugaku, p. 609, fig. 172—YAMADA, Mar. Alg. N. Kuriles, p. 348.

G. unalaskensis YENDO, Notes. IV, (1916), fig. 2.

G. unalaskensis OKAMURA, Mar. Alg. Jap. (1936), fig. 310.

Fronde 5–7 cm. alta; segmentis 2.5–4.5 cm. in latitudine maxima; papillis marginis multis minutis.

f. *irregularis* NAGAI, f. nov.

Fronde 3–4 cm. alta; segmentis 7–10 mm. in latitudine maxima; pinnulis marginis elongatis, irregulariter divisis, ad usque 8 mm. longis, papillis ad apices prolificationibus formatis.

Among the specimens from Hokkaido and the Kuriles, there are found at least three forms in the present species, though with only slight differences in shape and dimension among them. Most of the specimens are referred to f. *typica*. They are 1 to 5 times dichotomously divided. The division occurs deeply below and shallowly above the frond. They are flabellate or reniform in general outline. On the terminal and lateral margins of the frond, there are abundant papillate processes and some appear on one or both of the surfaces. In some specimens, the upper lobes are palmately divided. They are narrow and short. The narrower specimens somewhat resemble the broad form of *G. ochotensis* RUPR., but they differ from the latter by having some processes on the surface of the frond. Forma *grandifolia* is characteristic in the comparatively large, scarcely or several times divided fronds which are usually broader than those of f. *typica*. The fronds are broad-cuneate at the bases and crispate at the apices. The processes are abundant on the margin and the surface of the frond. The specimens, referable to the present form, measure 5 to 7 cm. high and 2.5 to 4.5 cm. wide at the broadest part. This form appears to correspond to YENDO's plant which was delineated in fig. 2 in his "Notes on Algae new to Japan", IV. As to YENDO's plant, SETCHELL thinks it an extreme form or a broad form verging toward *G. pacifica* KJELLM. Forma *irregularis* was rarely found in the Kuriles. It is characteristic in the irregular branching of the processes on the margin of the frond. Such an irregularity was also mentioned by YENDO in his plant. (Cfr. l.c. 1916, p. 57).

On the specimens from Hurukamappu, Kunasiri Isl., an epiphytic Myxophyceae, *Dermocarpa pacifica* SETCH. et GARDN. was often found, as already stated under that alga.

Habitat and localities. Growing gregariously on rocks in tide-pools in the littoral zone.

f. *typica*.

M. Kuriles. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Misima.

S. Kuriles. Etorohu Isl.—Wenbetu, Iriribusi, Tosirari, Arimoe. Sikotan Isl.—Syakotan, Tiboi. Kunasiri Isl.—Rebun-iso, Wennai, Tohutu, Sokobetu, Sibetoro, Kotankesi.

f. *grandifolia.*

N. Kuriles. Paramusiru Isl.—Noda-wan (YAMADA).

S. Kuriles. Sikotan Isl.—Syakotan. Kunasiri Isl.—Hurukamappu, Tohutu.

f. *irregularis.*

S. Kuriles. Kunasiri Isl.—Tohutu.

Distrib. *Sp.*—Alaska, Okhotsk Sea and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles); f. *grandifolia*—Bering Isl. and Japan (Hokkaido and the Kuriles); f. *irregularis*—endemic (the Kuriles).

2. *Gigartina ochotensis* RUPRECHT

(Pl. IV, figs. 33, 34)

in litt. Herb. Acad. Petropol.—DE TONI, Syll. Alg. IV, 1, p. 228; VI, p. 182—YENDO, Notes Alg. New to Jap. IV, p. 57, fig. 4—OKAMURA, Icon. Jap. Alg. V, 10, p. 183, pl. CCXLVII, fig. 9; Mar. Alg. Jap. p. 651—SINOVA, Alg. Mer Ochotsk, p. 107; Alg. Kamtschatka, p. 30.

Chondrus mamillosus var. *ochotensis* RUPRECHT, Tange Och. Meeres, (1851), p. 318.

Jap. name. Hoso-ibonori.

Fronds gregarious, arising from a callous disc, subcoriaceous, small, narrow, 3–8 times di-, rarely trichotomously or subpinnately or partly fasciculately or polychotomously divided, dark brownish purple, 2.5–4 cm. high 420–660 μ thick; segments narrow-cuneate or narrow-linear, with papillate processes or flat lobules on the terminal margin, rarely also on the upper lateral margins, 0.5–4 mm. wide at the broadest part; tissue composed of 3 layers, cortical subcortical and medullary; cortex of 5–7 rows of abundant, small, ellipsoidal cells, arranged closely with their longer axis perpendicular to the surface of the frond; subcortical layer of rather loosely arranged, somewhat larger, subglobose, ovoid or irregular cells, joined by plasmic threads with each other, 1.5–2 times as thick as the cortex; medulla of slender rhizoidal cells, anastomosing, 0.5–3 times as thick as the subcortical layer; cystocarps formed within the papillate processes on the margins of the segments, 1 or 2 individuals within each process, carpospores subglobose, ellipsoid, ovoid, oblong, 10.5–15×7.5–9 μ or 7.5–12 μ diam.; tetrasporangia not found in the writer's specimens.

Key to the forms

I. Fronds large, 3–4 cm. high, regularly di- or rarely trichotomously or subpinnately divided; segments 2.5–4 mm. wide ..... f. *typica*
II. Fronds small, 2.5–3 cm. high, dichotomously below, but more or less fasciculately divided above; lower segments 1.5–2.5 mm., upper ones 0.5–2 mm. wide ..... f. *dissecta*

f. *typica* NAGAI, f. nov.

(Pl. IV, fig. 33)

Fronde majore et latiore, 3–4 cm. alta; segmentis 2.5–4 mm. in latitudine maxima.

f. *dissecta* NAGAI, f. nov.

(Pl. IV, fig. 34)

Fronde quam f. *typica* minore, angustiore et multidivisa, 2.5–3 cm. alta; segmentis inferne 1.5–2.5 mm. in latitudine maxima, superne 0.5–2 mm. latis.

RUPRECHT describes the present species as follows. "Die vielen mitgebrachten Exemplare dieser Var. *Ochotensis* (*Chondrus mamillosus*) sind immer klein, höchstens 1½ Zoll lang, mehr handförmig als gabelig getheilt; alle Lappen, weniger als 1 Lin. breit, gegen ihren Ursprung noch mehr verschmälert, kommen aus Stellen, wo das ursprüngliche Laub sich allmälig bis 2, höchstens 3 Linien ausgebreitet hat; Fruchtwarzen sind nur sparsam in den Endlappen order am Rande derselben." The present writer referred his specimens which accord well to the above description by RUPRECHT, to f. *typica*. As mentioned by YENDO, the present species stands very closely to *G. unalaschcensis* RUPR. It is often hardly distinguishable from the small simple form of the latter species. However the present species is characterized by the narrower segments and the absolute absence of the papillate processes on the surface of the frond. Forma *dissecta* is separable from f. *typica* by the smaller, narrower and much more divided fronds. In the present form, the branching of the fronds occurs mostly dichotomously, but sometimes fasciculately or polychotomously above.

On the fronds of the present species, an epiphytic Myxophyceae, *Dermocarpa pacifica* SETCH. et GARDN. was several times found as in the case of *G. unalaschcensis* RUPR.

Habitat and localities. Growing gregariously on rocks in tide-pools in the littoral zone.

f. *typica.*

N. Kuriles. Paramusiru Isl.—Murakami-wan. Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Misima.

S. Kuriles. Etorohu Isl.—Moyoro, Sibetoro, Bettobu, Arimoe, Syana. Sikotan Isl.—Syakotan, Tiboi, Aimizaki. Kunasiri Isl.—Rebun-iso, Seseki near Wennai, Hurukamappu, Tohutu.

f. *dissecta.*

N. Kuriles. Paramusiru Isl.—Kakumabetu.

M. Kuriles. Usisiru Isl.—Kitazima. Uruppu Isl.—Misima.

Distrib. *Sp.*—Okhotsk Sea, Kamchatka and Japan (Korea, Hokkaido and the Kuriles); f. *dissecta*—endemic (the Kuriles).

25. *Chondrus* STACKHOUSE, 1797

Chondrus pinnulatus (HARVEY) OKAMURA

Icon. Jap. Alg. VI, 3, (1930), p. 19, pl. CCLXI, pl. CCLXIII, fig. 1–6; Mar. Alg. Jap. p. 657—TOKIDA, Mar. Alg. Robben Isl. p. 13, pl. V, fig. b—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 209.

Gymnogongrus pinnulatus HARVEY, in GRAY's List of Plants collected in Japan, (1856), p. 332—MARTENS, Tange Ost-Asien, p. 133—J. AGARDH, Sp. Alg. III, 1, (Epicr.), p. 214—DE TONI, Syll. Alg. IV, 1, p. 253—YENDO, Kaisan-Syokubutugaku, p. 618, fig. 176—OKAMURA, Nippon Sorui Meii, ed. 2, p. 33.

Jap. name. Hirakotozi.

Key to the forms

I. Frond regularly and sparsely branched; upper ramuli compresso-subulate, not much branched ..... f. *typicus*

II. Frond branched densely above; upper ramuli broad, di- or polychotomously or short-palmately branched ..... f. *conglobatus*

f. *typicus* NAGAI, f. nov.

Ramulis superis linearibus vel compresso-subulatis, forcipatis, non dense divisis.

f. *conglobatus* NAGAI, f. nov.

Ramulis superis saepe latis, di- vel polychotomo divisis, vel breviter palmatis, dense conglobatis.

The present species is rather widely distributed in northern Japan, from Northeastern Honsyu northward to the Kuriles and Saghalien as well as in Korea. However it was found only in the southern islands of the Kuriles. Forma *conglobatus* is usually smaller than f. *typicus*. It is characteristic in a denser formation of the branches which are provided with somewhat broadened ramuli.

Habitat and localities. Growing on rocks in the lower littoral zone.

f. *typicus*.

S. Kuriles. Etorohu Isl.—Tosirari, Sibetoro, Bettobu, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan, Notoro. Kunasiri Isl.—Tokaisen, Rebun-iso, Wennai, Seseki near Wennai, Hurukamappu, Tohutu, Syarikisimoi, Sibetoro, Kotankesi.

f. *conglobatus*.

S. Kuriles. Etorohu Isl.—Wenbetu, Tosirari, Sibetoro, Bettobu. Kunasiri Isl.—Rebun-iso.

Distrib. *Sp.*—Japan (Korea, Northeastern Honsyu, Hokkaido, Saghalien and the Kuriles); f. *conglobatus*—endemic (the Kuriles).

26. *Iridophycus* SETCHELL et GARDNER, 1936

Key to the species

I. Frond entire or lobed.
  A. Frond ovate with shallow or deep bifurcate apex, rarely twice dichotomously divided ..... *I. cornucopiae* (1)
  B. Frond broad, cordate or between cordate and elliptic....*I. cordatum* (2)
II. Frond 3–5 times repeatedly and dichotomously, or rarely palmately divided ..... *I. subdichotomum* (3)

1. *Iridophycus cornucopiae* (POST. et RUPR.) SETCHELL et GARDNER

Iridophycus in N. Hemisphere, (1937), p. 170.

Iridaea cornucopiae POSTELS et RUPRECHT, Ill. Alg. (1840), p. 18, Pl. XXXVIII, fig. b.

I. laminarioides var. *cornucopiae* J. AGARDH, Sp. Alg. II, 1, (1851), p. 253; III, 1, (Epicr.), p. 180—YENDO, Notes Alg. New to Jap. VI, p. 78, fig. 1, 2—YAMADA, Mar. Alg. N. Kuriles, p. 348; Mar. Alg. Urup, p. 23—OKAMURA, Mar. Alg. Jap. p. 658, fig. 313.

Jap. name. Atuba-ginnanso.

Fronds caespitose, arising from a small scutate disc, for 1.5–3.5 cm. in length, below narrow-cuneate, naked and stem-like with 3–6 mm. width at the broadest part, cartilaginous, complanate, becoming then expanded or shallowly or deeply bifurcate, rarely twice dichotomously divided above, reddish purple, sometimes partly yellowish red or even yellowish green, 8–12 cm. high; stipe indistinct; lobes ovate or laterally expanded with bifid apices, entire or undulate and crenate, rarely with proliferous lobes on the margin, 8–18×4–11 cm.; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 4–5 rows of small, ellipsoidal cells, arranged closely with their longer axis perpendicular to the surface; subcortical layer composed of 3–5 series of subglobular cells, arranged in anticlinal order, nearly as thick as the cortex; medulla of network of slender fibres, measuring ca. 9 μ diam., with small meshes; cystocarps scattered rather widely on the whole frond except the basal portion, making both surfaces somewhat hemispherically elevated, 1–1.5 mm. diam., immersed deeply within the medulla, carpospores ovoid, oblong subglobose, 13.5–36×7.5–21 μ; tetrasporangial sori small, scattered widely on the whole frond except the basal portion, making both surfaces slightly elevated, round or ovate, not often confluent with each other, tetraspores subglobose, ovoid, elliptic-ovoid, cruciate, 33–42×21–27 μ.

The present species is widely distributed in the Kuriles. Comparing with the distribution of *I. subdichotomum*, however, it is more abundantly found in the South Kuriles and in Hokkaido.

Habitat and localities. Growing on rocks in the littoral zone.

N. Kuriles. Paramusiru Isl.—Murakami-wan, Kakumabetu (YAMADA).

M. Kuriles. Onnekotan Isl.—Nemo-wan. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune (YAMADA), Tokotan, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Tosirari, Sibetoro, Bettobu, Syana, Arimoe, Kamuikotan. Sikotan Isl.—Aimizaki. Kunasiri Isl.—Atoiya, Rebun-iso, Sokobetu.

Distrib. Kamchatka and Japan (Hokkaido and the Kuriles).

2. *Iridophycus cordatum* (TURNER) SETCHELL et GARDNER

Iridophycus in N. Hemisphere, (1937), p. 170.

Iridaea laminarioides f. *cordata* SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 299—YENDO, Notes Alg. New to Jap. VI, p. 80 (sub variety)—DE TONI, Syll. Alg. VI, p. 173—SINOVA, Alg. Mer Ochotsk, p. 106—OKAMURA, Mar. Alg. Jap. p. 659 (sub variety).

Fucus cordatus TURNER, Fuci, II, (1809), p. 118, pl. CXVI.
Iridaea cordata, J. AGARDH, Sp. Alg. II, 1, (1851), p. 254; III, 1, (Epicr.), p. 180—HARVEY, Ner. Bor.-Amer. II, p. 180—KÜTZING, Sp. Alg. p. 725; Tab. Phyc. XVII, Tab. 6, fig. a, b—DE TONI, Syll. Alg. IV, 1, p. 186.

YENDO reported the present species under the name *Iridaea laminarioides* var. *cordata* as growing on the Okhotsk and Pacific sides of the South Kuriles. However, there are no specimens in the writer's collection referable to the present species with certainty.

Localities. Okhotsk and Pacific sides of the South Kuriles.

Distrib. Alaska to Washington, Okhotsk Sea and Japan (the Kuriles).

3. *Iridophycus subdichotomum* NAGAI, sp. nov.

(Pl. VI, fig. 5)

Jap. name. Tisima-ginnan (n. n.).

Fronde cartilaginea, complanata, ad 1/3 distantiam a basi anguste cuneata, 3–4 cm. longa, 5–8 mm. in latitudine maxima, superne 3–5-plo dichotoma vel raro palmata, atropurpurea, 8–19 cm. alta; stipitibus distinctis, teretibus, brevissimis, ca. 1 mm. diam.; lobis oblongo-ovatis, marginibus saepe leviter crispatis, apicibus simplicibus rotundis vel bifidis, 1–3.5 cm., plerumque 2–2.5 cm. latis; textu e cortice, strato subcorticale et medulla composito: cortice e cellulis minutis, elongatis vel ellipsoideis, ad superficiem perpendiculariter 5–7 ordinatis dispositis; strato subcorticale e cellulis paene globosis, 4–5-anticlinis ordinatis, quam cortice 1–1.5-plo crassiore; medulla e filamenteis, libere aperteque anastomosantibus, ca. 7.5 μ diam.; cystocarpiis copiosis, parvis, 0.5–1 mm. diam., in medulla profunde positis, super latera frondis utraque multum protuberantibus, carposporis ovoideis, ovato-oblongis, oblongis, 15–25.5×10.5–15 μ; soris tetrasporangiferis numerosis, rotundis, ovatis, aliquando confluentibus, leviter super latera utraque protuberantibus, tetrasporis subglobosis, ovoideis, ellipsoideis, elliptico-ovoideis, cruciatis, 33–39× 24–30 μ.

The present species is characteristic in the narrower and 3 to 5 times repeatedly dichotomous or rarely palmate fronds. The fronds are caespitose, arising from a small scutate disc, and have very short, slender, cylindrical stipes, measuring scarcely 1 mm. diam., becoming then flattened above and narrow-cuneate for about one-

third of the whole length before division into lobes. They measure 8 to 19 cm. high and are dark reddish purple in color. The lobes are oblong-ovate with cuneate bases, round or bifid at apices, and entire or slightly crispate on margin. They measure 1 to 3.5 cm., mostly 2 to 2.5 cm. wide at the broadest part. The fronds are fairly thick. The tissue of the frond is composed of 3 layers, cortical, subcortical and medullary. The cortex consists of 5 to 7 rows of small, elongate or ellipsoidal cells which are arranged closely with their longer axis perpendicular to the surface of the frond. The subcortical layer is about 1 to 1.5 times as thick as the cortex, consisting of 4 to 5 series of subglobular cells which are arranged in anticlinal order. The medulla is composed of a fine, broad network of slender fibres with small meshes. The slender fibres of the network measure about 7.5 μ in diameter. The cystocarps are observed, being scattered widely on the upper lobes deeply immersed within the medulla, and making both surfaces of the frond hemispherically elevated. They measure about 0.5 to 1 mm. diam. in surface view. The carpospores are ovoid, ovate-oblong, oblong, measuring 15–25.5×10.5–15 μ. The tetrasporangial sori are observed being scattered widely on the upper lobes as in the case of the cystocarps, causing both surfaces of the frond to be slightly elevated. They are round or ovate in surface view and sometimes become confluent with each other. The tetraspores are subglobose, ovoid, ellipsoid, elliptic ovoid, and cruciate. They measure 33–39×24–30 μ.

It is probable that the species in question belongs to the Section Chondridaea SETCH. et GARDN., lying close to *I. dichotomum* (HOOK. fil. et HARV.) SETCH. et GARDN. But it differs from the latter in lacking the lateral, marginal fimbriae and leaflets. The present species is rather widely distributed from the North Kuriles southward to the eastern coast of Hokkaido.

Habitat and localities. Growing on rocks in the littoral zone.

N. Kuriles. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kamogawa, Kakumabetu.

M. Kuriles. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari. Uruppu Isl.—Kobune, Anama, Tokotan, Ahunruimoi.

S. Kuriles. Etorohu Isl.—Moyoro, Wenbetu. Sikotan Isl.—Syakotan. Kunasiri Isl.—Ponkotan, Syarikisimoi.

Distrib. Japan (Hokkaido and the Kuriles).

27. *Rhodoglossum* J. AGARDH, 1876

Rhodoglossum pulchrum (KÜTZING) SETCHELL et GARDNER

Iridophycus Gen. Nov. & its Represent. in S. Amer. (1936), p. 472.

Iridaea pulchra KÜTZING, Sp. Alg. (1849), p. 725; Tab. Phyc. XVII, Tab. 5, fig. c, d—DE TONI, Syll. Alg. IV, 1, p. 194; VI, p. 174—YENDO, Kaisan-Syokubutugaku, fig. 169 (fig. sinistr.); Notes Alg. New to Jap. VI, p. 81—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 31—OKAMURA, Mar. Alg. Jap. p. 660—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 209.

Jap. name. Usuba-ginnanso, Akaba-ginnanso.

Fronds caespitose, cartilaginous, complanate, arising from a scutate disc, for ca. 1/3–1/5 of the whole length, below broad-linear to narrow-cuneate, naked and stem-like, 2–5 mm. wide, then repeatedly and dichotomously branched above, with broad- or narrow-ovate lobes, rarely simple, not divided, crimson purple, sometimes partly yellowish green, 12–30 cm. high, 225–600 μ thick; lobes simple or bifid, ovate or elliptic ovate with round apices, broad-cuneate below; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of 3–4 rows of small, ellipsoidal cells, arranged closely with their longer axis perpendicular to the surface; subcortical layer of ca. 5–6 series of somewhat larger subglobose cells, arranged in anticlinal order; medulla of abundant, elongate cells, joined with the neighbouring cells by plasmic threads; cystocarps scattered richly on the whole of the frond, immersed within the medulla, making both surfaces of the frond hemispherically elevated ca. 2/3 mm., rarely 1 mm. diam. in surface view, carpospores ovoid, ovate-ellipsoid, ovate-oblong, or polygonal, 36–57×21–30 μ; tetrasporangial sori scattered on the whole of the frond slightly elevated, immersed within the subcortical layer, round or ovate, 1/3–1/2 mm. diam. in surface view, tetraspores ovoid, ovate-oblong, cruciate or tripartite, 48–72×33–45 μ.

Key to the forms

I. Lobes ovate or ovate-elliptic with round or bifid apices.
  A. Frond simple or 1–2 times dichotomously divided ..... f. *typicum*
  B. Frond 3–5 times dichotomously divided ..... f. *divergens*
II. Lobes linear-cuneate with round or bifid apices; frond 5–8 times dichotomously divided ..... f. *luxurians*

f. *typicum* NAGAI, f. nov.

Fronde simplice, ovata vel ovato-elliptica cum apicibus rotundatis vel bifidis, aliquando profunde 1–2-plo dichotoma, 7.5–15 cm. longa, 3.5–6 cm. lata, raro amplissima, ca. 30 cm. longa, 5.5–12–17 cm. lata, basi late cuneata vel rotundata.

f. *divergens* NAGAI, f. nov.

Fronde profunde 3–5-plo dichotoma; lobis ovatis vel ovato-ellipticis cum apicibus rotundatis vel profunde bifidis, 3.5–7–13 cm. longis, 1.5–3.5–6 cm. latis, basi late cuneata.

f. *luxurians* NAGAI, f. nov.

Fronde produnde 5–8-plo dichotoma; lobis lineari-cuneatis cum apicibus obtusis, rotundatis vel leviter bifidis, 1.5–4 cm. longa, 0.5–1.5 cm. lata.

In f. *typicum*, the frond is simple or sometimes barely divided into 2, very rarely 4 lobes. The lobes are of medium size, measuring about 7 to 9 cm. long, including their narrowed bases. The present form bears somewhat larger fronds in comparison with the other forms. This form appears to correspond to KÜTZING's plant. In f. *divergens*, the frond is dichotomously and repeatedly divided 3 to 5 times. The present form does not often attain to a dimension so large as the simple, undivided form, but is nearly as high as the bilobed one of f. *typicum*. Forma *divergens* is commonly found in the South Kuriles. In f. *luxurians*, the frond is divided dichotomously and repeatedly 5 to 8 times. The frond of the present form is narrow-cuneate, having narrow lobes, while the lobes of the other forms are usually ovate-elliptic. Forma *luxurians* is found more frequently in the North Kuriles than the other parts of the Archipelago.

Habitat and localities. Growing on rocks in the littoral zone.

f. *typicum*.

S. Kuriles. Etorohu Isl.—Moyoro. Sikotan Isl.—Syakotan, Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Idasibenai, Rebun-iso, Kuraoi.

f. *divergens*.

N. Kuriles. Paramusiru Isl.—Suribati-wan.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Wenbetu, Iriribusi, Sibetoro, Kamuikotan. Sikotan Isl.—Syakotan, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Tokaisen, Idasibenai, Rebun-iso, Kuraoi, Seoi, Seseki near Wennai.

f. *luxurians*.

N. Kuriles. Paramusiru Isl.—Suribati-wan, Murakami-wan.
S. Kuriles. Sikotan Isl.—Syakotan, Notoro. Kunasiri Isl.—Kuraoi.

Distrib. *Sp.*—Kamchatka and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles); f. *divergens* and f. *luxurians*—endemic (the Kuriles).

Order IV. Rhodymeniales

Family 15. *Rhodymeniaceae*

Key to the genera

I. Frond solid ..... 28. *Rhodymenia*
II. Frond solid when young, becoming hollow later ..... 29. *Halosaccion*

Subfamily. *Rhodymenieae*

28. *Rhodymenia* GREVILLE, 1830

Key to the species

I. Frond coriaceous to submembranaceous, variable in shape, without perforations ..... 1. *R. palmata*
II. Frond membranaceous, obovate with cuneate base, usually with perforations ..... 2. *R. pertusa*

1. *Rhodymenia palmata* (L.) GREVILLE

(Pl. VI, fig. 6)

Alg. Brit. (1830), p. 93—HARVEY, Phyc. Brit. II, pl. CCXVII; Ner. Bor.-Amer. II, p. 148—J. AGARDH, Sp. Alg. II, 2, p. 376; III, 1, (Epicr.), p. 329—KJELLMAN, Alg. Arct. Sea, p. 147—DE TONI, Syll. Alg. IV, 2, p. 512; VI, p. 289—OKAMURA, Nippon Sorui Meii, ed. 1, p. 43, ed. 2, p. 48; Mar. Alg. Jap. p. 674, fig. 322 (1)—SETCHELL & GARDNER, Alg. N. W. Amer. p. 314—YENDO, Kaisan-Syokubutugaku, p. 659, fig. 188, 189—KYLIN, Mar. Red Alg. Friday Harb. p. 41; Florideenordn. Rhodym. p. 22—SINOVA, Alg. Mer Ochotsk, p. 113; Alg. Kamtschatka, p. 32—ROSENVINGE, Mar. Alg. Denmark, IV, p. 569, fig. 564–571—TOKIDA, Mar. Alg. Robben Isl. p. 16—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 46—YAMADA, Mar. Alg. N. Kuriles, p. 349; Mar. Alg. Urup, p. 23—KAWABATA, List Mar. Alg. Isl. Shikotan. p. 209—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 306, pl. XLI, fig. 7, pl. XLII, fig. 3.

Fucus palmatus LINNAEUS, Sp. Pl. ed. 2, (1763), p. 1636—TURNER, Fuci, II, p. 114, pl. CXV.

F. dulcis GMELIN, Hist. Fuc. (1768), p. 189, Tab. XXVI.

Halymenia palmata AGARDH, Sp. Alg. I, 1, (1820), p. 204—POSTELS et RUPRECHT, Ill. Alg. p. 18, Tab. XXXIV.

Sphaerococcus palmatus KÜTZING, Sp. Alg. (1849), p. 781; Tab. Phyc. XVIII, Tab. 89, 90.

Jap. name. Darusu.

Key to the forms and subforms

I. Frond coriaceous or subcoriaceous.
  A. Frond of moderate width, 0.8–3 cm. wide.
    1. Frond without proliferations, rather simple, linear to subpalmate.
      a. Frond linear to linear-lanceolate ..... f. *typica* subf. *linearis*
      b. Frond 1–5, mostly 1–3 times dichotomously divided, when many times divided, appears subpalmate ..... f. *typica* subf. *nuda*
    2. Frond consisting of a few to many segments which are proliferated from the margin of almost decayed frond of the previous year... ..... f. *prolifera*
  B. Frond narrow, 0.1–0.8 cm. wide, 4–8 times di- or trichotomously divided ..... f. *sarniensis*

II. Frond submembranaceous.
  A. Frond ample, obovate, sometimes 1–3 times dichotomously divided, without proliferations ..... f. *grandifolia*
  B. Frond linear-lanceolate, without or with a few proliferations, richly variegated with abundant, deep colored dots..... f. *ochotensis*

f. *typica* KJELLMAN

Alg. Arct. Sea, (1883), p. 147—OKAMURA, Alg. fr. Alaska, p. 90, pl. IV, fig. 4, 5; Mar. Alg. Jap. p. 675; Icon. Jap. Alg. VII, 9, p. 76, pl. CCCXLIII, fig. 4–9, pl. CCCXLIV, fig. 6.

Frond coriaceous or subcoriaceous, dark purplish red, simple, linear or 1–5 times divided into subpalmate form, without proliferations, mostly 2–3 cm. wide, 150–300 μ thick; tetrasporangia oblong to ovoid, tetraspores cruciate, 36–45×15–18 μ.

subf. *linearis* SETCHELL et GARDNER

l.c. (1903), p. 315.

Frond simple, linear to linear-lanceolate, without proliferations, rounded at the apex, 19–42 cm. long, 1–3.5 cm., mostly 2–3 cm. wide.

subf. *nuda* KJELLMAN

l.c. (1883), p. 147.

Frond rather simple, 1–5, mostly 1–3 times dichotomously divided into subpalmate form, without proliferations, more or less attenuate or rounded at the apex, in typical ones 20–36 cm. long; segments 1–5 cm., mostly 2–3 cm. wide.

f. *prolifera* (KÜTZING) KJELLMAN

l.c. (1883), p. 148.

Sphaerococcus palmatus γ *prolifer* KÜTZING, Sp. Alg. (1849), p. 781.

Frond consisting of a few to many segments which are proliferated from the margin of the almost decayed frond of the previous year; segments 4–17 cm. long, 0.8–2 cm. wide.

f. *sarniensis* (MERTENS) GREVILLE

Alg. Brit. (1830), p. 93—J. AGARDH, Sp. Alg. II, 2, p. 377; III, 1, (Epicr.), p. 329—KJELLMAN, l.c. p. 148—INAGAKI, l.c. p. 47 (sub variety)—OKAMURA, Mar. Alg. Jap. p. 676 (sub variety); Icon. Jap. Alg. VII, 9, p. 77, pl. CCCXLIV, fig. 7, 8.

Fucus sarniensis MERTENS, in ROTH Cat. Bot. III, (1806), p. 103, fig. 1—TURNER, Fuci, I, p. 95, pl. XLIV.

Halymenia palmata ε *Sarniensis* AGARDH, Sp. Alg. I, 2, (1822), p. 206.

Sphaerococcus sarniensis KÜTZING, Phyc. Gen. (1843), p. 409; Sp. Alg. p. 779.

Frond subcoriaceous, dark to light purplish red, narrow, 4–8 times di- or rarely trichotomously divided, without or with short proliferations on the margin, narrow-cuneate at the base, more or less attenuate at the apex, 15–30 cm. long, 0.1–0.8 cm. wide, 180–240 μ thick.

f. *grandifolia* OKAMURA

Alg. fr. Alaska, (1933), p. 90, pl. IV, fig. 1–3; Mar. Alg. Jap. p. 675; Icon. Jap. Alg. VII, 9, p. 76, pl. 343, fig. 1–3.

Frond submembranaceous, light purplish to yellowish red, ample, obovate with cuneate to broad-cuneate base, sometimes divided dichotomously 1–3 times, rounded at the apex, without proliferations on the margin, 11–54 cm. long, 135–150 μ thick; segments 7–18 cm.

wide; tetrasporangia ellipsoid, ovoid to subglobose, rarely more or less flattened ellipsoid, tetraspores cruciate, rarely tripartite, 21–36 μ diam., or 18–21×30–42 μ.

f. *ochotensis* NAGAI, f. nov.
(Pl. VI, fig. 6).

Fronde submembranacea, diluto- vel obscuro-purpureorubente, lineari-lanceolata, simplice vel lacerata ad marginem inferne paulo, vittis dense coloratis minutis et elongatis tetrasporarum globosarum variegata; segmentis lineari-lanceolatis, 7–50 cm. longis, 0.8–3 cm. latis, 150–240 μ crassis; tetrasporangiis ellipsoideis vel ovoideis, tetrasporia cruciatis, 27–39×21–27 μ.

The present writer has obtained a large number of specimens of this species, among which there are five forms to be referred as above. The forma which is more often found in the Kuriles, is f. *typica*. Next, there come f. *prolifera* and f. *sarniensis*. These are all coriaceous or subcoriaceous forms. There are also found two submembranaceous forms. They are f. *grandifolia* and f. *ochotensis*. As to f. *grandifolia* OKAM., YAMADA states in his "Marine Algae of Urup": "the latter form (f. *grandifolia*) seems to agree well with f. *mollis* SETCH. et GARDN., but not being informed about the characteristics of the surface cells of f. *mollis*, I cannot here enter into the question". There has been deposited an authentic specimen of f. *mollis* from Alaska in our Herbarium, which was kindly donated by the Department of Botany, University of California. This is a sterile, simple specimen, showing linear-lanceolate shape and dividing into two short segments above. It is submembranaceous and dull reddish purple in color. The segments are 7 to 20 cm. long, 0.5 to 18 cm. wide at the broadest part. According to the original description, f. *mollis* appears to be a simple or palmately lobed or cleft, more or less linear-lanceolate to broad-ovate form in general outline. Comparing with the original description and the above authentic specimen of f. *mollis* and the original description of f. *grandifolia*, the writer's specimens appear to be referable to the latter form by the resemblance of the frond color as well as by the more loose arrangement of surface cells, rather than to the former. The another submembranaceous form, f. *ochotensis* f. nov., is closely related to f. *grandifolia* OKAM., but it differs from the latter in the linear and variegate appearances of the frond. In the dotted parts

of the frond, showing variegation, there are observed more or less densely gathered tetrasporangia as stated in the description. They are deep colored. Besides them, there are found deep colored, purple cortical cells in the dotted parts, while there are pale yellowish cortical cells in the light colored parts. Fig. 567 given by ROSENVINGE in his "Marine Algae of Denmark," IV, p. 572, appears to show also such a variegate appearance.

Habitat and localities. Growing gregariously on rocks in the upper sublittoral zone, rarely epiphytic on *Fucus evanescens*.

f. *typica*.

N. Kuriles. Araido Isl.—Uomizaki, Minami-ura. Simusyu Isl.—Tenzin-iwa, Nagasaki. Paramusiru Isl.—Titose-wan, Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Memo-wan, Odomari. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan. Uruppu Isl.—Yosinohama, Kobune, Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Wenbetu, Iriribusi. Sikotan Isl.—Aimizaki, Notoro.

f. *prolifera*.

M. Kuriles. Ketoi Isl.—Minami-ura. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Yosinohama, Misima.

S. Kuriles. Kunasiri Isl.—Wennai.

f. *sarniensis*.

M. Kuriles. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-wan. Simusiru Isl.—Broughton Bay.

S. Kuriles. Etorohu Isl.—Moyoro. Sikotan Isl.—Tiboi. Kunasiri Isl.—Wennai, Tohutu, Sokobetu, Sibetoro, Nisiura.

f. *grandifolia*.

N. Kuriles. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Kakumabetu, Kurosaki.

S. Kuriles. Etorohu Isl.—Kamuikotan. Kunasiri Isl.—Seseki near Wennai.

f. *ochotensis*.

N. Kuriles. Simusyu Isl.—Kosekigawa.

S. Kuriles. Sikotan Isl.—Aimizaki. Kunasiri Isl.—Seseki near Wennai.

Distrib. *Sp.*—Atlantic Ocean, Arctic Ocean, Alaska to Washington, Kamchatka, Okhotsk Sea and Japan (Korea, Honsyu, Hokkaido, Saghalien and the Kuriles); f. *typica*—Arctic Ocean, Alaska and Japan (the Kuriles); f. *prolifera*—Atlantic Ocean, Arctic Ocean and Japan (the Kuriles); f. *sarniensis*—Atlantic Ocean, Arctic

Ocean, Alaska and Japan (Hokkaido and the Kuriles); f. *grandifolia* —Alaska and Japan (the Kuriles); f. *ochotensis*—endemic (the Kuriles).

2. *Rhodymenia pertusa* (POSTELS et RUPRECHT) J. AGARDH

Sp. Alg. II, 2, (1852), p. 376; III, 1, (Epicr), p. 329—HARVEY, Ner. Bor.-Amer. II, p. 147—KJELLMAN, Alg. Arct. Sea, p. 150; Beringhafv. Algfl. p. 28—DE TONI, Syll. Alg. IV, 2, p. 511; VI, p 289—OKAMURA, Nippon Sorui Meii, ed. 1, p. 43, ed. 2, p. 48; Icon. Jap. Alg. I, 5, p. 93, pl. XXI, fig. 1–7; Mar. Alg. Jap. p. 673, fig. 322 (2, 3)—SETCHELL & GARDNER, Alg. N. W. Amer. p. 313—KYLIN, Mar. Red Alg. Friday Harb. p. 41; Entwicklungsgesch. Flor. p. 35, fig. 22, 23; Florideenordn. Rhodym. p. 21—SINOVA, Alg. Mer Ochotsk, p. 112—TOKIDA, Mar. Alg. Robben Isl. p. 17—INAGAKI, Mar. Red. Alg. Osyoro Bay, Hokkaido, p. 46—KAWABATA, List Mar. Alg. Isl. Sikotan, p. 209.

Porphyra pertusa POSTELS et RUPRECHT, Ill. Alg. (1840), p. 20, Tab. XXXVI—KÜTZING, Sp. Alg. p. 693.

Jap. name. Ana-darusu.

The present species is one of the striking species of the Rhodophyceae in the Kuriles. The perforations do not appear in the young frond, but are abundantly found in the old. Fissure of the frond occurs sometimes from near the base to the tips or intercalarly. As mentioned by SETCHELL and GARDNER, the tetrasporic plant is, also in the Kurile specimens, more ample than the cystocarpic plant. The cystocarpic plant is characteristic in having abundant, dark, prominent cystocarps on the whole frond.

Habitat and localities. Found cast ashore.

M. Kuriles. Onnekotan Isl.—Odomari. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Minamizima.

S. Kuriles. Etorohu Isl.—Wenbetu, Iriribusi. Sikotan Isl.—Aimizaki. Kunasiri Isl.—Tokaisen.

Distrib. Arctic Ocean, Greenland, Alaska, Washington, Bering Isl., Kamchatka, Okhotsk Sea and Japan (Korea, Honsyu, Hokkaido, Saghalien and the Kuriles).

29. *Halosaccion* KÜTZING, 1843

Key to the species

I. Frond saccate, simple, not proliferated ..... *H. saccatum* (1)

II. Frond cylindrical or complanate, wholly or partly hollow.
A. Frond firm, cartilaginous or subcartilaginous.
1. Frond spathulate, complanate, becoming sometimes partly hollow.. ..... *H. firmum*(2)
2. Frond narrow-linear, tubular, with numerous segments proliferated from the main axis ..... *H. ramentaceum*(3)
B. Frond tender, flattened oblong or oblong-ovate .... *H. microsporum* var. *subsimplex*(4)

1. *Halosaccion saccatum* KÜTZING

Tab. Phyc. XVI, (1866), Tab. 78, fig. a, b—YENDO, Notes Alg. New to Jap. p. 129—OKAMURA, Nippon Sorui Meii, ed. 2, p. 53; Mar. Alg. Jap. p. 680, fig. 325—DE TONI, Syll. Alg. IV, 2, p. 605; VI, p. 318—TOKIDA, Mar. Alg. Robben Isl. p. 17—YAMADA, Mar. Alg. N. Kuriles, p. 349; Mar. Alg. Urup, p. 24—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 209.

Fucus saccatus TURNER, Fuci, IV, p. 104, pl. CCXLI (excl. fig. d dextra).

Dumontia hydrophora POSTELS et RUPRECHT, Ill. Alg. (1840), p. 19, Tab. XXXV, fig. C—KÜTZING, Sp. Alg. p. 719—J. AGARDH, Sp. Alg. II, 2, p. 358; III, 1, (Epicr.), p. 258.

D. decapitata POSTELS et RUPRECHT, Ill. Alg. (1840), p. 19, Tab. XXXV, fig. E—KÜTZING, Sp. Alg. p. 720.

Halosaccion glandiforme RUPRECHT, Tange Och. Meeres, (1851), p. 279, Tab. XVI—SETCHELL & GARDNER, Alg. N. W. Amer. p. 318 (p. p.).

H. fucicola RUPRECHT, l.c. (1851), p. 293—KÜTZING, Sp. Alg. p. 720—J. AGARDH, Sp. Alg. II, 2, p. 358; III, 1, (Epicr.), p. 258—HARVEY, Ner. Bor.-Amer. II, p. 194—KJELLMAN, Beringhafv. Algfl. p. 29—DE TONI, Syll. Alg. IV, 2, p. 604; VI, p. 318—SAUNDERS, Harriman Alaska Exped. p. 436.

H. Hydrophora J. AGARDH, Sp. Alg. II, 2, (1852), p. 358; III, 1, (Epicr.), p. 258—HARVEY, Ner. Bor.-Amer. II, p. 194—DE TONI, Syll. Alg. IV, 2, p. 604; VI, p. 318—OKAMURA, Nippon Sorui Meii, ed. 1, p. 47—SINOVA, Alg. Mer Ochotsk, p. 114; Alg. Kamtschatka, p. 33.

H. hydrophorum KÜTZING, Tab. Phyc. XVI, (1866), Tab. 78, fig. c.

H. decapitatum KÜTZING, Tab. Phyc. XVI, (1866), Tab. 79, fig. a–h—J. AGARDH, Sp. Alg. II, 2, p. 358.

Jap. name. Beni-hukuronori.

The present species is easily identifiable by the coriaceo-pergameous or tender saccate frond. There are, however, divergencies in size, consistency and color of the frond due to the age and habitat. In the North Kuriles, the present species is often found growing abundantly on flat rocks forming a dense association in the littoral zone. The specimens, collected from such a habitat, are of coriaceo-pergameous, broad-cylindrical frond which attains often to 15 cm. in

length. The color is dark purple. The plant is usually filled up with sea water within the sacks when fresh. As the plant becomes older, the fronds are torn or eroded at the tips and becomes filled up with sand within the whole or a part of the interior. The alga has been sometimes observed growing rather sparsely on rocks. The specimens, collected from such a spot, are of medium size, having rather tender and olive brown frond. In the South Kuriles, the alga was also found epiphytic on the fronds of other algae. In such case, the alga is more tender and dark purplish red to olive brown. As to the shape of the frond, it is typically broad-cylindrical, but sometimes becomes subpiriform. Besides the above forms, polymorphism of the frond is observed in the present species, as suggested by SETCHELL and GARDNER, and also by YENDO. On the specimens from Suribati-wan and Kakumabetu, Paramusiru Isl., there are observed several times an epiphytic Rhodophyceae, *Rhododermis parasitica.*

Habitat and localities. Growing gregariously on rocks in the upper littoral zone in the North Kuriles, but rather sparsely in the same zone in the South Kuriles, occasionally epiphytic on the fronds of other algae and marine Phanerogam, e.g. *Fucus evanescens, Corallina pilulifera, Odonthalia corymbifera, O. aleutica, O. Lyallii, Ptilota Asplenioides, Rhodomela Larix, R. subfusca, Rhodymenia palmata, Phyllospadix sp.* etc.

N. Kuriles. Araido Isl.—Uomizaki. Simusyu Isl.—Tenzin-iwa, Kosekigawa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan. Uruppu Isl.—Yosinohama, Kobune, Misima, Tokotan, Iema (YAMADA), Tomarigawa.

S. Kuriles. Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Tosirari, Sibetoro, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Tiboi, Aimizaki, Notoro, Syakotan, Matakotan. Kunasiri Isl.—Rebun-iso, Pontomari, Seseki near Wennai.

Distrib. Alaska, Bering Isl., Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Halosaccion firmum* (POSTELS et RUPRECHT) RUPRECHT

Tange Och. Meeres, (1851), p. 292—J. AGARDH, Sp. Alg. II, 2, p. 357; III, 1, (Epicr.), p. 259—KÜTZING, Tab. Phyc. XVI, Tab. 78, fig. d-g—KJELLMAN, Beringhafv. Algfl. p. 29—DE TONI, Syll. Alg. IV, 2, p. 605; VI, p. 319—

SAUNDERS, Harriman Alaska Exped. p. 436—YENDO, Notes Alg. New to Jap. p. 131—OKAMURA, Nippon Sorui Meii, ed. 2, p. 53; Mar. Alg. Jap. p. 680—SINOVA, Alg. Kamtschatka, p. 33—YAMADA, Mar. Alg. Urup, p. 23.

Dumontia firma POSTELS et RUPRECHT, Ill. Alg. (1840), p. 19, Tab. XXXV, fig. B, Tab. XL, fig. 82, 83—KÜTZING, Sp. Alg. p. 720.

Jap. name. Kata-benihukuronori.

Fronds caespitose, spathulate, narrow-cuneate toward the bases, rounded at the apices, very rarely once dichotomously divided, firm, thick, subcoriaceous, complanate but slightly bullose in the median part at maturity, in the second year proliferated fasciculately on the top and from the margin of the remaining part of the old frond, dull purplish red, 4–15 cm. long, 0.3–2.3 cm., mostly 1–1.5 cm. wide at the broadest part, 210–300 μ thick; tissue composed of 2 layers, cortical and medullary; cortex of 3–6 rows of small, sub-oblong or sub-cuboidal cells, arranged rather closely with their longer axis perpendicular to the surface of the frond, medulla of 4 or 5 irregular rows of large, thick-walled, irregular cells, filled up with granular contents even after dried, about 5 times as thick as the cortex; cystocarps and tetraspores unknown.

The present species is characteristic in having the firm, subcoriaceous and complanate frond, by which character it differs remarkably from the allied species. Such a complanate frond has been often found in the Kurile specimens, but becomes later slightly bullose in its median portion at the old stage. In these bullose specimens, there occurs a decaying of a row of cells in the central portion of the medulla, showing the separation of both groups of the cells of the medulla into two, upper and lower parts. The separation of the tissue has not been observed anywhere other than in the median portion of the frond at the old stage.

Habitat and localities. Found cast ashore; according to YAMADA, found growing in the littoral zone in Uruppu Isl.

N. Kuriles. Araido Isl.—Uomizaki. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Titose-wan, Kurosaki.

M. Kuriles. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Misima, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Iriribusi, Syana, Rubetu. Sikotan Isl.—Syakotan, Notoro, Tiboi. Kunasiri Isl.—Atoiya, Hurukamappu.

Distrib. Bering Sea (St. Lawrence Isl.), Kamchatka and Japan (Hokkaido and the Kuriles).

3. *Halosaccion ramentaceum* (L.) J. AGARDH

Sp. Alg. II, 2, (1852), p. 358; III, 1, (Epicr.), p. 260—HARVEY, Ner. Bor.-Amer. II, p. 194, pl. XXIX, fig. A—KJELLMAN, Alg. Act. Sea, p. 153—DE TONI, Syll. Alg. IV, 2, p. 606; VI, p. 318—SETCHELL & GARDNER, Alg. N. W. Amer. p. 319—OKAMURA, Nippon Sorui Meii, ed. 2, p. 53; Mar. Alg. Jap. p. 681—SINOVA, Alg. Mer Ochotsk, p 114—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 304.

Fucus ramentaceus LINNAEUS, Syst. Nat. II, p. 718.

Dumontia sobolifera POSTELS et RUPRECHT, Ill. Alg. (1840), p. 19—KÜTZING, Sp. Alg. p. 719.

Halosaccion soboliferum RUPRECHT, Tange Och. Meeres, (1851), p. 268—KÜTZING, Tab. Phyc. XVI, Tab. 81, fig. d, e.

f. *robusta* KJELLMAN

l.c. (1883), p. 153, pl. XII, fig. 4, pl. XIII, fig. 1, 2.

Fronds coriaceo-pergameous, narrow-linear, tubular, attenuate toward both ends, numerously proliferated on the margin of the main axis; segments 3.5–8 cm. long, 1–2.5 mm. wide, 60–120 μ thick; tissue composed of 2 layers, cortical and medullary; cortex of 2 rows of small, cuboidal cells, arranged rather closely with their longer axis perpendicular to the surface of the frond, medulla of several irregular rows of large, irregular cells which are filled up with granular contents, about 2–5 times as thick as the cortex.

In northern Japan, there are found two different forms of Halosaccion, of which one is referable to *H. ramentaceum*, and the other to *H. microsporum*. *H. ramentaceum* is found very often in Saghalien, but not so much as in the Kuriles. The observations were made on the specimens from Saghalien as follows. The frond is coriaceo-pergameous, and composed of numerous narrow (1–2 mm. wide) or broad (5–12 mm. wide) segments which are proliferated close-pinnately from the main axis. Comparing with KJELLMAN's description and figures of the forms of *H. ramentaceum*, in his "Algae of the Arctic Sea", the above alga is referable to f. *robusta*. Comparing with these Saghalien specimens, only a few specimens from the Kuriles are identifiable with the present form.

Habitat and locality of f. *robusta*. Found cast ashore.

S. Kuriles. Kunasiri Isl.—Ponkotan.

Distrib. *Sp.*—Arctic Ocean, North Atlantic, Alaska, Kamchatka, Okhotsk Sea and Japan (Saghalien and the Kuriles); f. *robusta*—Arctic Ocean and Japan (Saghalien and the Kuriles).

4. *Halosaccion microsporum* RUPRECHT

Tange Och. Meeres, (1851), p. 277, Tab. XV—J. AGARDH, Sp. Alg. III, 1, (Epicr.), p. 259—DE TONI, Syll. Alg. IV, 2, p. 606; VI, p. 318—SINOVA, Alg. Kamtschatka, p. 33—NAGAI, Meeresalg. Kamtschatka, p. 18—OKAMURA, Mar. Alg. Jap. p. 681.

var. *subsimplex* RUPRECHT

(Pl. V, fig. 7.)

l.c. (1851), p. 277, Tab. XV, fig. c, d.

Jap. name. Tisima-benihukuro (n. n.).

Fronds caespitose, tender, complanate but becoming somewhat bullose, simple or rarely once or twice dichotomously divided, narrow-cuneate at the bases, slightly dilated upward, rounded at the apices, dull-purplish to dull-yellowish red, 6–26 cm. long, 0.5–4 cm. wide at the broadest part, 45–75 μ thck; tissue composed of 2 layers, cortical and medullary; cortex of 2–4 rows of small, ovate-cuboidal cells, arranged closely with their longer axis perpendicular to the surface of the frond, medulla of about 2 or 3 irregular rows of large, more or less flattened or irregular cells, about 0.5–2 times as thick as the cortex; tetrasporangia abundant, formed within the cortex, ovoid, sometimes subglobose, when immature ellipsoid, tetraspores cruciate, 21–33×30–39 μ.

The specimens that the present writer has obtained are tender, complanate but partly become somewhat bullose. They are simple or, rarely, once or twice dichotomously divided and measure 0.5 to 4 cm. wide at the broadest part. In referring these specimens to the present species, the writer found much trouble, because some algologists have treated the present species as an independent one, while some others amalgamated it with *H. ramentaceum*. The writer would not enter into discussion of this question, but would state merely that his specimens resemble well figs. c and d, pl. XV of RUPRECHT's *H. microsporum* var. *subsimplex* in his "Tange des Ochotskischen Meeres". As to the name of *subsimplex*, KJELLMAN recorded it in a form of *H. ramentaceum* in his "Algae of Arctic Sea", but it appears to be quite different from RUPRECHT's *H. microsporum* var. *subsimplex* by having far narrower fronds. A specimen from Simusyu Isl. in our Herbarium which was collected and determined by YENDO as *H. ramentaceum*, is also referable to the present form of this species. This is a simple, non-divided specimen, of 15 to 19 cm. length and 0.6 to 0.8 cm. width.

Habitat and localities of var. *subsimplex*. Growing on rocks in the littoral zone; according to RUPRECHT, found on the fronds of other algae, e.g., *Rhodomela Larix* (*Fuscaria Larix*), *R. subfusca* (*F. tenuissima*), *Halosaccion ramentaceum* (*H. soboliferum*), etc.

N. Kuriles. Simusyu Isl.—Kataoka-wan? (YENDO). Paramusiru Isl.—Kakumabetu.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai.

Distrib. *Sp.* and var. *subsimplex*—Okhotsk Sea, Kamchatka and Japan (the Kuriles).

Order V. Ceramiales

Family 16. *Ceramiaceae*

Key to the genera

I. Fronds consisting of main axis and branches; both of a single row of jointed cells.
  A. Fronds ecorticate for the whole or the most part of the length.
    1. Main axis and branches without whorls of pinnae or opposite pinnae at the joints ..... *Pleonosporium* (30)
    2. Main axis and branches with whorls of pinnae or opposite pinnae at the joints ..... *Antithamnion* (31)
  B. Fronds corticate ..... *Ceramium* (33)

II. Fronds consisting of main axis and branches; both of many rows of cells, forming tissue ..... *Ptilota* (32)

Subfamily 1. *Monosporeae*

30. *Pleonosporium* NAEGELI, 1861

Pleonosporium Kobayashii OKAMURA

Alg. Alaska, (1933), p. 91, pl. V; Icon. Jap. Alg. VII, 1, p. 4, pl. CCCII, fig. 7–13; Mar. Alg. Jap. p. 700—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211.

Jap. name. Tisima-kusudama.

KAWABATA and OKAMURA respectively reported this species from the Kuriles. But the writer failed to find any specimen referable to the present species in his collection.

Habitat and localities. According to OKAMURA, found epiphytic on the holdfast of *Thalassiophyllum Clathrus;* according to KAWABATA, found on rocks in the tide-pools in the littoral zone.

M. Kuriles. Uruppu Isl. (OKAMURA).
S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. Alaska and Japan (the Kuriles).

Subfamily 2. *Callithamnieae*

31. *Antithamnion* NAEGELI, 1847

Key to the species

I. Each cell in the main axis with 2 opposite pinnae; pinnae slender, with secund or rarely pinnate branchlets; branchlets sharply pointed at the apices ..... *A. Shimamuranum* (1)

II. Each cell in the main axis with whorls of 4 pinnae, or partly with 2 opposite pinnae; pinnae thick, several times pinnately branched, concavely curved upwards; branchlets or pinnulae obtuse or subacute at the apices..*A. sp.* (2)

1. *Antithamnion Shimamuranum* NAGAI, sp. nov.

(Pl. VI, figs. 8–11)

Antithamnion sp. YAMADA, Mar. Alg. Urup, (1934), p. 45.

Fronde caespitosa, 8–20 cm. alta, alterne ramosa; rachide principale e serie singulare cellularum elongatarum composita, nude; cellulis rachidum principalium 120–190 μ diam., diametro 4–7-plo longioribus; pinnis, 240–400 μ longis ad basin 66–81 μ diam., in parte superiore frondis tetrasporangiferae paucis sed cystocarpiferae multis, ad partem mediam ad 2/3 distantiam a basi cellulae, superne prope apicem oppositis, secundatim vel raro 2–7 pinnulatis; pinnulis e 3–6 cellulis compositis, versus apices acutis; cystocarpiis terminalibus, sphaericis, cum pinnis numerosis laxe involvitis, carposporis ovoideis, oblongis, 45–63–27–42 μ; tetrasporangiis solitariis, breviter pedicellatis, ellipticis, cruciatim vel interdum plus minus irregulariter divisis, 60–69×45–60 μ, in parte superiore cellularum pinnularum ornatis.

This is one of the striking algae, found rather widely in the Middle Kuriles. The plant is caespitose, arising from the host, measuring 8 to 20 cm. in height with beautiful red color. The fronds are alternately branched, of which the main axis consists of a single row of ecorticate, elongate cells. The cells of both the main axis and the main branches are 120 to 190 μ diam., 4 to 7 times as long as the breadth with two subulate, opposite pinnae at about two-thirds of the distance from the bases in the middle of the frond,

but nearly at the apices in the upper portions. In the tetrasporic plant, the pinnae at the subapical portions of the frond, are not abundant, but in the cystocarpic plant they are usually crowded around the cystocarps. The pinnae are 240 to 400 μ long, at the bases 66 to 81 μ diam., and bear 2 to 7 secund or rarely pinnate branchlets. The branchlets consist of a row of 3 to 6 cells and taper toward the pointed tips. The cystocarps are subspherical, enwrapped rather loosely with many pinnae as stated above. The ripe carpospores are ovoid or oblong, and measure 45–63×27–42 μ. The tetrasporangia are formed generally on the upper side of the cells of pinnae. They are soiltarily formed on the short, 1 or 2 celled pedicel, ellipsoid and divided cruciately, but sometimes more or less irregularly with likeness to the tripartite division. They measure 60–69×45–60 μ.

The specific name has been given in memory of Mr. MITSUTARO SHIMAMURA who was a good collaborator in the botanizing excursion in Kunasiri Island, 1929. The present species is characteristic in having subulate, opposite pinnae throughout the whole length of the main axis except the upper portions of the cystocarpic frond. In these points the species is nearly related to *A. floccosum* (MÜLL.) KLEEN and *A. pacificum* (HARV.) KYLIN, but it differs from them in the mode of branching of pinnae. According to KYLIN, these species have no pinnulae on the opposite pinnae. On the other hand, it resembles *A. plumula* (ELLIS) THUR., *A. subulatum* (HARV.) J. AG. and *A. occidentale* KYLIN in the subulate shape of pinnae, but it is separable, from the first in wanting of glandular cells and the size of tetrasporangia, from the latter two in having not three or four, but two opposite pinnae. According to ROSENVINGE, the tetrasporangia of *A. plumula* measure 42–45.5×29–40 μ in the specimens from the Skagerak and 35–38×27–30 μ in those from the Little Belt in Danish waters, while those of the writer's are 60–67×45–60 μ in measurement.

Habitat and localities. Epiphytic on the fronds of *Ptilota pectinata* in Simusiru Isl.; found often cast ashore.

M. Kuriles. Matuwa Isl.—Yamato-wan. Rasyuwa Isl. Usisiru Isl.—Kitazima, Minamizima. Ketoi Isl.—Minamiura. Simusiru Isl.—Nakadomari, Simusiru-wan. Uruppu Isl.—Iema (YAMADA).

Distrib. Endemic (the Kuriles).

2. *Antithamnion* sp.

(Pl. V, fig. 4; pl. VI, figs. 12, 13)

Fronds beautiful red, 7–8 cm. high, repeatedly pinnately branched; attached to the substratum by means of rhizoidal filaments; principal rachis consisting of a single row of elongate cells, completely nude; cells of the principal rachis or of main branches 210–330 μ diam., 3–4 times as long as broad in the middle portion, with 4 whorled, sometimes 2, opposite pinnae at about 2/3 of the distance from the bases; pinnae several times pinnately branched, usually concavely curved upward, 51–75 μ diam. at the base, 330–690μ long, with numerous glandular cells on the upper pinnulae; pinnulae consisting of a row of 3–6 cells, obtuse or subacute at the apices; glandular cells elliptic or ovoid, lustrous with light olive brown color, 16.5–21×10.5–15 μ; cystocarps terminal on branches, subspherical in outline, without special involucre-like branchlets, but sometimes loosely enwrapped with normal pinnae, ripe carpospores oblong, oblong-triangular or elliptic-oblong, 40.5–67×21–30 μ; tetrasporangia unknown.

The present writer found only two specimens with cystocarps, epiphytic on the holdfast of *Alaria fistulosa* POST. et RUPR. The present plant is more coarse than the previous species. The plant is characteristic in having rather large and much branched pinnae which are usually concavely recurved upwards. The pinnae are arranged four in whorl and partly two on opposite sides of the cells on the main axis. The present writer cannot now clearly determine the present plant owing to the lack of any tetrasporic plant in the collection, though it appears to be new to science.

Habitat and locality. Epiphytic on the holdfast of *Alaria fistulosa*.

M. Kuriles. Matuwa Isl.—Yamato-wan.

Distrib. Endemic (the Kuriles).

Subfamily 3. *Ptiloteae*

32. *Ptilota* C. AGARDH, 1817

Key to the species

I. Fronds coarse; main axis 1.5–2 mm. wide; pinnulae comparatively large, almost always entire ..... *P. Asplenioides* (1)

II. Fronds slender; (main axis of *P. pectinata* 0.7–1 mm. wide); pinnulae small and finely pinnate.
A. Pinnulae opposite, one slightly serrate and another pinnate ..... *P. pectinata* (2)
B. Pinnulae opposite, both pinnate, though different in size... *P. filicina* (3)

1. *Ptilota Asplenioides* (TURNER) AGARDH

Sp. Alg. I, 2, (1822), p. 387—J. AGARDH, Sp. Alg. II, 1, p. 98; III, 1, (Epicr.), p. 77—KJELLMAN, Beringhafv. Algfl. p. 32—DE TONI, Phyc. Jap. p. 34; Syll. Alg. IV, 3, p. 1379—OKAMURA, Nippon Sorui Meii, ed. 1, p. 77, ed. 2, p. 94; Mar. Alg. Jap. p. 729, fig. 348—SETCHELL & GARDNER, Alg. N. W. Amer. p. 339—TOKIDA, Mar. Alg. Robben Isl. p. 22, pl. VII, fig. a, b—SINOVA, Alg. Kamtschatka, p. 38—YAMADA, Mar. Alg. N. Kuriles, p. 349; Mar. Alg. Urup, p. 24—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211.

Fucus asplenioides TURNER, Fuci, I, (1808), p. 139, pl. LXII.

Rhodocallis asplenioides KÜTZING, Sp. Alg. (1849), p. 671; Tab. Phyc. XII, Tab. 58.

Plumaria asplenioides RUPRECHT, Tange Och. Meeres, (1851), p. 334.

Pterota asplenioides CRAMER, Ceram. (1863), p. 46, Taf. VII, fig. 6–10.

Jap. name. Katawa-benihiba.

The present species is rather widely distributed in northern Japan, being common among the Kuriles, on the eastern coast of Hokkaido and in South Saghalien. As mentioned by TOKIDA in the Saghalien specimens, there are found also two different forms of the present species in the Kuriles, which are separable, if it were proper to do so, by the differences of the shape and size of the pinnulae and their arrangement on the branches. In the type form, the pinnulae are of two kinds; one is simple, linear-lanceolate and entire on margin, the other compound, rather small, alternately short-branched. These pinnulae, belonging to the different kinds, are arranged respectively in alternate order on the branches, showing the pinnate manner in general appearance. In this case, the branched pinnulae are usually smaller than the simple, linear-lanceolate ones, measuring only 3 to 8 mm. long. However, there is found another form, of which the pinnulae are composed of two kinds as in the type form, but branched pinnulae are remarkably large, measuring 2 to 5 cm. long and about 1.5 mm. wide. In this case, the branched pinnulae often attain to a length nearly as long as the simple ones.

Habitat and localities. Growing on rocks in the sublittoral zone; sometimes found epiphytic on the holdfast of various species of the Laminariaceae, e.g., *Thalassiophyllum Clathrus, Laminaria longipes, Pleuropterum paradiseum, Alaria fistulosa,* etc.

N. Kuriles. Araido Isl.—Uomizaki, Minamiura. Simusyu Isl.—Kataoka-wan, Nagasaki, Tenzin-iwa, Kosekigawa. Paramusiru Isl.—Suribati-wan, Titose-wan, Murakami-wan, Komogawa, Arakawa (YAMADA), Kurosaki, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Neme-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Musiru Islet. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan. Uruppu Isl.—Yosinohama, Kobune, Tokotan, Iema.

S. Kuriles. Etorohu Isl.—Tikohai, Wenbetu, Iriribusi, Rubetu. Sikotan Isl.—Syakotan, Tiboi, Notoro. Kunasiri Isl.—Atoiya, Idasibenai, Rebun-iso, Seoi, Seseki near Wennai, Hurukamappu, Tohutu.

Distrib. Alaska, Bering Isl., Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Ptilota pectinata* (GUNNERUS) KJELLMAN

Alg. Arct. Sea, (1883), p. 174, pl. XV, fig. 1–6; Beringhafv. Algfl. p. 32—OKAMURA, Nippon Sorui Meii, ed. 1, p. 77, ed. 2, p. 93; Icon. Jap. Alg. I, 10, p. 235, pl. XLVII; Mar. Alg. Jap. p. 728—DE TONI, Syll. Alg. IV, 3, p. 1377; VI, p. 486—SETCHELL & GARDNER, Alg. N. W. Amer. p. 341—SINOVA, Alg. Mer Ochotsk, p. 119—TOKIDA, Mar. Alg. Robben Isl. p. 21—YAMADA, Mar. Alg. Urup, p. 24—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211.

Fucus pectinatus GUNNERUS, Fl. Norv. II, (1772), p. 122.

Ptilota plumosa var. *serrata* KÜTZING, Sp. Alg. (1849), p. 670; Tab. Phyc. XII, Tab. 55, fig. e, f.

P. serrata J. AGARDH, Sp. Alg. II, 1, (1851), p. 96; III, 1, (Epicr.), p. 76.

Plumaria pectinata var. *integerrima* RUPRECHT, Tange Och. Meeres, (1851), p. 334.

Jap. name. Kusi-benihiba.

The present writer has obtained a large number of specimens of this species; some of them referable to var. *integerrima* RUPR., some to f. *litolaris* KJELLM. and the rest (most of the specimens) to f. *typica* KJELLM. But he cannot find any critically differentiated characters among them except the slenderness or rigidity of the frond and the shape of the pinnulae on the upper branches. As to the difference of the shape of the pinnulae, it appears to depend upon whether the plant is cystocarpic or tetrasporic, so far as the writer's observations have shown. In the cystocarpic plant, the shape

of the pinnulae of the upper branches and the order of the arrangement of the pinnulae of two kinds are normal. The simple, lanceolate pinnulae and the compound, pinnate ones, are regularly pinnately arranged in alternate order on the branches. Of course, there are some differences in length and breadth of the pinnulae in some individuals of the cystocarpic plant, but they may be caused by difference of the habitat or other environmental factors. In the tetrasporic plant, the difference of the pinnulae of the two kinds in length is at times not so remarkable as in the cystocarpic plant. The simple pinnulae of the tetrasporic plant are somewhat larger than those of the cystocarpic plant, but the compound pinnulae of the former plant are sometimes restrained from their growth in length. Therefore, the difference in the length of the pinnulae of two kinds, is not so remarkable as in the cystocarpic plant.

Habitat and localities. Growing on rocks in the lower part of the littoral zone and in the sublittoral zone; sometimes epiphytic on the fronds of *Erythrophyllum Gmelini* and on the holdfast of *Thalassiophyllum Clathrus*.

N. Kuriles. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Simusiru-wan. Uruppu Isl.—Yosinohama, Kobune, Misima, Tokotan, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Wenbetu, Iriribusi, Tosirari, Sibetoro, Bettobu, Arimoe, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan. Kunasiri Isl.—Atoiya, Rebun-iso, Seseki near Wennai, Hurukamappu, Tohutu, Kotankesi, Tomari.

Distrib. Arctic Ocean, Bering Sea (St. Lawrence Isl.), Alaska, Washington, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

3. *Ptilota filicina* J. AGARDH

Sp. Alg. III, 1, (Epicr.), (1876), p. 76—DE TONI, Syll. Alg. IV, 3, p. 1376; VI, p. 486—SETCHELL & GARDNER, Alg. N. W. Amer. p. 340—YENDO, Notes Alg. New to Jap. IV, p. 64—OKAMURA, Mar. Alg. Jap. p. 729.

YENDO reported this species from the Kuriles. When he stayed in Europe, he compared some Kurile specimens of Ptilota with the type specimen of *P. filicina* J. AGARDH in the Agardhian Herbarium at Lund.

Locality.

Kurile Islands (YENDO).

Distrib. Alaska, Vancouver Isl. to California and Japan (the Kuriles).

Subfamily 4. *Ceramieae*

33. *Ceramium* (ROTH, 1797) LYNGBYE, 1819

Key to the species

I. Fronds dichotomously branched.
   A. Fronds having sickle-shaped, crooked portions in some of the upper branches ..... *C. hypnaeoides*(1)
   B. Fronds lacking sickle-shaped portions in the branches.
      1. Cystocarps terminal on the branchlets ..... *C. Kondoi*(2)
      2. Cystocarps lateral on the branchlets ..... *C. rubrum*(3)
II. Fronds pinnately branched ..... *C. japonicum*(4)

1. *Ceramium hypnaeoides* (J. AGARDH) OKAMURA

On *Campylaephora hypnaeoides*. (1927), pp. 365–368, fig. A, B & fig. in p. 368; Mar. Alg. Jap. p. 740, fig. 354—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210.

Campylaephora hypnaeoides J. AGARDH, Sp. Alg. II, 1, (1851), p. 150; III, 1, (Epicr.), p. 108—SURINGAR, Alg. Jap. p. 28, Tab. XIV—DE TONI, Syll. Alg. IV, 3, p. 1503; VI, p. 526—OKAMURA, Nippon Sorui Meii, ed. 1, p. 83, ed. 2, p. 100; Icon. Jap. Alg. II, 6, p. 99, pl. LXXIX—YENDO, Kaisan-Syokubutugaku, p. 689, fig. 197—COLLINS, Chinese Mar. Alg. p. 206.
Chinese Mar. Alg. p. 206.

Ceramium hamatum COTTON, Mar. Alg. fr. Corea, (1906), p. 370—YENDO, Kaisan-Syokubutugaku, p. 687, fig. 196.

Jap. name. Egonori.

The specimens at hand are easily identifiable with the present species by the occurrence of the sickle-shaped portion in the upper branches.

Habitat and localities. Epiphytic on the leaves of *Phyllospadix sp.*

S. Kuriles. Etorohu Isl.—Syana (OKAMURA). Sikotan Isl. (KAWABATA). Kunasiri Isl.—Tohutu.

Distrib. China and Japan (Korea, Kyusyu, Honsyu, Hokkaido, Saghalien and the Kuriles).

2. *Ceramium Kondoi* YENDO

Nov. Alg. Jap. (1920), p. 9—DE TONI, Syll. Alg. VI, p. 511—OKAMURA, Mar. Alg. Jap. p. 738.

Jap. name. Kondo-igisu. (n. n.).

Fronds reddish purple, filiform, cylindrical, several times dichotomously branched, often with adventitive branchlets pinnately on the upper branches, 8–14 cm. high, 0.8–1 mm. diam. near the bases, 200–340 μ diam. in the upper portions, corticated throughout the whole length of the frond, articulated beneath the cortex, articulations 1–2 diam. long; branches in the lower portions widely, but those in the upper portions narrowly patent, ultimate branches forcipate, incurved at apices; cystocarps terminal on the branchlets, enwrapped with 3–6 involucres, subspherical, carpospores oblong, ovoid, ellipsoid, 27–57×24–36 μ in ripe ones; tetrasporangia formed isolatedly immersed within the cortex of the adventitive branchlets or of the upper branches, forming a circle around the articulations, 54–66 μ diam., tetraspores cruciate.

The present species is nearly related to *C. rubrum Ag.* According to YENDO, it differs, however, from the latter in the formation of cystocarps terminally on the branchlets, while they are formed laterally in the latter species.

Habitat and localities. Found cast ashore.

S. Kuriles. Kunasiri Isl.—Tosyoro, Sibetoro, Sokobetu.

Distrib. Japan (Honsyu, Hokkaido and the Kuriles).

3. *Ceramium rubrum* (HUDSON) AGARDH

Syn. (1817), p. VI; Sp. Alg. II, p. 146—KÜTZING, Sp. Alg. p. 685—HARVEY, Phyc. Brit. II, pl. CLXXXI; Ner. Bor.-Amer. II, p. 213—KJELLMAN, Alg. Arct. Sea, p. 170; Beringhafv. Algfl. p. 32—DE TONI, Syll. Alg. IV, 3, p. 1476; VI, p. 511—SETCHELL & GARDNER, Alg. N. W. Amer. p. 345—COTTON, Mar. Alg. fr. Corea, p. 371—YENDO, Kaisan-Syokubutugaku, p. 680, fig. 193—HOWE, Mar. Alg. Peru, p. 156; Chinese Mar. Alg. p. 141—OKAMURA, Nippon Sorui Meii, ed. 2, p. 99; Mar. Alg. Jap. p. 738—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 225—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 210.

Conferva rubra HUDSON, Fl. Angl. p. 600.

Jap. name. Igisu.

The present writer has obtained some specimens from Sikotan and the western coast of Kunasiri Isl., which may be referable either to the present or previous species in general appearance. The plant is 10 to 16 cm. high, dichotomously branched and patent, with forcipate and incurved filament tips. The filaments are corticate throughout the whole length and articulated beneath the cortex. But the specimens at hand are all quite lacking in reproductive organs. Therefore, the present writer failed to determine these specimens with certainty. This species was enumerated by KAWABATA only from Sikotan Isl. in the Kuriles.

Habitat and locality. According to KAWABATA, found on the fronds of other algae or on rocks in the littoral zone.

S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. Atlantic Ocean, S. America (Peru), Bering Sea (St. Lawrence Isl. and Port Clarence), Alaska, Washington, China and Japan (Korea, Honsyu, Hokkaido, Saghalien and the Kuriles).

4. *Ceramium japonicum* OKAMURA

Contr. Knowl. Mar. Alg. Jap. II, (1895), p. 38, pl. III, fig. 24–28; Nippon Sorui Meii, ed. 1, p. 82, ed. 2, p. 100; Icon. Jap. Alg. III, 5, p. 91, pl. CXXIV, fig. 14–22; Mar. Alg. Jap. p. 742—DE TONI, Syll. Alg. IV, 3, p. 1459; VI, p. 508—COTTON, Mar. Alg. fr. Corea, p. 370—COLLINS, Chinese Mar. Alg. p. 206—HOWE, Chinese Mar. Alg. p. 141.

Jap. name. Hane-igisu.

There has been deposited a specimen of this species from the western coast of Kunasiri Isl. in our Herbarium, which was determined before by the late Prof. OKAMURA. The specimen is a sterile plant, measuring only 5 cm. high, and having pinnate branches on the main filament, which is one of the important characters for identification of the present species.

Habitat and locality. The above specimen is epiphytic on the frond of *Corallina pilulifera.*

S. Kuriles. Kunasiri Isl.—Nisiura.

Distrib. China and Japan (Korea, Honsyu, Hokkaido and the Kuriles).

Family 17. *Delesseriaceae*

Key to the genera

I. Procarps found at the midrib of the fertile frond; apical portion of the frond with laterally jointed primary "Scheitelzellen"; no intercalar division occurs within the 1st order series of cells; rhizoidal cells absent.
  A. "Scheitelzellen" in the 3rd order series of cells all attain to the margin of the frond ..... *Laingia* (34)
  B. "Scheitelzellen" in the 3rd order series of cells not attain to the margin of the frond ..... *Membranoptera* (35)

II. Procarps scattered on the fertile portion of the frond.
  A. Apical portion of the frond with laterally jointed primary "Scheitelzellen"; intercalar division occurs within the 1st order series of cells.
    1. Midrib having rhizoidal cells ..... *Pseudophycodrys* (36)
    2. Midrib lacking of rhizoidal cells.
      a. Branching of the frond by fimbriation from the margin ..... *Phycodrys* (37)
      b. Branching of the frond by proliferation of new shoots from the midrib.
        i. Frond mono- or polystromatic, with both midrib and side-nerves ..... *Yendonia* (38)
        ii. Frond polystromatic, with midrib only.... *Hypophyllum* (39)
  B. Apical portion of the frond without laerally jointed "Scheitelzellen"; intercalar division occurs; rhizoidal cells absent; microscopic veins present ..... *Hymenena* (40)

Subfamily 1. *Delesserieae*

Group Hypoglossum

34. *Laingia* KYLIN, 1929

Laingia pacifica YAMADA

Notes on Some Jap. Alg. III, (1932), p. 122—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 22—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211—OKAMURA, Mar. Alg. Jap. p. 763, fig. 366.

Delesseria crassifolia OKAMURA (not RUPRECHT), Icon. Jap. Alg. IV, 4, (1921), p. 72, pjl. CLXVIII.

Pseudophycodrys pacifica YAMADA, Notes Some Jap. Alg. I, (1930), p. 32, pl. II.

Jap. name. Konohanori.

In the present species, there occurs an asexual reproduction by proliferation with many adventitive shoots from the surface along

the ribs of the frond. The proliferation is followed successively on the new fronds, which are grown on the initial fronds. Such a proliferation of the frond is also observed in *Pseudophycodrys Rainosukei* TOKIDA. But more abundant adventitive shoots are usually found on a frond in the present species than in *P. Rainosukei* TOKIDA.

Habitat and localities. Found cast ashore.

N. Kuriles. Paramusiru Isl.—Suribati-wan.

S. Kuriles. Etorohu Isl.—Wenbetu, Iriribusi. Sikotan Isl.—Syakotan, Tiboi, Aimizaki. Kunasiri Isl.—Idasibenai, Tokaisen, Kuraoi, Seseki near Wennai.

Distrib. Kamchatka and Japan (Korea, Hokkaido, Saghalien and the Kuriles).

Group Membranoptera

35. *Membranoptera* STACKHOUSE, 1809

Membranoptera denticulata (MONTAGNE) KYLIN

(Pl. V, figs. 5, 6; pl. VI, fig. 14)

Stud. Delesseriaceen, (1924), p. 16—OKAMURA, Mar. Alg. Jap. p. 766.

Delesseria alata var. *denticulata* MONTAGNE, in Ann. Sc. Nat., Bot. ser. 3, XI, (1849), p. 62.

D. denticulata MONTAGNE, in Ann. Sc. Nat., Bot. ser. 3, XII, (1849), p. 290—HARVEY, Ner. Bor.-Amer. II, p. 94.

Delesseria Beeringiana var. *spinulosa* RUPRECHT, Tange Och. Meeres, (1851), p. 248.

Hypoglossum denticulatum KÜTZING, Tab. Phyc. XVI, (1866), p. 6, Tab. 15, fig. a–c.

Delesseria spinulosa J. AGARDH, Sp. Alg. III, 1, (Epicr.), (1876), p. 483—SINOVA, Alg. Kamtschatka, p. 35.

D. Montagnei KJELLMAN, Alg. Arct. Sea, (1883), p. 135; Beringhafv. Algfl. p. 25.

Pteridium spinulosum J. AGARDH, Sp. Alg. III, 3, (Disp. Delesser.), (1898), p. 225—DE TONI, Syll. Alg. IV, 2, p. 714; VI, p. 351.

Jap. name. Kiyosi-beniyabanegusa.

Fronds beautiful red, caespitose, 3.5–12 cm. high, naked and stipitate below, provided with alae from lower part upward or sometimes only in the upper portions; alae membranaceous, monostromatic, denticulate, sometimes partly entire, often more or less crispate; tissue of the midrib composed of numerous rows of some-

what elongate cells (in cross section nearly round), consisting of 2 layers, cortical and medullary, cortex of a row of small ovoid cells, medulla of irregular rows of larger, ovate or round cells; microscopic side-veins arising from the midrib, generally unbranched, but sometimes slightly branched; adventitive leaflets sometimes given off from the marginal portion of the midrib; tetrasporangia formed within the ultimate branches along the midrib, tetraspores tripartite, 42–66 μ diam.; cystocarps unknown.

In his "Studien über die Delesseriaceen", KYLIN enumerated four species in the present genus. They are *M. alata* (HUDS.) STACKH., *M. platyphylla* (SETCH. et GARDN.) KYLIN, *M. denticulata* (MONT.) KYLIN, and *M. tenuis* KYLIN. To the above, TOKIDA (229) recently added another species, *M. robbeniensis* from Saghalien. The writer's specimens from the Kuriles, are often finely denticulate on the margin of the frond. As to the character, either dentate or entire, of the frond, *M. denticulata* and *M. robbeniensis* are both known to be dentate species. Of the dentate species, *M. robbeniensis*, according to TOKIDA, lacks the microscopic side-veins on the frond, while in *M. denticulata* they are present. Therefore, the specimens at hand are identifiable with the present species by the possession of the microscopic side-veins.

Habitat and localities. Epithytic on the stipe of *Alaria fistulosa*.

M. Kuriles. Onnekotan Isl.—Odomari. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima. Uruppu Isl.—Kobune.

Distrib. Greenland, Arctic Ocean, Bering Isl., Alaska, Kamchatka and Japan (the Kuriles).

Subfamily 2. *Nitophylleae*

Group Pseudophycodrys

36. *Pseudophycodrys* SKOTTSBERG, 1923

Pseudophycodrys Rainosukei TOKIDA

(Pl. V, fig. 7)

Mar. Alg. Robben Isl. (1932), p. 27, Text-fig. 11, 12, pl. X—OKAMURA, Alg. fr. Alaska, p. 93; Mar. Alg. Jap. p. 771, fig. 370.

Jap. name. Rainosuke-konoha.

TOKIDA failed to find any intercalary cell division in the primary cell row on the apical part of the frond. However, he referred his plant with some hesitation to the species of the present genus following KYLIN's opinion. In the Kurile specimens, there occurs in most cases no intercalary cell division in the primary cell row in the frond tip, but such a feature was once observed. Like the Saghalien plant, there are found such specimens in the Kuriles, in which the fronds are decayed away, leaving their midrib and side-veins behind.

Habitat and localities. Growing on rocks in the upper sublittoral zone.

M. Kuriles.. Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Musiru Islet. Ketoi Isl.—Minami-ura. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune.

Distrib. Alaska and Japan (Saghalien and the Kuriles).

Group Phycodrys

37. *Phycodrys* KÜTZING, 1843

Phycodrys fimbriata (DE LA PYLAIE) KYLIN

Stud. Delesseriaceen. (1924), p. 44—TOKIDA, Mar. Alg. Robben Isl. p. 29—YAMADA, Mar. Alg. N. Kuriles, p. 349; Mar. Alg. Urup, p. 24—OKAMURA, Mar. Alg. Jap. p. 774, fig. 373.

Delesseria fimbriata DE LA PYLAIE, in J. AGARDH Sp. Alg. II, 2, (1852), p. 690; III, 1, (Epicr.), p. 486; III, 3 (Disp. Delesser.), p. 160—HARVEY, Ner. Bor.-Amer. II, p. 94—DE TONI, Syll. Alg. IV, 2, p. 704; VI, p. 341—OKAMURA, Icon. Jap. Alg. II, 7, p. 114, pl. LXXXIII; Nippon Sorui Meii, ed. 2, p. 58.

D. sinuosa OKAMURA (not LAMOUROUX), Nippon Sorui Meii, ed. 1, (1902), p. 50.

Jap. name. Kasiwaba-konohanori.

Key to the forms

I. Laciniae rather simple, moderately lacerate and crenate on the margin.. ..... f. *typica*

II. Laciniae much and deeply lacerate, often with fimbriate leaflets on the margin ..... f. *dissecta*

f. *typica* NAGAI, f. nov.

Fronde magna, laciniata, profunde divisa, plerumque 12–16 cm. alta; lacinia magna, 3–7 cm. longa, 8–16 mm. lata, margine plus minus lacerata et crenata.

f. *dissecta* NAGAI, f. nov.

Fronde minore, laciniata, multo et profunde divisa, 8–12 cm. alta; lacinia parva, 2–3.5 cm. longa, 2–5–8 mm. lata, multo et plus minus profunde lacerata, saepissime foliolis lanceolatis fimbriata; tetrasporangiis ad superficiem frondis et foliolorum fimbriatorum extendentibus.

In the "Icones of Japanese Algae, II", OKAMURA described and delineated this species under the name of *Delesseria fimbriata* DE LA PYL. The writer's specimens are separable into two forms, *f. typica* and f. *dissecta*, of which the former corresponds to OKAMURA's plant while the latter is characteristic in dividing deeply and having many fimbriate margins of the frond. There are often observed numerous tetrasporangia, arranged with indefinite order within the area along both middle and side-veins on the upper part of the laciniae and also on the marginal leaflets.

Habitat and localities. Epiphytic on the fronds of various algae, e.g., *Erythrophyllum Gmelini, Ptiota pectinata, P. Asplenioides, Turnerella Mertensiana, Odonthalia Lyallii*, etc.

f. *typica*.

N. Kuriles. Araido Isl.—Minami-ura. Paramusiru Isl.—Suribati-wan; Titose-wan.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Usisiru Isl.—Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Simusiru-wan. Uruppu Isl.—Kobune, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Iriribusi. Kunasiri Isl.—Tokaisen, Seoi, Hurukamappu.

f. *dissecta*.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti.

Distrib. *Sp.*—Arctic Ocean, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles); f. *dissecta*—endemic (the Kuriles).

Group Ruprechtiella

38. *Yendonia* (KYLIN, 1935), emended

Yendonia KYLIN, Nomenklatur einiger Delesseriaceen, (1935), p. 2.
Ruprechtiella KYLIN, Stud. Delesseriaceen, (1924), p. 53.

In 1924, KYLIN established two new genera, Ruprechtiella and Hypophyllum in the Ruprechtiella group of the Nitophylleae. Each genus includes respectively a single species. *R. crassifolia* (RUPR.) KYLIN belongs to the former genus, and *H. Middendorfii* (RUPR.) KYLIN to the latter. The generic name, Ruprechitiella was revised later by KYLIN (Cfr. YAMADA, Notes on Some Jap. Alg. I, (1930), p. 33 and KYLIN, l.c. (1935), p. 2) as Yendonia, because this name had been given already by YENDO to a genus of Phaeophyceae. In the earlier account (1924), KYLIN classified these genera well by the differences of several characters, but he did not made clear the formation of tetrasporangia of Hypophyllum. OKAMURA (1936) elucidated this point and described the species in detail in his "Marine Algae of Japan". According to him, the tetrasporangia in this genus are found in the leaflets given off from the midrib of the frond as in Yendonia. In the course of the studies on the marine algae of the Kuriles, the present writer found an intermediate form between the above two genera. The alga in question differs from *Hypophyllum Middendorfii* in the manner in which cystocarps are produced and the presence of the side-veins on the frond, and from *Yendonia crassifolia* in the polystromatic habit of the frond. However, this alga is more closely related to the latter rather than to the former. The present writer is of opinion at present, that it should better be treated as another species in the genus, Yendonia, associated with *Y. crassifolia* (RUPR.) KYLIN than as a species of an independent new genus. Therefore the generic characters of the genus ought be emended in part, as to the layers of the cells of the frond, to be 'either monostromatic or polystromatic'.

Yendonia japonica NAGAI, sp. nov.

(Pl. V, figs. 8–12; pl. VI, figs. 15, 16)

Jap. name. Yendo-konoha (n. n.).

Thallo inferne caulescento, superne foliaceo, 7–22 cm. alto, e costa media ramoso; frondibus ellipticis vel elliptico-ovatis, polystromatis, costatis, opposite nervosis, apicibus rotundatis vel obtusis, 2–7×0.5–3 cm.; cystocarpiis in partem intercostalem frondis sparsis, ca. 0.5 mm. diam.; tetrasporangiis in foliolo ramoso e costa media et aliquando nervis lateralibus formatis, globosis, ovoideis vel plus minus polygonalibus, 39–66 μ diam.

The present species is rather widely distributed from the eastern coast of Etorohu Isl. northward to the North Kuriles. The alga is stipitate and subdichotomously branched below and foliaceous above. It measures 7 to 22 cm. high. The fronds are polystromatic, elliptic or elliptic-ovate with obtuse tips, and bear prominent midribs and opposite side-veins. They measure 2–7×0.5–3 cm., mostly 3–4.5× 1–1.8 cm. The branching of the frond takes place by proliferation from the midrib. The cystocarps are found scattered within the intercostal area of the frond. They are more abundantly formed on the upper part than on the lower. They measure about 0.5 mm. in diameter. The tetrasporangia are formed on the leaflets given off along the midrib or sometimes along the side-veins of the frond. They are globose, ovoid or polygonal, and 39 to 66 μ in diameter. The tetraspores are tripartite. The plant has no rhizoidal cells in the midrib.

The species in question apparently belongs to the Ruprechtiella group to judge by the branching mode of the frond, the lack of rhizoidal cells in the midrib, and the structure of the frond tip, in which there are found laterally jointed primary "Scheitelzelle". The frond is observed, in cross section, to be composed of 3 rows of cells in the membranaceous portion, but of more rows of cells near the veins. In the midrib, the tissue is composed of 2 layers, cortical and medullary. The cortex is composed of 7 to 10 rows of small cells, and the medulla of 3 to 5 or more rows of larger, somewhat flattened cells. Within the cortex, there are occasionally observed masses of a small or large number of elongate, crooked cells.

Habitat and localities. Epiphytic on the fronds of other algae, e.g. *Ptilota Asplenioides, P. pectinata,* etc.

N. Kuriles. Araido Isl.—Uomizaki. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari, Harumukotan Isl.—Harumukotan-byoti. Usisiru Isl.—Minamizima. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune.

S. Kuriles. Etorohu Isl.—Iriribusi.

Distrib. Endemic (the Kuriles).

39. *Hypophyllum* KYLIN, 1924

Hypophyllum Middendorfii (RUPRECHT) KYLIN

Stud. Delesseriaceen, (1924), p. 53, fig. 42 (f.)—TOKIDA, Mar. Alg. Robben Isl. p. 30—OKAMURA, Mar. Alg. Jap. p. 778, fig. 375.

Delesseria Middendorfii RUPRECHT, Tange Och. Meeres, (1851), p. 237, Tab. 12—J. AGARDH, Sp. Alg. II, 2, p. 696; III, 1, (Epicr.), p. 497; III, 3, (Disp. Delesser.), p. 161—DE TONI, Syll. Alg. IV, 2, p. 708; VI, p. 343—OKAMURA, Nippon Sorui Meii, ed. 1, p. 50, ed. 2, p. 59; Icon. Jap. Alg. II, 7, p. 118, pl. LXXXIV, pl. LXXXV, fig. 1–7; IV, 9, p. 174, pl. CXCI, fig. 8–11—SINOVA, Alg. Mer Ochotsk, p. 115.

Jap. name. Naga-konohanori.

In the present species, there are observed laterally jointed primary "Scheitelzelle" in the apical portion of the young proliferated leaflets as in *Yendonia japonica* NAGAI.

Habitat and localities. Found cast ashore.

S. Kuriles. Kunasiri Isl.—Tinomizi, Tohutu, Ponkotan.

Distrib. Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

Group Cryptopleura

40. *Hymenena* (GREVILLE, 1830), KYLIN, 1924

Hymenena cuneata GARDNER

(Pl. VI, figs. 17–19)

New Rhodophyc. fr. Pacific Coast N. America, II, (1927), p. 243, pl. XXXIII.

Jap. name. Tisima-usubanorimodoki (n. n.).

Frond beautiful red, membranaceous, oblong-obovate with cuneate base, simple or sometimes palmately or slightly divided, rounded or obtuse at the apex, 8–15 cm. long, 2–7.5 cm., mostly 2–4 cm. wide, monostromatic in the greater part except the region where reproductive organs are formed and the basal part; microscopic veinlets present only in the lower portion of the frond; cystocarps scattered widely on the whole surface of the frond except the basal part, slightly elevated on both surfaces, 0.5–0.7 mm. diam., carpospores ovoid, oblong, oblong-ovoid, terminal on the gonimoblast filaments, 66–114×39–57 μ; tetrasporic sori numerous, round or in part slightly elongated toward the longitudinal direction of the frond, 0.2–0.7 mm. diam., scattered widely on the whole surfaces of the frond except the basal part, tetrasporangia globular, 39–66–93 μ diam., tetraspores tripartite.

It is easily presumed that some or probably the most of the algae of Bering Isl. may be distributed to the North Kuriles, because the shores of the latter locality are washed by the same cold current as the former island in Bering Sea. The present writer has obtained a large number of specimens which resemble *Nitophyllum ruthenicum* KJELLM. in the "Beringhafvets Algflora". SETCHELL and GARDNER referred some specimens from Alaska and Whidbey Isl., to *N. ruthenicum* KJELLM. in their "Algae of N. W. America", p. 320. KYLIN almost did not touch on the American plant, identified by SETCHELL and GARDNER in his "Studien über Delesseriaceen", 1924, but later gave the following remarks in "Marine Red Algae of Friday Harbor", (1925), p. 67. "In the Herbarium of the University at Upsala I have seen two specimens of an alga, collected by GARDNER in 1908, at the west coast of Whidbey Island, Wash., which is supposed to be identical with *Nitophyllum ruthenicum*. The two specimens, one cystocarpic and the other tetrasporic, represent a Hymenena-species very closely related to *H. Freyana* (FARL.) KYLIN and probably identical with this species.—Microscopic veins are present, but not numerous; the carpospores are terminal on the gonimoblast filaments. I have seen the type specimens of *Nitophyllum ruthenicum* KJELLM. In this species there are no microscopic veins; in the gonimoblast filaments there are two or three carpospores, ranging one after the other. These two facts point out that the species in question represents a Myriogramme-species." In 1927, GARDNER described four species of the American Hymenena in his "New Rhodophyceae from the Pacific Coast", II, in which he established two new species, viz., *H. Kylini* and *H. cuneata*, taking *Nitophyllum Harveyanum* NOTT as the type of the former, and *N. ruthenicum* SETCHELL from the Alaskan shores as that of the latter. The writer's specimens are certainly referable to a species of Hymenena in view of the presence of the microscopic veins and the fact that the carpospores are not in chain, but terminal singly on the tips of the gonimoblast filaments. By the shape of the frond and other characters, they are identifiable with the present species.

Habitat and localities. Epiphytic on the fronds of various algae, e.g., *Ptilota Asplenioides, Odonthalia Lyallii, Amphiroa cretacea*, etc.

N. Kuriles. Paramusiru Isl.—Suribati-wan.
M. Kuriles. Onnekotan Isl.—Odomari. Simusiru Isl.—Simusiru-wan.
S. Kuriles. Etorohu Isl.—Iriribusi.

Distrib. Alaska and Japan (the Kuriles).

Family 18. *Rhodomelaceae*

Key to the genera

I. Fronds with a central cell-row only just beneath the growing point, in the other portions consisting of parenchymatous tissue ..... *Laurencia* (42)

II. Fronds with a central cell-row and few to many pericentral cells around it throughout the whole length.

A. Central cells nearly as long as the length of the pericentral cells, as a result of non-occurrence of lateral division.

1. Fronds cylindrical, rarely cylindric-polygonal or -complanate; branching occurs in every side; tetrasporangia arranged immersed within the stichidial branches in straight or spiral rows.. *Polysiphonia* (41)
2. Fronds cylindrical or slightly cylindric-complanate; branching occurs in 2 sides; tetrasporangia arranged immersed within the stichidial branches in straight rows ..... *Pterosiphonia* (43)

B. Central cells nearly 2 times as long as the length of the pericentral cells, as a result of the occurrence of lateral division.

1. Fronds cylindrical, with more or less abundant, spiral-alternately arranged ramuli on the branches; tetrasporangia arranged immersed within the stichidial branches in straight or spiral rows .... *Rhodomela* (44)
2. Fronds complanate or subcylindrical, with only lateral branches from the lower to the ultimate portions; tetrasporangia arranged immersed within the stichidial branches in straight rows..... *Odonthalia* (45)

Subfamily 1. *Polysiphonieae*

41. *Polysiphonia* GREVILLE, 1824

Key to the species

I. Pericentral cells 4 in number, not accompanied by subsidiary cells.

A. Tetrasporangia formed within the peculiar stichidial ramuli which are densely clustered together with sterile branchlets at the apical portion of the branches ..... *P. Morrowii* (1)

B. Tetrasporangia formed not within the peculiar ramuli, but within the normal upper branchlets.

1. Tetrasporangia arranged in a row with 5–7 individuals within a branchlet ..... *P. senticulosa* (2)
2. Tetrasporangia arranged in a spiral row with 6–20, commonly more than 10 individuals torulosely within a branchlet .... *P. sertularioides* (3)

II. Pericentral cells 4 in number, accompanied by some subsidiary cells .... *P. japonica* (4)

Subgenus Oligosiphonia

1. *Polysiphonia Morrowii* HARVEY

in GRAY's List of Plants collected in Japan, (1856), p. 331—KÜTZING, Tab. Phyc. XIV, p. 17, Tab. 47, fig. a-c—DE TONI, Phyc. Jap. p. 33; Syll. Alg. IV, 3, p. 960; VI, p. 393—OKAMURA, Nippon Sorui Meii, ed. 1, p. 59, ed. 2, p. 74; Icon. Jap. Alg. III, 6, p. 104, pl. CXXVII, fig. 1-8; Mar. Alg. Jap. p. 826, fig. 390 —INAGAKI, Mar. Red. Alg. Osyoro Bay, Hokkaido, p. 59—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 223.

Jap. name. Moroitogusa.

This is a familiar species in Hokkaido. As far as the writer is aware, no one describes the presence of hairs in this species. But there were found a few tufts of hairs, given off from the tips of the stichidial branches in the writer's specimens. They are often deciduous.

Habitat and localities. Growing on rocks in the littoral zone.
S. Kuriles. Kunasiri Isl.—Sibetoro, Sokobetu, Ponkotan.

Distrib. China and Japan (Honsyu, Hokkaido and the Kuriles).

2. *Polysiphonia senticulosa* HARVEY

in J. AGARDH Sp. Alg. II, 3, (1863), p. 974—DE TONI, Syll. Alg. IV, 3, p. 879—SETCHELL & GARDNER, Alg. N. W. Amer. p. 327—YENDO, Notes Alg. New to Jap. II, p. 276—OKAMURA, Nippon Sorui Meii, ed. 2, p. 75; Mar. Alg. Jap. p. 825—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 60, fig. 25—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211.

KAWABATA reported this species from Sikotan Isl. The present writer failed to find any specimen, referable to this species, in his collection.

Habitat and locality. Found cast ashore.
S. Kuriles. Sikotan Isl. (KAWABATA).

Distrib. Vancouver Isl. and Japan (Honsyu, Hokkaido and the Kuriles).

3. *Polysiphonia sertularioides* (GRATELOUP) J. AGARDH

(Pl. V, fig. 13)

Sp. Alg. II, 3, (1863), p. 969—DE TONI, Syll. Alg. IV, 3, p. 870; VI, p. 390 —FALKENBERG, Rhodomel. p. 122, Taf. I, fig. 1-16, Taf. II, fig. 14—OKAMURA, Mar. Alg. Jap. p. 826.

Ceramium sertularioides GRATELOUP, Descr. aliquor. Ceramior fig. IV. in appendice Diss. Observ. sur la Const. de l'ete de 1806 Montp. 1806; Jour. de med. prat. de Mont. pour an 1807.

Fronds 3.5–9 cm. high, caespitose, forming a globose mass with subdichotomous or sometimes subsecund or alternate branches, dark red but less dark than *P. japonica;* main filaments 90–120 μ diam. near the base; branches suberect in the upper part, but patent in the lower part, 45–60 μ diam.; articulations in the main filaments rather long, 1.5–4 diam. long, those of the branches 0.6–1.5 times; hairs much formed on the terminal or subterminal portions of the branches; pericentral cells 4 in number either in the main filaments or in branches, without subsidiary cells; tetrasporangia arranged in a spiral row with 6–20, commonly with more than 10 individuals in the upper portions of the stichidial branchlets and branches, tetraspores tripartite or sometimes irregularly cruciate, 60–75 μ diam. in the larger ripened ones; rhizoidal filaments often found given off from nearby the basal portions of the main filaments, consisting of a single hyaline cell for the greater part, elongate, slightly curved or crooked and expanded at the end into flattened hapteres; color dark brownish; neither cystocarps nor antheridia found in the writer's specimens.

Although no cystocarpic frond was found, the present writer referred his specimens to the present species from the resemblance of the following characters. The frond is delicate and rather short. The ratio of the length to the diameter of the articulations of the filaments answers comparatively well to that of the present species as given by various authors. The tetrasporangia are formed torulosely within a rather long distance on the branchlets and branches. However the writer's specimens show a somewhat larger measurement than that given by HAUCK in his "Die Meeresalgen Deutschlands und Oesterreichs", p. 219. J. AGARDH describes the articulations and tetraspores of the present species as follows: "Articuli longitudine variant pro magnitudine speciminum; saepius in filis primariis 2–3-plo diametro longiores, in ramulis aequales aut parum longiores; nunc in illis usque 4-plo, in his 2-plo longiores, basales filorum semper breviores, omnes 4-siphonii. Sphaerosporae in ramulis longa serie in articulo quoque provenientes, ramulos reddunt eximie torulosos fere siliquaeformes, nunc apicem, nunc totum ramulum occupantes, quin immo in ipsis ramis, ramulos generantibus, in planta robustiori et breviori vidi."

Habitat and localities. Found cast ashore.

S. Kuriles. Kunasiri Isl.—Tohutu, Rurui.

Distrib. Atlantic Ocean and Japan (Honsyu and the Kuriles).

4. *Polysiphonia japonica* HARVEY

in GRAY's List of Plants collected in Japan, (1856), p. 331—DE TONI, Phyc. Jap. p. 33; Syll. Alg. VI, p. 393—OKAMURA, Nippon Sorui Meii, ed. 1, p. 59, ed. 2, p. 75; Mar. Alg. Jap. p. 830—GEPP, Chinese Mar. Alg. p. 163, pl. 460, fig. 4–6—COLLINS, Chinese Mar. Alg. p. 206—HOWE, Chinese Mar. Alg. p. 140—YAMADA, Mar. Alg. Mutsu Bay, II, p. 522—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 63, fig. 26, 27—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 222—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 211.

Jap. name. Kiburi-itogusa.

Fronds 3–6 cm. high, solitary or caespitose, forming a globose mass with dichotomously or subdichotomously and much branched patent branches, dark red; main filaments 360–465 μ diam. near the basal portions; articulations rather short, nearly as long as the diameter; hairs present on the terminal or subterminal portions of the branches, deciduous; pericentral cells 4 in number, usually accompanied by some subsidiary cells in the main filaments which disappear in the branches; tetrasporangia formed in a spiral row with 4–10 individuals in the upper portions of the branchlets, tetraspores tripartite, 90–110 μ diam. in the larger ripened ones (in dried specimens); cystocarps formed on the branches or branchlets, usually sessile, ovate-globose with rather wide ostiole at the tip, carpospores subobovoid with tapering, acute base, 30–48×75–120 μ in the ripened ones; antheridia few, rarely found in the upper portions of the branches.

The present species was found not widely, but only from the southern islands in the Kuriles. In the writer's specimens, there are also observed root-like fibers, given off from the lower portions of the filaments, as stated by INAGAKI in the plant from Hokkaido.

Habitat and localities. Growing on the leaves of *Phyllospadix sp.*

S. Kuriles. Sikotan Isl. (KAWABATA). Kunasiri Isl.—Sibetoro, Tomari.

Distrib. China and Japan (Korea, Honsyu, Hokkaido and the Kuriles).

Subfamily 2. *Laurencieae*

42. *Laurencia* LAMOUROUX, 1813

Key to the species

I. Lenticular thickenings present in the walls of the medullary cells of the frond, especially in the main axis ..... *L. nipponica* (1)
II. Lenticular thickenings absent in the walls of the medullary cells of the frond ..... *L. glandulifera* (2)

1. *Laurencia nipponica* YAMADA

Notes on Laurencia, (1931), p. 209, pl. IX—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 56, fig. 24—OKAMURA, Mar. Alg. Jap. p. 855, fig. 400.

Jap. name. Ura-sozo.

The present species is rather widely distributed in the northern region of Japan, including Honsyu, Hokkaido and the Kuriles. There are observed somewhat numerous lenticular thickenings in the main axis in cross section, but they are not always present in the upper branches, or, if present, not numerous.

Habitat and localities. Growing on rocks in the lower littoral zone; in Etorohu cast ashore.

S. Kuriles. Etorohu Isl.—Tosimoe. Kunasiri Isl.—Atoiya, Sokobetu, Sibetoro, Tosyoro, Kotankesi, Ponkotan.

Distrib. China and Japan (Honsyu, Hokkaido and the Kuriles).

2. *Laurencia glandulifera* KÜTZING

Sp. Alg. (1849), p. 855; Tab. Phyc. XV, (1865), Tab. 59, fig. c, d—YAMADA, Notes on Laurencia, p. 218—INAGAKI, Mar. Red Alg. Osyoro Bay, Hokkaido, p. 57—OKAMURA, Mar. Alg. Jap. p. 858.

Chondria glandulifera KÜTZING, Phyc. Germ. (1845), p. 329.

Jap. name. O-sozo.

Only a few specimens are referable to the present species. The present species is readily distinguishable from the previous species by the more robust fronds and the lack of lenticular thickenings in the main axis or in the branches. This species differs from the latter also by the dark purplish color of the fronds.

Habitat and localities. Found cast ashore.

S. Kuriles. Kunasiri Isl.—Tohutu, Rurui, Ponkotan, Nisiura.

Distrib. Atlantic Ocean and Japan (Honsyu, Hokkaido and the Kuriles).

Subfamily 3. *Pterosiphonieae*

43. *Pterosiphonia* FALKENBERG, 1889

Key to the species

I. Pericentral cells more than 11 in number.
  A. Spiculae (mass of ultimate branchlets) short and wide, pyramidal in general outline; inner, earlier branchlets of the spiculae strongly incurved, but outer ones slightly incurved or even erect, sometimes patent outward ..... *P. bipinnata* (1)
  B. Spiculae narrow and long; inner and outer branchlets of the spiculae, both, not patent but slightly incurved ..... *P. robusta* (2)

II. Pericentral cells 6 in number.
  A. Spiculae large; branchlets of the spiculae erect; cystocarps pear-shaped ..... *P. arctica* (3)
  B. Spiculae narrow and long; branchlets of the spiculae strongly incurved; cystocarps urceolate ..... *P. japonica* (4)

1. *Pterosiphonia bipinnata* (POSTELS et RUPRECHT) FALKENBERG

(Pl. V, fig. 14; pl. VI, fig. 20)

Rhodomel. (1901), p. 273—SETCHELL & GARDNER, Alg. N. W. Amer. p. 328—OKAMURA, Nippon Sorui Meii, ed. 1, p. 63, ed. 2, p. 78; Icon. Jap. Alg. IV, 7, p. 134, pl. CLXXXV, fig. 1–7; Mar. Alg. Jap. p. 863—DE TONI, Syll. Alg. IV, 3, p. 997; VI, p. 408—KYLIN, Mar. Red Alg. Friday Harb. p. 72—SINOVA, Alg. Mer Ochotsk, p. 117; Alg. Kamtschatka, p. 37—TOKIDA, Mar. Alg. Robben Isl. p. 30—YAMADA, Mar. Alg. Urup, p. 24—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Polysiphonia bipinnata POSTELS et RUPRECHT, Ill. Alg. (1840), p. 22—KJELLMAN, Beringhafv. Algfl. p. 25.

Polyostea gemmifera RUPRECHT, Tange Och. Meeres, (1851), p. 226, Tab. XI.

Jap. name. Itoyanagi.

Fronds caespitose, tender, forming a dense tuft with many disticho-pinnate branches, ecorticate throughout the whole length, 6–30 cm. high, dark brown or almost black upon drying; main filaments 250–420 μ diam., slightly compressed in cross section; branchlets 120–240 μ diam., arranged repeatedly in disticho-alternate manner in an interspace of 2–4 articulations; ultimate branchlets (on the uppermost portion) richly branched, somewhat patent, forming short and somewhat wide spiculae; inner, earlier branchlets of the spiculae strongly incurved, but outer ones slightly incurved or even erect and sometimes patent outwards; articulations in the

main filament 2–4 diam. long, rarely up to 14 times near the basal portions, the ones in the branches become shorter, 0.5–2 times; pericentral cells variable in number, varying 11–14; rhizoidal cells sometimes observed, given off from the filaments in the middle or even in the upper portions; tetrasporangial fronds abundantly found; tetrasporangia formed in a row, arranged with 2–5 individuals in the ultimate branchlets, 90–120μ diam. in the larger ripened ones, tetraspores tripartite; neither antheridial nor cystocarpic fronds found in the writer's specimens.

There are two forms which recall *P. bipinnata* in the Kurile specimens of Pterosiphonia, the one taking somewhat robust and the other tender and delicate appearance. The morphological difference of these forms is due to the shape of the spiculae (mass of ultimate branchlets) and the larger diameter of the filaments in the basal portions. The number of pericentral cells is not certain. In the "New Rhodophyceae from the Pacific Coast of North America", GARDNER reported a firm and tough form under the name *P. robusta* GARDN. which is closely related to *P. bipinnata* (P. et R.) FLKBG. Comparing the specimens at hand with the description and figures of this species and the authentic specimens contributed kindly from the Department of Botany, University of California to our Herbarium, the present writer was inclined to refer his robust form to GARDNER's *P. robusta* and the tender and delicate form to *P. bipinnata*. The specimens from Usisiru Isl. were observed to be attacked abundantly by the Myxophycean parasite, *Dermocarpa pacifica* on the filaments.

Habitat and localities. Growing on rocks within the range from the lower to the upper littoral zone.

N. Kuriles. Simusyu Isl.—Kataoka-wan? (YENDO), Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Titose-wan, Murakami-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari. Uruppu Isl.—Kobune, Misima, Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai. Sikotan Isl.—Syakotan, Aimizaki, Notoro.

Distrib. Bering Isl., Alaska, Washington, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Pterosiphonia robusta* GARDNER

(Pl. V, fig. 15; pl. VI, fig. 21)

New Rhodophyc. fr. Pacific Coast N. America, VI, (1927), p. 102, pl. XXVI–XXIX.

Jap. name. Huto-itoyanagi (n.n.).

Fronds caespitose, moderately rigid and tough, forming a dense tuft with many distichous branches, ecorticate throughout the whole length, 10–21 cm. high, violet brown upon drying; main filaments 300–720 μ diam. below, slightly compressed in cross section; branchlets 150–240 μ diam., arranged repeatedly in disticho-alternate manner in an interspace of 3 articulations on the branches, ultimate branchlets (on the uppermost portions) arranged in disticho-alternate manner, forming small narrow spiculae; both inner and outer branchlets of the spiculae not patent but slightly incurved; articulations in the main filaments 2–4.5 diam. long, those of the branches 1–2 times; pericentral cells 15–16 in number; cystocarpic fronds not usually found; cystocarps laterally formed on the branches, sessile, obovoid with round or obtuse apices; tetrasporangial fronds usually abundant; tetrasporangia formed in a row, arranged with 2–5 individuals in the ultimate branchlets, 90–105 μ diam. in the large ripened ones, tetraspores tripartite.

The present species is closely related to *P. bipinnata* (P. et R.) FKBG., but it differs from the latter in having more robust fronds and rather long and narrower spiculae. Cystocarpic fronds were not usually found. The present writer came across only one specimen, cystocarpic, which was collected by KODAMA in Uruppu Isl.

Habitat and localities. Growing on rocks in the lower littoral zone.

N. Kuriles. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Rasyuwa Isl. (KODAMA). Uruppu Isl.—Iema (KODAMA).

S. Kuriles. Etorohu Isl.—Iriribusi, Tosirari, Sibetoro. Kunasiri Isl.—Atoiya.

Distrib. California and Japan (the Kuriles).

3. *Pterosiphonia arctica* SETCHELL et GARDNER

Alg. N. W. Amer. (1903), p. 329, pl. XIX, fig. 25–27—OKAMURA, Icon. Jap. Alg. IV, 7, p. 135, pl. CLXXXV, fig. 8–16 (excl. syn.); Alg. fr. Alaska, p. 94 (excl. syn.); Mar. Alg. Jap. p. 862—KYLIN, Mar. Red Alg. Friday Harb. p. 72—TOKIDA, Mar. Alg. Roöben Isl. (Suppl. Rept.), p. 23.

Jap. name. Inabogusa.

Fronds caespitose, forming a dense tuft with many subdichotomously branched or alternately pinnate branches, ecorticate throughout the whole length; tetrasporangial fronds more delicate and often larger (10–20 cm. high) than the cystocarpic one (7–10 cm. high); main filaments 300–400 μ diam., branches 180–240 μ diam., both slightly compressed in cross section; branches and branchlets not patent, but more or less erect, branchlets in the spiculae distichoalternately branched in an interspace of 3 articulations on the branches; articulations rather long, 2–9 diam. long in the main filaments, about half to slightly longer in the branches; pericentral cells 6 in number; rhizoidal cells not found; cystocarps formed laterally on the branches with rather long intervals, pear-shaped, sessile; tetrasporangia formed in a row, arranged with 3–6 individuals in the ultimate branchlets, 120–150 μ diam. in the larger ripened ones, tetraspores tripartite.

SETCHELL and GARDNER reported a Pterosiphonia from the western coast of North America, which was identified by them with *Polysiphonia arctica* of J. AGARDH. However it was already pointed out by ROSENVINGE in his "Marine Algae from North-East Greenland" that the latter plant is not a Pterosiphonia, but a true Polysiphonia. The writer's specimens represent a true Pterosiphonia and accord well to the figures of the present species, given by SETCHELL and GARDNER.

Habitat and localities. Found cast ashore.

N. Kuriles. Simusyu Isl.—Kataoka-wan.

M. Kuriles. Onnekotan Isl.—Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Uruppu Isl.—Kobune.

Distrib. Alaska, Washington and Japan (Hokkaido, Saghalien and the Kuriles).

4. *Pterosiphonia japonica* NAGAI, sp. nov.

(Pl. V, figs. 16–19; pl. VI, fig. 22)

Jap. name. Hoso-inabogusa (n.n.).

Fronde 10–25 cm. alta, alterne distiche ramosa, ramulis distiche pinnatis, ramis ramulisque 2-articulis distantibus, leviter complanatis, ecorticatis; filamentis principalibus 180–270 μ, ramis 120–180 μ crassis; articulis filamentorum principalium diametro 4–24-plo,

ramorum 2–4-plo longioribus; cellulis pericentralibus 6; cystocarpiis breviter pedicellatis unceolatis, ramulis lateraliter insidentibus; tetrasporangiis in pinnulis una serie dispositis.

The fronds are caespitose, forming a dense tuft with many distichous branches, and measure 10 to 25 cm. high. They are tender and violet brown. The branchlets are disticho-alternately arranged in an interspace of two articulations on the branches. The ultimate branchlets are richly formed on the uppermost portions of the branches, forming elongate spiculae. Each branchlet is usually strongly incurved. The branchlets in the middle and lower portions are relatively few, comparing with the ones in the upper part. They are arranged with rather longer intervals, being not strongly, but slightly curved or even erect. The main filaments are 180 to 270 μ in diameter in the middle part. The branchlets are 120 to 180 μ in diameter. The articulations in the main filament, are 4 to 24 times as long as the diameter and the ones in the branches are 2 to 4 times. The filaments are observed to be slightly compressed in cross section, and ecorticate throughout the whole length. The pericentral cells are six in number. Rhizoidal cells are sometimes found on the upper branches. The cystocarps are formed laterally on the branches. They are urceolate with very short pedicels. The stichidial branchlets are arranged on the subapical portions of the filaments. In the branchlets, the tetrasporangia are found, arranged with 3, 4 or more individuals in a row. In the specimens at hand, however, no ripened tetrasporangia have been found.

The species in question is closely related to *P. arctica* SETCH. et GARDN., but it differs from the latter in having tender fronds, elongate spiculae, of which the branchlets are strongly incurved, as well as urceolate cystocarps.

Habitat and localities. Found cast ashore.

M. Kuriles. Onnekotan Isl.—Odomari. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Minamizima.

Distrib. Endemic (the Kuriles).

Subfamily 4. *Rhodomeleae*

44. *Rhodomela* C. AGARDH, 1823

Key to the species

I. Frond robust, provided with thick, setaceous branchlets in spiral arrangement rather closely on the main axis and branches ..... *R. Larix* (1)

II. Frond gracile, provided with slender branchlets in several directions rather sparsely on the main axis and branches ..... *R. subfusca* (2)

1. *Rhodomela Larix* (TURNER) AGARDH

Sp. Alg. I, 2, (1822), p. 376—POSTELS et RUPRECHT, Ill. Alg. p. 14, Tab. XXXVIII, fig. h—HARVEY, Ner. Bor.-Amer. II, p. 24—J. AGARDH, Sp. Alg. II, 3, p. 886—KJELLMAN, Alg. Arct. Sea, p. 117; Beringhafv. Algfl. p. 24—FALKENBERG, Rhodomel. p. 600, Taf. XI, fig. 1—OKAMURA, Nippon Sorui Meii, ed., 1, p. 66, ed. 2, p. 81; Icon. Jap. Alg. IV, 8, p. 154, pl. CLXXXVIII, fig. 1–4; Mar. Alg. Jap. p. 898—DE TONI, Syll. Alg. IV, 3, p. 1131; VI, p. 431—SETCHELL & GARDNER, Alg. N. W. Amer. p. 330—SINOVA, Alg. Mer Ochotsk, p. 117; Alg. Kamtschatka, p. 37—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Fucus Larix TURNER, Fuci, IV, (1819), p. 23, pl. CCVII.

Lophura Larix KÜTZING, Sp. Alg. (1849), p. 850; Tab. Phyc. XV, Tab. 39, fig. a–c.

Fuscaria Larix RUPRECHT, Tange Och. Meeres, (1851), p. 219.

Jap. name. Huzimatumo.

The present species is easily identifiable by the robust fronds which are rather closely beset with thick, setaceous branchlets in spiral arrangement on the main axis and branches. This is rather widely distributed in northern Japan from Northeastern Honsyu northward to the North Kuriles, and Saghalien through Hokkaido.

Habitat and localities. Growing on rocks in the littoral zone.

N. Kuriles. Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Suribati-wan, Titose-wan, Kamogawa, Kurosaki, Kakumabetu.

S. Kuriles. Etorohu Isl.—Sibetoro, Bettobu, Arimoe. Sikotan Isl.—Syakotan, Notoro. Kunasiri Isl.—Rebun-iso, Hurukamappu, Tohutu, Tosyoro, Kotankesi.

Distrib. Arctic Sea, Bering Sea (Bering Isl., Port Clarence and St. Lawrence), Alaska, British Columbia, Washington, Kamchatka, Okhotsk Sea and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles).

2. *Rhodomela subfusca* (WOODWARD) AGARDH

Sp. Alg. I, 2, (1822), p. 378—HARVEY, Ner. Bor.-Amer. II, p. 26—J. AGARDH, Sp. Alg. II, 3, p. 883—OKAMURA, Nippon Sorui Meii, ed. 1, p. 66; Icon. Jap. Alg. IV, 8, p. 151, pl. CLXXXVI, pl. CLXXXVII, fig. 1–13; Mar. Alg. Jap. p. 899, fig. 421—COTTON, Some Chinese Mar. Alg. p. 112—COLLINS, Chinese Mar. Alg. p. 206—ROSENVINGE, Mar. Alg. Denmark, III, p. 451, fig. 411–421—HOWE, Chinese Mar. Alg. p. 141—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Fucus subfuscus WOODWARD, in Linn. Trans. I, p, 131, Tab. XII—TURNER, Fuci, I, p. 20, pl. X.

Fuscaria tenuissima RUPRECHT, Tange Och. Meeres, (1851), p. 221, Tab. X.

Rhodomela lycopodioides f. *tenuissima* KJELLMAN, Alg. Arct. Sea, (1883), p. 109; Beringhafv. Algfl. p. 24—YENDO, Notes Alg. New to Jap. p. 132—SINOVA, Alg. Mer Ochotsk, p. 118.

Jap. name. Itohuzimatu.

Fronds slender, caespitose, arising from the slightly branched, filiform hapteres, with terete stipe below, pinnately or alternately branched, 11–20 cm. high, dark violet; main branches cylindrical, almost straight or slightly flexuous, often naked, 0.5–1 mm. diam.; branches patent, densely beset with branchlets alternately in irregular spiral arrangement; branchlets simple, subulate, incurved, 0.5–2 mm. long, very slender; stichidial branchlets transformed from the ultimate branchlets of the upper branches; tetrasporangia arranged, being immersed in 1 or 2 rows within the stichidial branchlets, 90–129 μ diam., tetraspores tripartite; cystocarps urceolate, sessile, 540–600 μ diam., carpospores ellipsoidal ovoid, 108–129×54–72 μ; antheridia formed on the apical portions of the upper branchlets, suboblong, slightly recurved, 170–540×60–120 μ.

In "Icones of the Japanese Algae," IV, p. 152, OKAMURA states: "The specific determination of the species of Rhodomela is very difficult in *R. subfusca, virgata* and *lycopodioides,* and there are some confusions among them. To a certain extent I have followed KJELLMAN's definition of the species, and many forms are met with in our specimens differing in several minute characters chiefly according to their localities and they may be separated in other days into some varieties." As to the definition of the species, GOBI, J. AGARDH, FALKENBERG and others take a rather wide conception. They held the view that *R. lycopodioides* might be combined with *R. subfusca,* while KJELLMAN held an opposing opinion. However, ROSENVINGE amalgamated these species into one species under the name of *R. subfusca.* The present writer would not enter into discussion about the present question, but merely mentions the occurrence of the plant in the Kuriles, that answers well with OKAMURA's plant.

Habitat and localities. Growing on rocks in the upper sublittoral zone.

N. Kuriles. Simusyu Isl.? (YENDO).

S. Kuriles. Etorohu Isl.—Tosirari, Sibetoro, Bettobu, Arimoe. Sikotan Isl.—Syakotan. Kunasiri Isl.—Atoiya, Rebun-iso, Tohutu, Sokobetu, Sibetoro, Tosyoro, Nikisiro, Kotankesi, Nisiura, Ponkotan, Tomari.

Distrib. North Atlantic, Arctic Ocean, Bering Sea, Okhotsk Sea, China and Japan (Korea, Honsyu, Sikoku, Hokkaido, Saghalien and the Kuriles).

45. *Odonthalia* LYNGBYE, 1819

Key to the species

I. Frond broad-linear, decidedly compressed, moderately often branched, dentate on margin.
  A. Frond cartilaginous; both tetrasporic and cystocarpic fronds present ..... *O. corymbifera* (1)
  B. Frond submembranaceous; neither tetrasporic nor cystocarpic frond known ..... *O. sp.* (2)

II. Frond linear, subterete or slightly compressed below, becoming very compressed above, much branched, provided with compresso-subulate or sometimes somewhat broadened ramuli on branches.
  A. Frond linear throughout the whole length.
    1. Frond cartilaginous ..... *O. ochotensis* (3)
    2. Frond subcartilaginous, somewhat more tender than the above.. ..... *O. aleutica* (4)
  B. Frond linear, but slightly broadened above.
    1. Midrib absent in the upper branches ..... *O. Lyallii* (5)
    2. Midrib generally present ..... *O. kamtschatica* (6)

III. Frond linear, subterete or slightly compressed, much branched, provided with numerous, terete-subulate ramuli on branches..... *O. floccosa* (7)

1. *Odonthalia corymbifera* (GMELIN) J. AGARDH

Sp. Alg. II, 3, (1863), p. 894—DE TONI, Syll. Alg. IV, 3, p. 1136; VI, p. 432—OKAMURA, Nippon Sorui Meii, ed. 1, p. 66, ed. 2, p. 81; Icon. Jap. Alg. II, 9, p. 143, pl. XCI; Mar. Alg. Jap. p. 902—SINOVA, Alg. Kamtschatka, p. 36—YAMADA, Mar. Alg. Urup, p. 25—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Fucus corymbiferus GMELIN, Hist. Fuc. (1768), p. 124, Tab. IX.

Rhodomela corymbifera AGARDH, Sp. Alg. I, 2, (1822), p. 371.

Odonthalia Gmelini POSTELS et RUPRECHT, Ill. Alg. (1840), p. 14, Tab. XXVIII—KÜTZING, Sp. Alg. p. 847.

Atomaria corymbifera RUPRECHT, Tange Och. Meeres, (1851), p. 213.

Jap. name. Hakezaki-nokogirihiba.

This is a widely distributed species in the Kuriles from the eastern coast of Kunasiri northward to the North Kuriles where the shores are washed by the cold current. It is also found on the eastern coast of Hokkaido and Saghalien.

Habitat and localities. Growing on rocks in the lower littoral zone.

N. Kuriles. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kurosaki.

M. Kuriles. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Sosei-wan, Kobune, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Wenbetu, Iriribusi, Sibetoro, Rubetu. Sikotan Isl.—Syakotan, Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Rebun-iso, Hurukamappu.

Distrib. Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

2. *Odonthalia* sp.

OKAMURA, Mar. Alg. Jap. (1936), p. 905.

Odonthalia semicostata OKAMURA (not J. AGARDH), Icon. Jap. Alg. IV, 2, (1916), p. 25, pl. CLVII, fig. 1–6—YAMADA, Mar. Alg. Urup, p. 26.

Jap. name. Hiroha-nokogirihiba.

Frond flat, submembranaceous, arising from a small, scutate disc, broad-linear, alternately dentate on margin, alternate-pinnately branched, 9–15 cm. high, 4–10 mm. wide in the main axis, 2–3 mm. in the branches, brick- to purplish-red; midrib somewhat distinct in the main axis and in some branches, but not much protruded, often evanescent at the apices; both cystocarps and tetrasporangia unknown.

A large number of specimens have been obtained from the North and Middle Kuriles. But they lack both cystocarps and tetrasporangia. In these specimens, there are often found clustered, ultimate ramuli in the axils on the dentate margin of the frond. As far as the writer's observation has shown, these are nothing but the ramuli in budding stage of the branches. The present alga appears to be related to *O. washingtoniensis* KYLIN from the Pacific coast of North America.

Habitat and localities. Growing on the fronds of various algae, e.g., *Ptilota Asplenioides, P. pectinata, Turnerella Mertensiana, Odonthalia Lyallii, O. corymbifera,* etc.

N. Kuriles. Araido Isl.—Minami-ura. Paramusiru Isl.—Suribati-wan.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Usisiru Isl.—Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune.

Distrib. Kamchatka and Japan (the Kuriles).

3. *Odonthalia ochotensis* (RUPRECHT) J. AGARDH

Sp. Alg. II, 3, (1863), p. 897—DE TONI, Syll. Alg. IV, 3, p. 1140—OKAMURA, Nippon Sorui Meii, ed. 2, p. 82; Icon. Jap. Alg. IV, 10, p. 185, pl. CXCVI, fig. 1–6; VII, 1, p. 6, pl. CCCIV; Mar. Alg. Jap. p. 902, fig. 422—TOKIDA, Mar. Alg. Robben Isl. p. 31 (p. p.).

Atomaria Ochotensis RUPRECHT, Tange Och. Meeres, (1851), p. 212, Tab. IX.

Jap. name. Sinobuba-nokogirihiba.

Fronds caespitose, arising from a common scutate holdfast, linear, subterete below, moderately flattened above, alternately decompound-pinnately branched, naked or with small protruded scars of the fallen branches on the margin of the lower part, 9–19 cm. high; main axis 0.6–1 mm., branches 0.5–0.6 mm. wide; branches patent and partly flexuous; ultimate ramuli narrow and subulate, more or less recurved and patent; midrib distinct, occupying almost whole breadth of the axis; both cystocarps and tetrasporangia not found in the writer's specimens.

Through the courtesy of Prof. YAMADA, the present writer was able to examine the specimens identified by the late Prof. OKAMURA with this species, which are now deposited in Prof. YAMADA's Herbarium. OKAMURA described and delineated these specimens in his "Icones of Japanese Algae", vol IV. There are two specimens in a seat, the one (left specimen) narrow and linear on the whole and the other (right specimen) linear in the lower and middle portions, becoming slightly compressed and somewhat broadened above. Of these specimens, the former resembles more closely figure b in Tab. 9 in RUPRECHT's "Tange des Ochotskischen Meeres" and the latter is nearly like figure a on the same plate. Measurements on them were taken as follows.

	Main axis	Branches
Left specimen	ca. 0.5 mm. wide	ca. 0.3 mm. wide
Right specimen	ca. 0.6 mm. ,,	ca. 0.25–0.6 mm. ,,

Comparing with the above specimens, the present writer referred his specimens from the following localities to the present species.

Habitat and localities. Growing on rocks in the upper sublittoral zone.

M. Kuriles. Uruppu Isl.—Misima.

S. Kuriles. Etorohu Isl.—Iriribusi. Sikotan Isl.—Syakotan, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Rebun-iso, Pontomari, Tohutu.

Distrib. Okhotsk Sea and Japan (Saghalien and the Kuriles).

4. *Odonthalia aleutica* (MERTENS) J. AGARDH

Sp. Alg. II, 3, (1863), p. 895—KJELLMAN, Beringhafv. Algfl. p. 23—OKAMURA, Nippon Sorui Meii, ed. 1, p. 67, ed. 2, p. 82; Icon. Jap. Alg. VI, 8, p. 75, pl. CCLXXXVI; Mar. Alg. Jap. p. 904—SETCHELL & GARDNER, Alg. N. W. Amer. p. 333—DE TONI, Syll. Alg. IV, 3, p. 1138—SINOVA, Alg. Mer Ochotsk, p. 118; Alg. Kamtschatka, p. 35—YAMADA, Mar. Alg. N. Kuriles, p. 350; Mar. Alg. Urup, p. 25—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 23, pl. III, pl. IV, fig. a—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Fucus Aleuticus MERTENS mscr. in herb. CHAMISSOI.

Rhodomela aleutica AGARDH, Sp. Alg. I, 2, (1822), p. 375; Syst. Alg. p. 198; Icon. Alg. Ined. Fasc. q. Exst. Duo, Ed. Nova, Tab. V.

Jap. name. Aleutian-nokogirihiba.

Fronds caespitose, arising from a common scutate holdfast, linear, subterete below, moderately or much complanate above, alternately decompound-pinnately branched, 4–13 cm. high; main axis ca. 0.6 mm., branches 0.5 mm. wide; midrib generally indistinct, slightly elevated, continuing lengthwise and fluctuating within the whole breadth of the branches; only tetrasporic fronds found in the writer's specimens, but immature.

The present writer felt greatly puzzled in determining with certainty the present species and its allies. He owed his identification much to OKAMURA's "Icones of Japanese Algae". The writer's specimens are almost all sterile. Only one specimen was observed to bear immature tetrasporangia. In this specimen, the ultimate ramuli appear almost to develop in a way to completion of stichidia. The ramuli are formed corymbosely on the upper branches, of which ramuli the lowest one is very long compared with the rest. They are all recurved inwardly, toward the axis of the branches. In these ramuli, there are observed 10 to 15 tetraspores immersed in a row, though all immature. The present species appears to be most closely related to *O. ochotensis* J. AG. But, so far as the writer's observations have shown, it is hardly separable from the latter by the more tender frond and the more closely arranged branches, on which slightly longer ramuli are borne.

Habitat and localities. Growing on rocks in the lower littoral zone.

N. Kuriles. Araido Isl.—Kita-ura (YAMADA). Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Murakami-wan, Kakumabetu.

M. Kuriles. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Uruppu Isl.—Kobune, Misima, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Wenbetu. Sikotan Isl. (KAWABATA).

Distrib. Bering Isl., Alaska, Washington, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

5. *Odonthalia Lyallii* (HARVEY) J. AGARDH

Sp. Alg. II, 3, (1863), p. 894—SETCHELL & GARDNER, Alg. N. W. Amer. p. 335, pl. XXVII, fig. 51–53—DE TONI, Syll. Alg. IV, 3, p. 1137; VI, p. 432—OKAMURA, Icon. Jap. Alg. VII, 2, p. 12, pl. CCCVIII, fig. 1–5; Mar. Alg. Jap. p. 904—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 212.

Rhodomela Lyallii HARVEY, Coll. Alg. Vancouver Island, (1862), p. 168.

Jap. name. Lyall-nokogirihiba.

Fronds subterete below, becoming flattened above, alternately decompound-pinnately branched, with slightly elevated midrib in the middle part, but quite compressed in the upper branches, 20–40 cm. high, dark red upon drying; axis 0.5–1.5 mm., sometimes 2 mm. wide; main axis and branches in the 1st order sometimes more or less strongly flexuous; ultimate ramuli narrow, subulate, rarely slightly flabellate-incised at apices, up to 2 mm. wide at the broadest part; cystocarps abundant, arranged alternately on the branches, urceolate, sessile or with short thickened pedicel, ecalcarate, 0.65–1.2 mm. diam.; corymbose masses of the stichidial branches arranged alternately in pinnate manner on the upper branches, tetrasporangia arranged being immersed in 1, partly 2 rows within the stichidial branchlets, 120–150 μ diam., tetraspores tripartite.

The present species is closely related to *O. kamtschatica* J. AG., but it differs from the latter in the slenderness and flexuosity of the frond. The species was found rather widely in the Kuriles, within the region where the shores of the islands are washed by the cold current, from the coast of Sikotan northward to the North Kuriles.

Habitat and localities. Growing within the area from the lower littoral zone to the upper sublittoral zone in the North Kuriles; often found cast ashore.

N. Kuriles. Simusyu Isl.—Tenzin-iwa, Kataoka-wan? (YENDO). Paramusiru Isl.—Suribati-wan, Titose-wan, Kakumabetu.

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Smusiru-wan. Uruppu Isl.—Misima, Tokotan.

S. Kuriles. Etorohu Isl.—Moyoro, Tikohai, Kamuikotan. Sikotan Isl.—Aimizaki.

Distrib. Washington and Japan (the Kuriles).

6. *Odonthalia kamtschatica* (RUPRECHT) J. AGARDH

Sp. Alg. II, 3, (1863), p. 896—KJELLMAN, Beringhafv. Algfl. p. 23—SETCHELL & GARDNER, Alg. N. W. Amer. p. 336—DE TONI, Syll. Alg. IV, 3, p. 1139—SINOVA, Alg. Kamtschatka, p. 36—OKAMURA, Icon. Jap. Alg. VI, 8, p. 76, pl. CCLXXXVII; Mar. Alg. Jap. p. 905—YAMADA, Mar. Alg. N. Kuriles, p. 350—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 24, pl. IV, b. pl. V, VI.

Atomaria Kamtschatica RUPRECHT, Tange Och. Meeres, (1851), p. 214.

Jap. name. Kamchatka-nokogirihiba.

Prof. YAMADA reported *O. kamtschatica* J. AG. from Paramusiru Isl. The present writer failed to collect any specimen, referable to this species with certainty. Some specimens in the writer's collection, that bear somewhat broader fronds (ca. 2 mm. wide) which are now identified with *O. Lyallii* J. AG. come nearest to the present species.

Locality.

N. Kuriles. Paramusiru Isl.—Noda-wan (YAMADA).

Distrib. Bering Isl., British Columbia, Washington, Alaska, Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

7. *Odonthalia floccosa* (ESPER) FALKENBERG

Rhodomel. (1901), p. 607—SETCHELL & GARDNER, Alg. N. W. Amer. p. 333—DE TONI, Syll. Alg. IV, 3, p. 1137; VI, p. 432—OKAMURA, Nippon Sorui Meii, ed. 2, p. 82; Mar. Alg. Jap. p. 906—KYLIN, Mar. Red Alg. Friday Harb. p. 75—YAMADA, Mar. Alg. Urup, p. 25, pl. X—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 379.

Fucus floccosus EEPER, Icon. Fuc. II, (1802), p. 42, Tab. CXXX—TURNER, Fuci, I, p. 16, pl. VIII.

Rhodomela floccosa AGARDH, Sp. Alg. I, 2, (1822), p. 376—POSTELS & RUPRECHT, Ill. Alg. p. 14, pl. XXXVIII, fig. c—HARVEY, Ner. Bor.-Amer. II, p. 24—J. AGARDH, Sp. Alg. II, 3, p. 887—KJELLMAN, Beringhafv. Algfl. p. 24.

Lophura floccosa KÜTZING, Phyc. Gen. (1843), p. 436; Sp. Alg. p. 850; Tab. Phyc. XV, Tab. 38, fig. c–e.

Jap. name. Husa-nokogirihiba.

Fronds caespitose, arising from a common scutate holdfast, linear, terete and naked below, subterete for the greater part above, with protruded scars of fallen ramuli in the upper portions of main axis and in the lower portions of branches, alternately decompound-pinnately branched, 7–20 cm. high; main axis ca. 1 mm. diam.; branches ca. 0.25 mm. diam.; ultimate ramuli setaceous, 3–7 mm. long, disticho-alternately arranged singly or in short clusters on the upper branches; cystocarps globular, pedicellate, ecalcarate, 0.6–1.25 mm. diam.; stichidial branchlets corymbose, tetrasporangia arranged being immersed in 1 or 2 rows within the stichidial branchlets, 90–120 μ diam., tetraspores tripartite.

The writer's specimens are easily identifiable with the present species by having linear, subterete fronds for the greater part, of which the upper branches are usually beset rather closely with setaceous ramuli singly or in short clusters. In respect to the somewhat larger, globular cystocarps, this species is also separable from the allied species in the genus.

Habitat and localities. Growing on rocks in the littoral zone.

N. Kuriles. Araido Isl. Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Kakumabetu.

M. Kuriles. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan? Ketoi Isl.—Minami-ura. Uruppu Isl.—Misima, Tokotan, Iema (YAMADA).

S. Kuriles. Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Onnebessyo. Sikotan Isl.—Syakotan, Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Sokobetu, Kontankesi.

Distrib. Atlantic Ocean, Bering Isl., Alaska, British Columbia and Japan (the Kuriles).

2. Conclusion in the Classification

a. The total number of the species treated in the present paper is 187, belonging to 93 genera and 44 families. The largest family is the Laminariaceae, comprising 30 species. Next come the Rhodomelaceae, having 19 species. Then follow the Cladophoraceae, Fucaceae, Ceramiaceae and Bangiaceae, the first with 11 species, the second and the third respectively with 10 and the last with 9.

b. The number of genera, species, varieties and forms in the families found in the Kuriles, are as follows:

Name of Family	Genera	Species	Varieties	Forms
CYANOPHYCEAE	(1)	(1)	—	—
Chamaesiphonaceae	1	1	—	—
CHLOROPHYCEAE	(14)	(32)	(4)	(2)
Chlorochytriaceae	1	1	—	—
Ulotrichaceae	1	2	—	—
Ulvaceae	2	9	—	2
Monostromaceae	1	6	2	—
Chaetophoraceae	1	1	—	—
Schizogoniaceae	2	2	—	—
Cladophoraceae	6	11	2	—
PHAEOPHYCEAE	(33)	(71)	(2)	(42)
Ectocarpaceae	2	2	—	—
Ralfsiaceae	1	1	—	—
Elachistaceae	1	1	—	—
Sphacelariaceae	1	1	—	—
Dictyotaceae	1	1	—	—
Leathesiaceae	1	2	—	—
Chordariaceae	2	5	—	2
Aegiraceae	1	1	—	—
Heterochordariaceae	1	2	—	—
Desmarestiaceae	1	4	—	—
Punctariaceae	1	2	—	—
Asperococcaceae	1	1	—	—
Scytosiphonaceae	2	2	—	5
Coilodesmaceae	1	4	—	—
Dictyosiphonaceae	1	1	—	—
Chordaceae	1	1	—	—
Laminariaceae	10	30	2	19
Fucaceae	4	10	—	16
RHODOPHYCEAE	(45)	(83)	(4)	(36)
Bangiaceae	2	9	—	6
Chantransiaceae	1	2	—	—
Dumontiaceae	4	6	—	—
Squamariaceae	2	2	—	—
Corallinaceae	3	3	—	7
Endocladiaceae	1	1	—	1
Tichocarpaceae	1	1	—	2
Callymeniaceae	4	5	1	2

Name of Family	Genera	Species	Varieties	Forms
Nemastomaceae	1	1	1	—
Solieriaceae	1	1	—	—
Rhodophyllidaceae	1	1	—	—
Gracilariaceae	1	1	—	—
Phyllophoraceae	1	1	1	—
Gigartinaceae	4	7	—	10
Rhodymeniaceae	2	6	1	6
Ceramiaceae	4	10	—	—
Delesseriaceae	7	7	—	2
Rhodomelaceae	5	19	—	—
Total sum	93	187	10	80

c. One new genus, several new species, many new forms and five new combinations, are established by the present writer or jointly with Prof. Emer. K. MIYABE in the present paper as follows:

New genus. Phaeophyceae—*Streptophyllum* MIYABE et NAGAI.

New species. Chlorophyceae—*Monostroma ochotensis* NAGAI, *Entocladia Pterosiphoniae* NAGAI, *Aegagropila kurilensis* NAGAI; Phaeophyceae—*Ectocarpus fusiformis* NAGAI, *Punctaria flaccida* NAGAI, *Laminaria sikotanensis* MIYABE et NAGAI, *Cymathaere japonica* MIYABE et NAGAI; Rhodophyceae—*Porphyra ochotensis* NAGAI. *Rhodochorton kurilense* NAGAI, *Iridophycus subdichotomum* NAGAI, *Antithamnion ochotense* NAGAI, *Yendonia japonica* NAGAI, *Pterosiphonia japonica* NAGAI.

New forms. Phaeophyceae—*Laminaria longipes* f. *linearis* MIYABE et NAGAI, *L. diabolica* f. *genuina* MIYABE et NAGAI and f. *angustifolia* MIYABE et NAGAI, *Costaria costata* f. *cuneata* MIYABE et NAGAI, *Alaria dolichorhachis* f. *typica* MIYABE et NAGAI; Rhodophyceae—*Porphyra amplissima* f. *elliptica* NAGAI and f. *lanceolata* NAGAI, *Amphiroa cretacea* f. *typica* NAGAI, *Tichocharpus crinitus* f. *linearis* NAGAI and f. *complanatus* NAGAI, *Callophyllis rhynchocarpa* f. *subsimplex* NAGAI, *Gigartina unalaschcensis* f. *typica* NAGAI, f. *grandifolia* NAGAI and f. *irregularis* NAGAI, *G. ochotensis* f. *typica* NAGAI and f. *dissecta* NAGAI, *Chondrus pinnulatus* f. *typicus* NAGAI and f. *conglobatus* NAGAI, *Rhodoglossum pulchrum* f. *typicum* NAGAI, f. *divergens* NAGAI and f. *luxurians* NAGAI, *Rhodymenia palmata* f. *ochotensis* NAGAI, *Phycodrys fimbriata* f. *typica* NAGAI and f. *dissecta* NAGAI.

New combinations. Phaeophyceae—*Dictyopteris divaricata* (OKAMURA) NAGAI, *Coilodesme fucicola* (YENDO) NAGAI, *Streptophyllum spirale* (YENDO) MIYABE et NAGAI, *Laminaria longipes* f. *angustifolia* (POST. et RUPR.) MIYABE et NAGAI, *Costaria costata* f. *latifolia* (POST. et RUPR.) MIYABE et NAGAI.

d. The species new to the Kuriles are 54, among which 22 species, are also new to Japan. They are as follows:

Cyanophyceae—**Dermocarpa pacifica;* Chlorophyceae—**Chlorochytrium inclusum, *Ulothrix pseudoflacca, *Ulva fenestrata, Enteromorpha intestinalis, E. prolifera, E. clathrata, *Monostroma ochotensis, *Gayella polyrhiza, *Entocladia Pterosiphoniae, Cladophora glaucescens, Hormiscia penicilliformis;* Phaeophyceae—**Ectocarpus fusiformis, *Sphacelaria subfusca, Dictyopteris divaricata, Leathesia difformis, L. sphaerocephalus, Chordaria cladosiphon, *Desmarestia media, Punctaria latifolia, *P. flaccida, Coilodesme Cystoseirae, Chorda Filum, *Laminaria sikotanensis, Alaria praelonga, A. taeniata, Cystophyllum hakodatense, Sargassum Horneri, S. Thunbergii;* Rhodophyceae—*Goniotrichum Alsidii, *Rhodochorton moniliforme, *R. kurilense, Farlowia mollis, *Rhododermis parasitica, Hildenbrandtia prototypus, Amphiroa cretacea, Callophyllis rhynchocarpa, Rhodophyllis capillaris, *Iridophycus subdichotomum, Halosaccion ramentaceum, *Antithamnion Shimamuranum, *Antithamnion sp., Ceramium Kondoi, C. japonica, Pseudophycodrys Rainosukei, *Yendonia japonica, Hypophyllum Middendorfii, *Hymenena cuneata, Laurencia nipponica, L. glandulifera, Polysiphonia Morrowii, P. sertularioides, *Pterosiphonia robusta, *P. japonica.*

III. The Phytogeographical Distribution of the Marine Algae in the Kurile Islands

In order to make clear the present knowledge of the marine flora of the Kurile Islands, the writer intends first to compare the flora on the whole with those of other regions, then to analyse it from the standpoint of marine phytogeography.

1. Floristic Relationships between the Kurile Islands and other Regions

The following tables have been prepared to use as a basis for discussion on the relationships between the flora of the Kurile Islands and those of other regions. They include all the species, that the writer has treated in the systematic part of the present paper, except *Aegagropila kurilensis* which is an unique species of the freshwater algae.

The mark * indicates species, new to Japan.

TABLE I. Showing the relationships of the marine flora of the Kurile Islands to those of other regions.

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
MYXOPHYCEAE														
COCCOGONALES														
Chamaesiphonaceae														
Dermocarpa pacifica	....	....	....	....	....	....	....	....	....	+	....	....	....	....
CHLOROPHYCEAE														
PROTOCOCCALES														
Chlorochytriaceae														
Chlorochytrium inclusum	....	....	....	....	....	....	+	....	+	+	+	+	....	....
CHAETOPHORALES														
Ulotrichaceae														
Ulothrix flacca	....	....	....	....	....	....	....	....	+	+	....	+	....	....
pseudoflacca	....	....	....	....	....	....	....	....	+	+	....	+	....	....
Ulvaceae														
Ulva Linza	+	+	....	+	+	+	....	+	+	+	....	+	+	....
pertusa	+	+	+	+	+	+	....	....	....	....	....	....	....	....
fenestrata	....	....	....	....	....	....	....	+	+	+	....	....	....	....
latissima	....	....	....	....	....	....	+	....	+	....	....	+	....	....
Enteromorpha micrococca	....	....	....	....	....	+	....	+	+	+	+	+	....	....
intestinalis	+	....	+	+	+	....	....	+	+	+	+	+	+	....
prolifera	+	....	+	+	+	+	....	....	+	+	....	+	+	....
clathrata	....	....	+	+	....	....	....	+	+	+	+	+	....	....
plumosa	+	....	....	+	....	....	....	....	....	+	....	+	....	....
Monostromaceae														
Monostroma groenlandicum	....	....	....	....	....	....	....	....	+	....	+	+	....	....
Grevillei	....	....	....	....	....	+	....	+	+	....	+	+	....	....
arcticum	....	....	....	....	+	+	....	+	+	....	+	....	....	....
ochotensis	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
zostericola	....	....	....	....	+	+	....	....	....	+	....	....	....	....
fuscum	....	....	....	....	....	....	+	+	+	+	+	+	....	....
Chaetophoraceae														
Entocladia Pterosiphoniae	....	....	....	....	Peculiar to the Kuriles						....	....	....	....

TABLE I. (*Continued*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, north-eastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
SCHIZOGONIALES														
Schizogoniaceae														
Prasiola boreàlis	....	....	....	....	....	....	....	.....	+	.....	....	....	....	....
Gayella polyrhiza	....	....	....	....	....	....	....	.....	+	.....	+	+	....	....
SIPHONOCLADIALES														
Cladophoraceae														
Rhizoclonium tortuosum	....	....	....	....	....	....	....	.....	+	+	....	+	....	....
Hormiscia penicilliformis	....	....	....	....	....	+	+	+	+	+	+	+	....	....
Chaetomorpha aerea	+	....	....	+	....	+	....	.....	....	+	....	+	....	....
moniligera	....	....	....	+	+	+	....	.....	....	.....	....	....	....	....
melagonium	....	....	....	+	....	+	+	+	+	.....	+	+	....	....
Cladophora glaucescens	....	....	....	+	....	+	....	.....	....	+	+	+	....	....
Spongomorpha duriuscula	....	....	....	....	+	....	+	.....	+	.....	....	....	....	....
Hystrix	....	....	....	....	....	+	....	.....	+	.....	+	+	....	....
Mertensii	....	....	....	....	....	+	....	+	+	+	....	....	....	....
saxatilis	....	....	....	....	....	+	+	+	+	+	....	....	....	....
PHAEOPHYCEAE														
ECTOCARPALES														
Ectocarpaceae														
Pylaiella littoralis	....	....	....	....	+	+	+	+	+	+	+	+	....	....
Ectocarpus fusiformis	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
Ralfsiaceae														
Ralfsia fungiformis	....	....	....	....	....	+	....	+	+	.....	+	+	....	....
Elachistaceae														
Elachista lubrica?	....	....	....	....	....	....	+	.....	+	.....	+	+	....	....
SPHACELARIALES														
Sphacelariaceae														
Sphacelaria subfusca	+	....	....	....	....	....	....	.....	+	+	....	....	....	....
DICTYOTALES														
Dictyotaceae														
Dictyopteris divaricata	+	+	+	+	....	+	....	.....	....	.....	....	....	....	....
CHORDARIALES														
Leathesiaceae														
Leathesia difformis	+	....	+	+	....	+	....	.....	+	+	+	+	....	....
sphaerocephalus	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....

TABLE I. (*Continued*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
Chordariaceae														
Gobia simplex	....	....	....	....	+	+	....	.....	+	+	....	....	.....	....
Chordaria flagelliformis	....	....	....	....	+	+	+	+	+	.....	+	+	....	....
gracilis	....	....	....	....	....	+	....	.....	+	.....	....	....	.....	....
cladosiphon	+	+	+	+	....	+	....	.....	.....	.....	....	....	.....	....
Nagaii	....	....	....	....	+	....	....	.....	.....	.....	....	....	.....	....
Aegiraceae														
Aegira virescens	....	....	....	....	....	....	....	.....	+	.....	....	+	.....	....
Heterochordariaceae														
Heterochordaria Gunjii	....	....	....	....	Peculiar to the Kuriles						....	....	.....	....
abietina	....	....	....	+	+	+	....	+	+	+	....	....	.....	....
DESMARESTIALES Desmarestiaceae														
Desmarestia media	....	....	....	....	....	....	....	.....	+	.....	....	....	.....	....
aculeata	....	....	....	....	+	....	....	+	....	.....	+	+	.....	....
kurilensis	....	....	....	....	Peculiar to the Kuriles						....	....	.....	....
ligulata	....	....	....	+	+	+	....	.....	....	+	....	+	+	....
PUNCTARIALES Punctariaceae														
Punctaria latifolia	....	....	+	+	....	....	....	.....	....	.....	....	+	.....	....
flaccida	....	....	....	....	Peculiar to the Kuriles						....	....	.....	....
Asperococcaceae														
Soranthera ulvoidea	....	....	....	....	....	....	....	+	+	+	....	....	.....	....
Scytosiphonaceae														
Scytosiphon Lomentarius	+	....	+	+	+	+	+	+	+	+	+	+	....	+
Colpomenia sinuosa	+	....	+	+	+	+	....	+	+	+	....	....	+	....
Coilodesmaceae														
Coilodesme bulligera	....	....	....	....	+	....	....	.....	+	+	+	....	.....	....
Cystoseirae	....	....	....	....	....	+	....	.....	+	.....	....	....	.....	....
japonica	....	....	....	....	....	+	....	.....	....	.....	....	....	.....	....
fucicola	....	....	....	....	+	....	....	+	....	.....	....	....	.....	....
DICTYOSIPHONALES Dictyosiphonaceae														
Dictyosiphon foeniculaceus	....	....	....	+	....	+	+	+	+	+	+	+	.....	....

TABLE I. (*Continued*)

Name of Species \ Region	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
LAMINARIALES														
Chordaceae														
Chorda Filum	+	....	+	+	+	+	+	.....	+	+	....	+	....	....
Laminariaceae														
Laminaria longipes	....	....	....	....	+	....	....	+	+	.....	....	....	....	....
ochotensis	....	....	....	....	+	+	....	.....	....	.....	....	....	....	....
diabolica	....	....	....	....	+	+	....	.....	....	.....	....	....	....	....
angustata	....	....	....	+	....	+	....	.....	....	.....	....	....	....	....
coriacea	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
sachalinensis	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
sikotanensis	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
taeniata	....	....	....	....	....	....	....	+	+	.....	....	....	....	....
subsimplex	....	....	....	....	....	....	....	.....	....	+	....	....	....	....
dentigera	....	....	....	....	+	....	....	+	+	.....	....	....	....	....
platymeris	....	....	....	....	....	....	....	.....	+	+	+	+	....	....
yezoensis	....	....	....	....	....	+	....	+	....	.....	....	....	....	....
Cymathaere fibrosa	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
tripl cata	....	....	....	....	....	....	....	+	+	+	....	....	....	....
japonica	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
Kjellmaniella gyrata	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
Costaria costata	....	....	....	+	+	+	....	+	+	+	....	....	....	....
Agarum cribrosum	....	....	....	+	+	+	....	+	+	+	+	+	....	....
Streptophyllum spirale	....	....	....	....	....	....	+	+	....	.....	....	....	....	....
Arthrothamnus kurilensis	....	....	....	....	+	....	....	.....	....	.....	....	....	....	....
bifidus	....	....	....	....	....	+	+	+	+	.....	....	....	....	....
Thalassiophyllum Clathrus	....	....	....	....	....	....	....	+	+	+	....	....	....	....
Alaria fistulosa	....	....	....	....	+	....	....	+	+	.....	....	....	....	....
praelonga	....	....	....	....	....	+	+	+	+	.....	....	....	....	....
macroptera	....	....	....	....	....	+	+	+	....	.....	....	....	....	....
dolichorhachis	....	....	....	....	+	....	+	+	+	.....	+	....	....	....
tenuifolia	....	....	....	....	....	....	....	+	+	+	....	....	....	....
taeniata	....	....	....	....	....	+	....	+	....	.....	....	....	....	....
angusta	....	....	....	....	+	+	....	+	+	.....	....	....	....	....
Pleuropterum paradiseum	....	....	....	....	Peculiar to the Kuriles						....	....	....	....

TABLE I. (*Continued*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Bering Sea: Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
FUCALES Fucaceae														
Fucus evanescens	....	....	....	+	+	+	+	+	+	+	+	+	....	....
Pelvetia Wrightii	....	....	....	+	+	+	....	.....	....	.....	....	....	....	....
Cystophyllum geminatum	....	....	....	....	+	+	+	+	+	+	....	....	....	....
crassipes	....	....	....	....	+	+	....	.....	....	.....	....	....	....	....
hakodatense	....	+	....	+	+	+	....	.....	....	.....	....	....	....	....
Sargassum Horneri	+	+	+	+	....	+	....	.....	....	.....	....	....	....	....
confusum	+	+	+	+	+	+	....	.....	....	.....	....	....	....	....
Thunbergii	+	+	+	+	+	+	....	.....	....	.....	....	....	....	....
Kjellmanianum	....	....	+	+	+	+	....	.....	....	.....	....	....	....	....
Miyabei	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
RHODOPHYCEAE BANGIALES Bangiaceae														
Goniotrichum Alsidii	+	....	....	....	....	+	....	.....	....	.....	....	+	+	....
Porphyra umbilicalis	....	....	....	....	+	+	....	+	+	.....	+	+	....	....
pseudolinearis	....	+	....	+	....	+	....	.....	....	.....	....	....	....	....
ochotensis	....	....	....	....	+	....	....	.....	....	.....	....	....	....	....
occidentalis	....	....	....	....	....	....	....	.....	....	+	....	....	....	....
variegata	....	....	....	....	+	+	....	+	....	+	....	....	....	....
amplissima	....	....	....	....	+	....	....	.....	+	+	+	....	....	....
Tasa	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
bulbopes	....	....	....	....	....	....	....	+	....	.....	....	....	....	....
FLORIDEAE NEMARIONALES Chantransiaceae														
Rhodochorton moniliforme	....	....	....	....	....	....	....	.....	....	+	....	+	+	....
kurilense	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
CRYPTONEMIALES Dumontiaceae														
Dumontia filiformis	....	....	....	....	+	+	+	+	+	.....	....	+	....	....
Farlowia mollis	....	....	....	....	....	+	....	.....	....	+	....	....	....	....
irregularis	....	....	....	....	+	+	....	.....	....	.....	....	....	....	....

TABLE I. (*Continued*)

Name of Species \ Region	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, north-eastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
Dilsea edulis	....	....	....	+	+	+	....	.....	....	.....	+	+	....	....
Constantinea rosa-marina	....	....	....	....	+	+	....	+	+	.....	....	....	....	....
subulifera	....	....	....	....	....	+	....	.....	....	+	....	....	....	....
Squamariaceae														
Rhododermis parasitica	....	....	....	....	....	....	....	.....	....	.....	....	+	....	....
Hildenbrandtia prototypus	+	....	....	....	....	....	....	+	....	+	+	+	....	....
Corallinaceae														
Phymatolithon loculosum	....	....	....	....	....	....	....	+	+	.....	....	....	....	....
Amphiroa cretacea	....	....	....	+	....	+	....	+	+	.....	....	....	....	....
Corallina pilulifera	+	....	....	+	+	+	+	.....	+	.....	....	....	....	....
Endocladiaceae														
Gloiopeltis furcata	+	....	+	+	....	+	....	+	+	+	....	....	....	....
Tichocarpaceae														
Tichocarpus crinitus	....	+	....	....	+	+	+	+	....	.....	....	....	....	....
Callymeniaceae														
Callophyllis rhynchocarpa	....	....	....	....	+	+	+	+	+	.....	....	....	....	....
Erythrophyllum Gmelini	....	....	....	....	....	+	....	.....	+	.....	....	....	....	....
Euthora fruticulosa	....	....	....	....	+	....	+	+	+	+	....	....	....	....
Callymenia ornata	....	....	....	....	....	....	+	+	+	.....	....	....	....	....
reniformis	....	....	....	+	+	+	+	.....	+	+	....	+	....	....
GIAGRTINALES														
Nemastomaceae														
Schizymenia Dubyi	....	....	+	+	....	+	....	.....	....	.....	....	+	....	+
Solieriaceae														
Turnerella Mertensiana	....	....	....	....	+	+	....	+	+	+	....	....	....	....
Rhodophyllidaceae														
Rhodophyllis capillaris	....	....	....	....	....	+	....	.....	....	.....	....	....	....	....
Gracilariaceae														
Gracilaria confervoides	+	+	+	+	+	+	....	.....	....	+	....	+	....	+
Phyllophoraceae														
Ahnfeltia plicata	....	+	....	....	+	+	+	+	+	+	+	+	....	....

TABLE I. (*Continued*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, north-eastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, Washington & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
Gigartinaceae														
Gigartina unalaschcensis	....	....	....	+	+	+	+	+	+	.....	....	....	....	....
ochotensis	....	+	....	....	....	+	+	+	....	.....	....	....	....	....
Chondrus pinnulatus	....	+	....	+	+	+	....	.....	....	.....	....	....	....	....
Iridophycus cornucopiae	....	....	....	....	....	+	....	+	....	.....	....	....	....	....
cordatum	....	....	....	....	....	....	+	.....	+	+	....	....	....	....
subdichotomum	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
Rhodoglossum pulchrum	....	....	....	+	+	+	....	+	....	.....	....	....	....	....
RHODYMENIALES Rhodymeniaceae														
Rhodymenia palmata	....	+	....	+	+	+	+	+	+	+	+	+	....	....
pertusa	....	+	....	+	+	+	+	+	+	+	+	....	....	....
Halosaccion saccatum	....	....	....	....	+	+	+	+	+	.....	....	....	....	....
firmum	....	....	....	....	....	+	....	+	....	.....	....	....	....	....
ramentaceum	....	....	....	....	+	....	+	+	+	.....	+	+	....	....
microsporum	....	....	....	....	....	....	+	+	....	.....	....	....	....	....
CERAMIALES Ceramiaceae														
Pleonosporium Kobayashii	....	....	....	....	....	....	....	.....	+	.....	....	....	....	....
AntithamnionShimamuranum	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
sp.	....	....	....	....	Peculiar to the Kuriles						....	....	....	....
Ptilota Asplenioides	....	....	....	....	+	+	....	+	+	.....	....	....	....	....
pectinata	....	....	....	....	+	+	+	+	+	+	+	....	....	....
filicina	....	....	....	....	....	....	....	.....	+	+	....	....	....	....
Ceramium hypnaeoides	+	+	+	+	+	+	....	.....	....	.....	....	....	....	....
Kondoi	....	....	....	+	....	+	....	.....	....	.....	....	....	....	....
rubrum	+	+	....	+	+	+	....	+	+	+	+	+	+	....
japonicum	+	+	....	+	....	+	....	.....	....	.....	....	....	....	....
Delesseriaceae														
Laingia pacifica	....	+	....	....	+	+	....	+	....	.....	....	....	....	....
Membranoptera denticulata	....	....	....	....	....	....	....	+	+	.....	+	....	....	....
Pseudophycodrys Rainosukei	....	....	....	....	+	....	....	.....	+	.....	....	....	....	....
Phycodrys fimbriata	....	....	....	....	+	+	....	.....	....	.....	+	....	....	....

TABLE I. (*Concluded*)

Name of Species \ Region	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okho'sk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, *Washington* & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
Yendonia japonica					Peculiar to the Kuriles									
Hypophyllum Middendorfii					+	+	+							
Hymenena cuneata									+					
Rhodomelaceae														
Polysiphonia Morrowii	+			+		+								
senticulosa				+		+				+				
sertularioides				+								+		
japonica	+	+		+		+								
Laurencia nipponica	+			+		+								
glandulifera				+		+						+		
Pterosiphonia bipinnata					+	+	+	+	+	+				
robusta										+				
arctica					+	+			+	+				
japonica					Peculiar to the Kuriles									
Rhodomela Larix				+	+	+	+	+	+	+	+			
subfusca	+	+	+	+	+	+	+	+			+	+		
Odonthalia corymbifera					+	+		+						
sp.								+						
ochotensis					+		+							
aleutica					+	+	+	+	+	+				
Lyallii										+				
kamtschatica					+	+		+	+	+				
floccosa								+	+	+		+		

TABLE II. Showing the number of species in the classes of the marine algae, found in the Kuriles and those common in other regions.

Name of class \ Region	Kuriles	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	Okhotsk Sea	Bering Sea: Kamchatka, northeastern Siberia & Bering Isl.	Bering Sea: Alaska, including Aleutian Isls.	Brit. Columbia, *Washington* & California	Arctic Ocean	Atlantic Ocean	Pacific coast of South America	Mediterranean Sea
MYXOPHYCEAE	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—
CHLOROPHYCEAE	32	6	2	4	10	8	6	7	12	23	18	13	20	3	—
PHAEOPHYCEAE	71	10	6	11	20	30	42	13	29	33	21	13	15	2	1
RHODOPHYCEAE	82	12	14	5	25	39	52	23	38	35	28	14	18	3	2
Total sum	186	28	22	20	55	77	100	43	79	91	68	40	53	8	3

As the result of the above survey, the number of species common to the Kuriles and to other regions can be stated as follows:

China. The species common to the present region are 28 in number, of which the most are also common to Korea, Kyushyu, Sikoku, Honsyu and Hokkaido.

Korea. The species common to the present region are 22 in number, of which the most are also common to Honsyu and Hokkaido.

Kyusyu, Sikoku and other southern islands. The species common to the present regions are 20 in number, and they are also common to Honsyu.

Honsyu. The species common to the present region are 55 in number. They are all likewise common to Hokkaido, and a part of them to the previous regions and Korea.

Saghalien. The species common to the present region are 77 in number. The marine flora of Saghalien, Hokkaido and the Kuriles are, on the whole, far more similar to each other than to the southern districts of Japan.

Hokkaido. Among the regions, Hokkaido and Kamchatka are most closely related to the Kuriles in their marine flora, as their waters are contiguous. The species common to the present region are larger in number than to any of the other regions, comprising as many as 100.

Okhotsk Sea. The present region indicates the territory of the U. S. S. R., including the coasts and islands, facing the Okhotsk Sea. The species common to the present region are 43 in number.

Bering Sea.

a. *Kamchatka, Bering Isl. and the northeastern part of Siberia.* The species common to the present region are 79 in number. This number is, however, smaller than that common to Alaska.

b. *Alaska, including the Aleutian islands.* The species common to the present region are 91, showing the largest number next to Hokkaido.

British Columbia and Washington to California. The species common to the present region are 68, showing rather a larger number than that common to Honsyu.

Arctic Ocean. The species common to the present region are 40 in number.

Atlantic Ocean, South America and the Mediterranean Sea. The species common to the Atlantic Ocean are 53 in number. The species

common to the Pacific coast of South America are 8 and those to the Mediterranean Sea are 3 in number.

Species peculiar to the Kuriles. The species peculiar to the Kuriles are 16 in number. They are: *Monostroma ochotensis, Entocladia Pterosiphoniae, Ectocarpus fusiformis, Heterochordaria Gunjii, Desmarestia kurilensis, Punctaria flaccida, Cymathaere fibrosa, C. japonica, Pleuropterum paradiseum, Porphyra Tasa, Rhodochorton kurilense, Iridophycus subdichotomum, Antithamnion Shimamuranum, Antithamnion* sp., *Yendonia japonica, Pterosiphonia japonica.*

As shown just above, the marine flora of the Kuriles has respectively Hokkaido, Alaskan and Kamchatkan elements within the range from about two-thirds to about a half of the whole number of the species. Next to the above, it is represented by the elements of such regions as Saghalien, British Columbia and Washington to California, Honsyu, the Atlantic Ocean, Okhotsk Sea, the Arctic Ocean, etc., having 77 to 40 common species.

2. Analysis of the Marine Flora of the Kurile Islands.

Before entering into an analysis of the marine flora of the Kuriles, the present writer may touch briefly upon SETCHELL's (200) classification of oceans, proposed from the viewpoint of the distribution of algae. He divided the surface water of the oceans into nine zones according to the water temperatures, as follows: Upper Boreal, Lower Boreal, North Temperate, North Subtropical, Tropical, South Subtropical, South Temperate, Lower Austral, and Upper Austral. The limiting isotherms of surface temperature chosen are those of the summer month or maxim, i.e. the isotheres, which are those of February (or possibly March) for the southern hemisphere and those of August (or possibly September) for the northern hemisphere. Each of the zones he proposed covers 5°C. range of surface temperature with the exception of the Upper Boreal and the Upper Austral, each of which includes a range of 10°C. or slightly over. The zones are: the Upper Boreal and Upper Austral, between the isotheres of 0°C. (or even –2°C.) to 10°C., Lower Boreal and Lower Austral between the isotheres of 10°C. and 15°C., North Temperate and South Temperate between the isotheres of 15°C. and 20°C., North Subtropical and South Subtropical between the isotheres of 20°C. and 25°C., and the Tropical between 25°C. and 30°C. (or above).

In order to apply the above classification to the case of the

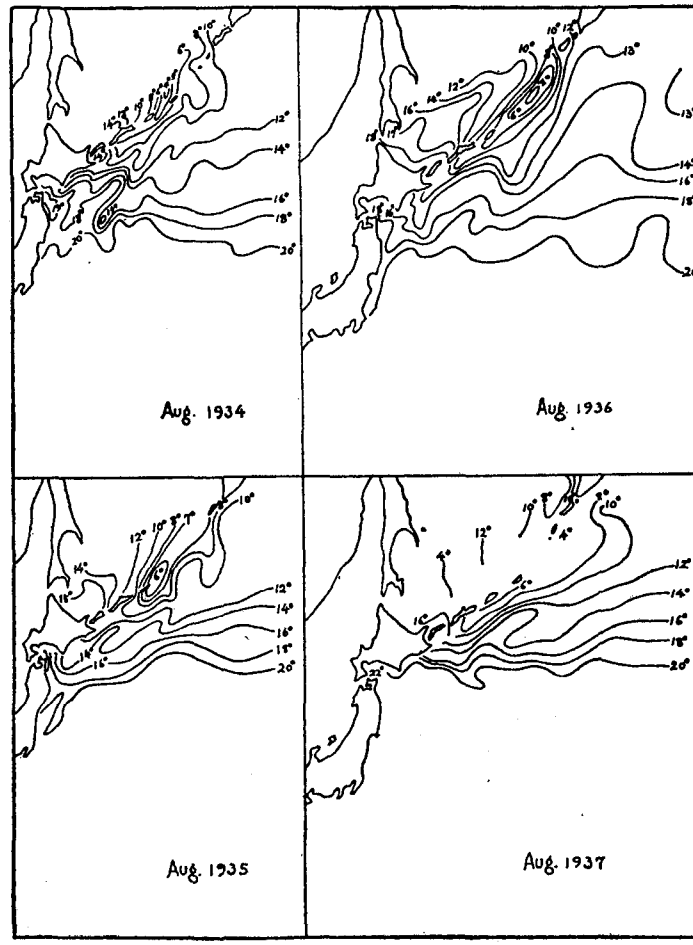
Kuriles the water temperatures along or adjacent to the islands in summer, must be known. They are shown in table III and the isothermal maps, based upon the data given by UDA (242) of the Imperial Fisheries Experimental Station, Tokyo, the Hokkaido Fisheries Experiment Station and the Hokkaido-tyo Expedition in the Kuriles, 1930.

TABLE III. Showing the water temperatures in the Kuriles and adjacent waters in Hokkaido in summer, summarized from the date given by the Hokkaido-tyo Expedition in the Kuriles and the Hokkaido Fish. Exp. Sta.

Island	Position of locality	Locality	Temperature C.
Kuriles Araido	Okhotsk Sea side	Minami-ura	7.53
Simysyu	Okhotsk Sea side Paramusiru Strait side	Tenzin-iwa Kataoka-wan	8.0 7.7
Paramusiru	Pacific side Okhotsk Sea side Okhotsk Sea side Okhotsk Sea side	Titose-wan Murakami-wan Kakumabetu Kuzira-wan	6.36 7.5 7.35 7.0
Simusiru	Simusiru Strait side	Broughton Bay	5.9
Uruppu	Okhotsk Sea side	Tokotan	3.8
Etorohu	Pacific side Okhotsk Sea side Okhotsk Sea side Okhotsk Sea side Okhotsk Sea side Okhotsk Sea side	**Several miles off the coast Sibetoro Bettobu Syamanbe Syana Rubetu	8.5–14.5–23.2 13.0 14.5 12.96 13.5 12.5
Sikotan		Syakotan	14.75
Kunasiri	Kunasiri Strait side	*Atoiya	16.33
Hokkaido	Kurile side	Nemuro	17.33
	Pacific side	*Nosyappu *Daikokuzima, Akkesi *Erimo *Esan	14.41 12.62 15.28 16.7
	Soya Strait side	*Soya	18.83

The mark * indicates the average of the water temperatures of 1931–'33, for July 20–Aug. 10, ** the water temperatures, Aug. 10–12, 1933 and the others those for July 20–Aug. 11, 1930.

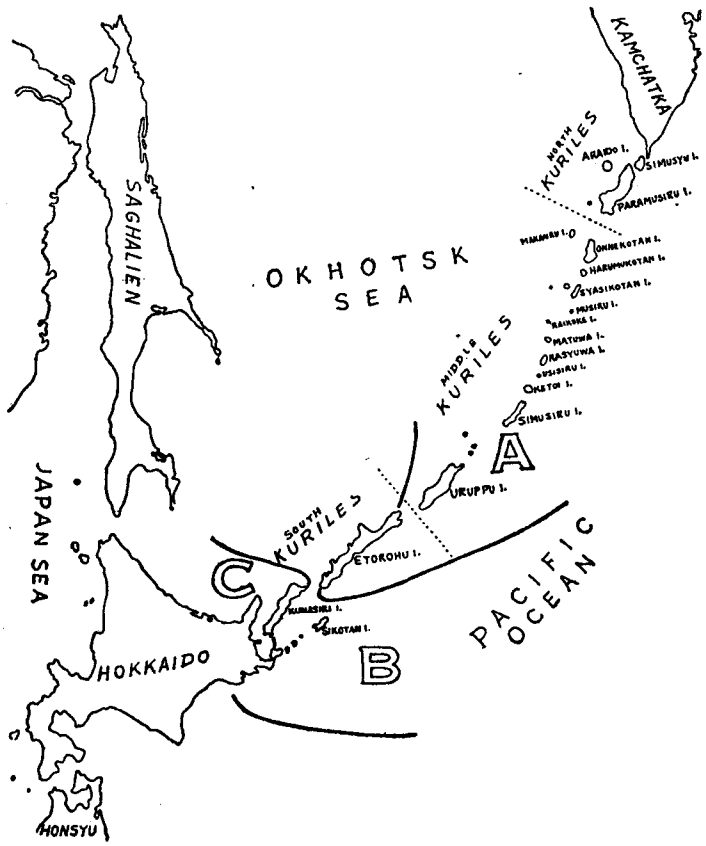
MAP I. Showing the distribution of water temperature in the area adjacent to the Kurile Islands from 1934 to 1937. (After UDA, 1938)



From the above data, the Kurile area is divisible into three districts, viz., the Upper Boreal, Lower Boreal and North Temperate Districts.

The Upper Boreal District is represented by the area including the greater part of the Kuriles from Simusyu to the eastern coast of Etorohu. As well known, the Kurile Islands are washed on the Pacific side by the cold Oyasiwo current, originating in the Bering

MAP II. Showing the boundary lines of the Kurile area, drawn upon the data in Table 3 and Map I.



A. Upper Boreal District; B. Lower Boreal District; C. North Temperate District.

Sea, and running southward down along the eastern coast of Kamchatka. In this case, the North Kuriles are known to be washed directly by the current, but the Middle Kuriles, from Matuwa Strait to Uruppu Strait by the cold waters, mostly of its upwellings. In the Okhotsk Sea, there is a current, which has come down along the eastern coast of Saghalien, then mixed with the subterminal part of the Tusima current on the Okhotsk Sea side of Hokkaido and then flowed up from the southern islands northward along the Kurile Archipelago. On the Pacific side, there flows another current,

which is a branch of the warm Kurosiwo current, running northwards off the coasts beyond the Oyasiwo. According to SUDA (221), besides the above, drift ice masses which have probably originated from the Okhotsk Sea, appear in spring in the Middle Kuriles more frequently than in the North Kuriles. He thinks that the Oyasiwo is much influenced by the ice in spring. The water temperature of the Middle Kuriles is known to be colder than that of the North Kuriles by the investigations of various authors. Under such conditions, it is easily presumed that the weather of this district in summer is comparatively cold and foggy.

The Lower Boreal District is represented by the area including the western coast of Etorohu, the eastern coast of Kunasiri, Sikotan and the Pacific coast of Hokkaido proper as far west as Kusiro. The northern boundary line of this district from the Upper Boreal District may be drawn at Cape Tosirari on the northwestern coast of Etorohu and the southern boundary at the southernmost point or its neighbourhood on the eastern coast of that island. In the present district, the coasts of the islands are washed by mixed waters of the cold and warm currents. In this district, there seem to exist a few differences in the thermal degrees among the coasts of the above mentioned three islands. It is not rare that the summer weather of this district is foggy and cold, though not so cold as in the Upper Boreal District.

The North Temperate District is represented by the western and southwestern coasts of Kunasiri Isl. The coasts are washed directly by the subterminal part of the warm Tusima current which has mixed with the current from the eastern coast of Saghalien as stated above. There are remarkable differences in climate between the present district and other parts of the Kuriles. There is as a rule no foggy weather in summer, while in the other districts fogs are usually heavier and more frequent in this season.

The composition of the vegetation in the above three districts is, as will be stated afterwards, somewhat too widely differing respectively to allow the Kuriles to be considered as a unit with regard to its flora. There are some species peculiar to a certain district, but some occur in two districts and some others in three districts, within the Kuriles. But some species are distributed to the adjacent waters and others farther to relatively remote regions. In order to make clear the composition of the flora on the whole, therefore, it may be necessary to make analysis of the geographical

distribution of the species among these districts and adjacent waters. After the examination of these species as to their distribution in and out of the Kurile Archipelago, they are divided into six groups.

They are:

I. *Upper Boreal Group,* indicating the species peculiar to the Upper Boreal District.

II. *Upper—Lower Boreal Group,* indicating the species found both in the Upper Boreal District and in the Lower Boreal District.

III. *Common Group from Boreal Origin,* indicating the species common to three districts and presumed to have affinity with boreal region.

IV. *Common Group from Temperate Origin,* indicating the species common to three districts and presumed to have affinity with temperate region.

V. *North Temperate—Lower Boreal Group,* indicating the species found both in the North Temperate District and in the Lower Boreal District.

VI. *North Temperate Group,* indicating the species peculiar to the North Temperate District.

The distribution of the species, belonging to the above groups, is given in Table IV–X.

TABLE IV. Showing the distribution of the species belonging to the Upper Boreal Group.

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles								N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.													
Chlorochytrium inclusum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	...	...	.....	+	+
Ulothrix flacca	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	?[3]	...	.....	+	..
pseudoflacca	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	+	...	...	...	...	...	...	...	.....	+	..
Monostroma groenlandicum	...	...	..	...	...	...	...	...	...	...	+	+	...	...	..	+	...	...	...	+	+	+	...	.....	+	..
ochotensis	...	...	...	...	...	...	...	...	...	...	+	...	+	...	+	...	...	+	...	...	...	+	...	.....	...	..
Entocladia Pterosiphoniae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	...	...	...	.....	...	..
Prasiola borealis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	.....	+	..
Gayella polyrhiza	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	...	...	...	.....	+	..
Ectocarpus fusiformis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	+	...	...	...	...	...	.....	...	..
Elachista lubrica	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	+	+
Desmarestia kurilensis	...	...	...	...	...	...	...	...	...	...	...	+	...	...	..	+	...	+	...	...	...	...	...	.....	...	..
Coilodesme bulligera	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	...	.....	+	..
fucicola	...	...	...	...	+	...	...	...	...	...	...	+	+	+	...	+	+	+	...	...	.	...	...	+	...	..
Laminaria longipes	...	...	...	...	+	...	...	...	...	..	...	+	+	+	+	+	+	+	+	+	+	+	+	+	+	..
taeniata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	...	+	+	..
subsimplex	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	..	...	...	...	+	+	...	.....	...	..

dentigera					+								+	+				+	+	+	+	+	+	+	+		
platymeris											+		+	+	+	+		+	+	+	+	+	+		+		
Cymathaere fibrosa											+	+	+	+		+				+	+		+				
triplicata												+	+	+		+			+	+	+	+	+	+	+		
Streptophyllum spirale													⊕[1]									+	+		+		+
Arthrothamnus kurilensis					+					+	+	+	+	+													
Thalassiophyllum Clathrus												+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Alaria fistulosa					+				⊕	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
tenuifolia											+	+		+					+	+	+		+	+	+		
Pleuropterum paradiseum												+		+		+			+	+			+				
Rhododermis parasitica											+		+		+	+		+		+	+						
Halosaccion microsprum											+											+	+		+		+
Antithamnion Shimamuranum														+	+	+	+	+									
sp.																		+									
Ptilota filicina																									+		
Membranoptera denticulata												+(?)[2]	+(?)			+		+		+				+	+		
Pseudophycodrys Rainosukei					+								+	+	+			+	+	+					+		
Yendonia japonica											+		+	+		+			+	+	+		+				
Hymenena cuneata											+			+						+	+				+		
Pterosiphonia japonica																+		+		+							
Odonthalia sp.													+	+	+	+			+	+	+		+	+			

1) The mark ⊕ indicates that the plant was obtained only from drift materials.

2) In Etorohu and Uruppu, there are a few records which are uncertain in which side of the island the plant was collected. The mark +(?) signifies such a case in the column of these two islands.

3) In the North Kuriles, there are a few records that are uncertain in what island the plant was found. In this case, the plant is designated provisionally by the mark ? in the column of Simusyu Isl.

TABLE V. Showing the distribution of the species, belonging to the Upper-Lower Boreal Group.

Name of Species \ Region	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.														
Dermocarpa pacifica	...	...	...	...	...	...	...	+	+	+	...	...	...	...	...	+	...	...	...	...	+	....	...	.....	..	....
Ulva fenestrata	...	...	...	...	...	...	...	+	...	+	+	+	+	+	...	...	...	...	...	...	+	+	...	+	+	....
latissima	...	...	...	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	....	...	.....	+	+
Monostroma Grevillei	...	...	...	...	...	+	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	+	...	+	+	....
arcticum	...	...	...	...	+	+	...	...	+	+	+	...	...	+	...	...	...	...	...	...	+	+	...	+	+	....
zostericola	...	...	...	...	+	+	...	...	+	+	+	+	...	+	+	...	+	...	...	...	...	?	...	.....	...	...
fuscum	...	...	...	...	...	...	...	...	+	...	+	+	+	+	+	+	+	+	+	+	+	+	...	+	+	+
Rhizoclonium tortuosum	...	...	...	...	...	...	...	+	+	+	+	+	...	+	+	+	+	...	...	...	+	....	+	.....	+	....
Hormiscia penicilliformis	...	...	...	...	...	+	...	...	...	+	+	+	...	+	+	+	...	+	...	...	+	...	...	+	+	+
Spongomorpha Hystrix	...	...	...	...	...	+	...	...	...	+	...	...	...	+	...	+	...	...	...	+	...	.....	...	.....	+	....
Mertensii	...	...	...	...	...	+	...	...	...	+(?)	+(?)	+	...	+	+	...	...	...	...	...	...	....	...	+	+	...
saxatilis	...	...	...	...	...	+	...	...	+	+	+	...	...	+	...	...	...	...	...	...	+	+	...	+	+	+
Aegira virescens	...	...	...	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	....	...	.....	+	....
Heterochordaria Gunjii	...	...	...	...	...	...	...	...	...	+	+	...	...	...	...	...	...	...	...	...	+	+	...	.....	...	....
Desmarestia media	...	...	...	...	...	...	...	+	+	+	+	+	...	...	...	...	...	+	...	...	...	....	+	.....	+	....
aculeata	...	...	...	...	+	...	...	+	...	...	...	+	+	+	...	...	+	+	...	+	+	+	...	+	...	....

Soranthera ulvoidea									+		+	+	+	+		+	+				+			+	+	
Laminaria yezoensis						+			+		+	+								+	+	+			+		
Arthrothamnus bifidus						+		+	+	+	⊕	+(?)	+(?)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Alaria macroptera						+		+	+	+	+	+	+	+						+	+			+		+	
dolichorhachis					+					+	+	+				+			+	+	+	+		+	+	+	
taeniata						+				+	+							+		+		+	+	+			
angusta					+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Porphyra umbilicalis					+	+		+	+	+	+	+	+	+	+					+	+	+		+	+		
Porphyra ochotensis					+				+	+		+	+	+	+	+	+	+	+		+	+					
occidentalis									+													+					
amplissima				+			⊕	+	+	+	+							+	+	+	+	+	+		+		
Tasa							⊕	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+				
bulbopes								+						+		+						+		+			
Farlowia mollis						+							+														
irregularis					+	+		+																			
Constantinea rosa-marina					+	+					+								+	+	+	+	+	+	+		
sublifera						+		+	+							+		+									
Phymatolithon loculosum										+												+		+	+		
Callophyllis rhynchocarpa					+	+		+			+										+			+	+	+	
Erythrophyllum Gmelini						+	⊕	+	+		+			+	+	+		+	+	+	+	+			+		
Euthora fruticulosa					+				+															+		+	
Callymenia ornata									+			+	+	+		+		+	+	+	+			+	+	+	
Schizymenia Dubyi			+	+		+		+			+	+	+	+					+	+	+	+					
Turnerella Mertensiana					+	+		+	+	+	+	+	+			+	+			+	+	+		+	+		
Rhodophyllis capillaris						+															+						
Gigartina ochotensis		+				+		+	+	+	+	+	+	+		+	+	+	+	+	+			+		+	
Rhodoglossum pulchrum				+	+	+		+	+	+	+										+			+			

TABLE V. (*Concluded*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, northeastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.														
Rhodymenia pertusa	...	+	....	+	+	+	...	+	+	...	+	...	...	...	...	+	...	+	...	+	...	.....	...	+	+	+
Halosaccion saccatum	...	...	....	...	+	+	...	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
firmum	...	...	....	...	...	+	...	+	+	+	+	+	...	+	...	...	...	...	...	...	+	+	+	+	....	....
Pleonosporium Kobayashii	...	...	....	...	...	...	...	...	+	...	...	+(?)	+(?)	...	...	...	...	...	...	...	...	...	...	.....	+	....
Ptilota Asplenioides	...	...	....	...	+	+	...	+	+	+	+	+	+	+	+	+	...	+	+	+	+	+	+	+	+	....
Laingia pacifica	...	+	....	...	+	+	...	+	+	...	+	...	...	...	...	...	...	...	...	...	+	.....	...	+	....	....
Phycodrys fimbriata	...	...	....	...	+	+	...	+	...	...	+	+	+	+	+	+	...	...	+	+	+	....	+	.....	....	....
Pterosiphonia bipinnata	...	...	....	...	+	+	...	...	+	...	+	+	+	+	+	+	+	...	+	+	+	+	...	+	+	+
robusta	...	...	....	...	...	...	...	+	...	+	+	+	...	...	...	...	+	...	...	...	+	...	...	.....	....	....
arctica	...	...	....	...	+	+	...	...	...	...	...	...	+	...	...	...	...	+	+	+	...	+	...	.....	+	....
Odonthalia corymbifera	...	...	....	...	+	+	...	+	+	+	+	+	+	+	...	...	...	...	...	...	+	+	...	+	....	....
aleutica	...	...	....	...	+	+	...	...	+	...	+	+	+	...	...	+	+	...	...	...	+	+	+	+	+	+
Lyallii	...	...	....	...	...	...	...	...	+	+	+	+	...	+	+	+	...	+	...	+	+	+	...	.....	....	....
Kamtschatica	...	...	....	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	.....	...	+	+	....
floccosa	...	...	....	...	...	...	⊕	...	+	+	+	+	...	...	+	...	+	+	...	...	+	+	+	+	+	....

TABLE VI. Showing the distribution of the species, belonging to the Common Group from Boreal Origin.

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls	
							W.C.	E.C.		W.C	E.C.	W.C.	E.C.														
Ulva Linza	+	+	....	+	+	+	+	+	+	...	...	...	...	+	...	...	...	...	...	...	+	...	....	+	+	....
Enteromorpha micrococca	...	...	....	...	...	+	+	+	+	+	+	+	...	+	...	...	...	...	...	+	+	...	....	+	+	....
Spongomorpha duriuscula	...	...	....	...	+	...	+	+	+	+	+	+	...	+	+	+	+	+	...	+	...	+	....	.....	+	+
Pylaiella littoralis	...	...	....	...	+	+	+	+	+	+	+	+	+	+	+	+	+	+	...	...	+	+	....	+	+	+
Ralfsia fungiformis	...	...	....	...	...	+	+	...	+	...	...	...	+	...	+	+	+	+	+	+	+	?	....	+	+	....
Chordaria flagelliformis	...	...	....	...	+	+	+	...	+	+	+	+	+	...	...	...	...	...	...	...	+	+	....	+	+	+
Heterochordaria abietina	...	...	....	+	+	+	+	+	+	+	+	+	+	+	...	...	+	...	...	...	+	+	....	+	+	....
Scytosiphon Lomentarius	+	...	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	...	...	...	+	+	+	+	+	+
Dictyosiphon foeniculaceus	...	...	....	+	...	+	+	...	+	+	+	+	...	+	...	...	...	...	...	...	...	...	....	+	+	+
Agarum cribrosum	...	...	....	+	+	+	+	+	+	+	+	...	...	...	+	+	...	...	...	...	+	+	....	+	+	....
Alaria praelonga	...	...	....	...	...	+	+	+	+	+	+	+	...	...	+	...	...	...	...	+	+	+	....	+	+	+

TABLE VI. (*Concluded*)

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Urupp u		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W C.	E.C.	W.C.	E.C.														
Fucus evanescens	...	...	....	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	...	+	+	+	+	+	+	+
Dumontia filiformis	...	...	....	...	+	+	+	...	+	+	+	+	+	+	...	+	+	+	+	...	+	+	...	+	+	+
Hildenbrandtia prototypus	+	...	....	...	...	...	+	+	+	+	...	+	+	...	...	+	+	...	+	+	...	...	...	+	....	....
Amphiroa cretacea	...	...	....	+	...	+	+	+	+	...	+	+(?)	+(?)	...	...	...	...	...	...	...	+	...	...	+	+	....
Corallina pilulifera	+	...	....	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	+	....	+	.....	+	+
Gloiopeltis furcata	+	...	+	+	...	+	+	...	+	+	+	+	+	+	+	...	...	...	...	...	+	...	...	+	+	....
Tichocarpus crinitus	...	+	....	...	+	+	+	+	+	+	+	+	...	...	+	...	...	...	...	...	+	+	+	+	....	+
Callymenia reniformis	...	...	....	+	+	+	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	?	...	.....	+	+
Gigartina unalaschcensis	...	...	....	+	+	+	+	+	+	+	+	+	...	+	...	...	...	...	..	...	+	....	...	+	+	+
Iridophycus cornucopiae	...	...	....	...	...	+	+	+	+	+	+	+	+	+	...	...	...	...	...	+	+	....	...	+	....	....
cordatum	...	...	....	...	...	...	South Kuriles					...	...	...	...	...	...	...	...	...	...	...	...	.....	+	+
subdichotomum	...	...	....	...	...	+	+	...	+	...	+	+	+	+	+	+	+	+	+	...	+	+	...	.....	....	....
Rhodymenia palmata	...	+	....	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	...	+	+	+	+	+	+	+
Halosaccion ramentaceum	...	...	....	...	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	+
Ptilota pectinata	...	...	....	...	+	+	+	+	+	+	+	+	+	+	+	+	...	+	+	+	+	....	...	+	+	+
Rhodomela Larix	...	...	....	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	+	+	...	+	+	+

TABLE VII. Showing the distribution of the species, belonging to the Common Group from Temperate Origin.

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other Southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.														
Chordaria gracilis	...	...	...	...	...	+	+	+	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	.....	+	....
Desmarestia ligulata	...	...	...	+	+	+	...	+	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Coilodesme japonica	...	...	...	...	...	+	...	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Laminaria angustata	...	...	...	+	...	+	...	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	+	+	....
Kjellmaniella gyrata	...	...	...	...	...	+	+	+	+	+	+	...	+	...	...	...	...	...	...	...	...	...	...	.....	...	....
Costaria costata	...	...	...	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	+	+	+
Pelvetia Wrightii	...	...	...	+	+	+	+	+	+	+	+	⊕	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Cystophyllum geminatum	...	...	...	...	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	.....	...	....
crassipes	...	...	...	...	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
hakodatense	...	+	...	+	+	+	+	+	+	...	+	...	...	⊕	...	...	...	...	...	...	...	...	...	.....	...	....
Sargassum confusum	+	+	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Porphyra pseudolinearis	...	+	...	+	...	+	...	...	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Dilsea edulis	...	...	...	+	+	+	...	+	+	...	+	+(?)	+(?)	...	...	...	...	...	...	...	...	...	...	.....	...	....
Chondrus pinnulatus	...	+	...	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	....
Rhodomela subfusca	+	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	?	...	+	....	+
Odonthalia ochotensis	...	...	...	...	+	...	...	+	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	.....	....	+

TABLE VIII. Showing the distribution of the species, belonging to the North Temperate—Lower Boreal Group.

Region / Name of Species	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.														
Ulva pertusa	+	+	+	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
Enteromorpha prolifera	+	...	+	+	+	+	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	+	....
clathrata	...	...	+	+	...	...	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	....
plumosa	+	...	...	+	...	...	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
Chaetomorpha aerea	+	...	...	+	...	+	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
moniligera	...	...	...	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
melagonium	...	...	...	+	...	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	+
Cladophora glaucescens	...	...	...	+	...	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
Sphacelaria subfusca	+	...	...	...	...	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	+	....
Leathesia sphaerocephalus	...	...	...	...	...	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	....	....
Gobia simplex	...	...	...	...	+	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	+	....

Chordaria Nagaii					+				+																				
Punctaria latifolia			+	+			+	+																					
Colpomenia sinuosa	+		+	+	+	+	+	+	+	+		⊕															+	+	
Coilodesme Cystoseirae						+	+	+	+	+																		+	
Laminaria ochotensis					+	+	+	+																					
diabolica					+	+	+	+		+																			
coriacea						+		+																					
sachalinensis						+	+	+																					
sikotanensis						+			+																				
Cymathaere japonica								+	+																				
Sargassum Horneri	+	+	+	+		+	+		+																				
Sargassum Thunbergii	+	+	+	+	+	+	+																						
Kjellmanianum			+	+	+	+	+	+		+																			
Miyabei						+	+	+	+																				
Goniotrichum Alsidii	+					+	+	+																					
Porphyra variegata					+	+		+	+																		+		
Gracilaria confervoides	+	+	+	+	+	+	+		+																				
Ahnfeltia plicata		+			+	+	+																				+	+	+
Ceramium hypnaeoides	+	+	+	+	+	+		+	+	+																			
rubrum	+	+		+	+	+			+																		+	+	
Hypophyllum Middendorfii					+	+	+	+																					+
Polysiphonia senticulosa				+		+			+																				
sertularioides				+			+	+																					
japonica	+	+		+		+	+		+																				
Laurencia nipponica	+			+		+	+	+			⊕																		
glandulifera				+		+	+	+																					

TABLE IX. Showing the distribution of the species, belonging to the North Temperate Group.

Name of Species \ Region	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles					Middle Kuriles									N. Kuriles			Bering Sea		Okhotsk Sea
							Kunasiri		Sikotan	Etorohu		Uruppu		Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	Paramusiru	Simusyu	Araido	Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	
							W.C.	E.C.		W.C.	E.C.	W.C.	E.C.														
Enteromorpha intestinalis	+	...	+	+	+	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	...
Dictyopteris divaricata	+	+	+	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leathesia difformis	+	...	+	+	...	+	+	...	...	...	⊕	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...
Chordaria cladosiphon	+	+	+	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Punctaria flaccida	...	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chorda Filum	+	...	+	+	+	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+
Rhodochorton moniliforme	...	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
kurilense	...	...	...	...	...	...	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ceramium Kondoi	...	...	...	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
japonicum	+	+	...	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Polysiphonia Morrowii	+	...	...	+	...	+	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE X. Showing the number of species, belonging to each Group, found in each island of the Kuriles and adjacent regions.

Region / Name of Group	China	Korea	Kyusyu, Sikoku & other southern isls.	Honsyu	Saghalien	Hokkaido	South Kuriles: Kunasiri W.C.	Kunasiri E.C.	Sikotan	Etorohu W.C.	Etorohu E.C.	Middle Kuriles: Uruppu W.C.	Uruppu E.C.	Simusiru	Ketoi	Usisiru	Rasyuwa	Matuwa & Musiru	Harumukotan	Onnekotan	N. Kuriles: Paramusiru	Simusyu	Araido	Bering Se: Kamchatka, north-eastern Siberia & Bering Isl.	Alaska, including Aleutian Isls.	Okhotsk Sea	All islands of the Kuriles
Upper Boreal Group	—	—	—	—	7	—	—	—	1	2	11	11 (12)	15 (16)	18	10	18	5	17	12	17	19	13 (14)	11	12	20	4	37
Upper—Lower Boreal G.	—	3	1	3	24	35	2	26	38	29 (30)	38 (39)	32 (34)	21 (23)	28	18	24	17	20	18	25	40	31 (32)	15	35	33	15	58
Common Group from Boreal Origin	5	3	2	13	17	23	25	18	24	20	20	19 (20)	13 (14)	15	12	11	10	8	5	9	21	13 (15)	5	22	23	17	27
Common Group from *Temperate Origin*	2	5	2	10	11	15	10	15	16	10	15	7 (8)	2 (3)	1	—	—	—	—	—	—	—	(1)	—	3	3	3	16
North Temperate—Lower Boreal Group	14	8	10	21	16	30	27	24	21	8	1	1	—	—	—	—	—	—	—	—	—	—	—	6	9	3	37
North Temperate Group	7	3	5	8	2	7	11	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	3	1	11
Total sum	28	22	20	55	77	110	75	83	100	69 (70)	86 (87)	70 (75)	51 (56)	62	40	53	32	45	35	51	80	57 (62)	31	79	91	43	186

To summarize the results of the above survey, the number of species belonging to each group are as follows:

I. *Upper Boreal Group.* The species belonging to this group, are 37 or 19.9% of the entire flora. Among them, 12 are common to Kamchatka, 20 to Alaska, 7 to Saghalien and 4 to the Okhotsk Sea.

II. *Upper—Lower Boreal Group.* The species belonging to this group, are 58 or 31.1% of the entire flora. Among them, 35 are common to Kamchatka, 33 to Alaska, 24 to Saghalien, 15 to the Okhotsk Sea northward, and 35 to Hokkaido, 3 to Honsyu and Korea each, respectively, and only one to Kyushu southward.

III. *Common Group from Boreal Origin.* The species belonging to this group, are 27 or 14.5% of the entire flora. Among them, 22 are common to Kamchatka, 23 to Alaska, 17 to Saghalien and the Okhotsk Sea northward, and 23 to Hokkaido, 13 to Honsyu, 5 to China, 3 to Korea, 2 to Kyusyu, Sikoku and other southern islands southward.

IV. *Common Group from Temperate Origin.* The species belonging to this group, are 16 or 8.6% of the entire flora. Among them, 15 are common to Hokkaido, 10 to Honsyu, 5 to Korea, 2 to Kyusyu, Sikoku and other southern islands and also to China, and 11 to Saghalien, 3 each to Kamchatka, the Okhotsk Sea and Alaska respectively northward.

V. *North Temperate—Lower Boreal Group.* The species belonging to this group, are 37 or 19.9% of the entire flora. Among them, 30 are common to Hokkaido, 21 to Honsyu, 10 to Kyusyu, Sikoku and other southern islands, 8 to Korea, 14 to China southward, and 16 to Saghalien, 6 to Kamchatka, 9 to Alaska, 3 to the Okhotsk Sea northward.

VI. *North Temperate Group.* The species belonging to this group, are 11 or 5.9% of the entire flora. Among them, 7 are common to Hokkaido, 8 to Honsyu, 5 to Kyusyu, Sikoku and other southern islands, 3 to Korea, 7 to China southward, and 3 to Alaska, one each to Kamchatka and the Okhotsk Sea northward respectively.

From the above, the total number of the species, presumed to have been distributed from boreal origin is 122 or 65.6%, and that of the species from temperate origin 64 or 34.4% of the entire flora. It is noteworthy that, among the boreal ones, 88 species or 72% of them are distributed through the Kuriles southward, viz., 58 species to Hokkaido, 16 to Honsyu, 6 to Korea, 3 to Kyusyu, Sikoku and other southern islands, and 5 to China. Furthermore, among the

temperate ones, 48 species or 75% of them are distributed continuously from the southern districts of Japan northward only as far as Kunasiri, Sikotan and the western coast of Etorohu and only 16 species or 25% are found also on the eastern coast of Etorohu or occasionally on Uruppu farther northward in the Kuriles. Ten species of temperate origin are, however, also found in Kamchatka beyond the Middle and North Kuriles. Such a discontinuous distribution is probably caused by the disturbance of the presence of the cold water area of the Middle Kuriles. As species peculiar to the Middle Kuriles area, *Ectocarpus fusiformis, Desmarestia kurilensis, Antithamnion Shimamuranum, Pterosiphonia japonica,* etc. are known to occur. *Arthrothamnus kurilensis* is also one of the species peculiar to this area with the one exception of its occurrence in the vicinity of Cape Notoro at the southern extremity of Saghalien, of which the shore is washed also by cold upwellings similar to those in the Middle Kuriles.

IV. The Marine Vegetation of the Kurile Islands

The marine vegetation of the Kurile Islands shows somewhat different physiognomies among the three districts described in the previous paragraphs.

1. Upper Boreal District.

The Upper Boreal District is represented by the greater part of the Kurile Islands, from Simusyu to the eastern coast of Etorohu. The vegetation is characteristic in the richness of the boreal species.

Littoral zone.

Fucus evanescens-formation. The alga which is abundantly found on stones or rocks in the upper littoral zone, is *Fucus evanescens.* Many forms of this species are found in the Kuriles. On the fronds of the present species, *Pylaiella littoralis, Rhizoclonium tortuosum,* etc. are often found, attached in the former firmly with basal part, and in the latter loosely entangled with irregular masses of filaments. Sometimes on the same species, *Monostroma arcticum, M. ochotensis, M. zostericola,* etc. are also found. A little below or sometimes mixed with this Fucus, the writer found *Halosaccion saccatum* on the rocks growing densely side by side, sometimes

having its basal part slightly buried in the sand. Another species of Halosaccion, viz., *H. firmum* is also found at about the same level in Uruppu Isl. according to YAMADA. In the habitat of *Fucus evanescens* or contiguous to it, there is usually found a comparatively vigorous development of *Ulva fenestrata*. In this part of the zone, *Odonthalia aleutica* was collected, being often overgrown with *Soranthera ulvoidea*, sometimes together with *Porphyra umbilicalis* f. *laciniata*. In the crevices or sheltered places of rocks, the writer collected *Iridophycus cornucopiae*, *I. subdichotomum*, etc. On the exposed surfaces of comparatively large, protruded rocks, he observed *Gloiopeltis furcata*, being rather vigorously developed, then somewhat downwards *Porphyra Tasa*, *P. ochotensis*, etc. *Porphyra umbilicalis* f. *laciniata* is also sometimes found on the lower part of these rocks. On the rocks or large stones, exposed to the surf, there are often observed *Ulothrix pseudoflacca*, forming velvety masses, and also *Spongomorpha spp.* In the Kuriles, the species found abundantly belonging to Spongomorpha, is *S. duriuscula*. The species next in abundance to the above, is *S. Hystrix*. Among the masses of *U. pseudoflacca*, there are sometimes found *Hormiscia penicilliformis*. In shallow pools among the rocks, *Ralfsia fungiformis*, *Scytosiphon Lomentarius*, *Heterochordaria abietina*, *H. Gunjii*, *Gigartina ochotensis*, *Dumontia filiformis*, *Corallina pilulifera*, *Pterosiphonia bipinnata*, *P. robusta*, etc. are also found. In the North Kuriles, *Streptophyllum spirale* is also abundantly found on the exposed places.

Alaria angusta-formation. In the comparatively lower part of the present zone, *Alaria angusta* is abundantly and vigorously grown covering a rather large area. *Hildenbrandtia prototypus* is observed over the rocks, forming blood-red, crustaceous thalli.

Laminaria longipes-formation. On the sea-level, at ebb-tide, *Laminaria longipes* is found vigorously developed by stolon. *Odonthalia corymbifera*, *Ptilota pectinata*, etc. are sometimes observed in the crevices of rocks.

Sublittoral zone.

Arthrothamnus bifidus-formation. In the upper sublittoral zone in the North Kuriles, there is found a formation of *Arthrothamnus bifidus*. The decumbent thallus of this species is attached to the substratum by short rhizoidal hapteres which are produced from the outsides of the complanate stipe. The stipe is decumbent and branched every year repeatedly in dichotomous manner. The newly

formed stipe is also attached to the substratum by similar, short rhizoidal hapteres. Thus the plant is developed vigorously on rocks by the dichotomous branching and creeping. A little lower grow some Laminariaceae, such as *Alaria dolichorhachis, A. tenuifolia, Thalassiophyllum Clathrus,* etc. From Simusiru to the eastern coast of Etorohu *Arthr. bifidus* has not been much found, but it is replaced by *Arthr. kurilensis* in the sublittoral zone. *Ptilota Asplenioides, P. pectinata, Erythrophyllum Gmelini,* etc. are observed sometimes epiphytic on the holdfast of *T. Clathrus.* In the deeper bottom, about 2 to 3 fathoms at ebb-tide, in quiet waters, *Laminaria dentigera* is observed. *Laminaria platymeris* which is very similar to the species just mentioned, is found often cast ashore abundantly on the Pacific side of the Kuriles. It grows probably in deeper bottom in the sublittoral zone. On the stipe of *T. Clathrus, L. platymeris, Arth. kurilensis, Alaria dolichorhachis,* etc., an epiphytic alga, *Rhodoëermis parasitica* is observed, forming blood-red crustaceous thalli.

Alaria fistulosa-formation. In depths of about 10 to 20 fathoms, there is found a formation of a gigantic alga, *Alaria fistulosa.* The fronds of this species are extremely long, and, according to MIYABE, attain about 80 fathoms in longer specimens. They stand erect in the middle and lower parts, then float and sway in the upper part to and fro on the water surface. When one enters into a dense formation of *A. fistulosa* in a small boat, his rowing is often greatly hampered by the masses of floating fronds. In the North Kuriles, the present writer has several times observed a number of fur-seals resting upon the masses of the floating fronds of the present species.

2. Lower Boreal District.

The Lower Boreal District is represented by the area including the western coast of Etorohu, eastern coast of Kunasiri, and Sikotan Isl. The vegetation is somewhat similar to that of the Upper Boreal District, but lacks some of the boreal species. In the present district, there are found also a few temperate species.

Littoral zone.

Fucus evanescens-formation. *Fucus evanescens* grows rather abundantly in the upper littoral zone in Etorohu, Sikotan and the eastern coast of Kunasiri Isl. in the South Kuriles. The following species are also found in the same zone: *Rhizoclonium tortuosum, Spongomorpha duriuscula, Pylaiella littoralis, Porphyra umbilicalis*

f. *vulgaris* and f. *laciniata, Gloiopeltis furcata, Iridophycus cornucopiae, Ulva fenestrata,* etc.

Pelvetia Wrightii-formation. Besides the species above enumerated, *Pelvetia Wrightii* is one of the algae which grow vigorously in the present zone. In shallow pools among the rocks, the present writer collected *Ralfsia fungiformis, Heterochordaria abietina, Scytosiphon Lomentarius, Dictyosiphon foeniculaceus, Corallina pilulifera, Gigartina unalaschcensis, G. ochotensis,* etc. In Sikotan and Etorohu, there are often found *Chordaria flagelliformis, C. gracilis, Chondrus pinnulatus,* etc. in sheltered places. *Tichocarpus crinitus* is also added to the vegetation of the present district being found within the range from the lower littoral zone to the upper sublittoral zone.

Sublittoral zone.

Kjellmaniella gyrata-formation. The formation of *Kjellmaniella gyrata* is widely found in the upper part of the sublittoral zone. At the same level, *Alaria praelonga,* and somewhat below, *A. macroptera* are also found. On stones in open places, *Porphyra bulbopes* is found about a half fathom deep at Sikotan Isl. In the crevices of rocks, deeper than the above, *Porphyra amplissima* and *Schizymenia Dubyi* var. *palmata* are found in the South Kuriles. *Costaria costata* also grows widely in the South Kuriles, at depths of about 1/2 to 1 fathom at ebb-tide. In this part of the zone, there are also found *Cymathaere japonica* and *Laminaria sikotanensis* in Sikotan Isl.

Laminaria-formation. In water deeper than those where the above formation is found, one can collect *Laminaria coriacea* on the eastern coast of Kunasiri Isl. at depths of about 2 to 5 fathoms, singly or in company with other Laminariae. *Laminaria angustata* is a species rather widely distributed on the eastern coast of Kunasiri, Sikotan and the southern part of Etorohu Isl. The type form of this species is only found in the localities where a comparatively large amount of warm water is mixed with the cold current, but var. *longissima* is more widely distributed than the type form. *L. angustata* var. *longissima* has been collected even at a depth of about 7 fathoms.

3. North Temperate District.

The North Temperate District is represented by the western and southwestern coasts of Kunasiri Isl. The vegetation of this district

is characteristic in the occurrence of many temperate species. There are also a few boreal ones.

Littoral zone.

Pelvetia Wrightii-formation. The alga which grows somewhat vigorously in the upper part of the present zone is *Pelvetia Wrightii*. *Fucus evanescens* is also found, but not growing so abundantly and vigorously as in the other districts. In this level, there are often found *Chaetomorpha aerea, C. moniligera, Enteromorpha micrococca, Gloiopeltis furcata,* etc. on the exposed places at ebb-tide. In Tomari Bay, the present writer observed also *Cladophora glaucescens* on gravel, and *Enteromorpha spp.*, viz. *E. intestinalis, E. clathrata, E. plumosa,* etc., and also *Gracilaria confervoides,* in the present zone. In the lower part, there occur *Rhodomela Larix, Laurencia nipponica, Polysiphonia Morrowii,* etc. on rocks in the open places.

Sublittoral zone.

Sargassum-formation. In the lower littoral zone below the upper sublittoral zone, there are vigorous formations of *Sargassum spp.*, such as *S. confusum, S. Thunbergii,* etc. Near to the above formation, there are found *Rhodomela subfusca, Iridophycus spp.*, etc. *Leathesia difformis* and *L. sphaerocephalus* are found attached on *Chaetomorpha aerea* in the littoral zone and also on *Cystophyllum spp., Rhodomela subfusca* and *Ahnfeltia plicata* var. *tobuchiensis* in the present zone. *Gobia simplex* is also found on the fronds of *Chordaria flagelliformis.* In Tomari Bay, the writer collected *Chorda Filum* on gravel and *Chordaria cladosiphon* on the leaves of *Phyllospadix sp.*

Laminaria-formation. In the parts deeper than those where the above formation is found, one finds several species of Laminaria, such as *L. sachalinensis, L. ochotensis, L. diabolica,* etc. *L. sachalinensis* was collected at 2 to 4 or 5 fathoms, *L. ochotensis* at 4 to 5 fathoms, and *L. diabolica* var. *genuina* at 3 to 5 fathoms depths. However, at Ponkotan, southwestern coast, *L. diabolica* var. *longipes* was collected from about 7 fathoms depth. At Cape Atoiya, the northern point of Kunasiri Isl., it is quite noteworthy that *Sargassum Horneri* grows abundantly in a depth of about 2 fathoms. This is one of the temperate species and at present unknown from the Kuriles except in this locality and at Tiboi in Sikotan Isl. In Tomari Bay, *Ahnfeltia plicata* var. *tobuchiensis* was observed within a large area in depths of about 2 to 6 fathoms, forming a thick layer lying on sandy bottom.

V. Summary

1. The present study includes all the species of the marine algae occurring in the Kurile Islands except a few undetermined species, of which the specific identification was impossible on account of the small number of specimens or for other reasons. Two algae, other than marine forms, are added. The one is *Aegagropila kurilensis*, a fresh water alga and the other *Prasiola borealis*, an alga growing on rocky cliffs in the sprinkle zone. Most of the materials were collected by the present writer himself during the years 1929 to 1936. The species which have been recorded from the Kuriles by other authors, are also all included.

2. The total number of species treated in the present paper, is 187, belonging to 93 genera and 44 families. The largest family is the Laminariaceae, comprising 30 species. Next come the Rhodomelaceae, having 19 species. Then follow the Cladophoraceae, Fucaceae, Ceramiaceae and Bangiaceae, the first with 11 species, the second and the third respectively with 10 and the last with 9.

3. One new genus, several new species, many new forms, and five new combinations, are established by the present writer or jointly with Prof. Emer. K. MIYABE in the present paper as follows:

New genus. *Streptophyllum* MIYABE et NAGAI.

New species. *Monostroma ochotensis* NAGAI, *Entocladia Pterosiphoniae* NAGAI, *Aegagropila kurilensis* NAGAI, *Ectocarpus fusiformis* NAGAI, *Punctaria flaccida* NAGAI, *Laminaria sikotanensis* MIYABE et NAGAI, *Cymathaere japonica* MIYABE et NAGAI, *Porphyra ochotensis* NAGAI, *Rhodochorton kurilense* NAGAI, *Iridophycus subdichotomum* NAGAI, *Antithamnion Shimamuranum* NAGAI, *Yendonia japonica* NAGAI, *Pterosiphonia japonica* NAGAI.

New forms. *Laminaria longipes* f. *linearis* MIYABE et NAGAI, L. *diabolica* f. *genuina* MIYABE et NAGAI and f. *angustifolia* MIYABE et NAGAI, *Costaria costata* f. *cuneata* MIYABE et NAGAI, *Alaria dolichorhachis* f. *typica* MIYABE et NAGAI, *Porphyra amplissima* f. *elliptica* NAGAI and f. *lanceolata* NAGAI, *Amphiroa cretacea* f. *typica* NAGAI, *Tichocarpus crinitus* f. *linearis* NAGAI, and f. *complanatus* NAGAI, *Callophyllis rhynchocarpa* f. *subsimplex* NAGAI, *Gigartina unalaschcensis* f. *typica* NAGAI, f. *grandifolia* NAGAI and f. *irregularis* NAGAI, *G. ochotensis* f. *typica* NAGAI and f. *dissecta* NAGAI, *Chondrus pinnulatus* f. *typicus* NAGAI and f. *conglobatus* NAGAI, *Rhodoglossum pulchrum* f. *typicum* NAGAI, f. *divergens* NAGAI and f. *luxurians* NAGAI, *Rhodymenia palmata* f. *ochotensis* NAGAI, *Phycodrys fimbriata* f. *typica* NAGAI, and f. *dissecta* NAGAI.

New combinations. *Dictyopteris divaricata* (OKAMURA) NAGAI, *Coilodesme fucicola* (YENDO) NAGAI, *Streptophyllum spirale* (YENDO) MIYABE et NAGAI, *Laminaria longipes* f. *angustifolia* (POST. et RUPR.) MIYABE et NAGAI, *Costaria costata* f. *latifolia* (POST. et RUPR.) MIYABE et NAGAI.

4. The species new to the Kuriles are 54, among which 22 species are also new to Japan.

5. The relationships of the marine flora of the Kuriles to those of other regions are studied. The number of algae common to the other regions and peculiar to the Kuriles, are as follows:

Common to China	28	Okhotsk Sea	43
Korea	22	Bering Sea: Kamchatka, Bering Isl. northeastern part of Siberia	79
Kyusyu, Sikoku & other southern isls.	20	Bering Sea: Alaska, including the Aleutian islands	91
Honsyu	55	British Columbia & Washington to California	68
Saghalien	77	Arctic Ocean	40
Hokkaido	110	Mediterranean Sea	3
Atlantic Ocean	53	Species peculiar to the Kuriles	16
Pacific coast of South America	8		

6. Following SETCHELL's classification of oceans, the Kurile Archipelago is divided from the marine phytogeographical standpoint into three zones, viz., Upper Boreal, Lower Boreal and North Temperate. The Upper Boreal Zone is represented by the district including the greater part of the islands from Simusyu southward to the eastern coast of Etorohu, having the isotheres of 0°C. to 10°C.; the Lower Boreal Zone is represented by the district including the western coast of Etorohu, the eastern coast of Kunasiri and the island of Sikotan, having the isotheres of 10°C. to 15°C.; the North Temperate Zone is represented by the western and southwestern coasts of Kunasiri, having the isotheres of 15°C. to 20°C.

7. After the analysis of the composition of the marine flora, the Kurile algae are divided into six groups.

i. *Upper Boreal Group.* Species peculiar to the Upper Boreal District, are 37 or 19.9% of the entire flora.

ii. *Upper—Lower Boreal Group.* Species found within both the Upper and Lower Boreal District, are 58 or 31.1% of the entire flora.

iii. *Common Group from Boreal Origin.* Species found commonly among three districts and presumed to have affinity with boreal region, are 27 or 14.5% of the entire flora.

iv. *Common Group from Temperate Origin.* Species found commonly among three districts and presumed to have affinity with temperate region, are 16 or 8.6% of the entire flora.

v. *North Temperate—Lower Boreal Group.* Species found

within both the North Temperate and Lower Boreal District, are 37 or 19.9% of the entire flora.

vi. *North Temperate Group.* Species peculiar to the North Temperate District, are 11 or 5.9% of the entire flora.

8. From the above results, the total number of the species, presumed to have been distributed from boreal origin is 122, or 65.6%, and that of the species from temperate origin 64, or 34.4%, of the entire flora. It is noteworthy that, among the boreal ones, 88 species or 72% of them are distributed through the Kuriles southward, viz., 58 species to Hokkaido, 16 to Honsyu, 6 to Korea, 3 to Kyusyu, Sikoku and other southern islands, and 5 to China. Furthermore, among the temperate ones, 48 species or 75% of them are distributed continuously from the southern districts of Japan northward only as far as Kunasiri, Sikotan and the western coast of Etorohu and only 16 species or 25% are found also on the eastern coast of Etorohu or occasionally on Uruppu farther northward in the Kuriles. Ten species of temperate origin are, however, also found in Kamchatka beyond the Middle and North Kuriles. Such a discontinuous distribution is probably caused by the disturbance of the presence of the cold water area of the Middle Kuriles. As species peculiar to the Middle Kuriles area, *Ectocarpus fusiformis, Desmarestia kurilensis, Antithamnion Shimamuranum, Pterosiphonia japonica,* etc. are known to occur. *Arthrothamnus kurilensis* is also one of the species peculiar to this area with the one exception of its occurrence in the vicinity of Cape Notoro at the southern extremity of Saghalien, of which the shore is washed also by cold upwellings similar to those in the Middle Kuriles.

9. The physiognomy of the marine vegetation of the Kurile Islands differs to a certain extent amongst the three districts, viz., Upper Boreal, Lower Boreal and North Temperate. The Upper Boreal District is characterized by the richness of the boreal species. The Lower Boreal District is somewhat similar to the Upper Boreal District, but lacking some boreal species which are replaced by a few temperate ones. The North Temperate District is characterized by poverty of boreal species rather than by richness of the temperate ones.

VI. Bibliography

1. ABE, K. (1938) Entwicklung der Fortpflanzungsorgane und Keimungsgeschichte von *Desmarestia viridis* (MÜLL.) LAMOUR. Sci. Rept. Tôhoku Imp. Univ., 4 ser., Biol., vol. XII, no. 3, pp. 475–482, pl. XXXIX. Sendai.
2. AGARDH, C. A. (1817) Synopsis algarum Scandinaviae, adjecta dispositione universali algarum. Lund.
3. ——— (1820–'28) Species algarum rite cognitae cum synonymis, differentiis specificis et descriptionibus succinctis. Vol. I, pt. 1 (1820), pp. 1–168: pt. 2 (1822), pp. 169–531: vol. II, pt. 1 (1828), pp. i–lxxvi & 1–189. (According to SETCHELL, the Lund edition is dated 1820, but the Gryphiswald edition is dated 1821).
4. ——— (1824) Systema algarum. Lund.
5. ——— (1828–'35) Icones algarum europaearum. Pl. I–XL.
6. ——— (1846) Icones algarum ineditae. Fasciculi qui extant duo., ed. nova, pls. I–XX.
7. AGARDH, J. G. (1848–1901) Species genera et ordines algarum. Vol. I (1848); vol. II, pt. 1 (1851): pt. 2 (1852): pt. 3 (1853); vol. III, pt. 1 (1876): pt. 2 (1880): pt. 3 (1898): pt. 4 (1901). Lund.
8. ——— (1867) De Laminarieis. Lunds Univ. Årsskr., vol. IV, pp. 1–36.
9. ——— (1868) Bidrag till Kännedomen af Spetsbergens Alger. Kongl. Sv. Vet.-Akad. Handl., vol. VII, no. 8, pp. 1–12, 27–49, pls. I–III. Stockholm.
10. ——— (1872) Bidrag till Kännedomen af Grönlands Laminarieer och Fucaceer. Kongl. Sv. Vet.-Akad. Handl., vol. X, no. 8.
11. ——— (1889) Species Sargassorum Australiae, descriptae et dispositae, etc. Kongl. Sv. Vet.-Akad. Handl., vol. XXIII, no. 3, pp. 1–133, pls. I–XXXI.
12. ——— (1896) Analecta Algologica. Observationes de speciebus algarum minus cognitis earumque dispositione. Continuatio III. De formis, quas ad Punctariam referre consueverunt. pp. 1–140, pl. I. Lund.
13. ARESCHOUG, J. E. (1854) Phyceae novae et minus cognitae in maribus extraeuropaeis collectae, etc. Act. Reg. Soc. Sci., ser. 3, vol. I, pp. 329–372. Upsala.
14. ——— (1866–'84) Observationes phycologicae. Nova Act. Reg. Soc. Sci., ser. 3. pt. I (1866); pt. II (1874); pt. III (1875); pt. IV (1883); pt. V (1884). Upsala.
15. ARWIDSSON, T. (1932) The Higher Marine Algae hitherto known from Kamtchatka. Rev. Alg., vol. VI, pt. 2, pp. 147–158.
16. ——— (1934) Eine Aegagropiloide *Cladophora* von den Kurilen und ihre Entstehung. Arkiv f. Bot., vol. XXVI, no. 11, pp. 1–10. Stockholm.

17. BATTERS, E. A. L. (1889) A List of the Marine Algae of Berwick-on-Tweed. Repr. fr. Berwickshire Nat. Club, Trans., pp. 1–171, pls. I–V.
18. ———— (1900) New or Critical British Marine Algae. Jour. Bot., vol. XXXVIII, pp. 369–379, pl. CDXIV.
19. BØRGESEN, F. (1902) Marine Algae in Botany of the Faeröes, pt. II, pp. 339–532. Copenhagen.
20. ———— (1905) The Algae-Vegetation of the Faeröese Coasts with remarks on the Phyto-Geography in Botany of the Faeröes, pt. III, pp. 683–834, pls. XIII–XXIV. Copenhagen.
21. ———— (1913–'20) The Marine Algae of the Danish West Indies. Vol. I (1913–'14): vol. II (1915–'20). Copenhagen.
22. ———— and JÓNSSON, H. (1905) The Distribution of the Marine Algae of the Arctic Sea and of the Northernmost Part of the Atlantic in Botany of the Faeröes, pt. III, Appendix, pp. I–XXVIII. Copenhagen.
23. BORY DE SAINT VINCENT, J. B. (1826) In Dictionnaire classique d'histoire naturelle, Paris. Vol. IX.
24. BRAND, F. (1902) Die *Cladophora*-Aegagropilen des Süsswassers. Hedwigia, vol. XLI, pp. 34–71, pl. I.
25. COLLINS, F. S. (1903) The Ulvaceae of North America. Rhodora, vol. V, no. 1, pp. 1–31, pls. XLI–XLIII.
26. ———— (1912–'18) The Green Algae of North America. Suppl. I (1912), Tufts College Stud., vol. III, no. 2, Sci. Series: suppl. II (1918), ibid., vol. IV, no. 7. Mass. (The photographic reprint was published in 1928).
27. ———— (1913) The Marine Algae of Vancouver Island. Canada Geological Survey. Victoria Memorial Museum, bull. no. 1, pp. 99–137. Victoria.
28. ———— (1919) Chinese Marine Algae. Rhodora, vol. XXI, pp. 203–207.
29. ————, HOLDEN, I. and SETCHELL, W. A. (1895–1919) Phycotheca Boreali-Americana. (Exsicc.) Fasc. 1–46 and A-E., Malden, Mass.
30. COTTON, A. D. (1906) Marine Algae from Corea. Bull. Misc. Inform., Royal Bot. Gard., Kew, [1906], pp. 366–373.
31. ———— (1915) Some Chinese Marine Algae. Bull. Misc. Inform., Royal Bot. Gard., Kew, [1915], pp. 107–113.
32. CRAMER, C. (1863) Physiologisch-systematische Untersuchungen über die Ceramiaceen. Denkschr. schweiz. naturf. Ges., (Reprint), pp. 1–130, pls. I–XIII. Zürich.
33. DE LA PYLAIE, B. (1829) Flore de Terre-Neuve et des îles Saint Pierre et Miclon avec figures dessinées par l'auteur sur la plante vivante, pl. XVII. Paris.
34. DERBES, A. and SOLIER, A. J. J. (1856) Mémoire sur quelques points de la Physiologie des Algues. Suppl. aux C. R. de l'Acad. des Sci., vol. I, pp. 1–120, pls. I–XXIII. Paris.
35. DE TONI, J. B. (1889–1924) Sylloge algarum omnium hucusque cogni-

tarum. Vol. I (1889); vol. III (1895); vol. IV, sect. 1 (1897): sect. 2 (1900): sect. 3 (1903): sect. 4 (1905); vol. V (1907); vol. VI (1924).

36. DE TONI, J. B. (1895) Phyceae japonicae novae, addita enumeratione algarum in ditione maritima japoniae hucusque collectarum. Mem. R. Istituto Veneto Sci., Lett. ed Art., vol. XXV, no. 5, pp. 1–70, 2 pls. Venezia.
37. ENDLICHER, S. L. (1843) Mantissa botanica altera. Suppl. III, pp. 1–104.
38. ESPER, E. J. C. (1802) Icones fucorum, cum characteribus systematicis, synonimis auctorum et descriptionibus novarum specierum. Theil II.
39. FALKENBERG, P. (1901) Die Rhodomelaceen des Golfes von Neapel und der angrenzenden Meeresabschnitte. Fauna u. Floras des Golfes von Neapel. Vol. XXVI, Monographie. Berlin.
40. FARLOW, W. G. (1875) List of the Marine Algae of the United States with Notes on New and Imperfectly Known Species. Proc. Am. Acad. Arts & Sci., N. S., vol. II (whole series, vol. X), pp. 351–380.
41. ———— (1881) Marine Algae of New England and Adjacent Coast. Report of U. S. Fish Commission for 1879. Washington.
42. FOSLIE, M. (1890–'91) Contribution to the Knowledge of the Marine Algae of Norway. I (1890), East-Finmarken. Tromsø Mus. Aarshefter, vol. XIII; II (1891). Species from different Tracts. ibid., vol. XIV.
43. ———— (1900) Revised Systematical Survey of the Melobesieae. Kgl. Norske Vid. Selsk. Skr. 1900, no. 5, pp. 1–22. Trondhjem.
44. ———— (1905) Remarks on Northern *Lithothamnia*. Kgl. Norske Vid. Selsk. Skr. 1905, no. 3, pp. 1–138. Trondhjem.
45. ———— (1929) Contributions to a Monograph of the *Lithothamnia*. Kgl. Norske Vid. Selsk. Museet, pp. 1–60, pls. I–LXXV.
46. FREEMAN, E. H. (1899) Observations on *Constantinea*. Minnesota Bot. Stud., ser. 2, pt. 2, pp. 175–190, pl. II. Minneapolis.
47. ———— (1899a) Observations on *Chlorochytrium*. Minnesota Bot. Stud., ser. 2, pt. 3, pp. 195–204, pl. III, Minneapolis.
48. FRITSCH, F. E. (1912) Freshwater Algae of the South Orkneys. Report on the Scientific Results of the Scottish National Antarctic Expedition. III, pp. 95–134, pls. I, II.
49. ———— (1912a) Freshwater Algae collected in the South Orkneys by Mr. R. N. RUDMOSE BROWN, B. Sc. Jour. Linn. Soc. Bot., vol. XL, pp. 293–338, pls. X, XI.
50. ———— (1935) The Structure and Reproduction of the Algae. Vol. I, Cambridge.
51. GAIL, H. (1936) Ahnfeltia in Peter the Great Bay. (Russian with English summary). Bull. Far. East. Branch Acad. Sci. U.S.S.R. (1936), no. 20, pp. 115–124.
52. GARDNER, N. L. (1917–'19) New Pacific Coast Marine Algae. Pt. I (1917), Univ. Calif. Bot. vol. VI, no. 14, pp. 377–416, pls. XXXI–XXXV;

pt. II (1918), ibid., no. 16, pp. 429–454, pls. XXXVI–XXXVII; pt. III (1918a), ibid., no. 17, pp. 455–486, pls. XXXVIII–XLI; pt. IV (1919), ibid. no. 18, pp. 487–496, pl. XLII.

53. GARDNER, N. L. (1922) The genus *Fucus* on the Pacific Coast of North America. Univ. Calif. Publ. Bot., vol. X, no. 1, pp. 1–180, pls. I–LX.
54. ——— (1926–'27) New Rhodophyceae from the Pacific Coast of North America. Pt. I (1926), Univ. Calif. Bot., vol. XIII, no. 11, pp. 205–226, pls. XV–XXI: pt. II (1927), ibid., no. 13, pp. 235–272, pls. XXIV–XXXV; pt. III (1927a), ibid., no. 16, pp. 333–368, pls. LIX–LXXI; pt. IV (1927b), ibid., no. 18, pp. 373–402, pls. LXXIII–LXXXIII; pt. V (1927c), ibid., no. 19, pp. 403–434, pls. LXXXIV–XCIII; pt. VI (1927d), ibid., vol. XIV, no. 4, pp. 99–138, pls. XX–XXXVI.
55. GEPP, E. S. (1904) Chinese Marine Algae. Jour. Bot., vol. XLII, pp. 161–165, pl. CDLX.
56. GMELIN, S. G. (1768) Historia Fucorum.
57. GOBI, C. (1878) Die Algenflora des Weisen Meeres und der demselben zunächstliegenden Theile des nördlichen Eismeeres. Mém. l'Acad. Imp. des Sci. de St. Petersbourg, sér. 7, vol. XXVI, no. 1, pp. 1–92.
58. GREVILLE, R. K. (1830) Algae Britannicae, or descriptions of the marine and other inarticulated plants of the British Islands, belonging to the order, Algae; with plates illustrative of the genera. Edinburgh.
59. GRIGGS, R. F. (1907) *Cymathaere*, a Kelp from the Western Coast. Ohio Naturalist, vol. VII, no. 5, pp. 89–96, pl. VII.
60. GRUNOW, A. (1870) Algen. Reise der österr. Fregatte "Novara" um die Erde. Bot. Teil, vol. I, pp. 1–104, pls. I–XI.
61. HAMEL, G. (1928) Floridées de France, V. Rev. Alg., vol. III [1926], pp. 99–158.
62. ——— (1928a) Sur les genres *Acrochaetium* NAEG. et *Rhodochorton* NAEG. Rev. Alg., vol. III [1926], pp. 159–210.
63. ——— (1931–'32) Chlorophycées des côtes françaises. (Fin) Rev. Alg., vol. VI, pp. 9–73.
64. HARVEY, W. H. (1846–'51) Phycologia Britannica. Vol. I (1846); vol. II (1849); vol. III (1851). London.
65. ——— (1851–'57) Nereis Boreali-Americana. Pt. I (1851); pt. II (1853); pt. III (1857).
66. ——— (1856) Algae: in GRAY's List of Dried Plants Collected in Japan. Mem. Am. Acad. Art & Sci., vol. II, pp. 331–332.
67. ——— (1858–'63) Phycologia Australica. Vol. I (1858); vol. II (1859); vol. III (1860); vol. IV (1862); vol. V (1863). London.
68. ——— (1859) Characters of New Algae, chiefly from Japan and Adjacent Regions, collected by CHARLES WRIGHT in the North Pacific Exploring Expedition under Captain JOHN RODGERS. Proc. Amer. Acad., vol. IV, pp. 327–335.
69. ——— (1862) Notice of a Collection of Algae made on the North-West Coast of North America, chiefly at Vancouver's Island, by DAVID LYALL, Esq., M. D., R. N., in the years 1859–'61. Jour. Linn. Soc. Bot., vol. VI, pp. 157–177.

70. HAUCK, F. (1885) Die Meeresalgen Deutschlands und Oesterreichs. in RABENHORST's Kryptogamen-flora von Deutschland, Oesterreich und der Schweiz. Vol. II. Leipzig.

71. HEERING, W. (1921) Chlorophyceae IV (Siphonocladiales und Siphonales). in PASCHER's Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. No. VII. Jena.

72. HIGASHI, M. (1934) Nihon Kaiso Zuhu. (Illustrations of Japanese Marine Algae) (With Jap. explanations). Tokyo.

73. HOKKAIDO-TYO (1931) Report of Hokkaido-tyo (Pref. Government) Expedition in the Kuriles in 1930. (in Japanese). Sapporo.

74. HOLMES, E. M. (1896) New Marine Algae from Japan. Jour. Linn. Soc. Bot., vol. XXXI, pp. 248–260, pls. VII–XII.

75. HOOKER, J. D. (1847) The Botany of the Antarctic Voyage of H. M. Discovery Ships Erebus and Terror, in the years 1839–43 under the Command of Captain Sir JAMES CLARK ROSS, Kt., R. N., F. R. S., etc. London. Vol. I. Flora Antarctica, pt. 2, Botany of Fuegia, the Falklands, Kerguelen's Land, etc. Algae, pp. 454–519, pls. CLXV–CXCIV.

76. HORNBY, A. J. W. (1918) A New British Fresh Water Alga. New Phytol., vol. XVII, pp. 41–43.

77. HOWE, M. A. (1914) The Marine Algae of Peru. Mem. Torr. Bot. Club, vol. XV, pp. 1–185, pls. I–LXVI.

78. ——— (1924) Chinese Marine Algae. Bull. Torr. Bot. Club, vol. LI, pp. 133–144, pls. I–II.

79. HUS, H. T. A. (1900) Preliminary Notes on West Coast Porphyras. Zoe, vol. V, nos. 4 & 5, pp. 61–70.

80. ——— (1902) An Account of the Species of *Porphyra* Found on the Pacific Coast of North America. Proc. Calif. Acad. Sci., ser. 3, Bot., vol. II, no. 6, pp. 173–240, pls. XX–XXII.

81. IMHÄUSER, L. (1889) Entwicklungsgeschichte und Formenkreis von *Prasiola*. Flora, 1889, no. 3, pp. 1–58, pls. X–XIII.

82 INAGAKI, K. (1933) Marine Red Algae of Osyoro Bay, Hokkaido and its Adjacent Waters. (in Japanese). Inst. Alg. Research Bull., no. II, Fac. Sci., Hokkaido Imp. Univ., pp. 1–77. Sapporo.

83. JÓNSSON, H. (1901–'03) The Marine Algae of Iceland. I (1901), Bot. Tidsskr., vol. XXIV, pp. 127–155; II (1903), ibid., vol. XXV, pp. 141–195; III & IV (1903), ibid., vol. XXV, pp. 337–385.

84. ——— (1904) The Marine Algae of East Greenland. Med. om Grønland, vol. XXX, pp. 1–73.

85. KANNO, R. (1934) A Study of *Aegapropila* of Japan, with Special Reference to the Ball Formation. (Japanese with Eng. synopsis). Bull. Jap. Soc. Sci. Fish., vol. II, no. 5, pp. 217–228. Tokyo.

86. ——— and MATUBARA, S. (1932–'37) Studies on *Ahnfeltia plicata* var. *Tobuchiensis*. Rept. I (1932) (Researches on the Lake Tobuchi, Saghalien and *Ahnfeltia plicata* var. *Tobuchiensis*, var.

nov.) Jour. Fish., School of Fish., Hokkaido Imp. Univ., no. XXXV, pp. 97–132, pls. I, II, Sapporo; rept. II (1933) (On the Growing Condition and Culture Experiments of *Ahnfeltia plicata* var. *Tobuchiensis*) ibid., no. XXXVI, pp. 51–58; rept. III (1935), ibid., Hakodate College of Fish., no. XXXVIII, pp. 47–65 Hakodate; rept. IV, (1936), ibid., no. XXXIX, pp. 38–51; rept. V (1937), ibid., no. XL, pp 25–37. (Nos. 35 and 36 of the Journal of Fisheries were published by the School of Fishery, Hokkaido Imp. Univ., Sapporo, and nos. 38 to 40 were published by the Hakodate College of Fisheries.)

87. KAWABATA, S. (1936) A List of Marine Algae from the Island of Shikotan. Sci. Papers Inst. Alg. Research, Fac. Sci., Hokkaido Imp. Univ., vol. I, no. 2, pp. 199–212. Sapporo.

88. KAWAKAMI, T. (1898) Botanical Excursion in Akan District, Prov. Kusiro, Hokkaido. (in Japanese). Bot. Mag., vol. XII, pp. 220–225. Tokyo.

89. KAWANA, T. and NAKAZIMA, Y. (1934–'35) Hydrographical Survey of the Adjacent Waters around Hokkaido. (in Japanese). Rept. Hokkaido Fish. Exp. Sta., nos. XXX, XXXII [1934]; no. XXXVIII [1935]. Yoiti, Hokkaido.

90. KIBBE, A. L. (1915) Some Points in the Structure of *Alaria fistulosa*. Puget Sound Mar. Sta. Publ., vol. I, no. 8, pp. 43–57, pls. VII–IX.

91. KINOSITA, T. (1933) *On the Variation in the Number of Ribs of Costaria costata*. Hokkaido Suisan-Sikenzyo Zigyo-Zyunpo (Hokkaido Fish. Exp. Sta. Bull.), no. 213, pp. 91–92, figs. 1–12. Yoiti, Hokkaido.

92. KJELLMAN, F. R. (1872) Bidrag till Kännedomen om Skandinaviens Ectocarpeer och Tilopterider. Akad. Afhandl. Stockholm.

93. ——— (1875–'77) Om Spetsbergens marina, klorofyllförande Thallophyter. I (1875), Bihang till Kgl. Sv. Vet.-Akad. Handl., vol. III, no. 7, pp. 1–34, 1 pl.; II (1877), ibid., vol. IV, no. 6, pp. 1–61, pls. I–V.

94. ——— (1877) Ueber die Algenvegetation des Murmanschen Meeres an der Westküste von Nowaja Semlja und Wajgatsch. Nova Acta Reg. Soc. Sci., ser. 3, vol. extra-ord. (no. 12). Upsala.

95. ——— (1883) The Algae of the Arctic Sea. Kongl. Sv. Vet.-Akad. Handl., vol. XX, no. 5. Stockholm.

96. ——— (1889) Om Beringhafvets Algflora. Kongl. Sv. Vet.-Akad. Handl., vol. XXIII, no. 8. Stockholm.

97. ——— (1891–'93) Phaeophyceae und Dictyotales. in ENGLER u. PRANTL, Natürl. Pflanzenfam., I Teil, 2 Abteil., 1897, pp. 176–297. Leipzig.

98. ——— (1892) Om en ny Organisationstyp inom slägtet *Laminaria*. Bihang till Kgl. Sv. Vet.-Akad. Handl., vol. XVIII, Afd. 3, no. 7, pp. 3–17, 1 pl.

99. ——— (1897) Marina Chlorophyceer från Japan. Bihang till Kgl. Sv. Vet.-Akad. Handl., vol. XXIII, Afd. 3, no. 2.

100. KJELLMAN, F. R. and PETERSEN, J. V. (1885) Om Japans Laminariaceer. Vega-Expeditionens Vetenskapliga Iakttagelser, vol. IV, pp. 259–280, pls. X, XI. Stockholm.
101. KNEBEL, G. (1935) Monographie der Algenreiche der Prasiolales, insbesondere von *Prasiola crispa*. Hedwigia, vol. LXXV, no. 1/2, pp. 1–120.
102. KUCKUCK, P. (1897) Beiträge zur Kenntnis der Meeresalgen. Wiss. Meeresuntersuch. N. F., Abt. Helgoland, vol. II, no. 1, pp. 1–46, pls. VII–XIII. Kiel & Leipzig.
103. ——— (1929–'30) Fragmente einer Monographie der Phaeosporeen. Wiss. Meeresuntersuch. N. F., Abt. Helgoland, vol. XVII, no. 2, pp. 1–93. Kiel & Leipzig.
104. KUNIEDA, H. (1934) On the Life-History of *Monostroma*. Proc. Imp. Acad., vol. X, no. 2, pp. 103–106, figs. 1–12. Tokyo.
105. KUNTZE, O. (1893–'98) Revisio generum plantarum. Pt. III, no. 1 (1893); no. 2 (1898).
106. KÜTZING, F. T. (1843) Phycologia generalis, oder Anatomie, Physiologie und Systemkunde der Tange. Leipzig.
107. ——— (1845) Phycologia germanica, d. i. Deutschlands Alger in bündigen Beschreibungen, nebst einer Anleitung zum Untersuchen und Bestimmen dieser Gewächse für Anfänger. Nordhausen.
108. ——— (1845–'69) Tabulae Phycologicae, oder Abbildungen der Tange. Vol. I (1845–'49); II (1850–'52); III (1853); IV (1854); V (1855); VI (1856); VII (1857); VIII (1858); IX (1859); X (1860); XI (1861); XII (1862); XIII (1863); XIV (1864); XV (1865); XVI (1866); XVII (1867); XVIII (1868); XIX (1869).
109. ——— (1849) Species Algarum. Leipzig.
110. KYLIN, H. (1907) Studien über die Algenflora der schwedischen Westküste. Akad. Abhandl. Upsala.
111. ——— (1908) Zur Kenntnis der Algenflora der schwedischen Westküste. Arkiv f. Bot., vol. VII, no. 10, pp. 1–10. Upsala & Stockholm.
112. ——— (1923) Studien über die Entwicklungsgeschichte der Florideen. Kungl. Sv. Vet.-Akad. Handl., vol. LXIII, no. 11. Stockholm.
113. ——— (1924) Studien über die Delesseriaceen. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XX, no. 6. Lund.
114. ——— (1925) The Marine Red Algae in the Vicinity of the Biological Station at Friday Harbor, Wash. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXI, no. 9. Lund.
115. ——— (1928) Entwicklungsgeschichtliche Florideenstudien. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXIV, no. 4. Lund.
116. ——— (1929) Die Delesseriaceen Neu-Seelands. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXV, no. 2. Lund.
117. ——— (1930) Ueber die Entwicklungsgeschichte der Florideen. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXVI, no. 6. Lund.
118. ——— (1931) Die Florideenordnung Rhodymeniales. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXVII, no. 11. Lund.

119. KYLIN, H. (1932) Die Florideenordnung Gigartinales. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXVIII, no. 8. Lund.
120. ——— (1933) Ueber die Entwicklungsgeschichte der Phaeophyceen. Lunds Univ. Årsskr., N. F., Avd. 2, vol. XXIX, no. 7. Lund.
121. ——— (1933a) On Three Species of Delesseriaceae from New Zealand. Trans. New Zealand Inst., vol. LXIII, pp. 109–110, pls. XIX, XX.
122. ——— (1935) Zur Nomenklatur einiger Delesseriaceen. Kungl. Fysiograf. Sällsk. i Lund Förhandl., vol. V, no. 23, pp. 1–5. Lund.
123. LAGERHEIM, G. (1892) Ueber die Fortpflanzung von *Prasiola* (AG.) MENEGH. Ber. d. deut. Bot. Ges., vol. X, pp. 366–374, pl. XX.
124. LAMOUROUX, J. V. F. (1813) Essai sur les genres de la famille des thalassiophytes non articulées. Ann. du Mus. d'Hist. Naturelle par les professeurs de cet établissement, vol. XX, pp. 21–47, 115–139, 267–293, pls. V–XIII.
125. LE JOLIS, A. (1855) Examen des espèces confondues sous le nom de *Laminaria digitata* Auct., suivi de quelques observations sur le genre *Laminaria*. Mém. Soc. Imp. Sci. Nat. Cherbourg, vol. III, pp. 241–304, 65–72.
126. ——— (1863) Liste des algues marines de Cherbourg. Mém. Soc. Imp. Sc. Nat. Cherbourg, vol. X, pp. 1–168, pl. I–VI. (According to SETCHELL, this paper was published separately in 1863 before it appeared in the Memoirs in 1864.)
127. LINNAEUS, C. (1753) Species plantarum, exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus secundum systema sexuale digestas. Ed. I. Stockholm. (Photographic reprint in Tokyo).
128. LYNGBYE, H. C. (1819) Tentamen Hydrophytologiae Danicae, continens omnia hydrophyta cryptogamia Daniae, Holsatiae, Faeroae, Islandiae, Groenlandiae hucusque cognita, systematice disposita, descripta et iconibus illustrata, adjectis simul speciebus Norvegicis. Copenhagen.
129. MARTENS, G. v. (1866) Die Preussische Expedition nach Ost-Asien. Bot. Theil., Tange, pp. 1–152, pls. I–VIII. Berlin.
130. MERTENS, H. (1829) Zwei botanisch-wissenschaftliche Berichte vom Dr. HEINRICH MERTENS, ... Erster Bericht über verschiedene *Fucus*-Arten, an den Vater, Prof. MERTENS in Bremen. Linnaea, vol. IV, pp. 43–58.
131. MIYABE, K. (1902) Laminariaceae of Hokkaido. (in Japanese). Rept. Fish. Dept. of Hokkaido-tyo (Pref. Government), no. III, pp. 1–60, pls. I–XXXIX. Sapporo.
132. ——— (1928) On the Occurrence of a Certain Behring and Kurile Species of Laminariaceae in a Small Isolated Region off the Southern Extremity of Saghalien. Proc. 3rd Pan-Pacif. Sci. Congr., Tokyo, 1926, pp. 954–958.
133. ——— (1936) Laminariaceae of Hokkaido. (in Japanese). in OKAMURA's Marine Algae of Japan, pp. 283–300. Tokyo.

134. MIYABE, K. and NAGAI, M. (1932) *Cymathaere crassifolia* (P. et R.) DE TONI from the Southern Kuriles. Proc. Imp. Acad., vol. VIII, no. 4, pp. 123–126.
135. ——— and ——— (1932a) *Pleuropterum paradiseum*, a New Genus and Species of Alariae from the Northern Kuriles. Proc. Imp. Acad., vol. VIII, no. 4, pp. 127–130.
136. ——— and ——— (1932b) On *Hedophyllum Bongardianum* (P. et R.) YENDO and Five Species of *Laminaria* from the North Kuriles. Trans. Sapporo Nat. Hist. Soc., vol. XII, pt. 4, pp. 194–205, pl. V.
137. ——— and ——— (1933) Laminariaceae of the Kurile Islands. Trans. Sapporo Nat. Hist. Soc., vol. XIII, pt. 2, pp. 85–102.
138. MIYAKE, K. and KUNIEDA, H. (1931) On the Conjugation of the Gametes and the Development of the Zoospores in Ulvaceae. Jour. Coll. Agr., Imp. Univ. Tokyo, vol. XI, no. 3, pp. 341–357, pls. XXI–XXIV.
139. MÜNSCHER, W. C. (1917) A Key to the Phaeophyceae of Puget Sound. Puget Sound Marine Sta. Publ., vol. I, no. 25, pp. 249–284.
140. NAGAI, M. (1933) Meeresalgen aus Kamtschatka. Trans. Sapporo Nat. Hist. Soc., vol. XIII, pt. 1, pp. 12–19.
141. ——— (1933a) On a New Species of *Cymathaere* from the Kurile Islands. Proc. Imp. Acad., vol. IX, no. 9, pp. 531–534.
142. ——— (1935) Die japanischen Formen von *Fucus evanescens*. Jap. Jour. Bot., vol. VII, nos. 3–4, pp. 323–348. Tokyo.
143. ——— (1935a) On *Constantinea rosa-marina* (GMEL.) P. et. R. and *C. subulifera* SETCH. (in Japanese). Jour. Jap. Bot., vol. XI, no. 11, pp. 780–783. Tokyo.
144. ——— (1936) *Laminaria diabolica* MIYABE and its f. *longipes* MIYABE et TOKIDA. (in Japanese). Kwagaku (Science), vol. VI. no, 11, pp. 464–466. Tokyo.
145. NAKANO, H. (1917) A Rare Fresh Water Alga, *Aegagropila*, in Japan. (in Japanese). Jour. Jap. Bot., vol. I, no. 6, pp. 137–139, figs. 1–5. Tokyo.
146. NAKAZIMA, Y. (1938) Hydrographical Survey of the Adjacent Waters around the Kurile Islands. (in Japanese). Rept. Hokkaido Fish. Exp. Sta., no. XLIII, pp. 95–123. Yoiti, Hokkaido.
147. NISHIMURA, M. (1923) The Theory of the Spherical Thallus Formation of *Aegagropila Sauteri* (NEES) KÜTZ. (in Japanese). Bot. Mag., vol. XXXVII, pp. 105–117, pl. II. Tokyo.
148. ——— and KANNO, R. (1927) On the Asexual Reproduction of *Aegagropila Sauteri* (NEES) KÜTZ. (in Japanese). Bot. Mag., vol. XLI, pp. 432–438, pls. XIII, XIV. Tokyo.
149. OKADA, Y. (1934) Kaiso Zuhu. (Illustrations of Marine Algae) (with Jap. explanations). Tokyo.
150. ——— (1938) Studies on the Japanese Prasiolaceae. (Japanese with Eng. résumé). Jour. Jap. Bot., vol. XIV, no. 7, pp. 469–480. Tokyo
151. ——— (1938a) Studies on the Ball-formation of *Aegagropila* in Etorohu Island. (Japanese with Eng. résumé). Jour. Jap. Bot., vol. XIV, no. 12, pp. 791–798.

152. OKAMURA, K. (1891) On the Marine Algae of Hokkaido. (in Japanese). Bot. Mag., vol. V, pp. 333–336. Tokyo.
153. ———— (1891a) Marine Algae of the Kurile Islands. (in Japanese). Bot. Mag., vol. V, pp. 408–409. Tokyo.
154. ———— (1895) Contributions to the Knowledge of the Marine Algae of Japan. II. Bot. Mag., vol. X, pp. 21–28, 33–40, pl. III. Tokyo.
155. ———— (1896) On *Laminaria* of Japan. Bot. Mag., vol. X, pp. 87–99, pl. VII. Tokyo.
156. ———— (1901) Illustrations of the Marine Algae of Japan. Vol. I. Tokyo. (Only one volume was published.)
157. ———— (1902–'16) Nippon Sorui Meii. (Enumerations of Japanese Algae) (in Japanese). Ed. 1 (1902); ed. 2 (1916). Tokyo.
158. ———— (1907–'37) Icones of Japanese Algae. Vol. I, nos. 1–5 (1907): nos. 6–9 (1908); no. 10; vol. II, nos. 1–4 (1909): nos. 5–7 (1910); nos. 8–10 (1912); vol. III, nos. 1–4 (1913): nos. 5, 6 (1914): nos. 7–10 (1915); vol. IV, nos. 1, 2 (1916): no. 3 (1918): nos. 4–7 (1921): nos. 8, 9 (1922): no. 10; vol. V, no. 1 (1923): nos. 2, 3 (1924): nos. 4–6 (1925): no. 7 (1926): nos. 8, 9 (1927): no. 10 (1928); vol. VI, nos. 1, 2 (1929): nos. 3, 4 (1930): nos. 5, 6 (1931): nos. 7–10 (1932); vol. VII, nos. 1, 2 (1933): nos. 3–5 (1934): nos. 6–8 (1935): no. 9 (1937).
159. ———— (1927) On *Campylaephora hypnaeoides* J. AG. Bot. Mag., vol. XLI, pp. 365–368. Tokyo.
160. ———— (1928) On the Distribution of Marine Algae in Japan. Proc. 3rd Pan-Pacif. Sci. Congr., Tokyo, 1926, pp. 958–963.
161. ———— (1928a) Algae from Kamtschatka. Records Ocean. Works Japan, Tokyo, vol. I, pp. 52–55, pls. XIII–XV.
162. ———— (1929) Geographical Distribution of Marine Plants. (in Japanese). Iwanami's Series of Geography. Tokyo.
163. ———— (1930) Sorui Keitogaku. (Systematic Phycology) (in Japanese). Tokyo.
164. ———— (1932) The Distribution of Marine Algae in Pacific Waters. Records Ocean. Works Japan, vol. IV, pp. 30–150. Tokyo.
165. ———— (1933) On the Algae from Alaska collected by Y. KOBAYASHI. Records Ocean. Works Japan, vol. V, pp. 85–97, pls. IV, V. Tokyo.
166. ———— (1934) The Distribution of Marine Algae in Pacific Waters. Proc. 5th Pacif. Sci. Congr., Canada, 1933, pp. 3133–3144.
167. ———— (1936) Nihon Kaisosi. (Marine Algae of Japan) (in Japanese). Tokyo.
168. ———— and UEDA, (1925) On *Laminaria angustata* KJELLM. and *L. longissima* MIYABE. (Japanese with Eng. résumé). Jour. Imp. Fish. Instit., vol. XXI, no. 2, pp. 20–25, 63–69, pl. I. Tokyo.
169. OLTMANNS, F. (1922–'23) Morphologie und Biologie der Algen. 2 Aufl. Vol. I, II (1922); vol. III (1923). Jena.
170. PEASE, VINNIE A. (1917) North Pacific Coast Species of *Desmarestia*. Puget Sound Mar. Sta. Publ., vol. I, nos. 30–31, pp. 383–394, Pls. LXXXIII, LXXXIV.

171. PEASE, VINNIE A. (1920) Taxonomy and Morphology of the Ligulate Species of the Genus *Desmarestia*. Publ. Puget Sound Biol. Sta., vol. II, nos. 53–56, pp. 313–367, pls. LIX–LXIII.

172. POSTELS, A. and RUPRECHT, F. J. (1840) Illustrationes Algarum in itinere circa orbem jussu Imperatoris NICOLAI I, atque auspiciis NAVARCHI FRIDERICI LÜTKE annis 1826, 1827, 1828 et 1829, celoce Seniavin exsecuto in Oceano Pacifico, inprimis septemtrionali ad Littora Rossica Asiatico-Americana collectarum. St. Petersbourg.

173. PRINTZ, H. (1927) Chlorophyceae. in ENGLER u. PRANTL, Natürl. Pflanzenfam. 2 Aufl. Vol. III. Leipzig.

174. REED, M. (1902) Two New Ascomycetous Fungi parasitic on Marine Algae. Univ. Calif. Publ. Bot., vol. I, pp. 141–164, pls. XV, XVI.

175. REINBOLD, TH. (1920) Algae, in LOESENER, TH., Prodromus Florae Tsingtauensis. Die Pflanzenwelt des Kiautschou-Gebietes. Beih. Bot. Central., vol. XXXVII, no. 2, pp. 76–77.

176. ROSENVINGE, L. K. (1893) Grønlands Havalger. Med. om Grønland, vol. III, pp. 765–981, pls. I, II. Kjøbenhavn.

177. ———— (1899) Deuxième Mémoire sur les Algues marines du Groenland. Med. om Grønland, vol. XX, pp. 1–125, pl. I. Kjøbenhavn.

178. ———— (1899a) Om Algenvegetationen ved Grønlands Kyster. Med. om Grønland, vol. XX, pp. 131–242. Kjøbenhavn.

179. ———— (1899b) Sur la végétation d'algues marines sur les côtes du Grönland. Med. om Grønland, vol. XX, pp. 339–346. Kjøbenhavn.

180. ———— (1909–'31) The Marine Algae of Denmark. Vol. I, pt. I (1909): pt. II (1917): pt. III (1923–'24): pt. IV (1931). København.

181. ———— (1910) On the Marine Algae from North-East Greenland. Med. om Grønland, vol. XLIII, pp. 93–133. København.

182. ROTH, A. G. (1797–1806) Catalecta Botanica quibus Plantae Novae et Minus Cognitae Describuntur atque Illustrantur. Fasc. I (1797); fasc. II (1800); fasc. III (1806). Lipsiae.

183. RUPRECHT, F. J. (1848) Bemerkungen über den Bau und das Wachstum einiger grossen Algen-Stämme, und über die Mittel, das Alter derselben zu bestimmen. Mém. d. l'Acad. Imp. des Sci. Nat., vol. VI, pp. 59–70, pl. VI. St. Petersburg.

184. ———— (1851) Tange das Ochotskischen Meeres. MIDDENDORFF's sibirische Reise, vol. I, pt. 2, Liefer. 2, pp. 193–435, pls. IX–XVIII.

185. SAUNDERS, DE A. (1895) A Preliminary Paper on *Costaria* with Description of a New species. Bot. Gaz., vol. XX, pp. 54–58, pl. VII.

186. ———— (1898) Phycological Memoirs. Proc. Calif. Acad. Sci., ser. 3, Bot., vol. I, pp. 147–168, pls. XII–XXXII. San Francisco.

187. ———— (1901) Papers from the Harriman Alaska Expedition, 25. The Algae. Proc. Wash. Acad. Sci., vol. III, pp. 391–486, pls. XLIII–LXII. Washington.

188. SAUVAGEAU, C. (1900–'14) Remarques sur les Sphacelariacées. (1900) Jour. de Bot., vol. XIV, pp. 1–51: (1901) ibid., vol. XV, pp. 51–167: (1902) ibid., vol. XVI, pp. 167–228: (1903) ibid., vol. XVII, pp. 228–332: (1904) ibid., vol. XVIII, pp. 332–348: (1914) a separate publication pp. 349–634.

189. SCHMIDT, O. C. (1931) Die Marine Vegetation der Azoren in ihren Grundzügen Dargestallt. Bibliotheca Botanika, no. 102. Stuttgart.

190. SCHMITZ, FR. and FALKENBERG, P. (1897) Rhodomelaceae. in ENGLER u. PRANTL, Natürl. Pflanzenfam. I Teil, 2 Abteil., 1897, pp. 421–480. Leipzig.

191. ——— and HAUPTFLEISCH, P. (1896–'97) Rhodophyceae (excl. Rhodomelaceae) in ENGLER u. PRANTL, Natürl. Pflanzenfam. I Teil, 2 Abteil., 1897, pp. 298–420, 481–544. Leipzig.

192. SCHREIBER, E. (1931–'32) Ueber die Entwicklungsgeschichte und die systematische Stellung der Desmarestiaceeen. Zeitschr. f. Bot., vol. XXV, pp. 561–582.

193. SETCHELL, W. A. (1893) On the Classification and Geographical Distribution of the Laminariaceae. Trans. Conn. Acad., vol. IX, pp. 333–375.

194. ——— (1899) Algae of the Pribilof Islands. in JORDAN, Fur seals and fur-seal islands of the North Pacific Ocean, vol. III, pp. 589–596, pl. XCV. Washington.

195. ——— (1901) Notes on Algae I. Zoe, vol. V, nos. 6–8, pp. 121–129.

196. ——— (1905) Post-embryonal Stages of the Laminariaceae. Univ. Calif. Publ. Bot., vol. II, no. 4, pp. 115–138, pls. XIII, XIV.

197. ——— (1906) A Revision of the Genus *Constantinea*. Nuova Notarisia, ser. XVII, pp. 1-12.

198. ——— (1908) Critical Notes on Laminariaceae. Nuova Notarisia, ser. XIX, pp. 90–101.

199. ——— (1912) The Kelps of the United States and Alaska, in Fertilizer Resources of the United States. 62 Congr., 2 Sess., Sen. Doc. 190, pp. 130–178.

200. ——— (1914) The Law of Temperature connected with the Distribution of the Marine Algae. Ann. Mo. Bot. Gard., vol. II, pp. 287–305.

201. ——— (1920) The Temperature Interval in the Geographical Distribution of Marine Algae. Science, N. S., vol. LII, no. 1339, pp. 187–190. New York.

202. ——— (1923) *Dumontia filiformis* on the New England Coast. Rhodora, vol. XXV, no. 290, pp. 33–37.

203. ——— (1926) Phytogeographical Notes on Tahiti. II, Marine Vegetation. Univ. Calif. Publ. Bot., vol. XII, no. 8, pp. 291–324.

204. ——— (1934) Marine Plants and Pacific Paleogeography. Proc. 5th Pacif. Sci. Congr., Canada, 1933, pp. 3117–3131.

205. ——— (1935) Geographic Elements of the Marine Flora of the North Pacific Ocean. Amer. Naturalist, vol. LXIX, pp. 560–577.

206. SETCHELL, W. A. and GARDNER, N. L. (1903) Algae of Northwestern America. Univ. Calif. Publ. Bot., vol. I, no. 3, pp. 165–418, pls. XVII-XXVII.

207. ——— and ——— (1919–'25) The Marine Algae of the Pacific Coast of North America. Part I, (1919), Univ. Calif. Publ. Bot., vol. VIII, no. 1, pp. 1–138, pls. I–VIII; pt. II (1920), ibid., vol. VIII, no. 2, pp. 139–374, pls. IX–XXXIII; pt. III (1925), ibid., vol. VIII, no. 3, pp. 383–898, pls. XXXIV–CVII.

208. ——— and ——— (1920–'24) Phycological Contributions. I (1920), Univ. Calif. Publ. Bot., vol. VII, no. 9, pp. 279–324, pls. XXI–XXXI; II–VI (1922), ibid., vol. VII, no. 11, pp. 333–426, pls. XXXII–XLIX; VII (1924), ibid., vol. XIII, no. 1, pp. 1–13.

209. ——— and ——— (1933) A Preliminary Survey of *Gigartina*, with Special Reference to its Pacific North American Species. Univ. Calif. Publ., Bot., vol. XVII, no. 10, pp. 255–340, pls. XLVI–LXVI.

210. ——— and ——— (1936) *Iridophycus* Gen. Nov. and its Representation in South America. Proc. National Acad. Sci., vol. XXII, no. 8, pp. 469–473.

211. ——— and ——— (1937) *Iridophycus*, with Special Reference to the South American Species. Univ. Calif. Publ. Bot., vol. XIX, no. 6, pp. 195–228, pls. XXIII–XXIX.

212. ——— and ——— (1937a) *Iridophycus* in the Northern Hemisphere. Proc. National Acad. Sci., vol. XXIII, no. 3, pp. 169–174.

213. SIMMONS, H. G. (1897) Zur Kenntnis der Meeresalgen der Färöer. Hedwigia, vol. XXXVI, pp. 247–276.

214. SINOVA, E. S. (1927) Laminaria et autres algues comme branche d'industrie. (Russian with French résumé). pp. 77–142. Reprint.

215. ——— (1928–'29) Algae maris japonensis. (in Russian). Chlorophyceae (1928), Bull. Pacif. Sci. Fish. Res. Sta., vol. II, pt. 2, pp. 1–51: Phaeophyceae (1929), ibid., vol. III, pt. 4, pp. 1–62. Vladivostock.

216. ——— (1930) Algues de la Mer Ochotsk le long de la côte de l'île Grand Schantar. (Russian with French résumé). Trav. Soc. Naturalistes Leningrad, vol. LX, no. 3, pp. 81–125.

217. ——— (1932) Les algues de Kamtschatka. (Russian with French résumé). pp. 7–42. Reprint.

218. SKOTTSBERG, C. (1923) Botanische Ergebnisse der Schwedischen Expedition nach Patagonien und dem Feuerlande 1907–1909. IX. Marine Algae, 2. Rhodophyceae. Kungl. Sv. Vet.-Akad. Handl., vol. LXIII, no. 8, pp. 1–70.

219. SMITH, G. M. (1933) The Fresh-Water Algae of the United States. Ed. I. New York & London.

220. STACKHOUSE, J. (1795–1801) Nereis Britannica; continens species omnes Fucorum in insulis Britannicis crescentium. Bath. Fasc. I (1795); fasc. II (1797); fasc. III (1801).

221. SUDA, K. (1933) Science of Ocean. (in Japanese). Tokyo.

222. SURINGAR, W. F. R. (1870) Algae Japonicae Musei Botanici Lugduno-Batavi. pp. 1–39, pls. I–XXV.

223. SVEDELIUS, N. (1901) Studier öfver Oestersjöns Hafsalgflora. pp. 1–140. Upsala.

224. ——— (1924) On the Discontinuous Geographical Distribution of some Tropical and Subtropical Marine Algae. Arkiv f. Bot., vol. XIX, no. 3, pp. 1–70. Stockholm.

225. TATEWAKI, M. (1931) The Primary Survey of the Vegetation of the Middle Kuriles. Jour. Fac. Agr., Hokkaido Imp. Univ., vol. XXIX, pt. 4, pp. 127–190, pls. I–X. Sapporo.

226. ——— (1933) The Phytogeography of the Middle Kuriles. Jour. Fac. Agr., Hokkaido Imp. Univ., vol. XXIX, pt. 5, pp. 191–363, pls. I–VII. Sapporo.

227. TAYLOR, W. R. (1937) Marine Algae of the Northeastern Coast of North America. Ann Arbor.

228. TOKIDA, J. (1932) *Rhodophyllis capillaris* sp. nov. and some other Red-Algae on an Athecate Hydroid. Jour. Fish., School of Fish., Hokkaido Imp. Univ., no. XXXV, pp. 12–18, pl. I. Sapporo.

229. ——— (1932–'34) The Marine Algae from Robben Island, Saghalien. (1932) Bull. School of Fish., Hokkaido Imp. Univ., vol. II, pp. 1–34, pls. I–XI; suppl. rept. (1934), ibid., vol. IV, pp. 16–26, pls. I–VI. Sapporo.

230. ——— (1932a) On Two New Species of *Antithamnion* from Japan. Trans. Sapporo Nat. Hist. Soc., vol. XII, pts. 2 & 3, pp. 105–113, pl. III.

231. ——— (1934–'37) Phycological Observations. I (1934), Trans. Sapporo Nat. Hist. Soc., vol. XIII, pt. 3, pp. 196–202, pl. VIII; II (1935) (On the Structure of *Porphyra Onoi* UEDA), ibid., vol. XIV, pt. 2, pp. 111–114, pl. II; III (1937) (On the Juvenile Thallus and the Renovation of Lamina of *Arthrothamnus kurilensis* RUPR.), ibid., vol. XV, pt. 2, pp. 60–66.

232. ——— (1936) Taxonomic and Phytogeographical Studies on the Marine Algae of Saghalien. Prelim. Rept. (in Japanese), Kenkyu-Syoroku (Abstract of Researches), Hattori Hokokai (Hattori Gratitude Foundation), no. II, pp. 248–252.

233. TSENG, C. K. (1936) Notes on the Marine Algae from Amoy. Chin. Mar. Biol. Bull., vol. I, no. 1, pp. 1–86, pls. I–VI. Amoy, China.

234. ——— (1936a) Studies on the Marine Chlorophyceae from Hainan. Chin. Mar. Biol. Bull., vol. I, no. 5, pp. 129–200. Amoy, China.

235. ——— (1936–'37) On Marine Algae New to China. I (1936b), Bull. Fan. Memorial Instit. Biol., Bot., vol. VII, no. 3, pp. 169–196; II, (1937), ibid., vol. VII, no. 6, pp. 231–255. Peiping, China.

236. ——— and LI, L. C. (1935) Some Marine Algae from Tsingtao and Chefoo, Shantung. Bull. Fan. Memorial Instit. Biol., Bot., vol. VI, no. 4, pp. 183–235. Peiping, China.

237. TURNER, D. (1808–'19) Fuci sive plantarum fucorum generi a botanicis ascriptarum icones descriptiones et historia. London. Vol. I (1808); vol. II (1809); vol. III (1811); vol. IV (1819).

238. UCHIDA, T., YAMADA, Y. and HADA, Y. (1935) General Aspect of Akkeshi Marine Biological Station. (in Japanese), Fac. Sci., Hokkaido Imp. Univ., pp. 1–28, pls. I–VIII. Sapporo.

239. UDA, M. (1933) Hydrographical Researches on the Normal Monthly Conditions of Oyasiwo and Kurosiwo-Area. (Japanese with Eng. résumé), Jour. Imp. Fish. Exp. Sta., no. III, pp. 79–136. Tokyo.

240. ———— (1934) Hydrographical Researches on the Normal Monthly Conditions in the Japan Sea, the Yellow Sea, and the Okhotsk Sea. (Japanese with Eng. résumé), Jour. Imp. Fish. Exp. Sta., no. V, pp. 191–236. Tokyo.

241. ———— (1935) The Results of Simultaneous Oceanographical Investigations in the North Pacific Ocean adjacent to Japan made in August, 1933. (Japanese with Eng. résumé), Jour. Imp. Fish. Exp. Sta., no. VI, pp. 1–130. Tokyo.

242. ———— (1938) Hydrographical Fluctuation in the Northeastern Sea-Region adjacent to Japan of North Pacific Ocean. (A Result of the Simultaneous Oceanographical Investigations in 1934–'37.) (Japanese with Eng. résumé), Jour. Imp. Fish. Exp. Sta., no. IX, pp. 1–66. Tokyo.

243. UEDA, S. (1932) Taxonomic Studies on the Japanese *Porphyra*. (in Japanese), Jour. Imp. Fish. Inst., vol. XXVIII, no. 1, pp. 1–45, pls. I–XXIV. Tokyo.

244. ———— (1933) Suisan Syokubutugaku. (in Japanese), Tokyo.

245. ———— (1936) Studies on the Propagation of *Gelidium*. I. (in Japanese), Bull. Jap. Soc. Sci. Fish., vol. V, no. 3, pp. 183–186. Tokyo.

246. ———— (1937) Studies on the Life-History of *Porphyra tenera* KJELLM. (in Japanese), Bull. Jap. Soc. Sci. Fish., vol. VI, no. 2, pp. 91–104. Tokyo.

247. WILLE, N. (1887) Algologische Mitteilungen. I–IX. Jahrb. wiss. Bot., vol. XVIII, pp. 425–518, pls. XVI–XIX.

248. ———— (1901) Studien über Chlorophyceen. I–VII. Vid.-Selsk. Skrifter M.-N. Kl. 1900, no. VI, pp. 1–46, pls. I–IV.

249. WITTROCK, V. B. (1866) Försok till en monographi öfver algslägtet *Monostroma*. Akad. Afhandl.

250. WORONICHIN, N. N. (1928) Die Meeresalgen Kamtschatkas. in Rept. Bot. Sect. Kamchatka-Expedition by T. R. RJABUSCHINSKI (Translated into Japanese), Kamchatka Survey Series, South Manchurian Railway Co., vol. VI, pp. 103–176, 287–289.

251. YAMADA, Y. (1928) Marine Algae of Mutsu Bay and Adjacent Waters. II. Sci. Rept. Tohoku Imp. Univ., ser. 4, Biol., vol. III, no. 4, pp. 497–534. Sendai.

252. ———— (1930–'38) Notes on Some Japanese Algae. I (1930), Jour. Fac. Sci., Hokkaido Imp. Univ., Sapporo, ser. 5, vol. I, no. 1, pp. 27–36, pls. II–VI; III (1932), ibid., no 3, pp. 109–123, pls. XXI–XXV; IV (1932a), ibid., vol. II, no. 2, pp. 267–276, pls. III–IX; V (1933), ibid., no. 3, pp. 277–285, pls. X–XIII; VIII (11938), Sci. Papers Inst. Alg. Research, Fac. Sci., Hokkaido Imp. Univ., vol. II, no. 1, pp. 119–130, pls. XIX–XXXI.

253. YAMADA, Y. (1931) Notes on *Laurencia*, with Special Reference to the Japanese Species. Univ. Calif. Publ. Bot., vol. XVI, no. 7, pp. 185–310, pls. I–XXX.

254. ———— (1934) The Marine Algae of the Northern Kuriles. (in Japanese), Bull. Biogeogr. Soc. Jap., vol. IV, no. 4, pp. 343–350. Tokyo.

255. ———— (1934 & '35) Marine Algae from Urup, the Middle Kuriles, especially from the Vicinity of Iema Bay. (in Japanese), (1934), Inst. Alg. Research Bull., Fac. Sci., Hokkaido Imp. Univ., no. 3, pp. 1–50: (also in English), (1935), Sci. Papers Inst. Alg. Research, Fac. Sci., Hokkaido Imp. Univ., vol. I, no. 1, pp. 1–26, pls. I–X. Sapporo.

256. ———— (1934–'35 & 1938) Observations on *Arthrothamnus bifidus* J. AG. (in Japanese), I (1934), Jour. Jap. Bot., Tokyo, vol. X, no. 11, pp. 732–736; II (1935), ibid., vol. XI, no. 5, pp. 318–320: (also in English), (1938), Sci. Papers Inst. Alg. Research, Fac. Sci., Hokkaido Imp. Univ., vol. II, no. 1, pp. 113–118. Sapporo.

257. YENDO, K. (1902) Corallinae Verae Japonicae. Jour. Coll. Sci., Imp. Univ. Tokyo, vol. XVI, art. 3, pp. 1–36, pls. I–VII.

258. ———— (1902a) The Distribution of Marine Algae in Japan. Postelsia, Year Book of Minnesota Seaside Station, [1901], pp. 177–192, pls. XIX–XXI.

259. ———— (1903) *Hedophyllum spirale*, sp. nov., and its Relation to *Thalssiophyllum* and *Arthrothamnus*. Bot. Mag., vol. XVII pp. 165–173 pl. VI. Tokyo.

260. ———— (1904) A Study of the Genicula of Corallinae. Jour. Coll. Sci.. Imp. Univ. Tokyo, vol. XIX, art. 14, pp. 1–44, 1 pl.

261. ———— (1905) A Revised List of Corallinae. Jour. Coll. Sci., Imp. Univ. Tokyo, vol. XX, art. 12, pp. 1–46.

262. ———— (1905a) Principle of Systematizing Corallinae. Bot. Mag., vol. XIX, pp. 115–126. Tokyo.

263. ———— (1907) The Fucaceae of Japan. Jour. Coll. Sci. Imp. Univ. Tokyo, vol. XXI, art. 12, pp. 1–174, pls. I–XVIII.

264. ———— (1909–'18) Notes on Algae New to Japan. I (1909), Bot. Mag., vol. XXIII, pp. 117–133; II (1914), ibid., vol. XXVIII, pp. 263–281; III (1915), ibid., vol. XXIX, pp. 99–117; IV (1916), ibid., vol. XXX, pp. 47–65; V (1916a), ibid., vol. XXX, pp. 243–263; VI (1917), ibid., vol. XXXI, pp. 75–95; VII (1917a), ibid., vol. XXXI, pp. 183–207; VIII (1918), ibid., vol. XXXII, pp. 65–81; Conclus. Remark (1918a), ibid., vol. XXXII, pp. 175–178. Tokyo.

265. ———— (1910) Kaisan Syokubutugaku. (Marine Botany), (in Japanese). Tokyo.

266. ———— (1911) The development of *Costaria*, *Undaria*, and *Laminaria*. Ann. Bot., vol. XXV, pp. 691–715, pls. LIII–LV.

267. ———— (1913) Some New Algae from Japan. Nyt Mag. f. Naturvidensk., vol. LI, pp. 275–288, pls. XIII, XIV. Christiana.

268. ———— (1913a) On *Hapalosiphon filiformis* RUPR. Trav. Mus. l'Acad. Imp. Sci., St. Petersbourg, vol. X, pp. 114–121.

269. YENDO, K. (1914) On the Cultivation of Seaweeds, with Special Accounts of their Ecology. Econ. Proc. Royal Dublin Soc., vol. II, no. 7, pp. 105–122, pl. XII.
270. ———— (1915) *Erythrophyllum Gmelini* (GRUN.) Nov. Nom. Bot. Mag., vol. XXIX, pp. 230–237. Tokyo.
271. ———— (1919) A Monograph of the Genus *Alaria*. Jour. Coll. Sci. Imp. Univ. Tokyo, vol. XLIII, art. 1, pp. 1–145, pls. I–XIX.
272. ———— (1920) Novae Algae Japonicae. Decas I–III. Bot. Mag., vol. XXXIV, pp. 1–12. Tokyo.
273. ZANARDINI, J. (1858) Plantarum in mari Rubro hucusque collectarum. pp. 1–101, pls. I–XII.

VII. Indexes

1. Index of Latin Names

Pages where diagnoses or remarks about adopted species appear are in boldface, and those where synonyms [or other mention,] appear in *italics*.

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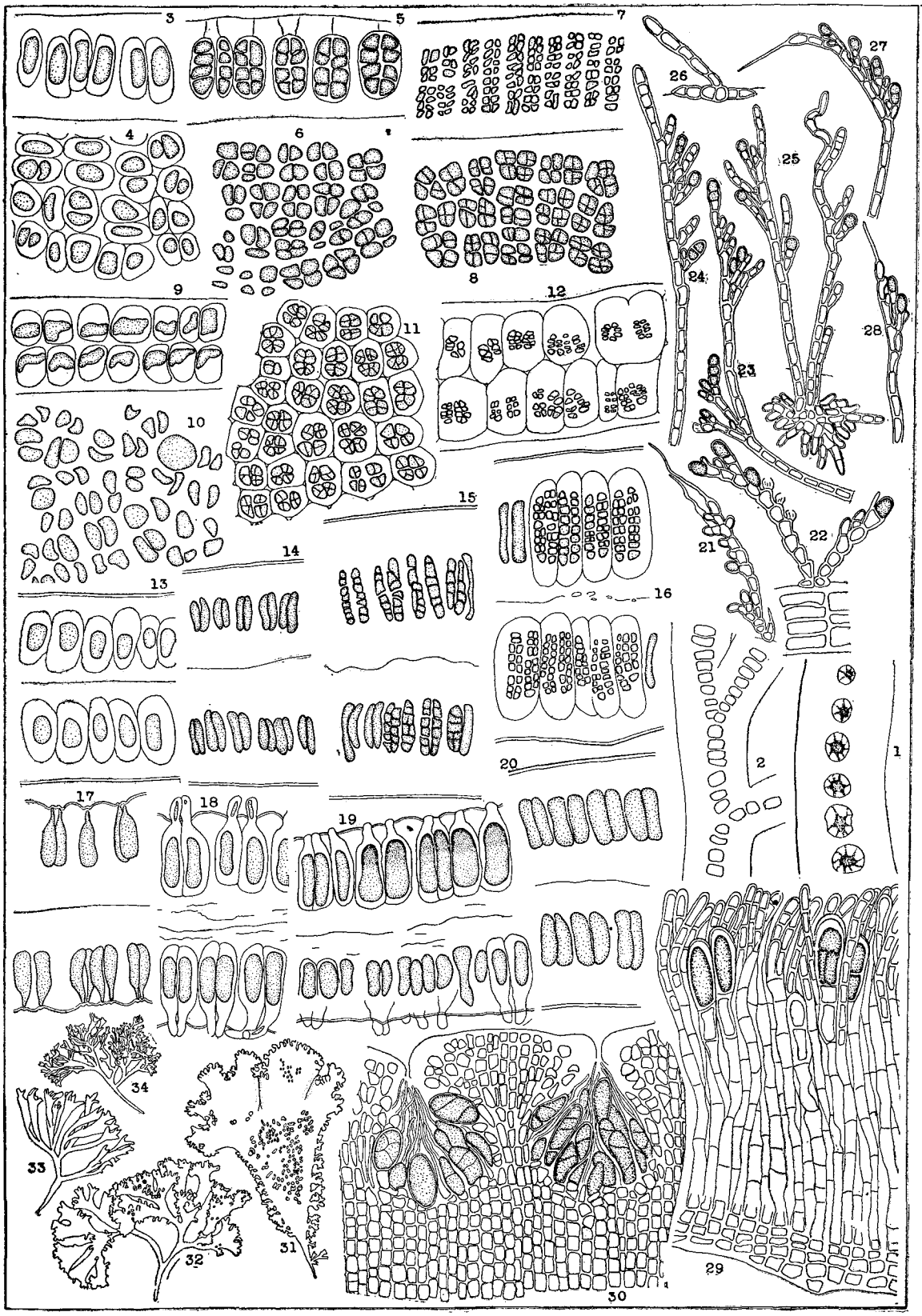
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PLATE V

Explanation of Plate V

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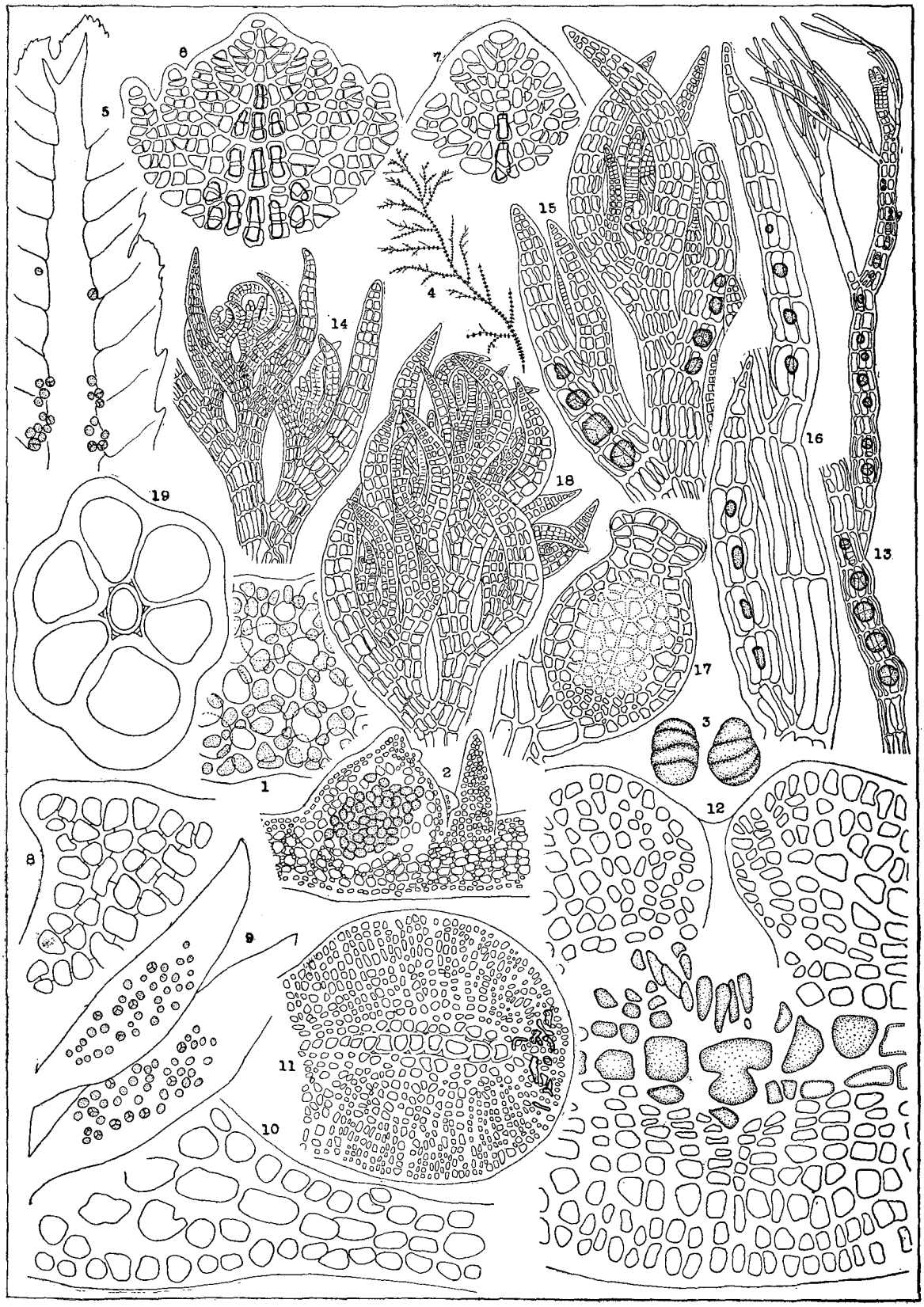

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PLATE VI

Explanation of Plate VI

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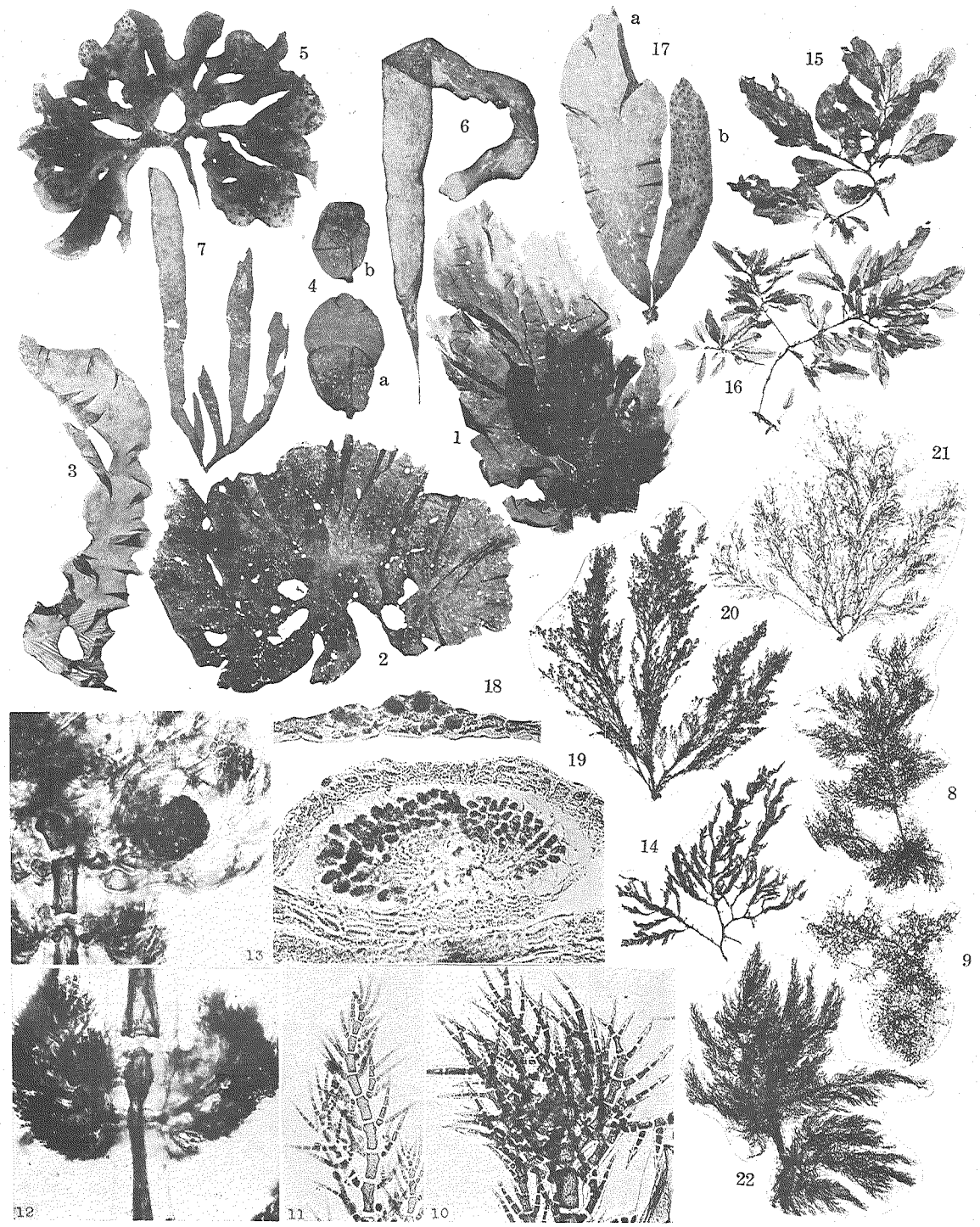

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