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Author(s)	NAGAI, Masaji
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# MARINE ALGAE OF THE KURILE ISLANDS. I

By

Masaji NAGAI

## I. Introduction

The first publication of the marine algae from the Kurile Islands was that by POSTELS and RUPRECHT on the distribution of *Alaria fistulosa* POST. et RUPR. from Kamchatka to Saghalien and the Kuriles, in their master work, "Illustrationes Algarum Oceani Pacifici Imprimis Septentrionalis", published in 1840. RUPRECHT in 1848 described *Arthrothamnus kurilensis* RUPR. from Uruppu Isl. under the subject of "Bemerkungen über den Bau und das Wachstum einiger Grossen Algen-Stämme, und über die Mittel, das alter derselben zu bestimmen." In his later work, "Tange des Ochotskischen Meeres", 1851, RUPRECHT described many species the same as those occurring in the Kuriles. Since the publication of RUPRECHT's account, investigations on the marine flora of the Kurile Islands have been made chiefly by Japanese algologists. It was the late Dr. K. YENDO who first visited this archipelago as an algologist. He visited Simusyu Isl. in the North Kuriles and Etorohu Isl. in the South Kuriles. His reports have been published in the Tokyo Botanical Magazine and elsewhere since 1903. They are, however, all fragmentary. Reports were also given by the late Dr. K. OKAMURA and Prof. K. MIYABE. Dr. OKAMURA reported his studies on the Kurile species of algae in various publications, such as the Tokyo Botanical Magazine, Icones of Japanese Algae, Nippon Sorui Meii (Enumerations of Japanese Algae), Nihon Kaisosi (Marine Algae of Japan), etc. Prof., Emer. K. MIYABE described several species of the Laminariaceae of the Kuriles in his "Laminariaceae of Hokkaido", in 1902, recently in conjunction with the present writer in the Transactions of the Sapporo Natural History

Society and also in the Proceedings of the Imperial Academy. The present writer has previously reported several species of marine algae. Prof. Y. YAMADA reported also the marine algae of the North Kuriles based upon OKADA's collection, in 1934. He paid a visit to Uruppu Isl. in 1933. His study on the marine flora of that island was published in 1934 (in Japanese) and also in 1935 (the same as the former, in English) under the title of "Marine Algae from Urup, the Middle Kuriles, especially from the vicinity of Iema Bay", in which fifty species, with five varieties and five forms are enumerated. Next year "A List of Marine Algae from the Island of Shikotan" was reported by S. KAWABATA who had studied the marine algae of that island for two years under the direction of Prof. YAMADA. In his report, seventy-eight species with four forms are enumerated.

The first botanizing excursion of the present writer was undertaken in the summer of 1929 with the late Mr. M. SHIMAMURA,\* who was a student of Botany in the university at that time, in the island of Kunasiri. In the summer of 1930, the writer took part in the "Hokkaido-tyo Expedition to the North Kuriles" under the command of Mr. R. NAKAMURA, Head of the Bureau of Harbor Works, on the S.S. "Sanyo-maru." He made explorations during the expedition to the islands of Paramusiru, Simusyu, Araido, Simusiru, Uruppu, Etorohu and Kunasiri, and collected many specimens of marine algae from these islands. Thereafter he made botanizing excursions five times before 1936 to many islands within the archipelago. The islands to which he went, are as follows: to Kunasiri and Etorohu three times, to Uruppu, Simusiru, Paramusiru and Simusyu twice and to Sikotan, Ketoi, Usisiru, Rasyuwa, Matuwa, Musiru, Harumukotan, Onnekotan and Araido once. A large number of specimens have been obtained in these expeditions. They are now deposited in the Herbarium of the Faculty of Agriculture, Hokkaidô Imperial University. Among the exotic specimens in this Herbarium, many specimens from the Pacific side of North America are very helpful in studying the

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\* It is the writer's deep grief that Mr. M. SHIMAMURA who was at the front as a cavalry sub-lieutenant in the present China Incident, died in January, 1939 in North China. The writer proposes in this paper to give his name to a new species of *Antithamnion*, one of the most beautiful algae in the Kuriles, in memory of the friendship enjoyed by the writer during the trip to Kunasiri Isl.

Kurile species. The writer is much obliged to Prof. Emer. W. A. SETCHELL and the late Prof. N. L. GARDNER of the University of California for their courtesies in sending many valuable specimens to our Herbarium.

The writer wishes to express his heartiest thanks to Prof. S. ITO under whose valuable guidance and constant encouragement the present work has been completed. The writer wishes to express his grateful acknowledgement to Prof. Emer. K. MIYABE and Prof. Y. YAMADA for their valuable suggestions and guidance and moreover for their kindness in reading the original manuscript. His indebtedness is also acknowledged to them for the free use of their libraries. He is very grateful to Prof. Y. TOCHINAI for his kind advices and encouragement throughout the present work.

Further the writer is much obliged to Mr. R. NAKAMURA, the Former Head of the Bureau of Harbor Works, Hokkaido Government, Mr. K. ISINO, the Chief Expert of the Fishery Bureau, Department of Agriculture and Forestry, Captain S. TAKASIMA and the late Captain U. OBAMA for their kindness and courtesies offered him in his trips in the Kuriles. For the expenses incurred in the expeditions from 1934 to 1936, the writer is indebted to the Fund for the Three Hundred Year's Memorial of Tosyogu and he desires to express his cordial thanks to that Foundation for its financial aid. Acknowledgement is also due to Dr. S. IMAI, Prof. J. TOKIDA, Mr. T. HATTORI, Mr. Y. HADA, Mr. K. ISHIZUKA, and other colleagues in and out of the Institute for kindnesses rendered him in various ways.

## II. The Classification of the Marine Algae in the Kurile Islands

### 1. Enumeration of the Species, Varieties and Forms

#### MYXOPHYCEAE

##### Order I. Coccogonales

##### Family 1. *Chamaesiphonaceae*

##### *Dermocarpa* CROUAN, 1858

##### *Dermocarpa pacifica* SETCHELL et GARDNER

(Pl. I, figs. 1, 2)

in GARDNER's New Pacific Coast Alg. II, (1918), p. 439, pl. XXXVII, fig. 22-24—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. I, p. 27, pl. III, fig. 22-24.

Cells aggregated into colonies, varying in shape from sub-spherical to narrow wedge-shape through broad-ovate or pear-shape, 27-42  $\mu$  long, 13.5-24  $\mu$  diam. at the widest part; cell-wall ca. 1.5  $\mu$  thick, hyaline, homogenous; cell contents bright blue-green or olive green when young, becoming brownish in age; gonidia numerous, ca. 2  $\mu$  diam.

The specimens at hand accord well with the original description of the present species in all respects except the dimension of the width of the cells and of the colonies. According to SETCHELL and GARDNER, the colonies of their specimens measured up to 200  $\mu$  in diameter. But those of the Kurile specimens are often 180 to 270  $\mu$ , and very rarely attain to about 1 mm. in diameter. They are round, sometimes expanded into irregular outline. The cells of the writer's specimens appear to be slightly smaller in width than those of the American plant. The writer would like to identify his specimens with the present species for the time being, though there are a few minute discrepancies as above mentioned.

**Habitat and localities.** Epiphytic on the fronds of various algae, e. g., *Ralfsia fungiformis*, *Gigartina ochotensis*, *G. unalascensis*, *Pterosiphonia bipinnata*, etc.

*N. Kuriles.* Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Usisiru Isl.—Kitazima.

*S. Kuriles.* Etorohu Isl.—Arimoe. Sikotan Isl.—Notoro. Kunasiri Isl.—Hurukamappu.

**Distrib.** California and Japan (the Kuriles).

## CHLOROPHYCEAE

### Order I. Protococcales

#### Family 1. Chlorochytriaceae

##### 1. *Chlorochytrium* COHN, 1872

##### *Chlorochytrium inclusum* KJELLMAN

Alg. Arct. Sea, (1883), p. 320, pl. XXXI, fig. 8-17—DE TONI, Syll. Alg. I, p. 637—BØRGESEN, Mar. Alg. Faeröes, p. 481—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 147, pl. XIII, fig. 1—SINOVA, Alg. Mer Ochotsk. p. 92—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 43.

Cells entirely included within the host tissue, pear-shaped, rounded at the bases,  $84-150 \times 80-144 \mu$ , much thickened at apices,  $30-33 \mu$  thick, becoming evenly thinner toward the lateral and basal wall,  $4.5-6 \mu$  thick.

As far as the writer's studies have shown, the cells are not elliptic or ovate with apiculate tips, but pear-shaped with obtuse tips. The writer's specimens are probably not fully grown plants, but in the way to ripeness. The contents of the cells are yellowish green in color. The above observations were made upon the dried specimens.

**Habitat and locality.** Endophytic within the fronds of *Callymenia ornata*.

*M. Kuriles.* Harumukotan Isl.—Harumukotan-byoti.

**Distrib.** Arctic Ocean, Atlantic Ocean, Alaska, Washington, Okhotsk Sea and Japan (the Kuriles).

## Order II. Chaetophorales

### Family 2. *Ulotrichaceae*

#### 2. *Ulothrix* KÜTZING, 1836

##### Key to the species

- I. Chromatophore of a complete ring; fertile filaments broad, measuring up to  $60 \mu$  or even  $80 \mu$  in diam. . . . . *U. flacca* (1)
- II. Chromatophore of an incomplete ring; fertile filaments much narrower, measuring less than  $45 \mu$  in diam. . . . . *U. pseudoflacca* (2)

#### 1. *Ulothrix flacca* (DILLWYN) THURET

in LE JOLLIS, *Liste Alg. Mar.* (1863), p. 56—COLLINS, *Green Alg. N. Amer.* p. 158, (Photogr. Repr.), p. 105—YENDO, *Notes Alg. New to Jap.* p. 119—SETCHELL & GARDNER, *Mar. Alg. Pacific Coast N. Amer.* II, p. 284—OKAMURA, *Mar. Alg. Jap.* p. 7, fig. 2.

*Conferva flacca* DILLWYN, *Brit. Conf.* (1809), pl. 49.

YENDO reported the present species from the North Kuriles. However there are no specimens in the writer's collection, referable to the present species.

**Locality.** *N. Kuriles.* Simusyu Isl. ? (YENDO).

**Distrib.** Atlantic Ocean, Alaska to California and Japan (the Kuriles).

## 2. *Ulothrix pseudoflacca* WILLE

(Pl. I, figs. 3, 4)

Stud. ueb. Chloroph. (1901), p. 22, Taf. II, fig. 64-81—BØRGESEN, Mar. Alg. Faeröes, p. 498—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 285, pl. IX, fig. 6, A-C.

Filaments 27-45  $\mu$  thick; cells 4-9  $\mu$  long, 13.5-28-33  $\mu$  diam., 0.2-0.6 as long as the diameter; chromatophore parietal, covering the outer cell wall, thickened in the region of the single pyrenoid, sometimes being partly set free as an incomplete ring.

As to the structure of chromatophore, WILLE states in the account above cited: "Der Chromatophor ist bandförmig und füllt meist die ganze Länge der Zelle aus, kann bisweilen an den Enden Partien freilassen, ist aber immer auf der einen Seite, wo ein einziges stark verdicktes Pyrenoid eingelagert ist, stark verdickt." In the specimens at hand, such a structure of the chromatophore is also observed. Some of the filaments show an advanced stage to ripeness. In these cells, the contents are divided or are to be divided into about 10 to 15 zoospores. The specimens may be referable to f. *maxima* SETCH. & GARDN. judging from the great breadth of the filaments.

**Habitat and localities.** Growing on rocks in the littoral zone, together with *Hormiscia penicilliformis*.

*M. Kuriles.* Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Nakadomari.

**Distrib.** Atlantic Ocean, Alaska to California and Japan (the Kuriles).

## Family 3. *Ulvaceae*

### Key to the genera

- I. Frond membranaceous, consisting of 2 layers of cells ..... *Ulva* (3)
- II. Frond tubular, simple or branched ..... *Enteromorpha* (4)

3. *Ulva* LINNAEUS, 1737

## Key to the species

- I. Frond lanceolate with tubular stipe ..... *U. Linza* (1)
- II. Frond variable in shape; stipe, when present, solid.
  - A. Cells, in cross section of frond, vertically oblong or subquadrate.
    - 1. Frond, at the basal portion, 86–140  $\mu$  thick; openings comparatively few ..... *U. pertusa* (2)
    - 2. Frond, at the basal portion, 69–90  $\mu$  thick; openings abundant ..... *U. fenestrata* (3)
  - B. Cells, in cross section of frond, subquadrate or horizontally elongated ..... *U. latissima* (4)

1. *Ulva Linza* L.

Sp. Plant. ed. 1, (1753), p. 1163—POSTELS et RUPRECHT, Ill. Alg. p. 21—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 262, pl. XII, fig. 1–4—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200.

*Enteromorpha Linza* J. AGARDH, Till Alg. Syst. Pt. 3, (1883), p. 134, pl. IV, fig. 110–112—COLLINS, Ulvaceae N. Amer. p. 23, pl. XLII, fig. 8; Green Alg. N. Amer. p. 206, (Photogr. Rept.), p. 126—SETCHELL & GARDNER, Alg. N. W. Amer. p. 212—HOWE, Mar. Alg. Peru, p. 24; Chinese Mar. Alg. p. 135—OKAMURA, Icon. Jap. Alg. III, 8, p. 163, pl. CXXXVIII; Nippon Sorui Meii, ed. 2, p. 226; Mar. Alg. Jap. p. 15—SINOVA, Alg. Kamtschatka, p. 10—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 200—TSENG, Mar. Alg. fr. Amoy, p. 14, pl. II, fig. 5—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 68, pl. III, fig. 8.

**Jap. name.** Usuba-awonori.

Since the publication of J. AGARDH's "Till Algernes Systematik," pt. 3, (1883), many authors have followed him in treating the present species as a member of the genus *Enteromorpha*. Recently SETCHELL and GARDNER restored the present species to the genus *Ulva* (l.c. 1920, p. 262). They state in their account "While *Ulva Linza* is an *Enteromorpha* at the base and on the lower margins, it is decidedly an *Ulva* so far as the expanded blade is concerned. It might, with justice, be placed in either genus, but since the habit in general is that of an *Ulva* and the greater portion of any plant of the species is ulvoid, it seems to us that the novice, at least, is more likely to arrange it with *Ulva* than with *Enteromorpha*." The present author follows them in treating this species as an *Ulva* in the present paper.

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

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

*M. Kuriles.* Simusiru Isl.—Broughton Bay.

*S. Kuriles.* Sikotan Isl.—Tiboi. Kunasiri Isl.—Tohutu, Tomari.

**Distrib.** Atlantic Ocean, S. America (Peru), Alaska to Mexico, Bering Isl., Kamchatka, China and Japan (Honsyu, Korea, Hokkaido, Saghalien and the Kuriles).

## 2. *Ulva pertusa* KJELLMAN

Mar. Chloroph. fr. Japan, (1897), p. 4, Taf. I, Taf. III, fig. 1–8—OKAMURA, Nippon Sorui Meii, ed. 1, p. 167; ed. 2, p. 224; Icon. Jap. Alg. IV, 4, p. 79, pl. CLXIX, fig. 8, pl. CLXX; Mar. Alg. Jap. p. 8, fig. 3—TOKIDA, Mar. Alg. Robben Isl. p. 3—TSENG, Mar. Alg. fr. Amoy, p. 16—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200.

**Jap. name.** Ana-awosa.

The present species is widely distributed in northern Japan. In the Kuriles, however, it seems to be distributed within the region, limited to the southern islands.

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

*S. Kuriles.* Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Atoiya, Rebun-iso, Seseki, Kotankesi, Nisi-ura.

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

## 3. *Ulva fenestrata* POSTELS et RUPRECHT

(Pl. I, figs. 5, 6; Pl. III, fig. 1)

Ill. Alg. (1840), p. 21, pl. XXXVII—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 267.

**Jap. name.** Tisima-ana-awosa (n.n.).

Frond membranaceous, distromatic, wider than long in typical form, rarely split, dull yellowish green, completely and more or less uniformly perforate with larger or smaller, round or irregular openings, when young broad-cuneate, later orbicular at the base, 8–25 cm. high, 12–30 cm. wide, (the largest specimen 37 × 60 cm.), 50–60  $\mu$  thick in the middle, 69–90  $\mu$  at the base; cells, in surface

view of frond, 4-6-angled with round corners, 9-15  $\mu$  diam., in cross section subquadrate or vertically oblong, in the middle of the frond ca.  $21 \times 9-18 \mu$ ; in the basal part more often oblong than subquadrate,  $24-33 \times 9-18 \mu$ ; chromatophore, according to SETCHELL & GARDNER, cucullate at outer end of the cell; plant becomes mature first from the marginal portion of the frond.

The present writer has obtained a large number of specimens of *Ulva* from the Kuriles, which are perforated abundantly in the frond, showing some of the openings larger and the others smaller in size. These specimens rather closely resemble *U. pertusa* KJELLM. in general appearances. But the writer would separate them from the latter species, and refer them to the present species for the following reasons. In the present species, the openings are usually numerous in the matured plant, while in *U. pertusa*, they are rather smaller in number. In the less thickness of the frond at the basal part, the present species differs also from *U. pertusa*. In either species, the cells in the middle part of the frond, are often subquadrate. But such subquadrate cells are observed more often in *U. pertusa* than in the present species. As for the thickness of the frond, SETCHELL and GARDNER describe it as up to 60  $\mu$ . In the Kurile specimens, it measures 50-60  $\mu$  thick in the middle part, and 69-90  $\mu$  in the basal part of the frond.

**Habitat and localities.** Growing on rocks in the lower littoral and upper sublittoral zones.

*N. Kuriles.* Simusyu Isl.—Kosekigawa, Tenzin-iwa, Kataoka-wan. Paramusiru Isl.—Suribati-wan, Murakami-wan.

*M. Kuriles.* Simusiru Isl.—Broughton Bay, Nakadomari. Uruppu Isl.—Kobune, Misima, Tokotan-wan.

*S. Kuriles.* Etorohu Isl.—Tikohai, Wenbetu, Iriribusi, Tosirari, Sibetoro, Bettobu, Rubetu. Kunasiri Isl.—Tohutu.

**Distrib.** Kamchatka, Alaska to Washington and Japan (the Kuriles).

#### 4. *Ulva latissima* LINNAEUS

Sp. Plant. ed. 1, (1753), p. 1163 (p.p.)—RUPRECHT, Tange Och. Meeres, p. 395—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 266—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200.

KAWABATA reported the present species from Sikotan Isl., and

he mentioned it as being found floating or attached to other algae.

**Habitat and localities.** Found floating or attached to other algae.

*S. Kuriles.* Sikotan Isl.—Notoro & Aimizaki (KAWABATA).

**Distrib.** Atlantic Ocean, Alaska, Okhotsk Sea and Japan (the Kuriles).

#### 4. *Enteromorpha* LINK, 1820

##### Key to the species

- I. Cells small, 4–6  $\mu$  in diam. in surface view of the frond. . . . . *E. micrococca* (1)
- II. Cells larger than the above.
  - A. Frond constricted, intestine-like . . . . . *E. intestinalis* (2)
  - B. Frond not constricted.
    - 1. Frond tubular, with many or few, delicate proliferous branches. . . . . *E. prolifera* (3)
    - 2. Frond filiform, cylindrical or compressed, much branched.
      - a. Main filament and branches in 1st order, 0.5–1.5 mm. in diam. . . . . *E. clathrata* (4)
      - b. Main filament 90–180  $\mu$  in diam. . . . . *E. plumosa* (5)

#### 1. *Enteromorpha micrococca* KÜTZING

(Pl. I, figs. 7, 8)

Tab. Phyc. VI, (1856), p. 11, Tab. 30, fig. II—KJELLMAN, Alg. Arct. Sea, p. 291—DE TONI, Syll. Alg. I, p. 119—COLLINS, Green Alg. N. Amer. p. 204, (Photogr. Repr.), p. 124—YENDO, Notes Alg. New to Jap. III, p. 99—OKAMURA, Nippon Sorui Meii, ed. 2, p. 225; Mar. Alg. Jap. p. 14—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 249—SINOVA, Alg. Kamtschatka, p. 10—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 67.

*Enteromorpha coarctata* KJELLMAN, Mar. Chloroph. fr. Japan, (1897), p. 15, Taf. III, fig. 19–21—OKAMURA, Nippon Sorui Meii, ed. 2, p. 229; Mar. Alg. Jap. p. 19.

*E. compressa* var. *minima* f. *micrococca* HAMEL, Chloroph. Franc. (Fin) (1931–32), p. 66, fig. 48 (7–8).

Frond tubular or compressed, simple or much contorted, slightly proliferous or with numerous, patent or uncinatate branches; cells very small, arranged in no definite order, 4–6  $\mu$  diam. in surface view of frond.

## Key to the forms

- I. Frond tubular or compressed, simple or slightly proliferous . . . . f. *typica*  
 II. Frond compressed, much contorted, with numerous, patent or uncinatè branches . . . . . f. *subsalsa*

f. *typica* KJELLMAN

l.c. (1883), p. 291.

Frond tubular or compressed, simple or slightly proliferous at times, tapering below, more or less broadened above, much curled and twisted, 1–13 cm. long, 0.5–9 mm., mostly 2.5–4 mm. wide; membrane 18–21  $\mu$  thick, with inner hyaline layer thicker than the outer; cells, in surface view of frond, angular, becoming slightly roundish at corners in the middle and upper portions, arranged in no definite order, 4–6  $\mu$  diam., in cross section, oblong, ca.  $9 \times 3$ –4.5  $\mu$ .

f. *subsalsa* KJELLMAN

(Pl. I, fig. 9)

l.c. (1883), p. 292, pl. XXXI, fig. 1–3—COLLINS, *Ulvac.* p. 20; *Green Alg.* p. 204, (Photogr. Repr.), p. 124—SETCHELL & GARDNER, l.c. p. 249, pl. XVI, fig. 1.—TAYLOR, l.c. p. 67.

Frond compressed, much contorted, with numerous, patent or uncinatè, shorter or longer branches from the margin, the latter again branched, all broad at the base and tapering to a point.

The specimens at hand are easily identified with the present species by the possession of very small cells and thin membrane, of which the inner layer is relatively thicker than the outer. The specimens, which the writer referred to f. *subsalsa*, are sometimes more slender than f. *typica*, and have numerous patent or uncinatè, shorter or longer branches. In the anatomical characters, however, there are no differences between these forms.

**Habitat and localities.** Forma *typica* growing on rocks and stones in the littoral zone.

*N. Kuriles.* Paramusiru Isl.—Suribati-wan, Kakumabetu.

*M. Kuriles.* Onnekotan Isl.—Nemō-wan. Simusiru Isl.—Broughton Bay, Simusiru-wan. Uruppu Isl.—Misima.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Tosimoe, Wenbetu, Iriribusi, Sibetoro, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Aimizaki, Tiboi. Kunasiri Isl.—Tohutu, Sokobetu, Kotankesi, Tomari.

f. *subsalsa* growing on stones in the fresh water along the sea shore.

S. *Kuriles*. Etorohu Isl.—Moyoro, Iriribusi, Syana.

**Distrib.** *Sp.*—Atlantic Ocean, Arctic Ocean, Alaska to Mexico, Kamchatka and Japan (Hokkaido and the Kuriles); f. *subsalsa*—Atlantic Ocean, Arctic Ocean, Alaska to Washington and Japan (the Kuriles).

## 2. *Enteromorpha intestinalis* (L.) LINK

Epistola. (1820), p. 5—AGARDH, *Sp. Alg.* I, 2, p. 418—KÜTZING, *Sp. Alg.* p. 478; *Tab. Phyc.* VI, Tab. 31—HARVEY, *Phyc. Brit.* II, pl. CLIV—J. AGARDH, *Till Alg. Syst.* 3, p. 131—KJELLMAN, *Alg. Arct. Sea*, p. 287—DE TONI, *Syll. Alg.* I, p. 123—COLLINS, *Ulvaceae N. Amer.* p. 23, pl. XLII, fig. 6, 7; *Green Alg. N. Amer.* p. 204, (Photogr. Repr.), p. 124; *Chinese Mar. Alg.* p. 205—OKAMURA, *Nippon Sorui Meii*, ed. 2, p. 226; *Mar. Alg. Jap.* p. 15, fig. 5 (2), 6 (9–10)—SETCHELL & GARDNER, *Mar. Alg. Pacific Coast N. Amer.* II, p. 252—SINOVA, *Alg. Kamtschatka*, p. 9—TSENG & LI, *Some Mar. Alg. fr. Tsingtao & Chefoo*, p. 200—TSENG, *Mar. Alg. fr. Amoy*, p. 14—TAYLOR, *Mar. Alg. N.-E. Coast N. Amer.* p. 65, pl. III, fig. 7, pl. IV, fig. 4, 5.

*Ulva intestinalis* LINNAEUS, *Fl. Suec.* ed. 2, (1755), p. 418.

*Enteromorpha compressa* var. *intestinalis* HAMEL, *Chloroph. Franc.* (Fin) (1931–32), p. 62, fig. 47 (II), 48 (9–10).

**Jap. name.** Yore-awonori. (n.n.)

SETCHELL and GARDNER stated, "There appears to be no authenticated type specimen of the *Ulva intestinalis* of LINNNAEUS in existence, so that we must follow general tradition as to the nature of this species. As generally agreed upon, it possesses a tubular frond usually inflated, of varying length and diameter, often twisted or constricted, usually branched from a slender base, occasionally slightly proliferous above, and with the rather large, angular or slightly elongated cells not arranged in longitudinal rows, at least not in the adult frond." In the writer's specimens, the cells of the frond are arranged in longitudinal series for the greater part in surface view and in part irregularly. However the specimens accord well with the present species in other respects.

**Habitat and locality.** Growing on small stones in the lower littoral zone in quiet warm water.

*S. Kuriles.* Kunasiri Isl.—Tomari.

**Distrib.** Atlantic Ocean, Arctic Ocean, Alaska to Mexico, Kamchatka, China and Japan (Ryukyu, Honsyu, Saghalien and the Kuriles).

### 3. *Enteromorpha prolifera* (MUELLER) J. AGARDH

(Pl. I, figs. 10, 11)

Till Alg. Syst. 3, (1883), p. 129, pl. IV, fig. 103, 104—DE TONI, Syll. Alg. I, p. 122—COLLINS, Ulvaceae N. Amer. p. 21, pl. XLII, fig. 5; Green Alg. N. Amer. p. 202, (Photogr. Repr.), p. 122; Chinese Mar. Alg. p. 205—YENDO, Notes Alg. New to Jap. II, p. 263—HOWE, Mar. Alg. Peru, p. 23; Chinese Mar. Alg. p. 136—OKAMURA, Nippon Sorui Meii, ed. 2, p. 225; Mar. Alg. Jap. p. 14, fig. 5 (4), 6 (1)—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 254—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 201—TSENG, Mar. Alg. fr. Amoy, p. 15—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 65, pl. III, fig. 2.

*Ulva prolifera* MUELLER, in Fl. Dan. V, Fasc. 13, (1778), pl. 763, fig. 1.

*Enteromorpha pilifera* KÜTZING, Tab. Phyc. VI, (1856), Tab. XXX, fig. III.

*E. compressa* var. *prolifera* HAMEL, Chloroph. Franc. (Fin) (1931-32), p. 65, fig. 48 (1-2).

**Jap. name.** Toge-awonori. (n.n.)

Frond 2-4.5 cm. long, tubular, with more or less abundant, delicate, proliferous branches which are usually simple, but sometimes repeatedly proliferous, 180-500  $\mu$  or more diam.; membrane 12-15  $\mu$  thick, not so much thickened exceeding the dimensions of the cell in cross section; cells, in surface view of frond, quadrate to subangular, in the middle to upper portions of the frond 6-12  $\times$  4.5-9  $\mu$ , in the lower portions more or less elongated, 15-30  $\times$  6-9  $\mu$ , arranged in longitudinal series, which become somewhat less distinct in the older parts, in cross section quadrate to oblong, 9-10.5  $\times$  6-7.5  $\mu$ .

The specimens at hand are of small dimensions, about 2-4.5 cm. long, 180-500  $\mu$  diam. They are tubular, with more or less abundant, short proliferous branches. The cells are quadrate to subangular and arranged in longitudinal series. The membrane is thickened evenly on both outer and inner sides, and not much exceeding the dimensions of the cells. Although the writer's specimens are all relatively small in size, they are identifiable with the present species by the above characters.

**Habitat and locality.** Growing on rocks in the lower littoral zone.

*S. Kuriles.* Etorohu Isl.—Syana.

**Distrib.** Atlantic Ocean, S. America (Peru), Alaska to California, China and Japan (Kyusyu, Honsyu, Hokkaido, Saghalien and the Kuriles).

#### 4. *Enteromorpha clathrata* (ROTH) GREVILLE

(Pl. I, figs. 12, 13)

Alg. Brit. (1830), p. 181—KÜTZING, Sp. Alg. p. 479; Tab. Phyc. VI, Tab. 33, fig. I—KJELLMAN, Alg. Arct. Sea, p. 287; Beringhafv. Algfl. p. 52—DE TONI, Syll. Alg. I, p. 133—COLLINS, Ulvaceae N. Amer. p. 28, pl. XLIII, fig. 4; Green Alg. N. Amer. p. 199, (Photogr. Repr.), p. 119—OKAMURA, Nippon Sorui Meii, ed. 2, p. 229; Mar. Alg. Jap. p. 19, fig. 7 (3)—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 260—SINOVA, Alg. Kamtschatka, p. 10—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 63, pl. III, fig. 1.

*Conferva clathrata* ROTH, Cat. Bot. III, (1806), p. 175.

Frond filiform, cylindrical or compressed, much branched in all directions, 11–18 cm. high; main filament and branches in 1st order 0.5–1.5 mm. diam.; branches tapering from base upward, ending in multicellular series, making tips rounded; cells, in surface view of frond, rectangular, often longer than broad, always in longitudinal series, 18–27 × 12–24  $\mu$ ; chromatophore not filling the cell.

SETCHELL and GARDNER mentioned, "*Enteromorpha clathrata* and *E. erecta* bear a similar relation to one another to that borne by *E. crinita* to *E. plumosa*." The present writer identified his specimens with the present species by the character of the frond, of which the branches are composed of multicellular series at the summit, and the cells are not completely filled with chromatophore. The present species is much thicker and higher than *E. plumosa*.

**Habitat and localities.** Growing on the leaves of *Phyllospadix* sp. in the lower littoral zone.

*S. Kuriles.* Sikotan Isl.—Notoro. Kunasiri Isl.—Tomari.

**Distrib.** Atlantic Ocean, Arctic Ocean, Bering Isl., Alaska to California, Kamchatka and Japan (Honsyu, Formosa and the Kuriles).

5. *Enteromorpha plumosa* KÜTZING

(Pl. I, figs. 14, 15)

Phyc. Gen. (1843), p. 300, Taf. XX, fig. 1—DE TONI, Syll. Alg. I, p. 132—COLLINS, Green Alg. N. Amer. p. 198, (Photogr. Repr.), p. 118; Chinese Mar. Alg. p. 205—OKAMURA, Nippon Sorui Meii, ed. 2, p. 228; Mar. Alg. Jap. p. 18, fig. 9 (1, 2)—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 259—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 62.

**Jap. name.** Kinuito-awonori. (n.n.)

Frond slender, filiform or later compressed, repeatedly branched, 2–4 cm. high; main filament percurrent, tapering at the base, 90–180  $\mu$  diam.; branches rather long, ending in a single series of cells; cells, in surface view of frond, arranged in longitudinal series, but regular arrangement less distinct in the older part, quadrate to subangular, in the upper to middle part of the main filament 15–27  $\times$  12–15  $\mu$ , in the lower part more or less elongated, 21–45  $\times$  12–21  $\mu$ , in the monosiphonous part 6–12  $\times$  6–9  $\mu$ ; chromatophore in most of the cells not filling the interior.

The present writer referred his specimens to the present species because of the character of the branches which consist of a single series of cells at the summit and also because the cells are not completely filled with the chromatophore.

**Habitat and localities.** Growing on the leaves of *Phyllospadix* sp.; found also on rocks and stones in the upper littoral zone, according to KAWABATA.

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

**Distrib.** Atlantic Ocean, Washington and California, China and Japan (Honsyu and the Kuriles).

Family 4. *Monostromaceae* KUNIEDA, 19345. *Monostroma* (THURET, 1854) WITTROCK, 1866

## Key to the species

- I. Frond tubular or saccate until late, then rupturing.
  - A. Frond filiform, tubular ..... *M. groenlandicum* (1)
  - B. Frond saccate.
    - 1. Cells, in cross section of frond, ovate.
      - a. Membrane delicate, 12–18  $\mu$  thick ..... *M. Grevillei* (2a)

- b. Membrane tougher, 21–27–60  $\mu$  thick ..... *M. arcticum* (3)
- 2. Cells, in cross section of frond, quadrate or rectangular with round corners.
  - a. Cells quadrate or vertically rectangular, 10.5–18  $\times$  7.5–13.5  $\mu$ ....  
..... *M. ochotensis* (4)
  - b. Cells compressed rectangular, 4–5  $\times$  6–9  $\mu$  .....  
..... *M. Grevillei* var. *Vahlia* (2b)
- II. Frond expanded very early.
  - A. Cells arranged in more or less distinct series, longitudinal and transverse; in cross section of frond, quadrate to vertically oblong, 7.5–9  $\mu$  high ..... *M. zostericola* (5)
  - B. Cells closely and irregularly arranged; in cross section of frond, vertically oblong, 39–45  $\mu$  high..... *M. fuscum* var. *splendens* (6)

### 1. *Monostroma groenlandicum* J. AGARDH

(Pl. I, figs. 22–24)

Till Alg. Syst. 3, (1883), p. 107, pl. III, fig. 80–83—DE TONI, Syll. Alg. I, p. 106—ROSENINGE, Grønl. Havalg, p. 954, fig. 53—SETCHELL & GARDNER, Alg. N. W. Amer. p. 208—COLLINS, Ulvaceae N. Amer. p. 18, pl. XLI, fig. 20, 21; Green Alg. N. Amer. p. 208, (Photogr. Repr.), p. 128—YENDO, Notes Alg. New to Jap. p. 117—OKAMURA, Nippon Sorui Meii, ed. 2, p. 223; Mar. Alg. Jap. p. 22—YAMADA, Mar. Alg. Urup, p. 9.

*Enteromorpha groenlandicum* SETCHELL & GARDNER, Phyc. Cont. I, (1920), p. 280; Mar. Alg. Pacific Coast N. Amer. II, p. 248—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 68.

**Jap. name.** Himo-hitoegusa.

Frond filiform, tubular, cylindrical, 4–15 cm. long, from a very slender base expanding to 1–3.5 mm. diam.; apex broken only at exit of spores; membrane monostromatic, 21–30  $\mu$  thick; cells of the lower part of frond, in surface view, quadrate with round corners, 4.5–7.5  $\mu$  diam., loosely but rather regularly arranged in twos or fours, those of the upper part 9–15  $\mu$  diam., loosely and more or less irregularly arranged, in cross section oblong-obovate or oblong, radially elongate, 15–18  $\times$  7.5–10.5  $\mu$ , spores or gametes formed first at the summit of the frond, further successively in the lower cells.

The present species is easily identified by the filiform, tubular frond and the loose arrangement of the cells. It has been found in Japan, up to the present, from the islands in the North Kuriles southward to the eastern coast of Etorohu Isl., the region washed by the cold current.

**Habitat and localities.** Growing on boulders in the littoral zone.

- N. Kuriles.* Simusyu Isl.—Kataoka-wan? (YENDO). Paramusiru Isl.—Murakami-wan, Kakumabetu.  
*M. Kuriles.* Onnekotan Isl.—locality unknown (YENDO). Usisiru Isl.—Kitazima. Uruppu Isl.—Iema (YAMADA).  
*S. Kuriles.* Etorohu Isl.—Moyoro.

**Distrib.** Greenland, Atlantic Ocean, Alaska and Japan (the Kuriles).

## 2a. *Monostroma Grevillei* (THURET) WITTOCK

(Pl. I, figs. 29, 30)

*Monostr.* (1866), p. 57, pl. IV, fig. 14—KJELLMAN, Alg. Arct. Sea, p. 298—DE TONI, Syll. Alg. I, p. 103—BØRGESEN, Mar. Alg. Faerøes, p. 495—SETCHELL & GARDNER, Alg. N. W. Amer. p. 208; Mar. Alg. Pacific Coast N. Amer. II, p. 236—COLLINS, Ulvaceae N. Amer. p. 12, pl. XLI, fig. 4, 5; Green Alg. N. Amer. p. 209, (Photogr. Repr.), p. 129—YENDO, Notes Alg. New to Jap. p. 118—OKAMURA, Nippon Sorui Meii, ed. 2, p. 223; Mar. Alg. Jap. p. 23—SINOVA, Alg. Kantschatka, p. 11—YAMADA, Mar. Alg. Urup, p. 9—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 74.

*Enteromorpha Grevillei* THURET, Note sur la Syn. Ulv. (1854), p. 25.

**Jap. name.** Usu-hitoegusa.

Frond attached, at first saccate, then opening at the top, and ultimately splitting to the base, soft and delicate, pale green, 7–14 cm. high; membrane monostromatic, 12–18  $\mu$  thick; cells, in surface view of frond, quadrate with round corners, closely arranged, 9–13.5  $\mu$  diam., in cross section horizontally oval, 4.5–7.5  $\times$  ca. 9  $\mu$ .

## 2b. var. *Vahlia* ROSENVINGE

Grønl. Havalg. (1893), p. 949—OKAMURA, Mar. Alg. Jap. p. 23.

*Monostroma Vahlia* J. AGARDH, Till Alg. Syst. VI, (1890), p. 109, fig. 84–89—YENDO, Notes Alg. New to Jap. VII, p. 188—TAYLOR, l.c. p. 74.

The present writer has obtained a single specimen, referable to the present species. The specimen is not completely saccate, but torn open at the top. The frond is soft, delicate, and not so much wrinkled upon drying on paper as in *M. arcticum*. In the thickness of the frond and the size of the cells, the specimen corresponds

well with the description and the figures of WITTRÖCK and other authors' accounts above cited. YENDO reported var. *Vahlîi* from the North Kuriles, treating it as an independent species.

**Habitat and localities.** Type form found epiphytic on *Gloiopeltis furcata* in the littoral zone.

*N. Kuriles.* Simusyu Isl.—Kosekigawa, Kataoka-wan ? (YENDO).

*M. Kuriles.* Uruppu Isl.—Iema (YAMADA).

Var. *Vahlîi*.

*N. Kuriles.* Simusyu Isl. ? (YENDO).

**Distrib. Sp.**—Greenland, Atlantic Ocean, Arctic Ocean, Alaska, Kamchatka and Japan (Hokkaido and the Kuriles); var. *Vahlîi*—Greenland to Massachusetts, Alaska and Japan (the Kuriles).

### 3. *Monostroma arcticum* WITTRÖCK

(Pl. I, figs. 31, 32)

*Monostr.* (1866), p. 44, pl. II, fig. 8—KJELLMAN, *Alg. Arct. Sea*, p. 299—DE TONI, *Syll. Alg. I*, p. 105—SETCHELL & GARDNER, *Alg. N. W. Amer.* p. 208; *Mar. Alg. Pacific Coast N. Amer. II*, p. 238—COLLINS, *Ulvaceae N. Amer.* p. 13, pl. XLI, fig. 6, 7; *Green Alg. N. Amer.* p. 210, (Photogr. Repr.), p. 130—YENDO, *Notes Alg. New to Jap.* p. 118—OKAMURA, *Nippon Sorui Meii*, ed. 2, p. 222; *Mar. Alg. Jap.* p. 24—SINOVA, *Alg. Kamtschatka*, p. 12.

*Monostroma cylindraceum* KJELLMAN, *Alg. Arct. Sea*, (1883), p. 295, pl. XXX.

*M. saccodeum* KJELLMAN, l.c. (1883), p. 296, pl. XXVIII, fig. 1–10.

*M. angicava* KJELLMAN, l.c. (1883), p. 297, pl. XXIX—YAMADA, *Notes Some Jap. Alg. III*, p. 109, pl. XXI, XXII—TOKIDA, *Mar. Alg. Robben Isl.* (Suppl. Rept.), p. 17—OKAMURA, *Mar. Alg. Jap.* p. 23, fig. 10.

*M. Grevillei*  $\gamma$  *arctica* ROSENVINGE, *Grøn. Havalg.* (1893), p. 949, fig. 51—BØRGESEN, *Mar. Alg. Faeröes*, p. 495.

FronD attached, at first saccate, globular, abruptly tapering at the base, 2.5–9 cm. high, 2–8 cm. diam., becoming larger and splitting later into a few broad laciniae, up to 30 cm. high, sub-radiately plicate, pale green; membrane monostromatic, 21–27  $\mu$  thick in the upper part, becoming thicker up to 60  $\mu$  in the lower part; cells, in surface view of frond, 4–6 angled with round corners, closely and irregularly arranged, 6–9  $\mu$  diam., in cross section, either vertically or horizontally ovate, 4.5–9  $\times$  7.5–13.5  $\mu$ .

ROSENVINGE amalgamated *M. saccodeum*, *M. cylindraceum* and *M. angicava* of KJELLMAN and *M. arcticum* WITTRÖCK with *M. Grevillei* WITTRÖCK, keeping the former four as a single variety, var. *arctica* for the reason of their possession of a tougher and thicker frond than

the last. COLLINS followed ROSENVINGE in the amalgamation of the former four species into an independent species, keeping it, however, separated from *M. Grevillei*. SETCHELL and GARDNER, and YENDO supported COLLINS in the treatment of the species. COLLINS mentions the present species as "a northern species, chiefly distinguished from *M. Grevillei* by the thicker frond, which is saccate only in the earliest stages and afterwards appears as a rather broad membrane, not split up into strips, as is usual in *M. Grevillei*." The present writer referred his specimens to the present species taking the same stand as COLLINS. In the specimens at hand, when dried on paper, much wrinkled and plicate appearances are observed.

**Habitat and localities.** Epiphytic on the fronds of various algae, e.g., *Corallina pilulifera*, *Fucus evanescens*, etc. in the littoral zone.

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

*M. Kuriles.* Simusiru Isl.—Broughton Bay.

*S. Kuriles.* Etorohu Isl.—Moyoro, Iriribusi, Kamuikotan. Sikotan Isl.—Tiboi, Aimizaki.

**Distrib.** Greenland, Arctic Ocean, Alaska, Kamchatka and Japan (Hokkaido, Saghalien and the Kuriles).

#### 4. *Monostroma ochotensis* NAGAI, sp. nov.

(Pl. I, figs. 33-35; pl. III, fig. 2)

Thallo subrigido, initio saccato (?), deinde plus minus cucullato, ad basin versus in segmentes fisso, 2-5 cm. alto, subflavovirido; membrana monostromatica, 24-45  $\mu$  crassa; cellulis a facie visis 4-6 angulato-rotundis, inordinatis, 9-12  $\mu$ , raro ca. 18  $\mu$  diam., in sectione thalli transversa quadratis vel verticaliter rectangularibus, 10.5-18  $\times$  7.5-13.5  $\mu$ .

The shape of the frond in younger stage, is not known, but probably saccate. The specimens at hand, are cucullate, rupturing their fronds at the summits, and are often divided into segments at the bases. They are 2 to 5 cm. high and yellowish green in color. The membrane is monostromatic, measuring 24-45  $\mu$  thick. The cells are 4-6 angled with round corners, and closely and irregularly arranged in surface view of the frond. They are 9 to 12  $\mu$ , rarely about 18  $\mu$  diam. In cross section, they are quadrate or vertically rectangular, occupying the central portion of the membrane arranged

in a row. They are 10.5 to 18  $\mu$  high, 7.5 to 13.5  $\mu$  wide. The plant is often observed bearing matured cells.

In external appearance, the present species resembles *M. zostericola*, but differs from it in the shape and size of the cells, and in the mode of their arrangement. The cells of *M. zostericola* are smaller and their arrangement is characteristic. In the quadrate or rectangular shape of the cells in cross section of the frond, the present species is, on the other hand, near to *M. fuscum*. In *M. fuscum*, however, the cells are said to occupy nearly the entire thickness of the membrane, while in the present species, they do not take such a feature.

**Habitat and localities.** Growing in the lower littoral zone and upper sublittoral zone, on the fronds of various algae, e.g., *Odonthalia Lyallii*, *Erythrophyllum Gmelini*, *Ptilota pectinata*, *Fucus evanescens*, *Rhodymenia palmata*, *Halosaccion saccatum*, *Corallina pilulifera*, etc.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan, Tenzin-iwa, Kosekigawa.

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Ketoi Isl.—Minami-ura. Uruppu Isl.—Kobune.

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

**Distrib.** Endemic (the Kuriles).

### 5. *Monostroma zostericola* TILDEN

(Pl. I, figs. 27, 28)

Amer. Alg. (Exsicc.) no. 388, (1900)—YENDO, Notes Alg. New to Jap. VII, p. 184—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 238, pl. XIV, fig. 12-13—YAMADA, Mar. Alg. Urup, p. 9—OKAMURA, Mar. Alg. Jap. p. 26—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 199.

**Jap. name.** Motuki-hitoe.

Frond more or less cucullate, cuneate-obovate or divided into segments of that form, 1.5–6 cm. high; membrane monostromatic, 9–21  $\mu$  thick; cells angular, 4.5–7.5  $\mu$  diam., arranged in more or less distinct, longitudinal and transverse series, in cross section quadrate to vertically oblong, 7.5–9  $\times$  3–6  $\mu$ .

In comparison with the description in SETCHELL and GARDNER's account, the writer's specimens appear to be slightly thicker than the American plant. However they answer well with the present species in the shape, size and arrangement of the cells. As to the

habitat, YENDO and YAMADA mention respectively that *Fucus evanescens* and *Phyllospadix* serve as hosts in the Kuriles. The present writer met with the plant once growing on a frond of *Rhodymenia palmata* in Simusyu Isl.

**Habitat and localities.** Epiphytic on the fronds of various plants, e.g., *Zostera sp.*, *Fucus evanescens*, *Rhodymenia palmata*, etc.

*N. Kuriles.* Simusyu Isl. (?) (YENDO).

*M. Kuriles.* Rasyuwa Isl.—Sonraku-wan. Ketoi Isl.—Minami-ura. Simusyu Isl.—Broughton Bay. Uruppu Isl.—Misima, Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Wenbetu, Iriribusi, Kamuikotan. Sikotan Isl.—Syakotan, Tiboi.

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

#### 6. *Monostroma fuscum* (POST. et RUPR.) WITTRÖCK

*Monostr.* (1866), p. 53, pl. IV, fig. 13—DE TONI, Syll. Alg. I, p. 109—ROSENVINGE, Grønl. Havalg. p. 490 (excl. syn.)—BØRGESEN, Mar. Alg. Faerøes, p. 494—SETCHELL & GARDNER, Alg. N. W. Amer. p. 208; Mar. Alg. Pacific Coast N. Amer. II, p. 242—COLLINS, Ulvaceae N. Amer. p. 11, pl. XLI, fig. 2, 3 (fig. sub f. *Blyttii*); Green Alg. N. Amer. p. 213, (Photogr. Repr.), p. 133, pl. VII, fig. 72—YENDO, Notes Alg. New to Jap. VII, p. 187—OKAMURA, Mar. Alg. Jap. p. 27.

*Ulva fusca* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 21.

#### var. *splendens* (RUPRECHT) ROSENVINGE

(Pl. I, figs. 25, 26)

COLLINS, Ulvaceae N. Amer. (1903), p. 12 (sub forma); Green Alg. p. 213, (Photogr. Repr.), p. 133 (sub f.)—SETCHELL & GARDNER, Alg. p. 209; Mar. Alg. p. 242—YENDO, Notes Alg. New to Jap. p. 117 (sub f.)—OKAMURA, Nippon Sorui Meii, ed. 2, p. 223 (sub f.); Mar. Alg. Jap. p. 27 (sub f.)—YAMADA, Mar. Alg. Urup, p. 10 (sub f.).

*Ulva splendens* RUPRECHT, Tange Och. Meeres, (1851), p. 410.

*Monostroma splendens* WITTRÖCK, *Monostr.* (1866), p. 50, pl. III, fig. 12—DE TONI, Syll. Alg. I, p. 107—KJELLMAN, Beringhafv. Algfl. p. 54—SINOVA, Alg. Kamschatka, p. 11.

**Jap. name.** O-hitoegusa.

Frond membranaceous, somewhat thicker below, thin and tender above, splitting deeply into laciniae, sometimes somewhat perforate, dark brownish green upon drying, 7–14 cm. high, 17–30

cm. wide; membrane monostromatic, 50–60  $\mu$  thick; cells 4–6 angled, 12–18  $\mu$  diam., very closely arranged, in cross section of frond vertically oblong, 30–45  $\times$  10.5–15  $\mu$ .

The writer's specimens accord well with the original description and the figures of *Monostroma splendens* WITTRÖCK in both the size of the frond and the cells, as well as in the shape of the latter. This is a rather widely spread alga in the Kuriles from the North Kuriles southward to Sikotan Isl. The specimens are sometimes somewhat perforate as in *Ulva pertusa*, but they are easily distinguished from the latter by the monostromatic habit and the dark brownish green color of the frond. The present species sometimes attains to a large dimension, measuring 45 cm. by 66 cm.

**Habitat and localities.** Var. *splendens* growing on stones and other algae in the littoral zone.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—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.—Kobune, Tokotan-wan, Zizonoma, Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Iriribusi. Sikotan Isl.—Aimizaki.

**Distrib. Sp.**—Greenland, Atlantic Ocean, Alaska to Washington and Bering Isl.; var. *splendens*—Bering Isl., Alaska to Vancouver Isl., Okhotsk Sea, Kamchatka and Japan (the Kuriles).

## Family 5. *Chaetophoraceae*

### 6. *Entocladia* REINKE, 1879

#### *Entocladia Pterosiphoniae* NAGAI, sp. nov.

(Pl. I, figs. 16, 17)

Thallo microscopico, ad membranam cellulae *Pterosiphoniae arcticae* endophytico, margine e filamentis repentibus articulatis ramosis, centro e strato singulo cellulare pseudoparenchymatico irregulare concreto; cellulis superficie visis centro thalli irregularis, 18–30  $\times$  12–18  $\mu$ , margine elongatis, 30–60  $\times$  ca. 9  $\mu$ , in sectione transversa complanatis, 3–12  $\mu$ , saepe 3–6  $\mu$  crassis; chromatophoris parietalibus, 1–3 pyrenoides globosos includentibus; zoosporis ca. 4  $\mu$  diam.

The present species was found endophytic within the cell-membrane of the filament of *Pterosiphonia arctica* SETCH. et GARDN. The thallus consists of branched filaments which coalesce to form a compact pseudoparenchymatous, 1-layered stratum. Neither erect branches nor hairs are observed. The cells bear chromatophores which are composed of large parietal plates with 1, 2 or 3 pyrenoids. The cells in the centre of the thallus are irregular in shape, often polyhedral in surface view, and  $18-30 \times 12-18 \mu$ . The cells in the periphery are elongate,  $30-60 \times$  ca.  $9 \mu$ , and, in cross section, complanate,  $3-12 \mu$ , mostly  $3-6 \mu$  thick. Reproductive bodies (probably zoospores) were observed within the cells of the central portion of the thallus. They are ca.  $4 \mu$  in diam. But the nature of them, their method of escape and their subsequent behavior have not been observed. However, cells which are probably exhausted sporangia, are observed. They are of flattened bottle-shape with short or moderately long beaks at the centre.

**Habitat and locality.** Endophytic within the cell-membrane of the filaments of *Pterosiphonia arctica*.

*M. Kuriles.* Matuwa Isl.—Yamato-wan.

**Distrib.** Endemic (the Kuriles).

### Order III. Schizogoniales

#### Family 6. Schizogoniaceae

##### Key to the genera

- I. Adult frond consisting of an expanded membrane ..... *Prasiola* (7)
- II. Adult frond consisting of a solid filament ..... *Gayella* (8)

#### 7. *Prasiola* MENEGHINI, 1838

##### *Prasiola borealis* REED

(Pl. III, figs. 3-5)

Two New Ascomycetous Fungi, (1902), p. 160, pl. XV, fig. 7, pl. XVI, fig. 8-13—SETCHELL & GARDNER, Alg. N. W. Amer. p. 215; Mar. Alg. Pacific Coast N. Amer. II, p. 277, pl. X, fig. 1-3—COLLINS, Green Alg. N. Amer. p. 220, (Photogr. Repr.), p. 140—KNEBEL, Monogr. Prasiolales, p. 47, fig. 25.

*Prasiola tessellata* OKADA (not KÜTZING), Stud. Jap. Prasiolaceae, (1938), p. 476, fig. 5-7.

**Jap. name.** Ibo-kawanori.

Fronds leaden olive, brittle and coriaceous upon drying, dull olive green, soft and flabby when moist, concave cuneate to obovate, with crenulate, crisped or entire margin, shortly stipitate or sessile, arising in tufts of several from one holdfast, 0.5–1.2 cm. high; membrane 36–45  $\mu$  thick in the monostromatic part, becoming thicker and irregularly polystromatic in the seriously infected part, associated with the fungus, 89–192  $\mu$  thick; cells in surface view, quadrate or rectangular with slightly rounded angles, occasionally much rounded at corners in the seriously infected part, 4.5–7.2  $\times$  8.4–10.8  $\mu$ , arranged in tetrads in the less seriously infected part, tetrads disposed in quadrate or polygonal areas with wide spaces between them; cells in cross section, oblong, 13.5–21  $\mu$  high.

There have been reported two species of *Prasiola*-composite which are associated with Ascomycetous fungi. The one is *Prasiola tessellata* (HOOK. fil. et HARV.) KÜTZ., associated with *Guignardia Prasiolae* (WINT.) REED and the other is *P. borealis* REED, with *G. Alaskana* REED. The former composite is known from the Antarctic region and the latter from Alaska. REED remarks, about his Alaskan *Prasiola* as follows: "The Alaskan *Prasiola* differs from HOOKER's *Prasiola tessellata* in the shape and color of the fronds and in the arrangement of the tetrads and areoles. There is not that distinct tessellate arrangement of the tetrads, but the areoles are polygonal or imperfectly quadrate." SETCHELL and GARDNER also remark: "*P. borealis* differs from *P. tessellata* at least in habit and in being less regularly areolate." Not only these two algal species but also the associated fungi, appear to resemble each other closely in each group in the shape and the general structure other than the above characters. The present writer compared his specimens respectively with the descriptions and figures of these two composites. At last he came to the conclusion that they should better be referable to *P. borealis* REED because of the resemblance in the character of the areoles and also in the measurements of the perithecia, asci and ascospores of the associated fungus.

The description of the fungus (*Guignardia Alaskana* REED) is given as follows.

Perithecia dark brown to blackish, numerous, spherical, scattered irregularly on the whole frond of *Prasiola borealis*, being immersed within but projecting roundly on both surfaces, 216–405  $\mu$  diam.,

vertex convex, pore simple, opening on either surface; asci club-shaped with long or rarely short stalks, with 8 spores,  $25.5-45 \times 7.5-13.5 \mu$ ; ascospores narrow-elliptic, with pointed ends, hyalin,  $8-13.5 \times 3-4.5 \mu$ . (Pl. II, fig. 8; pl. III, fig. 4)

**Habitat and locality.** Growing on rocks just above high water mark, where a plenty of nitrogenous food is supplied by sea-fowls.

*N. Kuriles.* Paramusiru Isl.—Kamogawa.

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

### 8. *Gayella* ROSENVINGE, 1893

#### *Gayella polyrhiza* ROSENVINGE

(Pl. I, figs. 18-21)

Grønl. Havalg. (1893), p. 937, fig. 45, 46—SETCHELL & GARDNER, Alg. N. W. Amer. p. 217; Mar. Alg. Pacific Coast N. Amer. II, p. 280—COLLINS, Green Alg. N. Amer. p. 221, (Photogr. Repr.), p. 141, pl. VII, fig. 78, 79—KNEBEL, Monogr. Prasiolales, p. 52, fig. 27.

*Prasiola crispera* subsp. *marina* BØRGESEN, Mar. Alg. Faeröes, (1902), p. 482, fig. 99.

*P. polyrhiza* JÓNSSON, Mar. Alg. Iceland, III, (1903), p. 353.

**Jap. name.** *Gayella*. (n.n.)

Filaments caespitose, attached to substratum by rhizoidal projections from lower cells, curved, ca. 5 mm. high, at first simple, of a single series of disk-shaped cells,  $10-15 \mu$ , rarely  $24 \mu$  diam., later increasing its diameter above by growth and division of cells,  $54-110 \mu$  diam., subterete, somewhat irregular in surface, not flattened; cells with parietal chromatophore and 1 pyrenoid,  $7.5-13.5 \times 2-6 \mu$  in young filaments of a single row of cells, in mature filaments showing superficially an arrangement in longitudinal and transverse lines, in cross section of the filaments, an arrangement by 2-4-8-16, etc.

The writer's specimens are not found associated with *Prasiola* type form, but only with *Hormiscia penicilliformis* (ROTH) FRIES. The specimens show a slightly larger diameter than the plant of ROSENVINGE. They are rarely slightly constricted. As far as the present writer is aware, two species are known at present in the genus, viz., *G. polyrhiza* ROSENV. and *G. constricta* SETCH. et GARDN.

According to SETCHELL and GARDNER, *G. constricta* differs from *G. polyrhiza* in having fewer rhizoids which are usually longer and multicellular, as well as in the much greater diameter of the upper portions of the filaments and in their uncinat tips. The writer cannot refer his specimens to *G. constricta* because they have unicellular rhizoids and show an arrangement of cells in pairs of an even number in a cross section of the filament. As to the feature of the filament of *G. constricta* in cross section, SETCHELL and GARDNER show the cells in radial arrangement in figure 10 of plate XII in their later account. KNEBEL recently transferred *G. constricta* to the genus *Schizomeris*.

**Habitat and locality.** Growing on rocks in the littoral zone.

*M. Kuriles.* Matuwa Isl.—Yamato-wan.

**Distrib.** Greenland, North Atlantic Ocean, Alaska and Japan (the Kuriles).

## Order IV. Siphonocladiales

### Family 7. *Cladophoraceae*

#### Key to the genera

- I. Filaments simple.
  - A. Filaments less than 100  $\mu$  in diam.
    - 1. Filaments unattached by definite holdfasts, prostrate..... *Rhizoclonium* (9)
    - 2. Filaments attached by definite holdfasts..... *Hormiscia* (10)
  - B. Filaments usually stiff or rigid, more than 450  $\mu$  in diam. in the upper portion ..... *Chaetomorpha* (11)
- II. Filaments branched.
  - A. Branches free.
    - 1. Filaments not held together by special rhizoidal or hooked branchlets ..... *Cladophora* (12)
    - 2. Filaments held together by special rhizoidal branchlets or by hooked branchlets or by both ..... *Spongomorpha* (13)
  - B. Branches densely intertwined with each other, forming a spherical thallus ..... *Aegagropila* (14)

9. *Rhizoclonium* KÜTZING, 1843*Rhizoclonium tortuosum* (DILLWYN) KÜTZING

Phyc. Germ. (1845), p. 205; Sp. Alg. p. 384; Tab. Phyc. III, Tab. 68, fig. I—DE TONI, Syll. Alg. I, p. 280—SETCHELL & GARDNER, Alg. N. W. Amer. p. 223; Mar. Alg. Pacific Coast N. Amer. II, p. 185—COLLINS, Green Alg. N. Amer. p. 328, (Photogr. Repr.), p. 248—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 83.

*Conferva tortuosa* DILLWIN, Brit. Conf. (1805), p. 46, pl. XLVI—HARVEY, Phyc. Brit. I, pl. LIV, A.

*Chaetomorpha tortuosa* KÜTZING, Sp. Alg. (1849), p. 376—OKAMURA, Nippon Sorui Meii, ed. 2, p. 243; Mar. Alg. Jap. p. 65.

**Jap. name.** Naga-moture (n.n.).

Filaments rigid, contorted, dark green, 60–90  $\mu$  diam., forming woolly skein-like horizontal masses; segments 1.5–5 diam. long, cylindrical, 120–285  $\mu$ , mostly 150–200  $\mu$  long; wall 9–18  $\mu$  thick, indistinctly lamellose; rhizoids short, few, or more usually, none.

The Kurile plant agrees well with the American specimen which has been identified by Profs. SETCHELL and GARDNER with the present species and kindly contributed by them to the Herbarium of our University.

**Habitat and localities.** Growing in the littoral zone, attached on the fronds of various algae, e.g., *Rhodomela subfusca*, *Odonthalia aleutica*, *Ptilota pectinata*, *Gigartina ochotensis*, *Rhodomela Larix*, *Heterochordaria abietina*, *Fucus evanescens*, *Corallina pilulifera*, etc.

*N. Kuriles.* Araido Isl.—Sekinezaki. Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari. Uruppu Isl.—Misima.

*S. Kuriles.* Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Tosirari. Sikotan Isl.—Syakotan, Tiboi. Kunasiri Isl.—Atoiya.

**Distrib.** Atlantic Ocean, Alaska to California and Japan (the Kuriles).

10. *Hormiscia* FRIES, 1835*Hormiscia penicilliformis* (ROTH) FRIES

Flora Scanica. (1835), p. 327—ARESCHOUG, Obs. Phyc. I, p. 12, Tab. I—COLLINS, Green Alg. N. Amer. p. 368, (Photogr. Repr.), p. 288, pl. XV, fig. 133—

SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 191, pl. IX, fig.4—  
TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 78.

*Conferva penicilliformis* ROTH, Cat. Bot. III, (1806), p. 272.

*Urospora penicilliformis* ARESCHOUG, Obs. Phyc. II, (1874), p. 4, Tab. I, fig. 1-6—KJELLMAN, Alg. Arct. Sea, p. 315; Beringhafv. Algfl. p. 55—DE TONI, Syll. Alg. I, p. 232—YENDO, Notes Alg. New to Jap. III, p. 101—SINOVA, Alg. Mer Ochotsk, p. 92—OKAMURA, Mar. Alg. Jap. p. 71.

Filaments dark green, simple, uniseriate, attached by extra-matrical rhizoids from a few of the lower segments, narrow below, becoming gradually thicker upward, ca. 4.5 cm. long; vegetative segments cylindrical; fertile more or less swollen to barrel-shape, 20-75  $\mu$  diam., 0.3-2.5 diam. long; chromatophore dense, of a continuous parietal band, or at times somewhat fenestrate; pyrenoids relatively few and large.

The specimens at hand were identified with the present species by examining and comparing with the American specimen which has been kindly despatched from the Department of Botany, University of California. The present specimens also accord quite well with the description and figures in the accounts, above cited.

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

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

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Kotoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Iema.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Iriribusu, Binnebetu.

**Distrib.** Arctic Ocean, Greenland to New Jersey, Bering Sea (Port Clarence), Alaska to California, Okhotsk Sea and Japan (Hokkaido and the Kuriles).

## 11. *Chaetomorpha* KÜTZING, 1845

### Key to the species

- I. Filaments delicate, mostly less than 600  $\mu$  in diam. at the upper segments  
..... *C. aerea* (1)
- II. Filaments coarse or robust, mostly over 700  $\mu$  in diam. at the upper segments.
  - A. Fronds pale green, small, less than 20 cm. long; segments from the middle of the filaments upward, evenly barrel-shaped or globular....  
..... *C. moniligera* (2)
  - B. Fronds dark glaucous green, large, more than 20 cm. long; segments in the upper part of the filaments, slightly swollen... *C. melagonium* (3)

### 1. *Chaetomorpha aerea* (DILLWYN) KÜTZING

Sp. Alg. (1894), p. 379; Tab. Phyc. III, Tab. 59—DE TONI, Syll. Alg. I, p. 272—COLLINS, Green Alg. N. Amer. p. 324, (Photogr. Repr.), p. 244, pl. XII, fig. 115—COTTON, Some Chinese Mar. Alg. p. 109—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 200, pl. XIV, fig. 9-11—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 201—TSENG, Mar. Alg. fr. Amoy, p. 17—OKAMURA, Mar. Alg. Jap. p. 66—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 81, pl. I, fig. 10-12.

*Conferva aerea* DILLWYN, Brit. Conf. (1809), Tab. LXXX.

**Jap. name.** Tarugata-zyuzumo.

Filaments rather delicate, rigid, erect, yellowish green, subcylindrical throughout except at the tapering base, 7-9 cm. long, 90-165  $\mu$  thick at the base, 450-690  $\mu$ , mostly less than 600  $\mu$  thick in the upper part; segments near the basal part of filaments 5-7 diam. long, those in the upper part globular, 0.8-2.5 diam. long; cell-wall thick, lamellose.

The present species is closely related to *C. moniligera*, but differs from it in having the delicate frond.

**Habitat and localities.** Growing on stones in the littoral zone.

*S. Kuriles.* Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Nikisiro, Tomari.

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

### 2. *Chaetomorpha moniligera* KJELLMAN

Mar. Chloroph. fr. Japan, (1897), p. 24, Taf. IV, fig. 17-23—OKAMURA, Nippon Sorui Meii, ed. 2, p. 244; Icon. Jap. Alg. VI, 2, p. 15, pl. CCLX, fig. 1-8; Mar. Alg. Jap. p. 66, fig. 34—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201.

**Jap. name.** Tama-zyuzumo.

The present species is characteristic in its pale green color and the globular segments from the middle portion of the filaments upwards. The writer is familiar with the present species in northern Japan, especially in Hokkaido. Its northern limit is now known to be in the southern islands of the Kuriles.

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

*S. Kuriles.* Sikotan Isl.—Notoro. Kunasiri Isl.—Tofutu, Sokobetu, Sibetoro, Kotankesi, Ponkotan, Tomari.

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

### 3. *Chaetomorpha melagonium* (WEBER et MOHR) KÜTZING

Phyc. Germ. (1845), p. 204; Sp. Alg. p. 379; Tab. Phyc. III, Tab. 61, fig. I—HARVEY, Ner. Bor.-Amer. III, p. 85—KJELLMAN, Alg. Arct. Sea, p. 311; Beringhafv. Algfl. p. 55—DE TONI, Syll. Alg. I, p. 273—BØRGESSEN, Mar. Alg. Faeröes, p. 503—COLLINS, Green Alg. N. Amer. p. 323, (Photogr. Repr.), p. 243—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 201—SINOVA, Alg. Mer Ochotsk. p. 91—OKAMURA, Mar. Alg. Jap. p. 67—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 200—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 82.

*Conferva melagonium* WEBER & MOHR, Reise nach Schweden. (1804), p. 194, pl. III, fig. 2—HARVEY, Phyc. Brit. I, pl. XCIX—RUPRECHT, Tange Och. Meeres, p. 396.

**Jap. name.** Harigane-zyuzumo.

Filaments closely caespitose, or at times scattered, erect, coarse, stiff, dark glaucous green, long, tapering below, gradually increasing their diameter upward, 180–260  $\mu$  thick at the base, 0.78–1 mm. thick in the upper part; segments in the basal part of the filaments subcylindrical, 2–5 diam. long, in the upper part slightly swollen, 0.5–1 diam. long; cell-wall thick, lamellose.

The writer has one specimen, referable to the present species. He compared his specimen with the American plant from the Atlantic coast, which was identified by FARLOW and has been contributed, after his death, from FARLOW's Herbarium to Emer. Prof. MIYABE.

**Habitat and localities.** Cast ashore; according to KAWABATA, found on shells and stones in the littoral zone.

*S. Kuriles.* Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Atoiya.

**Distrib.** Atlantic Ocean, Arctic Ocean, Bering Sea (St. Lawrence Isl. and Port Clarence), Alaska, Okhotsk Sea and Japan (Honsyu, Hokkaido and the Kuriles).

## 12. *Cladophora* KÜTZING, 1843

### *Cladophora glaucescens* HARVEY

Phyc. Brit. I, (1846), pl. CXCVI; Ner. Bor.-Amer. III, p. 77—KÜTZING, Tab. Phyc. IV, Tab. 24, fig. I—KJELLMAN, Alg. Arct. Sea, p. 208—DE TONI, Syll. Alg. I, p. 320—COLLINS, Green Alg. N. Amer. p. 336, (Photogr. Repr.), p. 256—YENDO, Notes Alg. New to Jap. V, p. 248—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 219—YAMADA, Mar. Alg. Mutsu Bay, p. 501, fig. 3—OKAMURA, Mar. Alg. Jap. p. 55—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 86.

The writer's specimens were compared with those from Mutsu Bay, which had been identified by Prof. YAMADA with the present species. The specimens accord well with the descriptions and figures of the present species, given by the various authors above cited.

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

*S. Kuriles.* Etorohu Isl.—Sibetoro. Sikotan Isl.—Notoro. Kunasiri Isl.—Tofutu, Nikisiro, Ponkotan, Tomari.

**Distrib.** Arctic Ocean, Atlantic Ocean, Vancouver Isl. to California and Japan (Honsyu, Hokkaido and the Kuriles).

### 13. *Spongomorpha* KÜTZING, 1843

#### • Key to the species

- I. Branches all blunt and rounded at tips.
  - A. Branchlets never hooked.
    - 1. Cell-wall thick, horizontally striate in the lower segment ..... *S. duriuscula* (1)
    - 2. Cell-wall thin, not striate ..... *S. Hystrix* (2)
  - B. Hooked branchlets present ..... *S. Mertensii* (3)
- II. Branches sometimes rounded, sometimes slightly tapering at tips..... *S. saxatilis* (4)

#### 1. *Spongomorpha duriuscula* (RUPRECHT) COLLINS

Green Alg. N. Amer. (1909), p. 357, (Photogr. Repr.), p. 277—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 225—TOKIDA, Mar. Alg. Robben Isl. p. 4, pl. II, fig. a—OKAMURA, Mar. Alg. Jap. p. 72—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201.

*Conferva duriuscula* RUPRECHT, Tange Och. Meeres, (1851), p. 401, 404.

*Acrosiphonia duriuscula* YENDO, Notes Alg. New to Jap. V, (1916), p. 246.

#### Key to the varieties

- I. Filaments less than 200  $\mu$  diam. at tips .....var. *tenuis*
- II. Filaments more than 300  $\mu$  diam. at tips .....var. *cartilaginea*

#### var. *tenuis* YAMADA

(Pl. II, figs. 1, 2)

Mar. Alg. Urup, (1935), p. 11—OKAMURA, l.c. p. 72.

**Jap. name.** Hosu-moturegusa.

Filaments dense, 4–7 cm., occasionally up to 12 cm. high, dark green, firm, straight, 75–120  $\mu$  diam. below, 100–150  $\mu$  in the middle, 120–200  $\mu$  at the tips; segments 1.8–5 diam. long below, 0.4–4 diam. in the middle; 1.5–3 diam. at the tips; branches often secund, rarely alternate, erect, with rounded tips; cell-wall 12–24  $\mu$  thick, in the lower segments finely horizontally striate; rhizoidal branches abundant; simple or branched, 45–69  $\mu$  diam., with segments, 5–6 diam. long.

var. *cartilaginea* (RUPRECHT) YAMADA

l.c. (1935), p. 10—OKAMURA, l.c. p. 72.

*Conferva cartilaginea* RUPRECHT, Tange Och. Meeres, (1851), p. 404.

**Jap. name.** Kata-moturegusa.

The specimens at hand are all referable to var. *tenuis* YAMADA. Besides the above, YAMADA reported var. *cartilaginea* RUPR. from Uruppu Isl. According to him, the specimens of this variety are very thick and cartilaginous, becoming very hard to the touch upon drying. In the Uruppu specimens, he described the cells of the filaments to be about 120  $\mu$  diam. near the bases and about 325  $\mu$  in the upper parts of the branches. The description of var. *cartilaginea* is translated from RUPRECHT's original account, above cited.

**Habitat and localities.** Var. *tenuis* growing on rocks in the lower littoral zone.

*N. Kuriles.* Simusyu Isl.—Tenzin-iwa.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Hitokappu-wan, Sibetoro, Kamuikotan. Sikotan Isl.—Syakotan, Tiboi, Aimizaki. Kunasiri Isl.—Siranuka, Rurui, Tyasikotu.

Var. *cartilaginea*

*M. Kuriles.* Onnekotan Isl.—locality unknown (YAMADA). Uruppu Isl.—Iema (YAMADA).

**Distrib.** *Sp.*—Alaska, Okhotsk Sea and Japan (Saghalien and the Kuriles); var. *tenuis*—endemic (the Kuriles); var. *cartilaginea*—Alaska and Japan (the Kuriles).

## 2. *Spongomorpha Hystrix* STROEMFELT

(Pl. II, figs. 4, 5)

Om Algvegt. vid Island Kuster, (1887), p. 54—COLLINS, Green Alg. N. Amer. p. 358, (Photogr. Repr.), p. 278—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 224—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 94.

*Cladophora Hystrix* DE TONI, Syll. Alg. I, (1889), p. 339.

*Spongomorpha arctica* f. *hystrix* FOSLIE, Mar. Alg. Norway, I, (1890), p. 131—YENDO, Notes Alg. New to Jap. V, p. 245.

**Jap. name.** Harige-moturegusa (n.n.).

Filaments rather dense, 7–15 cm. high, dark green, firm, straight, very erect, except those at the base of the tuft, which are somewhat more open, ca. 165  $\mu$  diam. below, 360–510  $\mu$  in the middle, 400–780  $\mu$  at the tips; segments 2–2.5 diam. long below, 0.5–1.7 diam. in the middle, 1.7–5.5 diam. at the tips; branches lateral, comparatively long, with rounded tips; cell-wall ca. 40–48  $\mu$  thick; rhizoidal branches not abundant, ca. 50  $\mu$  diam., with segments, 3–7 diam. long.

The writer referred to the present species those specimens that have larger and more robust filaments, bearing thinner segment-walls than *S. duriuscula* and lacking horizontal striae. The filaments are not so densely matted together below, but loosely intermingled with less numerous rhizoidal branches. SETCHELL and GARDNER are inclined to the opinion that the present species may possibly belong to *Cladophora* rather than to *Spongomorpha* in the aspect of the loose intermingling of the filaments.

**Habitat and localities.** Growing on stones in the littoral zone.

*M. Kuriles.* Onnekotan Isl.—locality unknown (YENDO). Usisiru Isl.—Kitazima. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan.

*S. Kuriles.* Etorohu Isl.—Kamuikotan.

**Distrib.** Iceland, Atlantic Ocean, Alaska and Japan (Hokkaido and the Kuriles).

## 3. *Spongomorpha Mertensii* (RUPRECHT) SETCHELL et GARDNER

(Pl. II, fig. 3)

Phyc. Cont. I, (1920), p. 280; Mar. Alg. Pacific Coast N. Amer. II, p. 227—YAMADA, Mar. Alg. Urup, p. 10—OKAMURA, Mar. Alg. Jap. p. 74.

*Conferva Mertensii* RUPRECHT, Tange Och. Meeres, (1851), p. 403.

*Cladophora Mertensii* DE TONI, Syll. Alg. I, (1889), p. 317.

*Acrosiphonia Mertensii* YENDO, Notes Alg. New to Jap. V, (1916), p. 246.

**Jap. name.** Kagi-moturegusa.

Filaments lax, moderately rigid, 4–7 cm. high, bright green, erect, 100–150  $\mu$ , at times only 60–70  $\mu$  diam; segments 1–2.5 diam. long, with rounded or gradually tapering tips; hooked branchlets numerous; cell-wall ca. 15  $\mu$  thick; rhizoidal branches 27–36  $\mu$  diam.

From the Okhotsk Sea, two species of Spongomorpha, having hooked branches or branchlets, have been reported. The one is *S. ochotensis* TOKIDA from Robben Isl., Saghalien, and the other *S. Mertensii* SETCH. & GARDN. from the Kuriles. Comparing the descriptions, these species resemble each other well. The present writer was much puzzled to settle to which species his specimens should better be referred. However they have been referred tentatively to *S. Mertensii* SETCH. & GARDN. from the agreement in the important characters and from the distribution of the present species.

**Habitat and localities.** Growing on the fronds of *Fucus evanescens*.

*M. Kuriles.* Ketoi Isl.—Minami-ura. Simusiru Isl.—Nakadomari. Uruppu Isl.—Zisonoma, Iema, (YAMADA).

*S. Kuriles.* Etorohu Isl.—locality unknown (YENDO).

**Distrib.** Alaska to California, Kamchatka and Japan (Hokkaido and the Kuriles).

#### 4. *Spongomorpha saxatilis* (RUPRECHT) COLLINS

(Pl. II, figs. 6, 7)

Green Alg. N. Amer. (1909), p. 360, (Photogr. Repr.), p. 280—YENDO, Notes Alg. New to Jap. V, p. 245—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. II, p. 226—OKAMURA, Mar. Alg. Jap. p. 73—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201.

*Conferva saxatilis* RUPRECHT, Tange Och. Meeres, (1851), p. 403.

*Cladophora saxatilis* DE TONI, Syll. Alg. I, (1889), p. 311—SINOVA, Alg. Kamtschatka, p. 13.

**Jap. name.** Togenasi-moturegusa.

Filaments dense but not much matted together, 5–8 cm. high, yellowish green, 81–150  $\mu$  diam., about the same diameter throughout;

segments 0.6–1.3 diam. long below, 0.7–1.8 diam. above, terminal segments 2.9–9 diam. long; branches lateral, erect, with rounded, occasionally somewhat acute or slightly tapering tips; older parts with descending rhizoidal filaments, simple or branched, 30–51  $\mu$  diam., with segments, 1.6–8 diam. long; cell-wall ca. 6  $\mu$  thick in the upper part, ca. 12  $\mu$  in the middle, ca. 27  $\mu$  in the lower part of the filament.

The writer's specimens appear to be somewhat smaller than the plants described by RUPRECHT and by COLLINS respectively, in proportion of the segment-length to its diameter. However the writer has referred his specimens to the present species because of the accordance of the other important characters, such as, the diameter of the segments, the rounded but occasionally slightly tapering tips of the segments, the presence of the descending rhizoids, the absence of hooked branchlets, etc.

**Habitat and localities.** Growing on rocks in the littoral zone; sometimes on the fronds of *Fucus evanescens*.

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

*M. Kuriles.* Simusiru Isl.—Nakadomari.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Iriribusi, Kamuikotan. Sikotan Isl.—Syakotan.

**Distrib.** Okhotsk Sea, Alaska to California, Kamchatka and Japan (Hokkaido and the Kuriles).

#### 14. *Aegagropila* KÜTZING, 1845

##### *Aegagropila kurilensis* NAGAI, sp. nov.

(Pl. III, fig. 6)

*Aegagropila Sauteri* var. *Borgeana* KANNO (not NORDSTEDT), Stud. Aegagropila of Japan, (1934), p. 225, fig. 3, 4—OKADA, Stud. on the Ball-formation of Aegagropila in Etorofu Isl. pp. 791–798, fig. 1–4.

*Cladophora* sp. ARWIDSSON, Eine aegagropiloide Cladophora von den Kurilen und ihre Entstehung, pp. 1–10, fig. 1.

Thallo sphaeroidale, 2–10 cm. diam., ex filamentis multo ramosis et dense intertextis constructo, in adulto superficie compacto, interiore laxo aut etiam cavo, subinde 1–3 *Aegagropila*-thallo intra thallum majorem ordinatim, aliquando calculem in cavernula capiente; filamentis 45–60  $\mu$  crassis, oppositis, alternis, secundis, in

ramificatione leviter crassis; articulis subcylindricis 6-16-plo diametro longioribus; ramulis ultimatis longioribus, 36-42  $\mu$  diam., apicibus leviter attenuatis, ex 1-5 articulis constructis.

It may be true that the present plant grows, in the earlier stages, by attaching either on small pebbles or on other substrata in the lake. But the present author could not obtain such a young specimen. The smallest specimen that he collected, is not grown up to a complete, spherical ball, but is only filamentous, growing radially from the centre of the thallus, of about 1 cm. in diameter. The typical, adult plant takes the shape of a spherical ball, intertwined densely on the surface and rather loosely in the interior by many filaments and their branches, or sometimes becoming even hollow at the center. The plant measures 2 to 10 cm., rarely only 1.7 cm. in diameter. It is not rare that the fully developed plant contains other *Aegagropila* thalli within the interior, placed closely with the outer thallus. A third thallus is occasionally observed in turn within the second. In cross section, the thallus is observed to be concentric with three layers of the two inner thalli and the outer layer. Each measures about 3 mm. thick in the fresh material. Within the interior of the innermost thallus, there is sometimes found a small pebble, but in other cases it is quite absent. In an old specimen, of which a part of the outer thallus is broken off, there is found some quantity of debris or muddy substances within the hollow cavity. The filaments of the thallus are 45 to 60  $\mu$  thick. The branching is opposite, alternate or secund. The ultimate branches are comparatively long and slightly attenuated at the tips. They measure 36 to 42  $\mu$  thick. They consist usually of 1 to 5 segments. The segments are subcylindrical and slightly thickened in the upper parts in the case of branching. They are 6 to 16 times as long as the breadth.

There had been known only *Aegagropila Sauteri* KÜTZING from Lake Akan, Hokkaido in Japan until the publication of KANNO's paper, "A Study of *Aegagropila* of Japan, with Special Reference to the Ball Formation," in which paper he enumerated *A. Lagerheimi* (BRAND) NORDSTEDT from Lake Toba, Saghalien, *A. Sauteri* (NEES) KÜTZING from Lake Akan, *A. Sauteri* var. *Borgeana* (BRAND) NORDSTEDT from Lake Timikeppu, Hokkaido and Lake Naibo, Etorohu Isl. and *A. Sauteri* f. *profunda* (BRAND) HEERING from Lake Toro and Lake Kimomato, Hokkaido. According to him, one

or more pebbles are often found contained within the hollow cavity of the *Aegagropila*-thallus of the specimens from Etorohu Isl. The present author hesitates to refer the Kurile plant to *A. Sauteri* var. *Borgeana*, because of the remarkable differences in the inner structure of the thallus. It is the writer's opinion that the Kurile plant should better be treated as an independent species rather than to be treated as a variety of *A. Sauteri* KÜTZ. Lately OKADA studied minutely on the ball-formation of the present species from Etorohu Isl. According to him, there are found three forms of *Aegagropila*; the one showing a hollow cavity and having one layer of the thallus but lacking any pebble, the second showing a hollow center and having one layer of the thallus in juvenile stage becoming later concentric with two or three layers and usually containing a pebble, the other showing not a hollow cavity but being compact and lacking any pebble. There are also intermediate forms between them, but all the forms are, if summarized, divided eventually into the above three types.

**Habitat and locality.** Growing in the depth of 1-2 fathoms, lying loosely on the lake-bottom.

*S. Kuriles.* Etorohu Isl.—Lake Naibo, about 9 km. distant from the sea shore.

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

## PHAEOPHYCEAE

### Order I. Ectocarpales

#### Family 1. *Ectocarpaceae*

##### Key to the genera

- I. Zoosporangia and gametangia catenate, intercalary..... *Pylaiella* (1)
- II. Zoosporangia and gametangia transformed branchlets or tips of branches or branchlets, strictly terminal ..... *Ectocarpus* (2)

#### 1. *Pylaiella* BORY, 1823

##### *Pylaiella littoralis* (L.) KJELLMAN

Skand. Ect. och Tilopt. (1872), p. 99; Alg. Arct. Sea, p. 281; Beringhafv. Algfl. p. 51—DE TONI, Syll. Alg. III, p. 531—SETCHELL & GARDNER, Alg. N. W.

Amer. p. 235; Mar. Alg. Pacific Coast N. Amer. III, p. 402, pl. XXXVII, fig. 32—YENDO, Notes Alg. New to Jap. p. 120 (sub var. *opposita* f. *rupicola*)—OKAMURA, Nippon Sorui Meii, ed. 2, p. 145; Mar. Alg. p. 135, fig. 65—SINOVA, Alg. Mer Ochotsk. p. 93; Alg. Kamtschatka, p. 14—YAMADA, Mar. Alg. Urup, p. 11—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 201—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 103, pl. IX, fig. 1-3.

*Conferva littoralis* LINNAEUS, Sp. Pl. ed. 1, (1753), p. 1165. (p p.)

**Jap. name.** Piraera.

The present species is rather widely distributed in northern Japan, in the Kuriles, Saghalien and the eastern coast of Hokkaido. In the Kuriles, it was found widely from the North southward. YENDO pointed out the presence of var. *opposita* f. *rupicola* from the North Kuriles, but the writer was unable to differentiate his specimens into forms.

**Habitat and localities.** Growing on the fronds of various algae, e.g., *Fucus evanescens*, *Heterochordaria abietina*, *Rhodomela subfusca*, etc., in the littoral zone; found more often on the first species.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* 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.—Moyoro, Iriribusi, Sibetoro, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Tohutu, Nikisiro, Kotankesi.

**Distrib.** Arctic Ocean, Atlantic Ocean, Bering Sea (St. Lawrence Isl., Bering Isl., Konyam Bay, Port Clarence) to California, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles).

## 2. *Ectocarpus* LYNGBYE, 1819

### *Ectocarpus fusiformis* NAGAI, sp. nov.

(Pl. II, figs. 16-18)

Thallis minutis, 3-4 mm. altis, filamentis repentibus et rhizoideis affixis; filamentis erectis simplicibus, superne sparse ramosis, apice versus gradatim attenuatis, 12-16.5  $\mu$  latis; filamentis repentibus irregularibus, ramosis, 9-12  $\mu$  latis; filamentis rhizoideis parvis, e cellulis inferis filamentorum erectorum descendentibus, leviter ramosis, 6-9  $\mu$  latis; cellulis filamentorum erectorum cylindricis,

24–57  $\mu$  longis, 1.6–3.5-plo diametro longioribus; chromatophoris taeniatis, parietes cellularum prope exacte tegentibus; gametangiis plurilocularibus fusiformibus vel oblongo-fusiformibus, in pedicellis cellulis 1–2 raro 5 compositis suffultis, alternis vel secundis, nunquam terminalibus, 57–150  $\times$  18–27  $\mu$ ; sporangiis unilocularibus ignotis.

The present alga forms a dense velvety layer on the host, measuring about 3 to 4 mm. in height. It consists of a basal part of creeping filaments and an upper part of erect filaments. On the latter, some rhizoidal ones are found, descending from the lower cells. The creeping filaments are composed of irregularly shaped cells which are slightly branched and measure 9 to 12  $\mu$  wide. The erect filaments are rather simple, sparingly branched, becoming attenuated slightly toward the tips. They measure 12 to 16.5  $\mu$  wide. The cells of the erect filaments are cylindrical, 24 to 57  $\mu$  long and 1.6–3.5 times as long as the diameter. The rhizoidal filaments are slightly narrower than the erect ones, measuring 6 to 9  $\mu$ , and are crooked and sparingly branched. The cells of the rhizoidal filaments measure 18 to 36  $\mu$  in length. The chromatophores are band-shaped, nearly covering the cells in the principal erect filaments. The plurilocular gametangia are placed alternately or secondly on the erect filaments, bearing short, 1 or 2, rarely 5-celled pedicels. They are occasionally terminal. There are rarely found newly formed gametangia within the empty ones as in the cases of the other species of *Ectocarpus*. The gametangia are fusiform or oblong-fusiform, measuring 57 to 150  $\mu$  long and 18 to 27  $\mu$  wide. Unilocular sporangia are not found in the writer's specimens.

The present species appears to be related to *E. terminalis* KÜTZ. in the resemblances of the small, simple, sparingly branched erect filaments and the size of the plurilocular gametangia. But it differs from the latter species in the presence of the descending rhizoidal filaments and the shape of the plurilocular gametangia. The present species was also compared with small forms of *E. confervoides* (ROTH) LE JOLIS. It resembles them in the shape, in some cases also in sizes, of the plurilocular gametangia and in their arrangement on the filament. But the writer failed to find any sessile gametangia in his specimens. He therefore, cannot refer his specimens to *E. confervoides* with certainty.

**Habitat and localities.** Epiphytic on the stipe of *Thalassio-phyllum Clathrus* and the shells of *Mytilus* sp.

*M. Kuriles.* Musiru Islet. Usisiru Isl.—Minami-zima.

**Distrib.** Endemic (the Kuriles).

## Family 2. *Ralfsiaceae*

### 3. *Ralfsia* BERKELEY, 1843

#### *Ralfsia fungiformis* (GUNNERUS) SETCHELL et GARDNER

Phyc. Cont. VII, (1924), p. 11; Mar. Alg. Pacific Coast N. Amer. III, p. 499—OKAMURA, Mar. Alg. Jap. p. 143—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 203—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 122.

*Fucus fungiformis* GUNNERUS, Fl. Norv. II, (1772), p. 107.

*Zonaria deusta* AGARDH, Syn. Alg. (1817), p. 40; Sp. Alg. I, 1, p. 132.

*Padina deusta* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 20.

*Ralfsia deusta* J. AGARDH, Sp. Alg. I, (1848), p. 63—HARVEY, Ner. Bor.-Amer. I, p. 130—KJELLMAN, Alg. Arct. Sea, p. 248—DE TONI, Syll. Alg. III, p. 312—SETCHELL & GARDNER, Alg. N. W. Amer. p. 253—YENDO, Notes Alg. New to Jap. p. 123—OKAMURA, Nippon Sorui Meii, ed. 2, p. 162.

**Jap. name.** Isogawara. (n.n.)

Thallus licheniform, coriaceous, dark brown, becoming black upon drying, loosely attached to substratum by numerous rhizoids in the central portion of the under side being free around the margin, with overlapping subreniform to circular lobes; lobes provided with concentric zones and radiating striae, 0.5–2 cm. diam., 240–600  $\mu$ , mostly 270–390  $\mu$  thick; cells forming rows curving upward and downward from a central layer in the lobes; zoo-sporangia and hairs unknown.

The specimens at hand are identifiable with the present species by examining and comparing with the Alaskan specimen which has been kindly contributed from the Department of Botany, University of California.

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

*N. Kuriles.* Simusyu Isl. ? (YENDO). Paramusiru Isl.—Murakami-wan.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonrakuwan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Uruppu Isl.—Kobune.

*S. Kuriles.* Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Kotankesi, Tomari.

**Distrib.** Arctic Ocean, Atlantic Ocean, Alaska, Kamchatka and Japan (Hokkaido and the Kuriles).

Family 3. *Elachistaceae*

4. *Elachista* DUBY, 1832

? *Elachista lubrica* RUPRECHT

Tange Och. Meeres, (1851), p. 196 (388 Orig.)—KJELLMAN, Alg. Arct. Sea, p. 254—DE TONI, Syll. Alg. III, p. 443—OKAMURA, Nippon Sorui Meii, ed. 2, p. 156; Mar. Alg. Jap. p. 147—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 504—SINOVA, Alg. Mer Ochotsk. p. 98—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 147.

The present writer has no specimen referable to this species, but OKAMURA records it with query in the above accounts from the Kuriles.

**Habitat and locality.** Found attached on the frond of *Halosaccion sp.*, according to OKAMURA.

*Kuriles.* Island and locality unknown (OKAMURA).

**Distrib.** Okhotsk Sea, Arctic Ocean, Atlantic Ocean, Alaska and Japan (the Kuriles).

Order II. *Sphacelariales*

Family 4. *Sphacelariaceae*

5. *Sphacelaria* LYNGBYE, 1819

*Sphacelaria subfusca* SETCHELL et GARDNER

(Pl. II, figs. 9-11)

Phyc. Cont. VII, (1924), p. 1; Mar. Alg. Pacific Coast N. Amer. III, p. 395, pl. XXXVII, fig. 28—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 205, fig. 6—TSENG, Mar. Alg. fr. Amoy, p. 21, pl. II, fig. 7.

**Jap. name.** Mitumata-kurogasira (n.n.).

Erect filaments arising from closely intertwined rhizoidal filaments, forming dense brown tufts, ca. 3-5 mm. high, and slightly

branched; cells nearly as long as the diameter, or a little longer or shorter, divided vertically by thin walls, 33–45  $\mu$  thick in the main filaments, 18–21  $\mu$  in the branches; propagula slender, often bi- or trifurcate, with slightly attenuate stalk of 180–330  $\mu$  length and 21–24  $\mu$  diam. beneath the fork; rays slightly attenuate toward the apices, 150–240  $\mu$  long; hairs present, but not abundant, 13.5–18  $\mu$ , mostly ca. 15  $\mu$  thick, 375–810  $\mu$  long, 7–17-celled; sporangia and gametangia unknown.

In the number of hairs and of their cells, the present writer finds a few discrepancies between the Kurile and the American plant. However the writer referred his specimens to the present species from the resemblance of the other characteristics.

**Habitat and localities.** Epiphytic on the fronds of *Rhodomela Larix*, *Chaetomorpha aerea*, etc.

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

**Distrib.** Alaska to California, China and Japan (the Kuriles).

### Order III. Dictyotales

#### Family 5. Dictyotaceae

#### 6. *Dictyopteris* LAMOUROUX, 1809

##### *Dictyopteris divaricata* (OKAMURA) NAGAI, comb. nov.

*Haliseris divaricata* OKAMURA, Icon. Jap. Alg. I, 3, (1907), p. 57, pl. XIII, pl. XIV, fig. 5; Nippon Sorui Meii, ed. 2, p. 183.

*H. evanescens* YENDO, Nov. Alg. Jap. Decas I-III, (1920), p. 2.

*Neurocarpus divaricatus* HOWE, Chinese Mar. Alg. (1924), p. 138—OKAMURA, Icon. Jap. Alg. V, 10, p. 190; Mar. Alg. Jap. p. 173—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 213.

**Jap. name.** Yezoyahazu.

The present species is commonly distributed in Japan, from Korea to Hokkaido through Sikoku and Honsyu. In Hokkaido, the present writer is familiar with this species, especially along the Japan Sea coast. It is apparently a temperate water species. The occurrence of the present species in the Kuriles is now first recorded; the western coast of Kunasiri Isl. is probably the northernmost limit in Japan.

**Habitat and locality.** Cast ashore.

*S. Kuriles.* Kunasiri Isl.—Tosyoro.

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

#### Order IV. Chordariales

#### Family 6. *Leathesiaceae*

#### 7. *Leathesia* GRAY, 1821

##### Key to the species

- I. Fronds large, 1–3.5 cm. in diam., growing on rocks or other algae.....  
 ..... *L. difformis* (1)
- II. Fronds small, 0.6–2–5 mm. in diam., growing on other algae.....  
 ..... *L. sphaerocephala* (2)

#### 1. *Leathesia difformis* (L.) ARESCHOUG

Phyc. Scand. I, (1846), p. 154—KJELLMAN, Alg. Arct. Sea, p. 252—DE TONI, Syll. Alg. III, p. 422—SETCHELL & GARDNER, Alg. N. W. Amer. p. 249; Mar. Alg. Pacific Coast N. Amer. III, p. 511, pl. XL, fig. 52, pl. XLIII, fig. 65, 66—OKAMURA, Icon. Jap. Alg. I, 4, p. 80, pl. XVIII; Nippon Sorui Meii, ed. 2, p. 159; Mar. Alg. Jap. p. 187, fig. 97—COLLINS, Chinese Mar. Alg. p. 205—HOWE, Chinese Mar. Alg. p. 136—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 209—TSENG, Mar. Alg. fr. Amoy, p. 24, pl. III, fig. 11—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 143, pl. XII, fig. 5, pl. XIV, fig. 8.

*Tremella difformis* LINNAEUS, Fl. Suec. ed. 2, (1755), p. 429.

**Jap. name.** Nebarimo.

The present species is a rather widely distributed alga in Japan, from Kyusyu to Hokkaido along both the Japan Sea coast and the Pacific coast of Honsyu. The present writer failed to obtain in his collection any specimen bearing zoosporangia.

**Habitat and localiteis.** Epiphytic on the fronds of various algae, e.g., *Sargassum Kjellmanianum*, *Cystophyllum geminatum*, *Chaetomorpha aerea*, *Rhodomela subfusca*, etc.; the specimen from Etorohu found cast ashore.

*S. Kuriles.* Etorohu Isl.—Tosimoe. Kunasiri Isl.—Sokobetu, Sibetoro, Tosyoro, Kotankesi, Tomari.

**Distrib.** Atlantic Ocean, Arctic Ocean, Alaska to California, China and Japan (Kyusyu, Honsyu, Hokkaido and the Kuriles).

## 2. *Leathesia sphaerocephala* YAMADA

Notes Some Jap. Alg. IV, (1932), p. 269, fig. 2—OKAMURA, Mar. Alg. Jap. p. 188.

**Jap. name.** Hime-nebarimo.

As to the formation of hairs, Prof. YAMADA denied their presence, but the present writer observed them in his specimen. They are simple or occasionally slightly branched, and measure about  $6\ \mu$  thick.

**Habitat and localities.** Epiphytic on the fronds of various algae, e.g., *Cystophyllum hakodatense*, *Chaetomorpha aerea*, *Ahnfeltia plicata* var. *tobuchiensis*, etc.

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

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

## Family 7. *Chordariaceae*

### Key to the genera

- I. Frond simple or rarely branched, tender, more or less lubricous... *Gobia* (8)
- II. Frond slightly or profusely branched or simple, more or less rigid and cartilaginous to slightly lubricous ..... *Chordaria* (9)

## 8. *Gobia* REINKE, 1889

### *Gobia simplex* (SAUNDERS) SETCHELL et GARDNER

Phyc. Cont. VII, (1924), p. 12; Mar. Alg. Pacific Coast N. Amer. III, p. 576, pl. XLII, fig. 58, pl. LXXVIII, fig. b—OKAMURA, Icon. Jap. Alg. VI, 1, p. 2, fig. 1, 2, pl. CCLI, fig. 8, 9; Mar. Alg. Jap. p. 202, fig. 107—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 203.

*Mesogloia simplex* SAUNDERS, Alg. Harriman Exped. (1901), p. 423, pl. L, fig. 2-4—SETCHELL & GARDNER, Alg. N. W. Amer. p. 250.

**Jap. name.** *Gobia*.

Comparing with SAUNDERS', and also with SETCHELL and GARDNER's descriptions, the writer's specimens appear to be slightly larger than the American plant in dimensions. However they coincide relatively well with the present species in the other characters.

**Habitat and localities.** Epiphytic on the fronds of *Chordaria flagelliformis*, rarely on *Heterochordaria abietina*.

*S. Kuriles.* Etorohu Isl.—Rubetu. Sikotan Isl.—Syakotan. Kunasiri Isl.—Siranuka, Sokobetu, Sibetoro, Kotankesi.

**Distrib.** Alaska to Vancouver Isl. and Japan (Hokkaido, Saghalien and the Kuriles).

## 9. *Chordaria* AGARDH, 1817

### Key to the species

- I. Frond solid.
  - A. Frond relatively robust, up to 1 m. long, ca. 0.5–1.5 mm. in diam. . . . . *C. flagelliformis* (1)
  - B. Frond slender, up to 35 cm. long, ca. 0.3–0.5 mm. in diam. . . . . *C. gracilis* (2)
- II. Frond more or less hollow.
  - A. Frond more or less irregularly and dichotomo-alternately branched. . . . . *C. cladosiphon* (3)
  - B. Frond not branched, simple and cylindrical. . . . . *C. Nagaii* (4)

### 1. *Chordaria flagelliformis* (MUELLER) AGARDH

Syn. Alg. Scand. (1817), p. 12 & xii; Sp. Alg. I, 1, p. 166—GREVILLE, Alg. Brit. p. 44, Tab. VII—HARVEY, Phyc. Brit. I, pl. CXI; Ner. Bor.-Amer. I, p. 123—J. AGARDH, Sp. Alg. I, p. 66—KÜTZING, Tab. Phyc. VIII, Tab. 11, fig. I—KJELLMAN, Spets. Thall. II, p. 28; Alg. Arct. Sea, p. 249; Beringhafv. Algfl. p. 48—DE TONI, Syll. Alg. III, p. 432—OKAMURA, Icon. Jap. Alg. II, p. 140, pl. XC; Nippon Sorui Meii, ed. 2, p. 160; Mar. Alg. Jap. p. 196, fig. 103—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 572—SINOVA, Alg. Kamtschatka, p. 16—TOKIDA, Mar. Alg. Robben Isl. p. 8—YAMADA, Mar. Alg. Urup, p. 13—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 202—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 143, pl. XII, fig. 6, pl. XIV, fig. 4.

*Fucus flagelliformis* MUELLER, Flor. Dan. (1771), pl. 650.

### Key to the forms

- I. Frond much branched . . . . . *f. typica*
- II. Frond simple or sparsely branched . . . . . *f. chordaeformis*

### *f. typica* KJELLMAN

Spets. Thal. II, (1877), p. 28—SETCHELL & GARDNER, Alg. N. W. Amer. p. 250; Mar. Alg. p. 573.

**Jap. name.** Naga-matumo.

*f. chordaeformis* KJELLMAN

Spets. Thall. II, (1877), p. 28, pl. I, fig. 13-15—SETCHELL & GARDNER, Alg. N. W. Amer. p. 251; Mar. Alg. p. 573—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 17, pl. I—YAMADA, Notes Some Jap. Alg. VI, p. 269, pl. IV; Mar. Alg. Urup, p. 13—KAWABATA, l.c. p. 202.

**Jap. name.** Himo-nagamatumo.

This is an alga, distributed commonly from the eastern coast of Hokkaido to the North Kuriles, but it is found rather sparingly to the northward.

**Habitat and localities.** Growing on rocks in the lower part of the littoral zone and the upper sublittoral zone.

*f. typica.*

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

*M. Kuriles.* Uruppu Isl.—Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Arimoe. Sikotan Isl.—Syakotan, Aimi-zaki. Kunasiri Isl.—Sokobetu, Sibetoro, Kotankesi.

*f. chordaeformis.*

*N. Kuriles.* Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Uruppu Isl.—Kobune (YAMADA), Tokotan, Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Kamuikotan. Sikotan Isl.—Tiboi. Kunasiri Isl.—Sibetoro, Kotankesi.

**Distrib. Sp.**—Arctic Ocean, Atlantic Ocean, Alaska, Bering Sea (Bering Isl., St. Lawrence Isl., Konyam Bay), Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles); *f. chordaeformis*—Bering Sea (Konyam Bay) and Japan (same localities as *Sp.*).

2. *Chordaria gracilis* SETCHELL et GARDNER

Phyc. Cont. VII, (1924), p. 8; Mar. Alg. Pacific Coast N. Amer. III, p. 573, pl. LXXXIV—YAMADA, Mar. Alg. Urup, p. 13, pl. III—OKAMURA, Mar. Alg. Jap. p. 196; Icon. Jap. Alg. VII, 9, p. 78, pl. CCCXLV, fig. 1—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 208.

**Jap. name.** Hoso-matumo.

The present species differs from the previous species in the slenderness and the smaller size of the fronds.

**Habitat and localities.** Growing on rocks in tide pools.

*M. Kuriles.* Uruppu Isl.—Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro. Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Atoiya, Tohutu, Kotankesi.

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

### 3. *Chordaria Cladosiphon* KÜTZING

Tab. Phyc. IX, (1859), p. 2, Tab. 2, fig. II—DE TONI, Syll. Alg. III, p. 433—OKAMURA, Icon. Jap. Alg. III, 9, p. 188, pl. CXLIV, CXLV, fig. 10-14; Nippon Sorui Meii, ed. 2, p. 313; Mar. Alg. Jap. p. 198—COLLINS, Chinese Mar. Alg. p. 205.

*Cladosiphon Chordaria* HARVEY, Phyc. Austr. I, (1858), pl. LX.

**Jap. name.** Kusa-mozuku.

Although sterile, the writer's specimens are easily identifiable with the present species by the characteristic features, external and internal as well. The present species is distributed rather widely in the middle and southern parts of Japan. The western coast of Kunasiri Isl. is probably its northernmost limit in Japan.

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

*S. Kuriles.* Kunasiri Isl.—Kotankesi, Pontarubetu, Tomari.

**Distrib.** Atlantic Ocean, China and Japan (Korea, Sikoku, Honsyu, Hokkaido and the Kuriles).

### 4. *Chordaria Nagaii* TOKIDA

Phyc. Observ. IV, (1938), p. 213, fig. 1-4.

*Chordaria* sp. KAWABATA, List Mar. Alg. Isl. Shikotan, (1936), p. 203, no. 20—TOKIDA, Taxon. & Phytogeogr. Stud. Mar. Alg. Saghalien, (Prelim. Rept.), p. 250, no. 18.

**Jap. name.** Nise-turumo.

Fronde gregarious, arising often from a confluent disc-shaped holdfast, cylindrical, hollow except the very base, slightly tapering at the base and the apices, sometimes twisted, 50-80 cm. long, 2.5-4 mm. diam., olive brown, subcoriaceous upon drying, especially in the fertile part, at maturity the greater part of the upper portions decayed away, leaving behind the lower portions, which are

clothed with uniseriate paraphyses (?) and unilocular sporangia; paraphyses clavate, 100–150  $\mu$  long, consisting of a row of 4–7 cells, of which the terminal cell is enlarged, globular or pyriform, ca. 13.5  $\mu$  diam., apical and subapical cells often provided with hyaline membranaceous projections on the wall; unilocular sporangia formed at the bases of the paraphyses, sometimes 2 or 3 or more arising successively from one and the same basal cell, oblong-ellipsoid, 36–63  $\mu$  long, 13.5–15  $\mu$  wide.

The present writer has obtained a curious alga which closely resembles both *Chorda Filum* and *Meylophycus intestinale* in external appearance. This alga differs, however, from the former in having uniseriate paraphyses and from the latter in the narrower, oblong-ellipsoidal unilocular sporangia. The present species was also found in Saghalien by Prof. TOKIDA. He gave the writer much kind assistance in studying the present Kurile plant.

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

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

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

### Family 8. *Aegiraceae*

#### 10. *Aegira* FRIES, 1825

##### *Aegira virescens* (CARMISCHAEI) SETCHELL et GARDNER

Phyc. Cont. VII, (1924), p. 11; Mar. Alg. Pacific Coast N. Amer. III, p. 547, pl. XLII, fig. 59, 60—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 203.

KAWABATA recorded this species from Sikotan Isl. But the present writer was unable to find any specimen referable to it.

**Habitat and locality.** Growing on the leaves of *Zostera sp.* in the littoral zone, according to KAWABATA.

*S. Kuriles.* Sikotan Isl.—Notoro (KAWABATA).

**Distrib.** Atlantic Ocean, Alaska and Japan (the Kuriles).

Family 9. *Heterochordariaceae*11. *Heterochordaria* SETCHELL et GARDNER, 1924

## Key to the species

- I. Frond simple, cylindrical, hollow, smooth or partly with minute conical processes on the surface ..... *H. Gunjii* (1)
- II. Frond composed of main axis and patent, radiating branchlets, hollow in the greater part ..... *H. abietina* (2)

1. *Heterochordaria Gunjii* (YENDO) TOKIDA

(Pl. II, figs. 14, 15; pl. III, fig. 8)

Phyc. Observ. IV, (1938), p. 218.

*Chordaria Gunjii* YENDO, Some New Alg. fr. Japan, (1913), p. 280, pl. XIII, fig. 12-17—OKAMURA, Nippon Sorui Meii, ed. 2, p. 160; Mar. Alg. Jap. p. 199.**Jap. name.** Gunji-matumo (n.n.).

Fronds simple, attached by small holdfast, often caespitose, cylindrical, hollow, tapering gradually toward the bases, with blunt apices, smooth, rarely with a few, minute processes on the surface of the lower portions, commonly unbranched, 3-10 cm., sometimes attaining to 30 cm. or more in height, 1.5-4 mm. diam. at the broadest part, yellowish to reddish brown; tissue composed of 3 layers, cortical, subcortical and medullary; cortex of several, irregularly arranged rows of thick-walled, cuboidal cells; subcortical layer of several rows of filamentous cells, arranged more or less compactly lengthwise, partly obliquely and here and there laterally connected; medulla of filamentous cells in the solid basal part, running straight lengthwise and occupying only an insignificant part of the whole structure, becoming hollow upward from the part just mentioned; unilocular sporangia numerous, ellipsoid to oblong-ellipsoid, sessile, 42-69  $\mu$  long, 18-42  $\mu$  wide in mature ones, formed at the bases of paraphyses; paraphyses numerous, clavate, uniseriate, ca. 60-100  $\mu$  long, consisting of 4-6 cells, of which the terminal one is pyriform or subglobular, 10-12  $\mu$  diam.; plurilocular sporangia compact, uni- to pluriseriate, terminating in a 2-celled, sterile clavate tip, 60-72  $\mu$  long, 9-15  $\mu$  wide at the broadest part, gametes 3-4  $\mu$  diam.; hairs present on both kinds of plant, bearing unilocular and plurilocular sporangia, ca. 6  $\mu$  wide; plants dioecious.

OKAMURA thinks that *Chordaria Gunjii* YENDO is probably an old form of *Heterochordaria abietina* SETCH. et GARDN., from which the branchlets have dropped away, leaving the basal parts of their petioles behind. However, SETCHELL and GARDNER hold the opinion that it may be simply the gametangial form of some species of *Meylophycus*. The present writer has obtained several specimens, both in the North and South Kuriles, which are probably referable to the present species. Most of the specimens were collected in the tide pools in the middle part of the littoral zone. They are rather small, measuring only 3-10 cm. long, and yellowish brown in color. They are not evenly cylindrical, but here and there slightly and irregularly constricted. The constriction at a certain point of the frond is not formed from all sides as in *Scytosiphon Lomentarius*, but on one side only or from two opposite sides. The surface of the frond is smooth on the greater part, but in the lower part possesses small irregular wart-like protuberances. Besides the above specimens, some larger ones were collected at Kamuikotan, Etorohu. They measure 30 cm. or more in length, and are reddish brown in color. The width at the broadest part is the same as that in the former. The shape of the fronds is similar to the former except for the lack of the small protuberances on the lower portions. The upper parts of the fronds are, however, often slightly broken here and there. In the former specimens, both zoosporangial and gametangial individuals are found, while in the latter, only the zoosporangial individual exists. Through the courtesy of Prof. TOKIDA, the present writer was able to examine the specimen of *Chordaria Gunjii*, determined by YENDO which has been deposited in the Herbarium of the Hakodate College of Fisheries. They are caespitose from a small callus, measuring 12 to 26 cm. in height. The fronds are compressed-cylindrical (in the pressed specimens), with a few incomplete constrictions from the middle upward and they are reddish brown in color. They are smooth for the greater part, but bear small dotted protuberances abundantly on the lower portions in some specimens. The present writer failed to find any specimens in his collection which bear abundantly dotted protuberances on the frond. However the specimens at hand, accord well with the original description and with the specimens determined by YENDO in the other important characters, external as well as internal. The writer has referred his specimens tentatively to the

present species in this paper. SETCHELL and GARDNER compared YENDO's plant with some species of *Meylophycus* as stated above. Judging from the figures of *Meylophycus intestinale*, delineated by SAUNDERS (187), the zoosporangial specimens of the writer's plant appear to be different from that species in having thinner-walled paraphyses.

**Habitat and localities.** Growing on rocks in the tide pools in the middle littoral zone.

*N. Kuriles.* Simusyu Isl.—locality unknown (YENDO). Paramusiru Isl.—Kakumabetu.

*S. Kuriles.* Etorohu Isl.—Moyoro, Kamuikotan.

**Distrib.** Endemic (the Kuriles).

## 2. *Heterochordaria abietina* (RUPRECHT) SETCHELL et GARDNER

Phyc. Cont. VII, (1924), p. 6; Mar. Alg. Pacific Coast N. Amer. III, p. 550, pl. XXXVI, fig. 18, 19, pl. XCI—YAMADA, Mar. Alg. N. Kuriles, p. 344—OKAMURA, Mar. Alg. Jap. p. 199, fig. 104—KAWABATA, List Mar. Alg. Isl. Sikotan, p. 203.

*Chordaria abietina* RUPRECHT, MS. in FARLOW, List Mar. Alg. U.S. (1875), p. 357—DE TONI, Phyc. Jap. p. 53—SAUNDERS, Alg. Harriman Exp. p. 424—OKAMURA, Nippon Sorui Meii, ed. 1, p. 124, ed. 2, p. 160; Icon. Jap. Alg. II, 7, p. 122, pl. LXXXV, fig. 8–15—SETCHELL & GARDNER, Alg. N. W. Amer. p. 251, pl. XVIII, fig. 16, 17—SINOVA, Alg. Kantschatka, p. 16.

**Jap. name.** Matumo.

The present species is one of the frequently occurring algae in Japan, from Simusyu Isl. southward through Hokkaido to Cape Inuboye on the Pacific side of Honsyu.

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

*N. Kuriles.* Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Rasyuwa Isl.—Sonraku-wan. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Yosinohama, Misima.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Wenbetu, Iriribusi, Tosirari, Sibetoro, Rubetu. Sikotan Isl.—Syakotan, Tiboi, Aimizaki. Kunasiri Isl.—Atoiya, Rebun-iso, Hurukamappu, Sibetoro.

**Distrib.** Bering Sea (St. Lawrence Isl.) to California, Kamchatka and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles).

Order V. Desmarestiales  
Family 10. Desmarestiaceae

12. *Desmarestia* LAMOUROUX, 1813

Key to the species

- I. Frond cylindrical or only very slightly compressed; branching mainly opposite ..... *D. media* (1)
- II. Frond not cylindrical, but compressed.
  - A. Frond compressed to slightly flattened, never strictly flattened-foliaceous, without midrib.
    - 1. Branching alternate ..... *D. aculeata* (2)
    - 2. Branching opposite ..... *D. kurilensis* (3)
  - B. Frond ligulate, with midrib, though barely discernible; branching opposite ..... *D. ligulata* (4)

Section 1. Viridis

1. *Desmarestia media* (AGARDH) GREVILLE

Alg. Brit. (1830), p. xl—KÜTZING, Sp. Alg. p. 571; Tab. Phyc. IX, Tab. 95, fig. II—PEASE, Taxon. of Desmarestia, p. 386—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 561.

*Sporochnus medius* AGARDH, Sp. Alg. I, 1, (1820), p. 153; Icon. Alg. Ined. Fasc. q. Exst. Duo, ed. nova, Tab. XVI.

*Desmarestia aculeata* Forma  $\gamma$  J. AGARDH, Sp. Alg. I, (1848), p. 168.

*D. aculeata* var. *media* ROSENVIINGE, Grønl. Havalg. (1893), p. 858—DE TONI, Syll. Alg. III, p. 459—SETCHELL & GARDNER, Alg. N. W. Amer. p. 246. (sub forma).

?*Desmarestia viridis* KAWABATA (not LAMOUROUX), List Mar. Alg. Isl. Shikotan, (1936), p. 204.

**Jap. name.** Nagabo-urusigusa (n.n.).

Frond 80 cm. or more high, arising from a relatively large, disc-shaped holdfast, cylindrical, cartilaginous, very profusely and oppositely branched throughout, dark brown, nearly black upon drying; primary axis ca. 2.5 mm. or more diam. near the base; branches of 5–6 orders, each successive order gradually reduced in size; ultimate branchlets long-attenuate and acute.

SETCHELL and GARDNER, and PEASE have been in doubt as to the occurrence of *D. viridis* on the Pacific coast of North America, and thought that the plants from this region reported as that

species were in all probability *D. media*. According to the descriptions and figures of various authors, *D. viridis* appears to be the more delicate species, having more closely branched fronds than *D. media*, although branching in these two species is opposite. The specimens at hand are cylindrical, cartilaginous, and branched profusely and oppositely throughout the whole length. Therefore these specimens would better be referred to the present species than to *D. viridis*.

**Habitat and localities.** Cast ashore.

*N. Kuriles.* Araidō Isl.—Minami-ura.

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Uruppu Isl.—Tokōan.

*S. Kuriles.* Etorōhu Isl.—Wenbetu, Iriribusi, Sibetoro. Sikotan Isl.—Syakotan, Notoro. Kunasiri Isl.—Tokaisen, Idasibenai.

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

## Section 2. Aculeatae

### 2. *Desmarestia aculeata* (L.) LAMOUROUX

Essai. (1813), p. 25—GREVILLE, Alg. Brit. p. 38, Tab. V, fig. 2, 3—HARVEY, Phyc. Brit. I, pl. XLIX; Ner. Bor.-Amer. I, p. 78—KÜTZING, Sp. Alg. p. 571; Tab. Phyc. IX, Tab. 94—KJELLMAN, Alg. Arct. Sea, p. 261; Beringhafv. Algfl. p. 50—OKAMURA, Icon. Jap. Alg. IV, 10, p. 193, pl. CXCIX, fig. 5-9; Mar. Alg. Jap. pp. 215 & 216 (sub forma)—SINOVA, Alg. Kamtschatka, p. 17—YAMADA, Mar. Alg. N. Kuriles, p. 344; Mar. Alg. Urup, p. 15—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 161, pl. XIII, fig. 4, 5, pl. XIV, fig. 7.

*Fucus aculeatus* LINNAEUS, Sp. Pl. ed. 2, (1753), p. 1632—TURNER, Fuci, III, (1811), p. 122, pl. CLXXXVII.

*Desmarestia aculeata* forma  $\alpha$  J. AGARDH, Sp. Alg. I, (1848), p. 167.

*D. latifrons* OKAMURA (not RUPRECHT), Icon. Jap. Alg. II, 5, (1910), p. 86, pl. LXXIV, pl. LXXV, fig. 7; Nippon Sorui Meii, ed. 2, p. 155.

**Jap. name.** Toge-urusigusa.

The primary branches which are given off in a bundle, are of uneven lengths. In most cases, one or a half of the branches are developed vigorously, while the others are restricted in their development. It seems to the writer that such a character is peculiar to the present species.

**Habitat and localities.** Cast ashore.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan ? (YENDO). Paramusiru Isl.—Kasiwabara-wan, Suribati-wan, Kakumabetu.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Matuwa Isl.—Yamato-

wan. Rasyuwa Isl.—Sonraku-wan. Simusiru Isl.—Nakadomari, Simusiru-wan. Uruppu Isl.—Kobune, Iema (YAMADA).  
*S. Kuriles.* Kunasiri Isl.—Tinomizi, Tohutu.

**Distrib.** Atlantic Ocean, Arctic Ocean, Bering Sea (St. Lawrence Isl. and St. Lawrence Bay), Kamchatka and Japan (Saghalien and the Kuriles).

### 3. *Desmarestia kurilensis* YAMADA

Mar. Alg. Urup, (1935), p. 14, pl. IV—OKAMURA, Mar. Alg. Jap. p. 216.

**Jap. name.** Tisima-urusigusa.

As for the distinction of the species, Prof. YAMADA states, "The new species reminds one of *D. viridis* LAMX. at first sight, but in the former the principal axis, as well as the axis of branches, is always compressed, which is not the case in the latter." From the above characters, the present species is easily identifiable.

**Habitat and localities.** Cast ashore.

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Uruppu Isl.—Iema (YAMADA).

**Distrib.** Endemic (the Kuriles).

## Section 3. Herbaceae

### 4. *Desmarestia ligulata* (LIGHTFOOT) LAMOUROUX

Essai. (1813), p. 25—GREVILLE, Alg. Brit. p. 37, Tab. V, fig. 1—HARVEY, Phyc. Brit. I, pl. CXV; Ner. Bor.-Amer. I, p. 78—J. AGARDH, Sp. Alg. I, p. 169 (excl. var. *β. herbacea* & *γ. firma*)—KÜTZING, Sp. Alg. p. 572; Tab. Phyc. XI, Tab. 99, fig. II—SETCHELL & GARDNER, Alg. N. W. Amer. p. 247; Mar. Alg. Pacific Coast N. Amer. III, p. 566, pl. LXXXVII—OKAMURA, Icon. Jap. Alg. II, 5, p. 82, pl. LXXII, pl. LXXV, fig. 1-4; Nippon Sorui Meii, ed. 2, p. 155; Mar. Alg. Jap. p. 216, fig. 115—PEASE, Taxon. Desmarestia, p. 388; Desmarestia. pp. 314, 332, pl. LIV, fig. 1, 2, pl. LXII, fig. 1-7, pl. LXIII—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204.

*Fucus ligulatus* LIGHTFOOT, Flora Scotia. II, (1777), p. 946, pl. XXIX—TURNER, Fuci, II, p. 74, pl. XCVIII.

*Sporochnus ligulatus* AGARDH, Sp. Alg. I, 1, (1820), p. 158.

**Jap. name.** Urusigusa.

It seems to the writer that the present species prefers to grow in the South Kuriles, while the other species of *Desmarestia* are distributed more widely from the North to South Kuriles or occur

more often in the northern part of the archipelago. The present species is also found on the Pacific sides of Hokkaido and the north-eastern part of Honsyu, and Saghalien.

**Habitat and localities.** Cast ashore.

*S. Kuriles.* Etorohu Isl.—Wenbetu. Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Tohutu.

**Distrib.** Atlantic Ocean, Chile, Cape Horn, Washington and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles).

## Order VI. Punctariales

### Family 11. Punctariaceae

#### 13. *Punctaria* GREVILLE, 1830

##### Key to the species

- I. Frond large, broad-lanceolate to obovate, 10–25 × 3.5–13 cm.; gametangia globular or slightly projected above the frond surface. . . . . *P. latifolia* (1)
- II. Frond small, linear-lanceolate, 2–4.5 × 0.3–1.3 cm.; gametangia conical, projected  $\frac{2}{3}$  or more of their length above the frond surface. . . . . *P. flaccida* (2)

#### 1. *Punctaria latifolia* GREVILLE

Alg. Brit. (1830), p. 52—J. AGARDH, Sp. Alg. I, p. 73—HAUCK, Meeresalg. p. 371, fig. 158—DE TONI, Syll. Alg. III, p. 474—YAMADA, Mar. Alg. Mutsu Bay, p. 506—OKAMURA, Mar. Alg. Jap. p. 219, fig. 116.

*Homoeostroma latifolium* J. AGARDH, Anal. Alg. Cont. III, (1896), p. 11—OKAMURA, Icon. Jap. Ag. IV, 1, p. 8, pl. CLIII; Nippon Sorui Meii, ed. 2, p. 150.

**Jap. name.** Habamodoki.

Frond broad-lanceolate to obovate, tapering gradually or abruptly toward the base, rounded or subtruncate at the apex, simple, or eroded or divided into 2 or 3 laciniae above, with minute dark brownish dots, densely scattered, often more or less perforate, olive brown, 10–25 cm. high, 3.5–13 cm. wide, ca. 180–210  $\mu$  thick; tissue composed of 4, at times 5 layers of cells, the cells in the inner layer much larger than those of the cortical layer; gametangia abundant, globular or slightly projected above the frond surface.

It seems to the present writer that the Japanese plant is rather thicker and more rugose than the American plant. (Cfr. SETCHELL

& GARDNER, Mar. Alg. Pacific Coast N. Amer. III, (1925), p. 519)  
The writer here follows OKAMURA's identification for the Japanese plant. The present species was found in the Kuriles only on the western coast of Kunasiri Isl., from the northern point southward.

**Habitat and localities.** Growing on rocks in the littoral zone, or epiphytic on the fronds of *Rhodomela subfusca*.

*S. Kuriles.* Kunasiri Isl.—Atoiya, Sokobetu, Sibetoro, Tosyoro, Ponkotan.

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

## 2. *Punctaria flaccida* NAGAI, sp. nov.

(Pl. II, figs. 12, 13; Pl. III, fig. 7)

Fronde solitaria aut pauciaggregata, flaccida, membranacea, lineari-lanceolata apice obtusa basi attenuata, dilute flavo-fuscescente, 2–4.5 cm. alta, 0.3–1.3 cm. lata, ca. 100–150  $\mu$  crassa, stipite brevissimo; cellulis 4-stratosis, duabus mediis multo majoribus quam corticalibus, illis 30–45  $\mu$ , his 21–27  $\mu$  altis; cellulis corticalibus parietalibus tenuibus, a superficie visis 4–5-angulatis, 21–33  $\mu$  diam.; gametangiis numerosis, plus minus conicis et  $2/3$  longitudinis suorum projicientibus; pilis ca. 15  $\mu$  latis.

The fronds are flaccid, membranaceous, linear-lanceolate with blunt apices and tapering at the bases, ending below in very short stipes. The color of the frond is light yellowish brown. When dried, the plant adheres firmly to paper. The specimens at hand measure 2 to 4.5 cm. high, 0.3 to 1.3 cm. wide and about 100 to 150  $\mu$  thick. In the cross section of the frond, the tissue is composed of 4 layers of cells, of which the cells in the inner layers are much larger than those of the cortical layers, measuring 30 to 50  $\mu$  diam. for the former and 21 to 27  $\mu$  for the latter. In the surface view of the frond, the cortical cells are 4–5 sided. They measure 21 to 33  $\mu$  in diameter. The gametangia are conical, measuring 36 to 60  $\mu$  high, 15 to 19.5  $\mu$  wide, and projecting two-thirds or more of their length above the frond surface. The hairs are found scattered in small groups upon the frond surface. They are about 15  $\mu$  wide. The species in question is characteristic in having conical gametangia and it differs from *P. latifolia* GREV. in the small size, the light yellowish color and the shape of the gametangia.

**Habitat and locality.** Growing solitary or in small groups, attached on sea grasses in the littoral zone.

*S. Kuriles.* Kunasiri Isl.—Tomari.

**Distrib.** Endemic (the Kuriles).

#### Family 12. *Asperococcaceae*

#### 14. *Soranthera* POSTELS et RUPRECHT, 1840

##### *Soranthera ulvoidea* POSTELS et RUPRECHT

Ill. Alg. (1840), p. 19—J. AGARDH, Sp. Alg. I. p. 120—KÜTZING, Sp. Alg. p. 566—KJELLMAN, Berighafv. Algfl. p. 47, pl. VII, fig. 4, 5—DE TONI, Syll. Alg. III, p. 492—SAUNDERS, Phyc. Mem. p. 165, pl. XXIX, fig. 4, 5—SETCHELL & GARDNER, Alg. N. W. Amer. p. 244; Mar. Alg. Pacific Coast N. Amer. III, p. 525, pl. XXXIX, fig. 40, 41, pl. LXXXIII, fig. b (figs. sub f. *typica*)—OKAMURA, Nippon Sorui Meii, ed. 2, p. 153; Mar. Alg. Jap. p. 223, fig. 118; Icon. Jap. Alg. VII, 9, p. 78, pl. CCCXLV, fig. 2, 3—YAMADA, Mar. Alg. Urup, p. 12, pl. II, fig. 1.

**Jap. name.** Tisima-hukuronori.

SETCHELL and GARDNER divided the species into two forms, f. *typica* and f. *difformis*, by the difference in the shape of the frond. According to them, f. *typica* is characterized by a frond which is nearly regular in outline, oval to spherical, measuring up to 7 cm. diam. and bearing thicker membrane, and f. *difformis* by gregarious, usually smaller and variously and deeply lobed fronds, with thinner membrane. As far as the writer has observed, the typical specimens in the Kuriles, are of nearly regular shape and measure 3 to 6 mm. diam., up to 1.8 cm. in extremity, but the difformous ones are usually larger than the former, measuring up to 3.8 cm. diam. The present writer therefore could not distinctly separate his specimens into the above forms, proposed by SETCHELL and GARDNER. This is a most common species in the Kuriles from the North Kuriles southward to Sikotan Isl. in the South Kuriles.

**Habitat and localities.** Growing on the fronds of various algae, e.g. *Odonthalia aleutica*, *O. floccosa*, etc., in the littoral zone, often found in the tide pools.

*N. Kuriles.* Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Simusiru Isl.—Nakadomari. Uruppu Isl.—Kobune, Misima, Iema (YAMADA).

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

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

### Family 13. *Scytosiphonaceae*

#### Key to the genera

- I. Fronds cylindrical, hollow ..... *Scytosiphon* (15)  
 II. Fronds globose or diffrmed, hollow ..... *Colpomenia* (16)

### 15. *Scytosiphon* AGARDH, 1811 (emend THURET, 1850)

#### *Scytosiphon Lomentarius* (LYNGBYE) J. AGARDH

Sp. Alg. I, (1848), p. 126—KJELLMAN, Alg. Arct. Sea, p. 258; Beringhafv. Algfl. p. 49—DE TONI, Syll. Alg. III, p. 485; Phyc. Jap. p. 56—SETCHELL & GARDNER, Alg. N. W. Amer. p. 243; Mar. Alg. Pacific Coast N. Amer. III, p. 531, pl. XLIV, fig. 72, 74, 75—OKAMURA, Nippon Sorui Meii, ed. 2, p. 152; Icon. Jap. Alg. I, 6, p. 144. pl. XXX; Mar. Alg. Jap. p. 227, fig. 121—COTTON, Some Chinese Mar. Alg. p. 111—HOWE, Chinese Mar. Alg. p. 136—SINOVA, Alg. Mer Ochotsk, p. 96; Alg. Kamtschatka, p. 15—TOKIDA, Mar. Alg. Robben Isl. p. 7—YAMADA, Mar. Alg. N. Kuriles, p. 344—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 210—TSENG, Mar. Alg. fr. Amoy, p. 25—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 202—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 174, pl. XV, fig. 2, pl. XVI, fig. 3.

*Chorda Lomentaria* LYNGBYE, Hydrophyt. Dan. (1819), p. 74, pl. XVIII, fig. E—HARVEY, Phyc. Brit. III, pl. CCLXXXV.

**Jap. name.** Kayamo-nori.

#### Key to the forms

- I. Fronds constricted at intervals, medium to large in size ..... f. *typicus*  
 II. Fronds not constricted.  
 A. Fronds cylindrical, percurrent ..... f. *cylindricus*  
 B. Fronds cylindrical, crooked or often twisted ..... f. *tortilis*

#### f. *typicus* SETCHELL et GARDNER

Mar. Alg. (1925), p. 533, pl. XXXIX, fig. 45, pl. XLIV, fig. 75.

#### f. *cylindricus* SETCHELL et GARDNER

l.c. (1925), p. 533.

f. *tortilis* YAMADA

Mar. Alg. Urup, (1935), p. 12, pl. I—OKAMURA, Mar. Alg. Jap. p. 228—KAWABATA, l.c. p. 202.

**Jap. name.** Yore-kayamo.

It seems to the writer that f. *typicus* grows more widely in the South Kuriles, while f. *tortilis* grows more frequently in the northern region and f. *cylindricus* is found more widely throughout the Kuriles than is either of the others.

**Habitat and localities.**

f. *typicus*. Growing on rocks in tide pools in the littoral zone.

*M. Kuriles*. Simusiru Isl.—Broughton Bay

*S. Kuriles*. Etorohu Isl.—Sibetoro. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Atoiya, Rebun-iso, Sokobetu, Tomari.

f. *cylindricus*. Growing on rocks along high-tide line in localities exposed to the surf.

*N. Kuriles*. Simusyu Isl.—Tenzin-iwa.

*M. Kuriles*. Rasyuwa Isl.—Sonraku-wan. Uruppu Isl.—Kobune.

*S. Kuriles*. Etorohu Isl.—Moyoro, Iriribusi. Sikotan Isl.—Tiboi, Notoro. Kunasiri Isl.—Atoiya, Sokobetu, Sibetoro, Tosyoro, Nikisiro, Kotankesi, Tomari.

f. *tortilis*. Growing in the same localities as f. *cylindricus*.

*N. Kuriles*. Araido Isl.—Sekinezaki. Paramusiru Isl.—Suribati-wan, Kurosaki.

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

*S. Kuriles*. Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Tosirari, Sibetoro, Rubetu. Sikotan Isl.—Notoro.

**Distrib.** *Sp.*—Atlantic Ocean, Mediterranean Sea, Arctic Ocean, Alaska, Bering Sea (Bering Isl., Konyam Bay, Port Clarence), Kamchatka, California, Okhotsk Sea, China and Japan (Formosa, Kyusyu, Honsyu, Hokkaido, Saghalien and the Kuriles); f. *cylindricus*—California and Japan (the Kuriles); f. *tortilis*—endemic (the Kuriles).

16. *Colpomenia* DERBES et SOLIER, 1856*Colpomenia sinuosa* (ROTH) DERBES et SOLIER

Mem. Phys. Alg. (1856), p. 11, pl. XXII, fig. 18–20—DE TONI, Syll. Alg. III, p. 489; Phyc. Jap. p. 55—SAUNDERS, Phyc. Mem. p. 164, pl. XXXII, fig. 7, 8;

Alg. Harriman Exp. p. 421—OKAMURA, Nippon Sorui Meii, ed. 1, p. 117, ed. 2, p. 151; Icon. Jap. Alg. I, 4, p. 86, pl. XIX, fig. 11, 12, pl. XX, fig. 10-12; Mar. Alg. Jap. p. 230, fig. 123—SETCHELL & GARDNER, Alg. N. W. Amer. p. 242; Mar. Alg. Pacific Coast N. Amer. III, p. 539, pl. XLV, fig. 82-86—HOWE, Mar. Alg. Peru, p. 50; Chinese Mar. Alg. p. 136—COLLINS, Chinese Mar. Alg. p. 205—SINOVA, Alg. Kamtschatka, p. 15—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 210—TSENG, Mar. Alg. fr. Amoy, p. 25—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 202.

*Ulva sinuosa* ROTH, Cat. Bot. III, (1806), p. 327, pl. XII.

*Encoelium sinuosum* AGARDH, Sp. Alg. I, 1, (1822), p. 146—KÜTZING, Sp. Alg. p. 552.

*Asperococcus sinuosus* BORY, Morée. III, (1832), p. 326—J. AGARDH, Sp. Alg. I, p. 75—HARVEY, Ner. Bor.-Amer. I, p. 118, pl. IX, fig. C.

#### Key to the forms

- I. Fronds globular, very thin and smooth ..... f. *typica*  
 II. Fronds extending into 1 to several, long, finger-like lobes..... f. *deformans*

#### f. *typica* SETCHELL et GARDNER

Mar. Alg. Pacific Coast. (1925), p. 540—OKAMURA, Mar. Alg. Jap. p. 231.

**Jap. name.** Hukuronori.

#### f. *deformans* SETCHELL et GARDNER

Alg. N. W. Amer. (1903), p. 242, pl. XVIII, fig. 13-15; Mar. Alg. Pacific Coast. p. 542—OKAMURA, Nippon Sorui Meii, ed. 2, p. 152; Mar. Alg. Jap. p. 231, fig. 124—YAMADA, Mar. Alg. Urup, p. 12.

*Scytosiphon bullosus* SAUNDERS, Phyc. Mem. (1898), p. 163, pl. XXXI, fig. 1-7; Alg. Harriman Exp. p. 421.

*Macrosiphon Asperococcoides* OKAMURA, Nippon Sorui Meii, ed. 1, (1902), p. 118 (nomen nudum).

**Jap. name.** Watamo.

The writer's specimens are sterile. They are, however, easily identifiable with the present species by the characteristic shape of the frond and its internal features. The present writer failed to find f. *deformans* in his collection, but was able to see the specimen from Uruppu Isl. through the courtesy of Prof. YAMADA.

**Habitat and localities.** Forma *typica* growing on the fronds of *Cystophyllum crassipes*.

*S. Kuriles.* Etorochu Isl.—Rubetu. Sikotan Isl.—Notoro. Kunasiri Isl.—Tohutu, Sibetoro, Kotankesi, Tomari.

f. *deformans*.

*M. Kuriles*. Uruppu Isl.—Iema (YAMADA).

**Disrtib.** *Sp.*—Atlantic Ocean, S. America (Peru), Alaska to California, Kamchatka, China and Japan (Kyusyu, Honsyu, Hokkaido, Saghalien and the Kuriles); f. *deformans*—Alaska to California, Kamchatka ?(YENDO) and Japan (Kyusyu, Honsyu, Hokkaido and the Kuriles).

#### Family 14. *Coilodesmaceae*

#### 17. *Coilodesme* STROEMFELT, 1886

##### Key to the species

- I. Fronds inflated.
  - A. Fronds subcomplanate and more or less bullose, saxicolous..... *C. bulligera* (1)
  - B. Fronds cylindrical, epiphytic on the fronds of other algae.
    - 1. Fronds 2–6 mm. wide ..... *C. Cystoseirae* (2)
    - 2. Fronds 0.8–4.5 cm. wide ..... *C. japonica* (3)
- II. Fronds complanate ..... *C. fucicola* (4)

#### 1. *Coilodesme bulligera* STROEMFELT

Meeresalg. Isl. (1886), p. 173; Om Algenveg. vid Isl. Kuster. p. 48, pl. II, fig. 9–12—DE TONI, Syll. Alg. III, p. 483—SAUNDERS, Alg. Harriman Exp. p. 422—YENDO, Notes Alg. New to Jap. p. 121—OKAMURA, Nippon Sorui Meii, ed. 2, p. 151; Mar. Alg. Jap. p. 235—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 581, pl. XLV, fig. 77, 78.

**Jap. name.** Oba-ezobukuro.

Fronds fasciculate, obolanceolate, more or less bullose, gradually tapering below and ending in slender stipes, slightly undulate on surface and margin, rounded or acuminate and later eroded at apices, 5.5–30 cm., mostly 12–20 cm. high, 1.5–4 cm. wide, yellowish brown, becoming olive- to dark-brown and adhering firmly to paper upon drying; stipes ca. 4–10 mm. long; frond wall 66–100  $\mu$  thick; frond tissue composed of 2 layers, cortical and medullary, cortex of 3 layers of subroundish cells, arranged in anticlinal rows, medulla of 1–2 layers of large, thin-walled, colorless cells; zoosporangia ovoid, 39–48  $\times$  18–24  $\mu$ , immersed within the cortex.

As to the length of the stipe, SETCHELL and GARDNER gave the dimension as about a decimeter long in the American plant, while the writer's specimens measure only about 4 to 10 mm. long. These specimens, however, accord well with the description and figures of the present species given by the authors above cited except for the measurement of stipe.

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

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

**Distrib.** Iceland, Alaska to Oregon and Japan (Saghalien and the Kuriles).

## 2. *Coilodesme Cystoseirae* (RUPRECHT) SETCHELL et GARDNER

Alg. N. W. Amer. (1903), p. 241; Mar. Alg. Pacific Coast N. Amer. III, p. 583—YAMADA, Notes Some Jap. Alg. VIII, p. 119, pl. XIX.

*Asperococcus Cystoseirae* RUPRECHT, Tange Och. Meeres, (1851), p. 370.

*Coilodesme linearis* SAUNDERS, Alg. Harriman Exp. (1901), p. 421, pl. XLVIII.

**Jap. name.** Hosozobukuro.

Lately Prof. YAMADA reported a plant identical with the true *C. Cystoseirae* which has a much narrower frond than the plant described by OKAMURA. As for the OKAMURA's plant, Prof. YAMADA treated it as a distinct new species. In his "Notes on Algae new to Japan," (1909), p. 122, YENDO mentions *C. Cystoseirae* as found attached to the frond of *Cystophyllum geminatum* in the Kuriles and Hokkaido. But the present writer cannot say exactly whether YENDO's plant belongs to the present or to the next species.

**Habitat and localities.** Growing on the fronds of *Cystophyllum crassipes*, *C. geminatum*, etc., in company with *C. japonica*.

*S. Kuriles.* Etorohu Isl.—Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan, Notoro. Kunasiri Isl.—Tohutu, Sokobetu, Tomari.

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

## 3. *Coilodesme japonica* YAMADA

Notes Some Jap. Alg. VII, (1938), p. 120, pl. XX.

*Coilodesme Cystoseirae* OKAMURA (not SETCHELL & GARDNER, Nippon Sorui Meii. ed. 2, p. 151; Icon. Jap. Alg. IV, 3, p. 55, pl. CLXIV, fig. 10-13; Mar. Alg. Jap. p. 235—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 202.

**Jap. name.** Yezobukuro.

The present species somewhat resembles *C. californica* KJELLM. in the external appearances. As far as the present writer is aware, *C. californica* is a plant of which the cortical cells are arranged in anticlinal rows, while such an appearance is not observable in the present species, but the cells are arranged in 1 to 3 rows and are cuboidal in shape. In these respects, the present species is related to *C. Cystoseirae*, but differs apparently from the latter in its broader fronds.

**Habitat and localities.** Growing on the fronds of *Cystophyllum crassipes*, *C. geminatum*, etc., often in company with *C. Cystoseirae*.

*S. Kuriles.* Etorohu Isl.—Iriribusi, Rubetu, Kamuikotan, Sikotan Isl.—Syakotan, Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Siranuka, Idasibenai, Rebun-iso, Seseki near Wennai, Huru-kamappu, Tohtu.

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

#### 4. *Coilodesme fucicola* (YENDO) NAGAI, comb. nov.

(Pl. II, figs. 19, 20)

*Coilodesme bulligera* f. *fucicola* YENDO, Some New Alg. fr. Japan, (1913), p. 279, pl. XIII, fig. 10, 11—OKAMURA, Nippon Sorui Meii, ed. 2, p. 151; Mar. Alg. Jap. p. 236, fig. 128—TOKIDA, Mar. Alg. Robben Isl. p. 8, fig. 2, pl. V, fig. a—YAMADA, Mar. Alg. Urup, p. 12, pl. II, fig. 2.

**Jap. name.** Hosoebukuro.

Fronds densely fasciculate, simple or rarely bifurcate, long-clavate, complanate, gradually tapering below and ending in slender stipes, slightly undulate on margin, rounded at apices, 3–7 cm. high, 0.5–1.2 cm. wide, 90–162  $\mu$  thick, greenish brown or olive brown upon drying; frond tissue composed of 2 layers, cortical and medullary, cortex of 2–3, usually 2 layers of small roundish cells, arranged vertically or in anticlinal rows, medulla of 2–3 layers of large, thin-walled colorless cells; zoosporangia ovoid, 30–36  $\times$  18–24  $\mu$ , immersed within the cortex.

YENDO first described the present species as a form of *C. bulligera* STROEMF. But it seems to the writer that it would better be treated as an independent species on account of the following characteristics. In the present species, the frond is smooth and

decidedly complanate, and has smaller dimensions compared with *C. bulligera*. The cortex is composed usually of 2 rows of small roundish cells, while it consists of 3 rows in *C. bulligera*. In the thickness of the frond, the dimensions of the zoosporangia and the difference of the habitat, it may possibly be separated from the latter species. TOKIDA states the presence of the bifurcate stipe in this species and in *C. bulligera*.

**Habitat and localities.** Growing on the blade of *Laminaria longipes*; according to Prof. YAMADA, also on *Desmarestia aculeata*.

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan, locality unknown (YENDO). Usisiru Isl.—Minamizima. Simusiru Isl.—Nakadomari. Uruppu Isl.—Kobune, Iema (YAMADA).

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

## Order VII. Dictyosiphonales

### Family 15. Dictyosiphonaceae

#### 18. *Dictyosiphon* GREVILLE, 1830

##### *Dictyosiphon foeniculaceus* (HUDSON) GREVILLE

Alg. Brit. (1830), p. 56, pl. VIII, fig. 1-4—J. AGARDH, Sp. Alg. I, p. 82—KÜTZING, Sp. Alg. p. 485—HARVEY, Phyc. Brit. III, pl. CCCXXVI; Ner. Bor-Amer. I, p. 114—KJELLMAN, Alg. Arct. Sea. p. 269; Beringhafv. Algfl. p. 51—DE TONI, Syll. Alg. III, p. 450—SAUNDERS, Alg. Harriman Exp. p. 422—OKAMURA, Nippon Sorui Meii, ed. 2, p. 157; Mar. Alg. Jap. p. 240, fig. 132—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 589, pl. XL, fig. 47-49—YAMADA, Mar. Alg. Mutsu Bay, II, p. 507; Mar. Alg. Urup, p. 14—SINOVA, Alg. Mer Ochotsk, p. 97; Alg. Kamtschatka, p. 18—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 183, pl. XII, fig. 4, pl. XIV, fig. 2.

*Conferva foeniculacea* HUDSON, Fl. Angl. (1762), p. 594.

**Jap. name.** Uikyomo.

Fronds finely branched, solitary or occasionally several arising from a confluent disc-shaped holdfast, terete, 10-28 cm. high, 0.3-0.5 mm. diam. in the main axis, alternate or occasionally opposite in branching, the earlier branches rather long, the ultimate branches fine, short, subulate and gradually attenuate; when young the

ultimate branches are covered with a dense growth of fine hairs, of ca. 6–7.5  $\mu$  width; superficial cells small, round or angular, ca. 4.5–6  $\mu$  diam., irregularly disposed or at times in subspiral longitudinal rows; zoosporangia spherical or ellipsoidal, 39–51  $\mu$  long, 24–39  $\mu$  wide, distributed at random immersed within the frond.

The writer could identify his specimens with the present species by the external appearances of the fronds, the arrangement of the superficial cells, the presence of the hairs, and the shape and size of the zoosporangia. The writer was able to compare his specimens with the American plant through the courtesy of Prof. Emer. MIYABE, to whom the specimen was presented from FARLOW's Herbarium after his death.

**Habitat and localities.** Growing on stones or on the fronds of *Scytosiphon Lomentarius* in the littoral zone.

*M. Kuriles.* Simusiru Isl.—Nakadomari. Uruppu Isl.—Misima, Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Iribusui, Rubetu. Sikotan Isl.—Tiboi, Syakotan, Notoro. Kunasiri Isl.—Ponkotan.

**Distrib.** Arctic Ocean, Atlantic Ocean, Bering Sea (Bering Isl. & Konyam Bay), Alaska to Washington, Kamchatka, Okhotsk Sea and Japan (Honsyu, Hokkaido and the Kuriles).

## Order VIII. Laminariales

### Family 16. Chordaceae

#### 19. *Chorda* STACKHOUSE, 1797

#### *Chorda Filum* (L.) LAMOUROUX

Essai. (1813), p. 26—HARVEY, Phyc. Brit. I, pl. CVII; Ner. Bor.-Amer. I, p. 98—HAUCK, Meeresalg. p. 394, fig. 172—DE TONI, Syll. Alg. III, p. 318; Phyc. Jap. p. 53—OKAMURA, Ill. Mar. Alg. Jap. I, p. 55, pl. XX; Nippon Sorui Meii, ed. 1, p. 126, ed. 2, p. 164; Mar. Alg. Jap. p. 243, fig. 134—SETCHELL & GARDNER, Alg. N. W. Amer. p. 254; Mar. Alg. Pacific Coast N. Amer. III, p. 592—YENDO, Kaisan-Syokubutugaku, p. 284, fig. 94—HOWE, Chinese Mar. Alg. p. 136—SINOVA, Alg. Mer Ochotsk, p. 100—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 211—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 187, pl. XIV, fig. 3, pl. XV, fig. 1.

*Fucus Filum* LINNAEUS, Sp. Plant. ed. 1, (1753), p. 1162.

**Jap. name.** Turumo.

The present plant was collected from the Bay of Tomari, Kunasiri Isl., but there are found no specimens, referable to the present species in the other islands. It is strange to say that the species in question is found on the American side of the Pacific Ocean in northern waters from Port Clarence, Alaska southward to the Strait of Juan de Fuca, while on the Asiatic side, it is verified to be distributed within the temperate region, from North China to the South Kuriles and Saghalien through Korea, Kyusyu, Honsyu and Hokkaido, as well as, rarely, in Schantar Isl. in the Okhotsk Sea, not far distant from Saghalien.

**Habitat and locality.** Growing on stones in quiet coves in the upper sublittoral zone.

*S. Kuriles.* Kunasiri Isl.—Tomari.

**Distrib.** Atlantic Ocean, Alaska to the Strait of Juan de Fuca, N. America, Okhotsk Sea, China and Japan (Kyusyu, Korea, Honsyu, Saghalien and the South Kuriles).

### Family 17. *Laminariaceae*

#### Key to the genera

- I. Sporophytic plant lacking any special blade (sporophyll) on which reproductive organ is formed.
  - A. Blade without perforations.
    1. Blade decaying away on the whole evenly from the tip downward to the base.
      - a. Rejuvenation occurs in a single region between stipe and blade.
        - i. Blade smooth.
          - a. Blade plane, sometimes ruffled along the median fascia ..... *Laminaria* (20)
          - β. Blade with 2-4, conspicuous, longitudinal folds on the median fascia ..... *Cymathaere* (21)
        - ii. Blade not smooth, but with sculptures on the surface..... *Kjellmaniella* (22)
      - b. Rejuvenation occurs in 2 different regions on both sides of the blade, forming dichotomous branching .... *Arthrothamnus* (26)
    2. Blade decaying away on the central fascia from the tip downward to the base, forming at last 2 arms from the thickened base, on which partial blades are formed as a result ..... *Streptophyllum* (25)
  - B. Blade sooner or later showing perforations.
    1. Blade with rib.
      - a. Ribs 5 in number ..... *Costaria* (23)
      - b. Only one rib, formed on the median portion.....*Agarum* (24)
    2. Blade without rib ..... *Thalassiohyllum* (27)

- II. Sporophytic plant having special blade (sporophyll) on which reproductive organ is formed.
- A. Sporophyll without midrib ..... *Alaria* (28)
- B. Sporophyll generally with midrib like that in the main blade.....  
..... *Pleuropterum* (29)

## 20. *Laminaria* LAMOUROUX (in part), 1813

### Key to the species and varieties

- I. Plant with a normal stipe and also with creeping rhizomes....*L. longipes* (1)
- II. Plant with only a normal stipe and lacking a creeping rhizome.
- A. Blade broad-lanceolate, lanceolate to linear-lanceolate, with rather thick, coriaceous, wide median fascia.
1. Marginal portion of the blade rather thick; holdfast composed of branched hapteres, which are arranged in 2-5 vertical rows at the base of stipe ..... *L. ochotensis* (2)
2. Marginal portion of the blade comparatively thin; holdfast composed of branched hapteres, which arise verticillately at first, then in irregular vertical rows..... *L. diabolica* (3)
- B. Blade linear.
1. Median fascia 1/5-1/6 as wide as the whole breadth of the blade.
- a. Stipe having abundant mucilage lacunae ... *L. angustata* (4<sup>a</sup>)
- b. Stipe lacking in mucilage lacunae .....  
..... *L. angustata* var. *longissima* (4<sup>b</sup>)
2. Median fascia 2/3-3/5 as wide as the whole breadth of the blade  
..... *L. coriacea* (5)
- C. Blade lanceolate, provided with 2 rows of bullae lengthwise on the median fascia throughout whole life.
1. Blade entire, not crispate on the margin ..... *L. sachalinensis* (6)
2. Blade more or less crispate on both margins.....*L. sikotanensis* (7)
- D. Blade linear, broad-linear or ovate, coriaceous, usually divided into several segments.
1. Holdfast composed of branched hapteres.
- a. Blade simple, more or less split at the upper end.
- i. Blade linear ..... *L. taeniata* (8)
- ii. Blade broad-linear ..... *L. subsimplex* (9)
- b. Blade palmate.
- i. Stipe cylindrical near to the apex..... *L. dentigera* (10)
- ii. Stipe compressed upward from 1/4-1/3 of the distance from the base ..... *L. platymeris* (11)
2. Holdfast scutate ..... *L. yezoensis* (12)

### 1. *Laminaria longipes* BORY

in Dict. Class. IX, (1826), p. 189—KÜTZING, Sp. Alg. p. 574—ARESCHOUG, Obs. Phyc. IV, p. 15.

*Lessonia repens* RUPRECHT, Tange Och. Meeres, (1851), p. 351.

*Laminaria Ruprechtiana* LE JOLIS, Examen. (1855), p. 71.

*Arthrothamnus ? longipes* J. AGARDH, De Lamin. (1867), p. 26—DE TONI, Syll. Alg. III, p. 370.

#### Key to the forms

- I. Blade linear.
  - A. Blade wide, 2–4 cm. wide ..... f. *angustifolia*
  - B. Blade narrow, 5–12 mm. wide ..... f. *linearis*
- II. Blade linear- or oblong-lanceolate, 4–13 cm. wide. .... f. *latifolia*

#### f. *angustifolia* (POST. et RUPR.) MIYABE et NAGAI, comb. nov.

*Laminaria saccharina* f. *angustifolia* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 10, Tab. XI.

*Laminaria longipes* BORY; KJELLMAN, Beringhafv. Algfl. (1889), p. 43—SETCHELL, Alg. Pribilof Isl. p. 591, pl. XCV; Kelps U.S. & Alaska, p. 150—SETCHELL & GARDNER, N. W. Amer. p. 260; Mar. Alg. Pacific Coast N. Amer. III, p. 597—YENDO, Notes Alg. New to Jap. p. 125; Kaisan-Syokubutugaku, p. 295—OKAMURA, Nippon Sorui Meii, ed. 2, p. 172; Mar. Alg. Jap. p. 251, fig. 139—SINOVA, Alg. Kamtschatka, p. 24, fig. 8–10—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 196; Laminariaceae Kuriles, p. 86—OKADA, Kaiso-zuhu, p. 46, pl. XLIII—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 288.

#### Jap. name. Hime-kombu.

Stipe terete, 13–37 cm. long, ca. 3–4 mm. diam.; blade coriaceous, plane, undivided, ribbon-shaped, with cuneate base and acuminate or rounded apex, pale brown in color, 2–4 cm. wide, 30–58 cm. long; mucilage lacunae absent from stipe, but present in blade; sori rarely observed, developing on one side of the blade, occupying almost whole surface of the basal portion.

#### f. *linearis* MIYABE et NAGAI, f. nov.

#### Jap. name. Himo-himekombu (n.n.).

Stipite tereti; lamina coriacea, anguste lineari, 37–62 cm. longa, 5–12 mm. lata, basi acuta; lacunis muciferis in stipite absentibus; lacunis laminae in subcortice sparse dispositis, aliquando absentibus; sori supra a basi in utraque superficie laminae lineariter evolutis.

The stipe is terete in great part, measuring 7 to 13 cm. long, about 2 to 3 mm. diam. The blade is narrow-linear, more or less thick, and acute at the base. Blades measure 37 to 62 cm. long, 5 to 12 mm. wide. The mucilage lacunae are absent from stipe, but

present or sometimes quite absent in blade. The sori are formed on both surfaces of the blade, making simple elongate patches.

f. *latifolia* YAMADA

Mar. Alg. Urup, (1935), p. 18, fig. 7, pl. VI—OKAMURA, Mar. Alg. Jap. p. 251—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 288.

**Jap. name.** Hiroha-himekombu.

The present species was easily identified by the characteristics of the rhizome-like holdfast on which new erect fronds are formed, and by the rather slender and cylindrical stipe, which is destitute of mucilage lacunae. The f. *latifolia* was found first by Prof. YAMADA in Uruppu Isl., and now its wider distribution among the other islands of the Kuriles has been ascertained. It is distinguishable from the typical form, f. *angustifolia* in having a broader blade which is at the base broadly cuneate or rounded. In the f. *linearis*, the blade is very narrow, measuring only 5 to 12 mm. wide, and acute at the base. It differs clearly from the others in these points.

**Habitat and localities.** Growing on rocks, forming an association, at the low tide water mark.

f. *angustifolia* is distributed more widely, compared with the other forms.

*N. Kuriles.* Araido Isl.—Uomizaki, Sekinezaki, Minami-ura. Simusyu Isl.—Kataoka-wan, Nagasaki, Tenzin-iwa, Kosekigawa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kuroaki, Kakumabetu.

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

f. *linearis* prefers a habitat where the current flows more strongly.

*M. Kuriles.* Musiru Islet, Ketoi Isl.—Minami-wan. Simusiru Isl.—Nakadomari.

f. *latifolia* seems to prefer comparatively calm waters.

*N. Kuriles.* Paramusiru Isl.—Kakumabetu.

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

**Distrib.** *Sp.*—Bering Sea (St. Paul Isl., Bering Isl.), Alaska, Aleutian Isls., Kamchatka, Okhotsk Sea and Japan (Saghalien and the Kuriles); *f. angustifolia*—Kamchatka, Bering Isl., Alaska and Japan (Saghalien and the Kuriles); *f. linearis*—endemic (the Kuriles); *f. latifolia*—endemic (the Kuriles).

## 2. *Laminaria ochotensis* MIYABE

Laminariaceae Hokkaido, (1902), p. 23, pl. II; in OKAMURA's Mar. Alg. Jap. p. 285—OKAMURA, Nippon Sorui Meii, ed. 1, p. 130, ed. 2, p. 170; Mar. Alg. Jap. fig. 138—YENDO, Kaisan-Syokubutugaku, p. 364, fig. 114—Ueda, Suisan-Syokubutugaku, p. 243, fig. 266—MIYABE & NAGAI, Laminariaceae Kuriles, p. 89—OKADA, Kaiso-zuhu, p. 47, pl. XLIV.

*Laminaria japonica f. angusta* OKAMURA, Laminaria Japan, (1896), p. 88 (p. p.).

*Laminaria japonica* OKAMURA (not ARESCHOUG), Mar. Alg. Jap. (1936), p. 248 (p. p.).

**Jap. name.** Risiri-kombu.

Holdfast composed of 4–7 times dichotomously branched hapteres, arising at an early stage of development verticillately from the base of stipe, soon newly issued successively above and more or less oppositely in 2 vertical rows, 5–9 cm. long; stipe 3–5 cm. long, subterete at the base, becoming flattened upward, 4–7 mm. wide, 1.5–2 mm. thick; blade coriaceous, dark brown upon drying, linear-lanceolate with entire margin, broad-cuneate at the base, 0.85–2.28 m., mostly 1.30–2.25 m. long, 6.5–15 cm., mostly 11–13 cm. wide, median fascia rather thick, ca. 1/3 as wide as the whole breadth of the blade, not so much ruffled along both sides as in *L. japonica*, marginal portions not very thin and very undulate; mucilage lacunae in stipe numerous, rather large, ovate or elliptic in cross section, arranged in a row in the subcortical layer, in addition to which there are some other large isolated ones; lacunae of blade round, arranged rather sparsely in a row in the subcortical layer; sori formed widely over the under surface of the basal part of the blade, developed further upward on the median fascia of the upper portion, sometimes found also on the upper surface.

This is one of the common species of *Laminaria* in Japan, which is sold widely on the market as food. In the present species, the blade is not so much ruffled along the median fascia as in *L.*

*japonica* ARESCH., but is more or less evenly thickened in the median and marginal portions. Upon drying it becomes rather dark brown, and more black in color than do the allied species. The base of the blade is generally broad-cuneate. The holdfast consists of many hapteres which arise at the earlier stage of development verticillately from the base of the stipe, but later develop successively above, resulting in vertical rows in outline. The present species has some resemblances either to a large specimen of *L. religiosa* MIYABE or of *L. fragilis* MIYABE, but it differs from these species in the above and other characters.

**Habitat and localities.** Growing in the sublittoral zone on rocks in a depth of 2-5, rarely 7 or 8 fathoms, preferring open places.

*S. Kuriles.* Kunasiri Isl.—Atoiya, Sokobetu, Rurui, Nikisiro, Kotankesi.

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

### 3. *Laminaria diabolica* MIYABE

Laminariaceae Hokkaido, (1902), p. 29.

Holdfast consisting of numerous, 4-5 times dichotomously branched hapteres, arising at an early stage verticillately from the base of stipe, soon newly issued successively above, resulting in more or less irregular vertical rows, 4-9 cm. long; stipe variable in length, subterete, becoming flattened upward; blade coriaceous, olive brown to dark brown, linear, linear- or broad-lanceolate, 1.5-13.20 m. long, variable in width, with thick or moderately thick median fascia and thinner conspicuously undulated marginal portions; mucilage lacunae in stipe of medium size, arranged rather closely in a circle in the middle portion of the subcortical layer; lacunae of blade round, arranged in a row or sometimes in 2 rows in the subcortical layer; sori formed on both surfaces of the blade.

#### Key to the forms

- I. Blade broad-lanceolate, thick.
  - A. Stipe 6-14 cm. long ..... f. *genuina*
  - B. Stipe 30-70 cm. long ..... f. *longipes*
- II. Blade linear-lanceolate ..... f. *angustifolia*

f. *genuina* MIYABE et NAGAI, f. nov.

*Laminaria diabolica* MIYABE, l.c. (1902), pl. VII; in OKAMURA's Mar. Alg. Jap. p. 285—OKAMURA, Nippon Sorui Meii, ed. 1, p. 131.

*L. longipedalis* OKAMURA, Nippon Sorui Meii, ed. 2, (1916), p. 170 (p. p.).

*L. longipedalis* var. *diabolica* MIYABE, in Proc. 3rd Pan-Pacific Sci. Congr. (1926), p. 956—MIYABE & NAGAI, Laminariaceae Kuriles, p. 88—OKAMURA, Mar. Alg. Jap. p. 250.

**Jap. name.** Oni-kombu.

Radice ramosa, ramis ex basi stipitis plus minus verticillatis; stipite in basi subtereti, supra gradatim complanato; lamina coriacea, lineari-lanceolata vel late lanceolata, basi rotundata vel late cuneata, fascia media crassa, ca. 1/2 – 1/4 totius latitudinis; lacunis muciferis in stipite in subcortice circulatim locatis; lacunis laminae rotundatis, in subcortice fasciae mediae sparse 1–2 ordines, in ipso marginis 1 ordinem dispositis; soris supra a basi in superficie utraque laminae late locatis.

f. *longipes* MIYABE et TOKIDA

in OKAMURA's Mar. Alg. Jap. (1936), p. 285.

*Laminaria longipedalis* SINOVA (not OKAMURA), Alg. Mar. Jap. (Phaeoph.), (1929), p. 39.

**Jap. name.** Enaga-onikombu (n.n.).

Stipite subter subtereti, supra complanato; lamina subcoriacea, late lanceolata, basi acuta, fascia media 1/4–1/5 totius latitudinis, parte extra tenui et plus minus undulata; lacunis stipitis muciferis in sectione transversa iis f. *genuinae* similibus; lacunis laminae rotundatis, minoribus, in subcortice seriatim dispositis; soris supra a parte media in superficie utraque laminae, dein ad marginem et inferne irregulariter evolutis.

f. *angustifolia* MIYABE et NAGAI, f. nov.**Jap. name.** Hosoba-onikombu (n.n.).

Stipite subter subtereti, supra complanato; lamina subcoriacea, lineari, marginibus totis, basi acuta, fascia media ca. 1/3 totius latitudinis; lacunis muciferis in sectione transversa stipitis amplitudinis mediae, ovatis, plerumque plus minus angustis, in cortice

inferiore seriatim juxta dispositis, lacunis laminae rotundatis, in subcortice plus minus irregulariter dispositis; soris supra in subfacie laminae a basi ad fasciam mediam biseriatim in longitudinales vittas extendentibus.

This is another large species, besides *L. japonica* ARESCH. among the Japanese species of *Laminaria*. The specimens of f. *genuina* which have a blade rounded at its base, resemble *L. japonica* f. *typica* OKAM. on the one hand and the blades which become broad-cuneate resemble *L. ochotensis* MIYABE on the other. This form differs, however, from both of them in the shape of the holdfast, of which the hapteres are arranged in more or less irregular vertical rows. There are also other differences among them. In the two year old individuals of *L. japonica* f. *typica* OKAM., the stipe is usually short and very complanate and wide, but in this form rather longer, subcylindrical and becoming slightly flattened above. The blade of *L. japonica* f. *typica* is thicker than that of this form. In the shape of the stipe, this form and *L. ochotensis* resemble each other rather closely, but differ in length. The stipe of the present form is rather longer than that of *L. ochotensis*. These species differ, moreover, in the consistency of the blade. In this form, the median fascia are thick and subcoriaceous, but the outer marginal portions are thinner. In *L. ochotensis*, however, there are as a rule no remarkable differences between them in respect to thickness. The blade of *L. ochotensis* is black or very dark brown in color, while in this form it is somewhat lighter upon drying. Among the Japanese species of *Laminaria* having an undivided blade there is no one that bears such a long stipe and large blade, as does f. *longipes* of the present species. The specimens that the writer collected at Ponkotan, Kunasiri Isl., reached a length of 13.96 m. The length of the blade, stipe and holdfast measured 7.25 to 13.20 m. for the first, 28 to 57 cm. for the second and 12 to 20 cm. long for the third, respectively. The base of the blade in this form, is usually broad-cuneate and does not become rounded as in f. *genuina*.

Forma *angustifolia* is characterized by its narrower blade which measured only 4 to 9 cm. wide, while the width of the blade in other forms attains to 40 cm. or more. The present form grows abundantly on the western coast of Kunasiri Isl.

**Habitat and localities.** Growing gregariously on stony or rocky

bottom in open or sheltered places.

f. *genuina* grows in the sublittoral zone in a depth of about 1–2 fathoms, preferring rather calm waters.

*S. Kuriles.* Etorohu Isl.—Torikamui, Sibetoro, Bettobu, Syana, Rubetu, Kamuikotan, Naibo. Kunasiri Isl.—Atoiya, Tohtu, Sokobetu, Rurui.

f. *longipes* grows in deeper bottom where a stronger current flows, in comparison with the habitat of f. *genuina*. In the island of Kunasiri, this form was obtained from a depth of ca. 7 fathoms by dredging.

*S. Kuriles.* Kunasiri Isl.—Ponkotan.

f. *angustifolia* grows in a depth of ca. 2–4 fathoms where the current is rather stronger than in the habitat of f. *genuina*.

*S. Kuriles.* Kunasiri Isl.—Atoiya, Rurui, Kotankesi.

**Distrib.** *Sp.*—Japan (Saghalien, Hokkaido and the Kuriles); f. *longipes*—Saghalien and the Kuriles; f. *angustifolia*—the Kuriles.

#### 4a. *Laminaria angustata* KJELLMAN

in KJELLMAN och PETERSEN, Japans Laminariaceer, (1885), p. 266—DE TONI, Syll. Alg. III, p. 350; Phyc. Jap. p. 51—OKAMURA, Laminaria Japan, p. 96, pl. VII, fig. 5; Nippon Sorui Meii, ed. 1, p. 132, ed. 2, p. 172; Mar. Alg. Jap. p. 252, fig. 135 (4)—MIYABE, Laminariaceae Hokkaido, p. 35, pl. V; in OKAMURA's Mar. Alg. Jap. p. 287—YENDO, Kaisan-Syokubutugaku, p. 355, fig. 112—OKAMURA & UEDA, *Laminaria angustata* & *L. longissima*, p. 20–25, (1–6), pl. I.

**Jap. name.** Mituisi-kombu.

Holdfast composed of 4–8 times dichotomously branched hapteres, arising verticillately from the base of stipe, 3–5 cm. long, with numerous mucilage lacunae in the subcortical layer; stipe 3–7.6 cm. long, subterete below, becoming flattened above, 6–8 mm. wide, 4–6 mm. thick; blade linear, plane on the whole or only on the narrow median fascia and slightly undulate on the marginal portions, mostly 1.2–14 m. long, 4.5–15 cm. wide, median fascia narrow, ca. 1/5–1/6 as wide as the whole breadth; mucilage lacunae in stipe numerous, small, elliptic or elliptic with angular edges in cross section, arranged closely in a row just beneath the periphery, sometimes discontinuous here and there in arrangement; lacunae of blade in surface view in disconnected linear or narrow reticula-

tions on the median fascia, becoming variable in shape and arrangement on the marginal regions, in cross section round, arranged in a row at irregular intervals in the subcortical layer; sori formed ordinarily on the under surface of the blade from the base upward about  $1/3$  to  $1/2$  of the whole length, leaving the median fascia sterile.

4b. var. *logissima* MIYABE

in OKAMURA's Mar. Alg. Jap. (1936), p. 287.

*Laminaria longissima* MIYABE, Laminariaceae Hokkaido, (1902), p. 37, pl. IV—OKAMURA, Nippon Sorui Meii, ed. 1, p. 132, ed. 2, p. 173—YENDO, Kaisan-Syokubutugaku, p. 367—MIYABE & NAGAI, Laminariaceae Kuriles, p. 78—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 205 (sub forma).

**Jap. name.** Naga-kombu.

Holdfast composed of verticillate, dichotomously branched hapteres, with numerous mucilage lacunae, like the species; stipe 4.5–7.6 cm. long, subterete, becoming flattened above, 6–8 mm. wide, 4–6 mm. thick; blade linear, very long, 3.2–10 m., rarely up to 21.8 m. long, 10–15 cm. wide, median fascia ca.  $1/5$  as wide as the whole breadth; mucilage lacunae absent from the stipe; lacunae of blade in surface view of the median fascia show linear or narrow reticulations, on the marginal region narrowly to widely reticulated, rarely somewhat variable in shape, in cross section round, arranged in a row in the subcortical layer; sori formed on the under surface of the blade except on the median fascia as in the species, or often developed on both surfaces from the base upward about one half of the whole length.

According to KJELLMAN, the present species is characteristic in having an enormously long blade, covered with sori on one of its surfaces, and lacking mucilage lacunae in both blade and stipe. In 1902, MIYABE published a paper on the Laminariaceae of Hokkaido, in which he noted this species as having mucilage lacunae in blade, and rarely also in stipe. He observed them in blade, in surface view being arranged more or less irregularly and isolated into many small pieces like a broken net. In his paper,<sup>1</sup> he established *Laminaria longissima*, related closely to *L. angustata* of KJELLMAN, but distinguished from it in having reticular lacunae which are arranged uniformly on the whole surface of the blade, as well as in wanting them in stipe, and also in being provided with sori on

both surfaces of the blade from the base upward to the middle. In 1925, OKAMURA and UEDA studied the structure of the mucilage lacunae in blade, stipe and rootlets, as well as the mode of the sori-formation of these species. As the result of their studies, they came to the opinion that these species should better be amalgamated into one species than be treated respectively as independent ones. After recent researches upon the materials collected from various districts, the present writer now agrees with OKAMURA and UEDA's opinion in the specific conception of these species. As far as the present studies have shown, the mucilage lacunae in the blade may be divided, as a whole, into four kinds in shape in surface view of the blade either in the present species or in its var. *longissima*, viz., linear, reticular, scattered into many small pieces of irregular shapes, and scatteringly spotted. In any of the above, the lacunae in the median fascia of the blade, are linear or narrowly reticulated. As to the lacunae in the marginal area, there are a few differences between the species and the variety. In the species, the lacunae are found also reticulated in the upper portion or on the whole of the blade, but occasionally are variable in shape and arrangement from the lower to the middle portions. In the latter case, they are scattered more often into small groups of irregular shape, and are sometimes lacking to a certain extent here and there in one side of the marginal regions or on one surface or on both surfaces of the blade. In var. *longissima*, the lacunae are almost always regularly reticulated and arranged uniformly on both surfaces from the base upward to the blade tip, or upward from some distance from the base. In the lower, rarely in middle portions, there are sometimes found widely separated numerous small masses of secreting cells which are scatteringly spotted without the development of lacunae.

As to the lacunae in the stipe, they are arranged in a row beneath the periphery, sometimes discontinuing here and there in the species, but quite absent in var. *longissima*.

As to the mode of sori-formation, the sori are formed only on the under surface of the blade leaving the median fascia sterile in the species, but they are formed on both surfaces in var. *longissima*. In the former, however, they are found rarely in a small area on the median fascia of the upper surface besides on the under surface.

**Habitat and localities.** Growing on rocks or on stones in the sublittoral zone in a depth of 7 fathoms at most.

The species prefers the open sea, in such localities as where a small amount of warm current is mixed with the cold.

*S. Kuriles.* Etorohu Isl.—Naibo. Sikotan Isl.—Syakotan. Kunasiri Isl.—Atoiya, Hurukamappu.

The habitat of var. *longissima* is like that of the species, but it seems that the variety prefers localities where a more or less plentiful amount of cold current washes the shores.

*S. Kuriles.* Etorohu Isl.—Iribusi. Sikotan Isl.—Notoro, Aimizaki, Tiboi. Kunasiri Isl.—Idasibenai, Tinomizi, Pontomari, Seseki near Wennai.

**Distrib.** *Sp.*—Japan (Honsyu, Hokkaido and the Kuriles); var. *longissima*—Hokkaido and the Kuriles.

### 5. *Laminaria coriacea* MIYABE

Laminariaceae Hokkaido, (1902), p. 40, pl. XI; in OKAMURA's Mar. Alg. Jap. p. 287—OKAMURA, Nippon Sorui Meii, ed. 1, p. 132, ed. 2, p. 173; Mar. Alg. Jap. p. 253—MIYABE & NAGAI, Laminariaceae Kuriles, p. 87—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 205.

**Jap. name.** Gaggara-kombu.

Holdfast composed of 3–6 times dichotomously branched hapteres, arising verticillately from the base of stipe, 2.5–5 cm. long; stipe rather short, 2.5–5 cm. long, subterete, slightly flattened upward, 2.5–7 mm., mostly 3.5–5 mm. diam.; blade coriaceous, linear, plane or with wide median fascia, olive brown, rounded at the base; 132–415 cm., mostly 150–250 cm. long, 5–21 cm., mostly 6–12 cm. wide, median fascia  $\frac{2}{3}$ – $\frac{3}{5}$  as wide as the whole breadth; mucilage lacunae absent from the stipe or very rarely present, arranged at irregular intervals in the subcortical layer, irregular in size and shape; lacunae of blade arranged sparsely in a row in the subcortical layer; sori formed on both surfaces of the blade, occupying almost whole surface of the lower, but extending upward separating into 2 longitudinal patches.

The present species is readily identifiable by the linear blade which is almost always plane and by the possession of a rather wider median fascia in comparison with the linear-formed species,

*L. angustata*. Moreover, the blade of the present species is far shorter than that of the latter. Sometimes specimens are found, in which the old blade is not frayed away from the apex of the new one.

**Habitat and localities.** Growing in the sublittoral zone on rocky bottom in a depth of 3–4 fathoms.

*S. Kuriles.* Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Tinomizi, Pontomari, Seoi, Hurukamappu, Tohutu.

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

### 6. *Laminaria sachalinensis* MIYABE

in MIYABE & NAGAI, Laminariaceae Kuriles, (1933), p. 87 (excl. syn. *L. cichorioides* var. *sachalinensis* MIYABE)—OKAMURA, Mar. Alg. Jap. (1936), p. 251 (excl. syn. *L. cichorioides* var. *sachalinensis*)—MIYABE in OKAMURA's Mar. Alg. Jap. p. 286.

Holdfast composed of 3–4 times dichotomously branched hapteres, arising more or less verticillately from the base of stipe, 3.5–6 cm. long; stipe rather short, terete, somewhat flattened upward, commonly 3.5–6.5 cm. long, 4–6 mm. diam.; blade simple, dark brown, lanceolate, becoming gradually broadened upward from  $1/6-2/3$  or  $3/4$  of the distance from the base, coriaceous and thickened in the median fascia, more or less membranaceous in the outer portions, rounded at the base, plane below, more or less undulate on the middle and upper regions, with 2 rows of fine bullae on the median portion extending throughout the whole length, of which the lower half sometimes vanish in the old specimens, 54–128 cm. long, 13–23 cm. wide at the broadest part, median portion ca.  $1/3$  as wide as the whole breadth; mucilage lacunae in stipe narrow, closely arranged just beneath the periphery in cross section; lacunae of blade of moderate size, arranged in a row in the outer portion of the subcortical layer; sori formed in patches on the median portion of the blade from near the base.

The present species closely resembles *L. cichorioides* MIYABE but it differs from the latter by its blade being not crispate at the margin of the lower half and by its larger size. The blade attains often to the size of *L. ochotensis* MIYABE and resembles closely that species, when the bullations appear less distinctly in some cases. The present species, however, differs from it in having verticillate

hapteres and narrower stipe.

**Habitat and localities.** Growing on rocky bottom in the sublittoral zone at a depth of ca. 2–4 fathoms.

*S. Kuribes.* Kunasiri Isl.—Atoiya, Tohutu, Sokobetu, Rurui, Nikisiro, Kotankesi, Ponkotan.

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

7. *Laminaria sikotanensis* MIYABE et NAGAI, sp. nov.

(Pl. III, fig. 10)

**Jap. name.** Sikotan-tororokombu.

Radice fibrosa, ramis numerosis, 5–8es dichotome ramosis, in infima parte basilari stipitis verticillatis; stipite brevi, 1.5–3 cm. longo, ca. 3.5 mm. diam.; lamina coriacea, in parte marginis membranacea, late lanceolata, ad 2/3 distantiam a basi latissima, 125–260 cm. longa, 18–45 cm., saepe 25–40 cm. lata, basi rotundata vel interdum cordata, ad marginem leviter undulata, bullis magnis longitudinaliter biserialiter insignantibus, in senili saepe inferius evanescentibus; lacunis muciferis in stipite absentibus; lacunis laminae in subcortice serialiter dispositis; soris superne in superficie utraque laminae irregulariter lateque evolutis.

The holdfast consists of numerous, 5 to 8 times branched hapteres, growing in more or less verticillate manner. The stipe is short, 1.5 to 3 cm. long, about 3.5 mm. in diam. The blade is coriaceous, broad-lanceolate with rounded or sometimes cordate base, keeping its maximum width to a point about 2/3 of the distance from the base, more or less undulate on the margin, and usually with two longitudinal rows of bullae on the median portion, of which the lower half sometimes vanish in age. The blade measures 125 to 260 cm. long, 18 to 45 cm., mostly 25 to 40 cm. wide. The median fascia of the blade is about 1/3 to 1/4 as wide as the whole breadth at the widest portion. The mucilage lacunae are absent from the stipe, and the lacunae of blade are round in a cross section, being arranged in a row in the outer portion of the subcortical layer. The sori are formed on both sides of the upper portion of the blade, forming irregular patches in a comparatively wide range on both surfaces.

The species in question is closely related to *L. Yendoana* MIYABE from Hokkaido and also to *L. sachalinensis* MIYABE in res-

pect to the possession of two longitudinal rows of bullae on the median fascia of the blade. But it differs from the former in being rather coarse and less mucilaginous in the blade and showing a slightly larger diameter of the stipe, and from the latter in having a larger but somewhat thinner blade as well as a lacunae-lacking stipe.

**Habitat and localities.** Growing on rocks in a depth of ca. 2 fathoms at ebb tide, in the sublittoral zone.

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

**Distrib.** Endemic (the Kuriles).

### 8. *Laminaria taeniata* POSTELS et RUPRECHT

Ill. Alg. (1840), p. 10, Tab. XXXVIII, fig. f.—KÜTZING, Sp. Alg. p. 576—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 197, fig. 1; Laminariaceae Kuriles, p. 89—OKAMURA, Mar. Alg. Jap. p. 255—MIYABE, in OKAMURA'S Mar. Alg. Jap. p. 289.

*Laminaria Bongardiana* f. *taeniata* KJELLMAN, Beringhafv. Algfl. (1889), p. 44.

*L. platymeris* f. *taeniata* SETCHELL et GARDNER, Mar. Alg. Pacific Coast N. Amer. III, (1925), p. 606.

**Jap. name.** Hosoba-tyasenkombu.

Holdfast composed of a globular mass of several times dichotomously branched hapteres, arising verticillately from the base of stipe, ca. 2 or 3 cm. long; stipe subterete below, more or less compressed upward, ca. 5 mm. diam., 6–9 cm. long; blade coriaceous, moderately thick, plane, linear, split into a few linear lobes at the upper end, more or less undulate on the margin, narrow-cuneate at the base, 8–15 cm., mostly 11–14 cm. wide, 229–426 cm. long, pale brown when dried; mucilage lacunae in stipe rather small, closely arranged in a row in the outer portion of the subcortical layer; lacunae of blade scanty, small and inconspicuous, situated in the outer portion of the subcortical layer; sori extended in longitudinal bands or scattered in small spots on the middle portions of the blade.

Although the present writer was not able to examine the authentic specimens, the characters of the plant at hand coincide well with the original description and illustration of POSTELS and RUPRECHT. The author collected a large number of specimens of

this species in the North Kuriles, not far from the type locality on the eastern coast of Kamchatka. Prof. MIYABE and the present author are of the opinion that it is better to treat the present plant as an independent one rather than as a form of either *L. Bongardiana* POST. et RUPR. or of *L. platymeris* DE LA PYL.

**Habitat and localities.** Found cast ashore.

*N. Kuriles.* Simusyu Isl.—Nagasaki, Tenzin-iwa. Paramusiru Isl.—Suri-bati-wan, Titose-wan.

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

### 9. *Laminaria subsimplex* MIYABE et NAGAI

Laminariaceae Kuriles, (1933), p. 89—OKAMURA, Mar. Alg. Jap. p. 254—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 289.

*Laminaria bullata* f. *subsimplex* SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 257—YENDO, Notes Alg. New to Jap. p. 124—OKAMURA, Nippon Sorui Meii, ed. 2, p. 174.

*L. cuneifolia* f. *subsimplex* SETCHELL et GARDNER, Mar. Alg. Pacific Coast N. Amer. III, (1925), p. 602—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 199, fig. 2.

**Jap. name.** Tisima-satumatakombu.

After comparison with the authentic specimen kindly contributed from the Department of Botany, University of California, the specimens at hand are able to be identified with *L. cuneifolia* f. *subsimplex* SETCH. et GARDN. In the Kurile plant, the bullation does not usually appear on the blade, but it does appear only in the specimens from the eastern coast of Paramusiru Isl. The stipe is terete below, but evidently compressed upward, and sometimes twisted. The plant having narrow blade is somewhat similar to the wide form of *L. taeniata* POST. et RUPR., but separable from it in the length of the blade and in the different forms of the mucilage lacunae in the stipe and blade. It seems that the present alga should better be treated as an independent species rather than as a form of *L. cuneifolia* J. AG. The present species differs from the latter in having the blade splitting often into two, three or more segments and in the scanty occurrence of the bullae.

**Habitat and localities.** Growing in the low tide mark zone, sometimes together with *Streptophyllum spirale*.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan, Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Murakami-wan, Arakawa, Kamogawa, Kakumabetu.

*M. Kuriles.* Simusiru Isl.—Broughton Bay.

**Distrib.** Whidbey Isl., Washington and Japan (the Kuriles).

#### 10. *Laminaria dentigera* KJELLMAN

Beringhafv. Algfl. (1889), p. 45, Tab. II, fig. 10-14—DE TONI, Syll. Alg. III, p. 342—YENDO, Notes Alg. New to Jap. p. 124; Kaisan-Syokubutugaku, p. 293, fig. 95—SETCHELL, Kelps of U.S. & Alaska, p. 151—OKAMURA, Nippon Sorui Meii, ed. 2, p. 174; Mar. Alg. Jap. p. 256—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 604—SINOVA, Laminaria et austr. Alg. comme branches d'industrie, p. 119—MIYABE, in Proc. 3rd Pan-Pacific Sci. Congr. Tokyo, 1926, p. 955; in OKAMURA's Mar. Alg. Jap. p. 289—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 202, fig. 4; Laminariaceae Kuriles, p. 90.

*Laminaria dentigera* f. *brevipes* SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 259—SINOVA, Alg. Kamtschatka, p. 19.

**Jap. name.** Kumade-kombu.

The present species closely resembles *L. platymeris* in general appearance and it is not easy to distinguish them from each other. However it is possible to separate the specimens from the Kuriles into two groups according to the shape of the stipe, the one having the stipe cylindrical throughout except the apex and the other only cylindrical up to about a half of the distance from the base and being much compressed upward. The specimens showing the former characters are referred to the present species, and the latter to *L. platymeris*.

**Habitat and localities.** Growing in the sublittoral zone, preferring rocky bottom in a depth of ca. 2 fathoms at ebb tide.

*N. Kuriles.* Araido Isl.—Sekinezaki, Minami-ura. Simusyu Isl.—Koseki-gawa. Paramusiru Isl.—Suribati-wan, Kamogawa, Kakumabetu.

*M. Kuriles.* Onnekotan Isl.—Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Simusiru Isl.—Nakadomari, Simusiru-wan. Uruppu Isl.—Kobune.

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

11. *Laminaria platymeris* DE LA PYLAIE

Flore de Terre-Neuve, (1829), p. 52—SETCHELL, Kelps U.S. & Alaska, p. 151 (p. p.)—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 605 (excl. syn. *Laminaria Bongardiana* P. et R., *L. taeniata* P. et R., *L. fissilis* J. AG.)—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 201, fig. 3; Laminariaceae Kuriles, p. 90—OKAMURA, Mar. Alg. Jap. p. 255—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 289.

*Laminaria Ruprechtii* MIYABE (not ARESCHOUG), Laminariaceae Hokkaido, (1902), p. 42, pl. XIV.

*L. dentigera* f. *longipes* SETCHELL et GARDNER, Alg. N. W. Amer. (1903), p. 259.

**Jap. name.** Tisima-goheikombu.

In the present plant, the stipe is usually rather long, but occasionally short, of about 8 to 21 cm. In the fresh materials the stipe is always cylindrical up to two-thirds or three-fourths of the distance from the base, and then compressed upward near to the transition region, but becomes conspicuously flattened, when dried, for the greater part of its length. The opinion of SETCHELL and GARDNER is here followed, tentatively, as to the specific identification, with limitation as to their synonyms. The blade of the young or regenerated plant is frequently split slightly on the upper end or is quite entire.

**Habitat and localities.** Found cast ashore.

*N. Kuriles.* Araido Isl.—Sekinezaki, Minami-ura. Simusyu Isl.—Koseki-gawa. Paramusiru Isl.—Suribati-wan, Titose-wan.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Usisiru Isl.—Kitazima, Minamizima. Katoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Tosimoe, Wenbetu, Iriribusi.

**Distrib.** Arctic region of the North Atlantic Ocean, Alaska and Japan (the Kuriles).

12. *Laminaria yezoensis* MIYABE

Laminariaceae Hokkaido, (1902), p. 41, pl. XII, XIII; in OKAMURA's Mar. Alg. Jap. p. 290—OKAMURA, Nippon Sorui Meii, ed. 1, p. 133, ed. 2, p. 174; Mar. Alg. Jap. p. 254, fig. 140—MIYABE & NAGAI, Laminariaceae Kuriles, p. 90—YAMADA, Mar. Alg. Urup, p. 18—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 205.

*Laminaria palmaeformis* OKAMURA, Alg. fr. Kamtschatka, (1928), p. 53, pl. XIV—ARWIDSSON, Higher Mar. Alg. hitherto known fr. Kamtschatka, p. 153.

**Jap. name.** Gohei-kombu.

Holdfast scutate, more or less flat and smooth when young, becoming subconic being elevated at the center when old, rigid, 3–5 cm. diam.; stipe perennial, flexible, becoming rigid when dried, terete in great part, compressed at the apex, 60–145 cm. (in younger specimens 6–21 cm.) long, thickened at the base, tapering gradually upward, 1.7–3.5 cm. diam. at the base, 1–1.8 cm. at the middle, 0.9–1.5 cm. at the apex (in younger specimens 3–5 mm.); blade broad-lanceolate or elliptic, divided nearly to the base into 13–29 segments, dark olive brown, broad-cuneate or rounded at the base, 78–114 cm. long, segments 1–3.5–5 cm. wide; mucilage lacunae absent from stipe; lacunae of blade round, of medium size, often rather abundant, arranged in a row in the subcortical layer near the periphery in cross section; sori unknown.

The present species belongs to the digitate group. Among the members of this group, however, such a plant that has a scutate holdfast has been not known except the present species.

**Habitat and localities.** Growing on the rocky bottom in the sublittoral zone in a depth of 1–4, mostly 3 or 4 fathoms.

*N. Kuriles.* Paramusiru Isl.—Titose-wan.

*M. Kuriles.* Onnekotan Isl.—Odomari. Harumukotan Isl.—Harumukotan-byoti. Uruppu Isl.—Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Tosimoe, Wenbetu. Sikotan Isl.—Syakotan, Aimizaki.

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

## 21. *Cymathaere* J. AGARDH, 1867

### Key to the species

- I. Blade linear to linear-elliptic, flabby when wet, becoming subcoriaceous upon drying.
  - A. Folds 2 in number; holdfast branched ..... *C. fibrosa* (1)
  - B. Folds 3 in number; holdfast scutate ..... *C. triplicata* (2)
- II. Blade linear-obovate or obovate-oblong, coriaceous in the basal and median part; folds 4 in number ..... *C. japonica* (3)

### 1. *Cymathaere fibrosa* NAGAI

(Pl. III, fig. 12)

New Sp. of *Cymathaere* fr. Kuriles, (1933), p. 532, fig. 2–6—MIYABE & NAGAI, Laminariaceae Kuriles, p. 91—YAMADA, Mar. Alg. Urup, p. 19—OKAMURA, Mar. Alg. Jap. p. 261—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 291.

**Jap. name.** Edane-suzikombu.

Holdfast composed of 2-4 times dichotomously branched hapteres, arising verticillately from the base of stipe, 1.5-5 cm. long; stipe terete, becoming gradually or soon flattened upward, 4-13 cm. long, 3-5 mm. diam., or 3-7 mm. wide and ca. 2 mm. thick at the complanate portion; blade simple, yellowish olive brown, delicate and flabby when wet, linear to linear-elliptic, broadest slightly below half of the distance from the base, tapering gradually toward both ends, narrow-cuneate or acute when young, broad-cuneate at maturity at the base, thick in the basal and median portions, but membranaceous in the marginal ones, deeply depressed on the basal median portion toward the under side, having 2 longitudinal parallel folds extending upward from about a half of the distance from the base outside the median fascia, 77-415 cm., mostly over 120 cm. long, 5-18 cm. wide at the broadest portion; mucilage lacunae in stipe numerous, angular or often round in cross section, of medium size, arranged in a row rather closely in the subcortical layer just beneath the periphery; lacunae of blade round, arranged in a row in the outer portion of the cortex; sori formed extended in longitudinal patches on the concave side along the median fascia on the under surface of the blade from base to a little distance upward.

It is necessary here to emend somewhat the description of the present species, concerning the feature and number of the folds in the blade. The author has already two times made botanizing excursions in the North Kuriles. On the first trip, he obtained some specimens which are very similar to *C. triplicata* in external appearances, especially in their delicate and flabby texture, dimensions and the percurrent folds of the blade. As already pointed out respectively by SETCHELL and by YAMADA, the holdfast of *C. triplicata* is at times of simple rudimentary hapteres. The holdfast of this species, when highly developed, is well branched, while in the younger ones it is rather poorly branched into two or three small hapteres. These specimens are often apt to be mis-identified to those of *C. triplicata*. The specimens were referred to that species without doubt during the tour and prepared as dried specimens there. After they were brought back to the laboratory, however, a few characters were found different from *C. triplicata* in

certain specimens which have been since that time referred to the species in question. Later the present author had some opportunities to make further observations on this species in the islands of Uruppu and Etorohu. In fresh materials, the blade was observed to be rather deeply depressed on the under side of the lower median fascia. Accordingly the upheavedness of the folds is not distinct in this part. However, it becomes distinct on the blade upward from a half of the distance from the base. The folds are counted not three but two in number from the upper side view. They run lengthwise outside the median fascia. The folds of the present and other species of *Cymathaere* are more remarkably upheaved than those of some species of *Laminaria*.

**Habitat and localities.** Most of the specimens found cast ashore; once obtained from the bottom in a depth of ca. 10 fathoms by dredging.

*N. Kuriles.* Araido Isl.—Minami-ura, Uomizaki. Paramusiru Isl.—Titosewan.

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

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

**Distrib.** Endemic (the Kuriles).

## 2. *Cymathaere triplicata* (POSTELS et RUPRECHT) J. AGARDH

*Laminarieis*, (1867), p. 30—ARESCHOUG, Obs. Phyc. IV, p. 21—KJELLMAN, Beringhafv. Algfl. p. 43—DE TONI, Syll. Alg. III, p. 360—SAUNDERS, Alg. Harri-man Exp. p. 430—SETCHELL & GARDNER, Alg. N. W. Amer. p. 264; Mar. Alg. Pacific Coast N. Amer. III, p. 608—GRIGGS, *Cymathaere*, p. 89, pl. VII—YENDO, Notes Alg. New to Jap. p. 123—SETCHELL, Kelps U.S. & Alaska, p. 154—OKAMURA, Nippon Sorui Meii, ed. 2, p. 177; Mar. Alg. Jap. p. 260—MIYABE & NAGAI, Laminariaceae Kuriles, p. 92—YAMADA, Mar. Alg. Urup, p. 19—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 292.

*Laminaria triplicata* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 10, pl. X—J. AGARDH, Sp. Alg. I, p. 136—KÜTZING, Sp. Alg. p. 576.

**Jap. name.** Misuzi-kombu.

The present plant was first described by POSTELS and RUPRECHT in "Illustrationes Algarum," 1840 as a member of the genus *Laminaria*. Afterward J. G. AGARDH established the present genus,

*Cymathaere*, taking this plant as the type species. Besides the characters pointed out by the above authors confined to the genus, the delicate and flabby texture of the blade and stipe seems to be the most important character except in *C. japonica*. This character is usually observed not only in juvenile but also in the mature sori-bearing specimens. As far as the present writer has observed, *Cymathaere fibrosa* in young stage is another one that shows such a delicate and flabby texture of blade and stipe among the members of the Japanese Laminariaceae. The holdfast is scutate, but sometimes developed in simple small rudimentary hapteres, as pointed out by SETCHELL and GARDNER, and also by YAMADA. As to the mucilage lacunae in the stipe, there has been a slight dispute about its presence or absence. SETCHELL and GARDNER maintained their presence against GRIGGS, who reported their absence. In the Kurile specimens, the writer and YAMADA respectively deny their presence.

**Habitat and localities.** Found cast ashore; according to Prof. YAMADA, growing in a rock pool in a depth of ca. 1 fathom at ebb tide at Iema, Uruppu Isl.

*N. Kuriles.* Araido Isl.—Uomizaki, Minami-ura. Simusyu Isl.—Kataokawan (YENDO), Nagasaki. Paramusiru Isl.—Kurosaki.

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

**Distrib.** Alaska to Washington, Aleutian Isls., Bering Isl. and Japan (the Kuriles).

### 3. *Cymathaere japonica* MIYABE et NAGAI, sp. nov.

(Pl. III, fig. 11)

*Cymathaere crassifolia* MIYABE et NAGAI (not DE TONI), *C. crassifolia* fr. S. Kuriles, p. 123, fig. 1-4; Laminariaceae Kuriles, p. 92—OKAMURA, Mar. Alg. Jap. p. 260, fig. 144—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 292—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 205.

**Jap. name.** Atuba-suzikombu.

Radice fibrosa, ramis numerosis, filiformibus, 4-7es dichotome ramosis, in infima parte basilari stipitis verticillate dispositis; stipite rigido, tereti, supra mox vel paulatim complanato; lamina

simplice, lineari-obovata vel obovato-oblonga, basi crassa, coriacea, rotundata vel subcordata, raro plus minus inaequilaterali, per totam longitudinem paralleliter quadruplicata, fascia media crassa, coriacea, marginibus tenuioribus, plus minus undulatis; lacunis stipitis muciferis grandis, in cortice orbiculare proxime dispositis, lacunis laminae rotundatis, in cortice seriatim dispositis; soris ad basin late in sub-facie laminae (partibus plicatis exceptis), dein aliquando ad  $1/2$  distantiam a basi fasciae mediae locatis.

The holdfast is composed of 4 to 7 times dichotomously branched hapteres, which arise rather verticillately from the base of stipe, measuring about 5 to 6 cm. long. The stipe is rigid, terete, and conspicuously or slightly flattened at the upper portion. It measures 3.5 to 7 cm. long, 6 to 8 mm. in diam. The blade is simple, linear-obovate or obovate-oblong with round, subcordate or rarely more or less inequilateral base, dark olive brown in color, and having 4 longitudinal parallel folds from the upper side view extending throughout the whole length on the median portion. The median basal portion is thick and coriaceous, but the marginal and upper portions are thinner, less coriaceous and more or less wavy. It measures 1 to 1.86 m. long, and 9 to 30 cm. wide near the base, 20 to 46 cm. wide at the middle portion. The mucilage lacunae in the stipe are large, arranged in a row in cross section closely in the subcortical layer. The lacunae in the blade are round, arranged in a row rather closely in the outer portion of the cortex. The sori are formed widely on the basal portion of the blade on the under side except the protruded portions of the folds, sometimes extended upward up to a half of the distance from the base on the median fascia.

In 1932, Prof. MIYABE and the writer reported the present plant under the name of *C. crassifolia* in the Proceedings of the Imperial Academy, vol. VII, no. 4, in which account the plant was described as having three longitudinal folds. During several later trips in the Kuriles, the author has found the plant also growing in Sikotan Isl. besides Kunasiri, but not in the other islands, either in the Middle or North Kuriles. In Sikotan Isl., the plant grows in the sublittoral zone on the rocky bottom in a depth of about 2 fathoms. At ebb tide it is easily observable in its natural state. The plant proves to be provided with prominent percurrent folds from the base upward on the median portion. In the fresh

materials, the folds are counted to the number of four from the upper but five from the under side view. When the plant is dried and prepared as a herbarium specimen, the folds become obscure. Cases were occasionally met with, in specimens from Kunasiri Isl., that the internal two folds unite, resulting in the apparent presence of three folds in all, of which the central one becomes wider than the outside ones. In such specimens, the number of folds is occasionally apt to be mistaken.

The blade of this kelp becomes so exceedingly mucilagino-gelatinous on the surface, when moistened with fresh water, that it becomes difficult to dry it on a sandy beach.

**Habitat and localities.** Growing on rocks in the sublittoral zone, in a depth of 2–4–5 fathoms in rather calm waters.

*S. Kuriles.* Sikotan Isl.—Aimizaki, Tiboi, Syakotan, Notoro (KAWABATA).  
Kunasiri Isl.—Atoiya, Odaibake, Seoi.

**Distrib.** Endemic (the Kuriles).

## 22. *Kjellmaniella* MIYABE, 1902

### *Kjellmaniella gyrata* (KJELLMAN) MIYABE

Laminariaceae Hokkaido, (1902), p. 44, pl. XV, XVI—OKAMURA, Nippon Sorui Meii, ed. 1, p. 134, ed. 2, p. 175; Icon. Jap. Alg. V, 5, p. 88, pl. CCXXIII; Mar. Alg. Jap. p. 256, fig. 141—YENDO, Kaisan-Syokubutugaku, p. 373, fig. 117—UEDA, Suisan-Syokubutugaku, p. 248—MIYABE & NAGAI, Laminariaceae Kuriles, p. 92—OKADA, Kaiso-zuhu, p. 50, pl. XLVII—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 290.

*Laminaria gyrata* KJELLMAN, Ny Organisationstyp inom Slägt. Laminaria, (1892), p. 16, 1 Taf.—DE TONI, Syll. Alg. III, p. 348; Phyc. Jap. p. 51—OKAMURA, Laminaria Jap. p. 90, pl. VII, fig. 6–10.

**Jap. name.** Tororo-kombu.

Holdfast composed of rather small globular mass of numerous, more or less filiform, rather slender, ca. 5 times dichotomously branched hapteres, arising verticillately from the base of stipe, 2.5 cm. long; stipe rather short, 2–5 cm. long, terete below, becoming compressed upward, 2–3 mm. diam. near the base, 2–3 mm. wide and 1–1.5 mm. thick on the middle part; blade pergamaceous, pale to dark olive brown, linear-lanceolate to obovate, entire or undulate on the margin, acute to broad-cuneate, or even cordate at

the base, 23–290 cm. long, 4–25 cm. wide, with two rows of bullae looking like numerous parallel branches accompanied by many, small, unbranched or once branched branchlets on the whole surface, being arranged at right angles to the median fascia, median fascia narrow,  $1/9$ – $1/33$  as wide as the whole breadth of the blade; mucilage lacunae in stipe small or large, arranged closely and perfectly in a circle or separately at irregular intervals just beneath the periphery, sometimes accompanied by glandular cells, lacunae of blade rather small, rather closely arranged in a row in the sub-cortical layer; sori formed in irregular, small patches disposed widely on the depressed sinuses on both surfaces of the blade.

#### Key to the forms

- I. Blade linear to linear-lanceolate, 5–7 cm. wide ..... f. *linearis*  
 II. Blade lanceolate, 8–16 cm. wide ..... f. *latior*  
 III. Blade obovate, 11–25 cm. wide ..... f. *obovata*

#### f. *linearis* OKAMURA

Nippon Sorui Meii, ed. 1, (1902), p. 134, ed. 2, p. 175; Mar. Alg. Jap. p. 257—MIYABE & NAGAI, Lamin. Kuriles, p. 93—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 291.

*Laminaria gyrata* f. *linearis* OKAMURA, Laminaria Jap. (1896), p. 91, pl. VII, fig. 7.

#### f. *latior* OKAMURA

l.c. ed. 1, (1902), p. 134, ed. 2, p. 175; Mar. Alg. p. 257—MIYABE & NAGAI, l.c. p. 93—MIYABE, in OKAMURA's Mar. Alg. p. 291—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 205.

*Laminaria gyrata* f. *latior* OKAMURA, Laminaria Jap. (1896), p. 92, pl. VII, fig. 8.

*Kjellmaniella gyrata* var. *crispata* MIYABE, Laminariaceae Hokkaido, (1902), p. 45, pl. XVI—OKAMURA, Nippon Sorui Meii, ed. 2, p. 175; Mar. Alg. p. 257.

#### f. *obovata* OKAMURA

l.c. ed. 1, (1902), p. 134, ed. 2, p. 175; Mar. Alg. p. 257—MIYABE & NAGAI, l.c.—MIYABE, in OKAMURA's Mar. Alg. p. 291.

*Laminaria gyrata* f. *obovata* OKAMURA, Laminaria Jap. (1896), p. 92.

The present species was first studied by KJELLMAN based upon the specimens from Hokkaido which had been preserved in the Herbarium of the Imperial Academy of St. Petersburg. He named

it *Laminaria gyrata* on account of the gyration of the blade which is shown on the whole surface except the median fascia. The blade is, however, not irregularly gyrated, but slightly elevated regularly on one surface, with many parallel branches of slender bullae rectangular to the narrow median fascia, accompanied by many, small, unbranched or once branched, short branchlets of bullae. The feature of younger blade is far more simple in surface view, having only two rows of simple bullae or of T-letter formed ones, of which both upper ends are curved roundly downward, on the whole length of the blade on the out-sides of the median fascia. In 1896, OKAMURA divided the present species into the following three forms, viz., f. *linearis*, f. *laticor* and f. *obovata*. According to him, the first, f. *linearis* corresponds to KJELLMAN's form. In other respects, he found newly, abundant mucilage lacunae in the stipe different to KJELLMAN's observation. MIYABE, in his "Laminariaceae of Hokkaido" in 1902, established a new genus *Kjellmaniella* taking the present plant as the type species. His advocacy of the establishment of the new genus is based upon the characteristic feature of the fine carvings on the blade.

In order to solve the conflict of opinion between KJELLMAN and OKAMURA concerning the presence or absence of the mucilage lacunae in stipe, abundant specimens from the following localities were examined:

Akkesi, Huren, Kiritappu, Nemuro in *Hokkaido*; Hurukamappu, Tinomizi, Wennai, Siranuka, Atoiya in *Kunasiri* Isl.; Rubetu, Arimoe, Syana, Bettobu, Sibetoro, Tosirari, Wenbetu, Tosimoe, Moyoro in *Etorohu* Isl. Among the above localities, the mucilage lacunae are usually found in the specimens from Huren, Kiritappu, Siranuka, Wennai, Rubetu, Arimoe, Syana, Bettobu, Sibetoro, Tosirari, Wenbetu, Tosimoe and Moyoro. The lacunae are, however, not uniformly equal in size, number and distribution in the stipe. In some cases, they are very small and arranged closely and perfectly in a circle or at irregular intervals just beneath the peripheral tissue, and in others rather large and unequal in size, and accompanied by or quite without glandular cells. In the latter case, they are mostly arranged in a row in somewhat irregular arrangement. In the materials from Akkesi, Nemuro, Hurukamappu, Tinomizi, Atoiya and Tosimoe, no lacunae are found in any part of the stipe.

The median fascia of the present species is very narrow, compared with the species of *Laminaria*. It measures 2 to 4 or 7 mm. wide at the lower and 2.5–4–10 or 17 mm., mostly 4 to 8 mm. at the middle portion of the blade. As stated above, it is mostly narrow below, increasing gradually in width at the middle and becoming again somewhat narrower upward.

**Habitat and localities.** Growing on rocks in rather shallow waters, preferring lower littoral to upper sublittoral zone, either in calm or in open places.

*f. linearis* is found growing in abundance on stones or rocks, preferring a comparatively rather deep bottom where the current is rapid.

*S. Kuriles.* Etorohu Isl.—Tosimoe, Wenbetu, Bettobu, Syana, Rubetu (YENDO), Naibo. Sikotan Isl.—Tiboi, Notoro. Kunasiri Isl.—Atoiya, Tinomizi, Wennai, Hurukamappu, Rurui.

*f. latior* grows in calm water.

*M. Kuriles.* Uruppu Isl.—Kobune (Herb. OKAMURA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Tosimoe, Wenbetu, Tosirari, Sibetoro, Bettobu, Arimoe, Rubetu, Kamuikotan. Sikotan Isl.—Tiboi. Kunasiri Isl.—Atoiya, Tinomizi, Wennai, Seseki near Wennai, Hurukamappu, Tohutu, Rurui.

*f. obovata* is often found on exposed places in the lower littoral zone.

*S. Kuriles.* Etorohu Isl.—Wenbetu, Iriribusi, Syana, Rubetu, Kamuikotan. Sikotan Isl.—locality unknown (Herb. OKAMURA). Kunasiri Isl.—Siranuka.

**Distrib.** *Sp.*—Japan (Hokkaido and the Kuriles); *f. linearis* and *f. latior*—Hokkaido and the Kuriles; *f. obovata*—the Kuriles.

### 23. *Costaria* GREVILLE, 1830

#### *Costaria costata* (TURNER) SAUNDERS

Prelim. Paper on *Costaria*, etc., (1895), p. 57—SETCHELL, *Kelps U.S. & Alaska*, p. 154—SETCHELL & GARDNER, *Mar. Alg. Pacific Coast N. Amer.* III, p. 610, pl. LVI, fig. B, pl. LXXIX, fig. A—MIYABE & NAGAI, *Laminariaceae Kuriles*, p. 93—HIGASHI, *Nihon-kaisozuhu*, p. 31, 1 fig.—YAMADA, *Mar. Alg. Urup*, p. 18—OKAMURA, *Mar. Alg. Jap.* p. 259, fig. 143—MIYABE, in OKAMURA'S *Mar. Alg. Jap.* p. 294—KAWABATA, *List Mar. Alg. Isl. Shikotan*, p. 205.

*Fucus costatus* TURNER, *Fuci*, IV, (1819), p. 72, pl. CCXXVI.

*Laminaria costata* AGARDH, *Sp. Alg. I*, 1, (1820), p. 109.

*Costaria Turneri* GREVILLE, Syn. in Alg. Brit. (1830), p. xxxix—J. AGARDH, Sp. Alg. I, p. 139—HARVEY, Ner. Bor.-Amer. I, p. 90—KÜTZING, Sp. Alg. p. 580—ARESCHOUG, Obs. Phyc. IV, p. 20—DE TONI, Syll. Alg. III, p. 361; Phyc. Jap. p. 51—SAUNDERS, Alg. Harriman Exp. p. 431—MIYABE, Laminariaceae Hokkaido, p. 50, pl. XX—OKAMURA, Nippon Sorui Meii, ed. 1, p. 135, ed. 2, p. 176; Icon. Jap. Alg. V, 6, p. 99, pl. CCXXVI—SINOVA, Laminaria et autres comme Branche d'Industrie, p. 121; Alg. Mar. Jap. (Phaeoph.), p. 41.

**Jap. name.** Suzime, Zarame.

**Key to the forms**

- I. Blade linear-lanceolate, cuneate at the base ..... f. *cuneata*  
 II. Blade oblong, ovate-oblong, rarely obovate, rounded or cordate at the base  
 ..... f. *latifolia*

f. *cuneata* MIYABE et NAGAI, f. nov.

*Costaria Turneri* var. *pertusa* HARVEY, Charact. New Alg. (1859), p. 329—DE TONI, Syll. Alg. III, p. 362—SINOVA, Alg. Mar. Jap. (Phaeoph.), p. 42 (sub forma):

Stipite 4–14 cm., raro usque ad 25 cm. longo, 1.5–4 mm. diam.; lamina lineari-lanceolata, 115–250 cm. longa, 4.5–13 cm. lata, basi cuneata.

f. *latifolia* (POST. et RUPR.) MIYABE et NAGAI, comb. nov.

*Costaria Turneri*  $\beta$  *latifolia* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 12, pl. XXIV.

*C. Mertensii* J. AGARDH, Sp. Alg. I, (1848), p. 140—HARVEY, Ner. Bor.-Amer. I, p. 90—DE TONI, Syll. Alg. III, p. 362—SINOVA, Laminaria, p. 121; Alg. Mar. Jap. (Phaeoph.), p. 40; Alg. Kamtschatka, p. 26.

*C. Turneri* OKADA (not GREVILLE), Kaisei-zuhu, (1934), p. 51, pl. XLVIII.

Stipe 5–40 cm., mostly 9–20 cm. long, 2–5 mm., mostly 3–5 mm. diam.; blade oblong to ovate-oblong, rarely obovate, rounded or cordate at the base, and 60–280 cm. long, 11–35 cm., mostly 16–30 cm. wide.

As to the wide or narrow form which is represented as being characterized respectively by the round to cordate or acute base, many authors did not differentiate this species into forms while only a few authors mentioned that character. As for the changes in shape of the blade, OKAMURA thinks that they may be caused by the differences of age. He states the present plant as having

an acute base when young, but round or cordate when old. However, the writer observed some specimens referred to *f. cuneata*, on which moderately large patches of sori are developed rather vigorously upon the depressed sinuses of the blade. It seems, therefore, that the difference in shape of the blade may be caused by the influence of the habitat where the plant grows rather than by the growing stages.

**Habitat and localities.** Growing in the low water mark to several fathoms of depth in the sublittoral zone.

*f. cuneata* seems to prefer an open place.

*S. Kuriles.* Etorohu Isl.—Moyoro, Sibetoro. Kunasiri Isl.—Idasibenai, Tinomizi, Pontomari, Wennai, Hurukamappu, Tohutu, Sokobetu, Atoiya.

*f. latifolia* seems to prefer a rather quiet, sheltered place.

*M. Kuriles.* Uruppu Isl.—Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Sibetoro, Rubetu, Kamuikotan. Sikotan Isl.—Notoro. Kunasiri Isl.—Atoiya, Idasibenai, Seseiki near Wennai, Wennai, Sokobetu, Rurui, Tosyoro.

**Distrib.** *Sp.*—California to Alaska, Kamchatka, Japan Sea coast of Siberia and Japan (Honsyu, Hokkaido, Saghalien and the Kuriles); *f. cuneata*—Japan Sea coast of Siberia and Japan (same localities as *Sp.*); *f. latifolia*—Kamchatka, California to Alaska and Japan (same localities as preceding).

## 24. *Agarum* (BORY, 1826) POSTELS et RUPRECHT, 1840

### *Agarum cribrosum* BORY

in Dict. Class. IX, (1826), p. 193 (p. p.)—SETCHELL, Kelps U.S. & Alaska, p. 155—MÜNSCHER, Key to Phaeophyceae, p. 260, fig. 12—SETCHELL & GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 615, pl. CXIII—TOKIDA, Mar. Alg. Robben Isl. p. 10—ARWIDSSON, Higher Alg. hitherto known fr. Kamtchatka, p. 153—MIYABE & NAGAI, Laminariaceae Kuriles, p. 94—HIGASHI, Nihon Kaiso-zuhu, p. 25, 1 fig.—OKAMURA, Mar. Alg. Jap. p. 258, fig. 142—MIYABE, in OKAMURA'S Mar. Alg. Jap. p. 293—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 197, pl. XXII, fig. 1.

*Fucus Agarum* TURNER, Fuci, II, (1809), p. 10, pl. LXXV.

*F. cribrosum* MERTENS Junior, in Linnaea, IV, (1829), p. 52.

*Agarum Gmelini* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 11, pl. XX, XXI—J. AGARDH, Sp. Alg. I, p. 141—KÜTZING, Sp. Alg. p. 580—SAUNDERS, Alg. Harri-man, Exp. p. 430, pl. LXI—OKAMURA, Nippon Sorui Meiji, ed. 1, p. 129—SINOVA, Alg. Mar. Jap. (Phaeoph.), p. 32; Alg. Kamtschatka, p. 26.

*A. Turneri* POSTELS et RUPRECHT, l. c. (1840), p. 12, pl. XXII—J. AGARDH, l. c. p. 141—KÜTZING, Sp. Alg. p. 580—HARVEY, Ner. Bor.-Amer. I, p. 95, pl. V, fig. 1—RUPRECHT, Tange Och. Meeres, p. 353—ARESCHOUG, Obs. Phyc. IV, p. 17—KJELLMAN, Alg. Arct. Sea, p. 222; Beringhafv. Algfl. p. 42—DE TONI, Syll. Alg. III, p. 334; Phyc. Jap. p. 52—SAUNDERS, l. c. p. 431—MIYABE, Laminariaceae Hokkaido, p. 59, pl. XXVII—OKAMURA, Nippon Sorui Meii, ed. 1, p. 129, ed. 2, p. 167; Icon. Jap. Alg. V, 5, p. 90, pl. CCXXI; Alg. fr. Kamtschatka, p. 53—SINOVA, Alg. Kamtschatka, p. 26—OKADA, Kaiso-zuhu, p. 41, pl. XXXVIII.

**Jap. name.** Aname.

Among the specimens in the writer's possession there are three different forms, the first with elliptic to oblong-elliptic, rarely rounded frond, provided with prominent, narrow midrib of about 3 mm. width and profusely perforated on the whole surface, the second somewhat similar to the former in shape, with a far wider and flattened midrib 6 to 8 mm. wide, the third mostly round and with prominent, narrow midrib of 1 to 5 mm. width, and with fewer perforations and provided with abundant small round bullae scattered on the blade. The openings scattered on the blade are circular or sometimes elliptic or somewhat irregular in outline in every form. They are plane on the inner margin and rather larger in average diameter in the case of the former two, while in the third they are somewhat elevated on the margin toward one side of the blade. The diameter of the openings measures 2 to 25 mm., mostly 5 to 15 mm. in the former two, but 2 to 16 mm., mostly 2 to 4 mm. in the third. Judging from the illustrations of POSTELS and RUPRECHT, the first form can be referred to *A. Turneri* and the second to *A. Gmelini*. As for the third form, it is probably one still in a young growing stage.

**Habitat and localities.** Found cast ashore; in Saghalien, however, found growing on rocks in the depth of 2-3 feet beneath the low water mark, according to TOKIDA.

- N. Kuriles.* Simusyu Isl.—Tenzin-iwa, Kosekigawa. Paramusiru Isl.—Suribati-wan.  
*M. Kuriles.* Usisiru Isl.—Minamizima. Ketoi Isl.—Minami-ura.  
*S. Kuriles.* Etorohu Isl.—Moyoro, Wenbetu, Iriribusi, Sibetoro, Bettobu, Arimoe, Rubetu. Sikotan Isl.—Syakotan, Tiboi. Kunasiri Isl.—Atoiya, Siranuka, Tinomizi, Kuraoi, Wennai, Hurukamappu, Tohtu, Tosyoro, Nihon-iwa, Kotankesi, Ponkotan, Tomari.

**Distrib.** North Atlantic, Bering Sea (St. Lawrence Isl., St. Lawrence Bay, Konyam Bay), Alaska, Washington, Kamchatka,

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

25. *Streptophyllum* MIYABE et NAGAI, gen. nov.

Radix rhizinis ramosis. Stipes erectus crassus inferne teretus superne complanato-caniculatus. Lamina in juvenili simplex obovata, ad partem inferam late subcucullata, dein ad marginem basalem incrassata, in adulta ad partem mediam ab apice deorsum, dein ad usque basin fissa, demum ad partem incrassatam basalem in stipites duas furcatis integras vel raro decomposito-divisas laciniis dividitur et subspiraliter evolvitur. Sori superficiem laminae occupantes.

The present genus is established taking *Hedophyllum spirale* YENDO as the type species. This is characterized by its extreme variability in the shape of the blade according to its age. At an early stage it takes Laminarian shape, flat, undivided and with two rows of bullae, soon becoming broader and somewhat cucullated at the lower portion, and digitately divided above. Erosion occurs on the central fascia downward to near the base, forming at last two arms from the thickened base, on which partial blades scroll spirally. The present genus differs from *Hedophyllum*, to which genus it is closely related, in the following respects. In *Hedophyllum subsessile* (ARESCH.) SETCH., according to SETCHELL, the plant is fastened to substratum by the normal holdfast as in *Laminaria* and also by the secondary hapteres which are given off from the margins of the decumbent secondary stipes, while in the present genus there are found no such secondary hapteres and the stipes are erect. Moreover, in the present genus, the partial blades, formed in the advanced stage as a result of erosion of the central fascia of the original blade, scroll back at each arm of the bifurcate stipe.

*Streptophyllum spirale* (YENDO) MIYABE et NAGAI, comb. nov.

(Pl. III, figs. 13, 14)

*Laminaria Bongardiana*  $\beta$  *bifurcata* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 10, Tab. XIV—KJELLMAN, Beringhafv. Algfl. p. 44—SINOVA, Alg. Kamtschatka, p. 20, fig. 1-4, 6.

*L. digitata* RUPRECHT (not LAMOUROUX), Tange Och. Meeres, (1851), p. 352 (p. p.).

*Arthrothamnus Bongardianus* J. AGARDH, Lamin. (1867), p. 28 (p. p.)—DE TONI, Syll. Alg. III, p. 370 (p. p.).

*Hafgygia Bongardiana* f. *furcata* ARESCHOUG, Obs. Phyc. IV, (1883), p. 5.

*Hedophyllum spirale* YENDO, *H. spirale* & its Relation to Thalassiophyllum and Arthrothamnus, (1903), p. 165, pl. VI, fig. 1-7 (excl. f. *kamtschatkensis*)—OKAMURA, Alg. fr. Kamtschatka, p. 54, fig. 1, pl. XV.

?*Laminaria bullata* f. *amplissima* YENDO (not SETCHELL & GARDNER), Notes Alg. New to Jap. (1909), p. 125—OKAMURA, Nippon Sorui Meii, ed. 2, p. 174—MIYABE & NAGAI, Laminariaceae Kuriles, p. 91.

*Hedophyllum Bongardianum* YENDO, Notes Alg. New to Jap. II, (1914), p. 269 (p. p.)—OKAMURA, Nippon Sorui Meii, ed. 2, p. 168 (excl. syn. *Laminaria Ruprechtii*, & f. *palmata* P. et. R.); Mar. Alg. Jap. p. 265, fig. 149—MIYABE & NAGAI, Hedophyllum & Laminaria N. Kuriles, p. 194, pl. V; Laminariaceae Kuriles, p. 94—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 292 (excl. syn. *Hedophyllum subsessile*).

**Jap. name.** Nezire-kombu.

Holdfast composed of filiform, 5-7 times dichotomously branched hapteres, arising verticillately from the base of stipe, 2-5 cm. long; stipe generally short, stout, erect, terete below, somewhat flattened, often broadened and canaliculate upward, ca. 5 mm. diam. below, 9-20 mm., mostly 11-15 mm. wide above, 2-7 cm., mostly 4-6 cm. long; blade simple, obovate or rarely oblong-obovate with two rows of bullae when young, rounded at the base, not plane but somewhat cucullate at the lower portion, later becoming broader than long, 29-45 × 56-78 cm., and split into 2 or 3 wide segments at the upper end, at maturity much thickened in the external margins near the base, and the central portion of the blade torn and frayed away downward to the base, forming at last two arms from the thickened base of the old blade, on which partial blades scroll back spirally; mucilage lacunae in stipe numerous, small, oblong in cross section, arranged in a row just beneath the periphery when young, becoming rather elongated when matured; lacunae of blade large, prominent, arranged rather sparsely in the subcortical layer; sori formed extended in irregular outlines on the basal portion of the blade.

In 1903, YENDO described a curious *Laminaria* from the North Kuriles considering it a member of *Hedophyllum*, coordinated with *H. sessile* and *H. subsessile* of SETCHELL. This plant was named *H. spirale* YENDO. It was, however, later referred by YENDO himself to *L. Bongardiana* of POSTELS and RUPRECHT with the amalgamation

of the species under question with *H. subsessile* and other digitate *Laminaria* under the name of *H. Bongardianum*. Since the first discovery of this plant by POSTELS and RUPRECHT in Kamchatka, it had been reported by ARESCHOUG and KJELLMAN in the North Pacific prior to YENDO's paper. As the basis for discussion, YENDO's short description given in his later account is cited below. (Cfr. l. c. 1914, p. 271). "When the plant is yet young, the stipe is simple and the blade, flat and undivided. In the advanced stages, the blade becomes broader and bullated, approaching, if not referable to at least a part of, *L. bullata* KJELLMAN. Then it splits into several segments, begins the scrollings of both margins of the transition region, at the same time, the meridional region of blade beginning to decay. The result is bifurcated stipe with one scrolled blade on each arm. New rhizoids may often appear later on the arms just below the blade." However, that "new rhizoids appear often later on the arms just below the blades" was not really observed either by POSTELS and RUPRECHT, or by KJELLMAN nor also by YENDO. It was by ARESCHOUG that this new rhizoidal development was found. He founded f. *subsessile* as a new form of *Hafgygia Bongardiana* (*L. Bongardiana* POST. et RUPR.) on account of the subsessile character and the new formation of rhizoids on the basal margin of blade. Afterwards SETCHELL transferred it to his new genus, *Hedophyllum*, when he established it by treating *L. sessile* of J. AGARDH as the type species.

After the issue of YENDO's later account, his amalgamation of his species with *H. subsessile* was seriously questioned by SETCHELL. (Cfr. SETCHELL and GARDNER, Mar. Alg. Pacific Coast N. Amer. III, p. 619). The latter authors also stated that YENDO's plant was standing, not decumbent, while *H. subsessile* showed the latter character. On several trips in the N. Kuriles, the author actually observed the present plant in natural state. The plant grows on rocks in the littoral zone which are exposed habitats when the tide has ebbed. In the plant of an early stage the blades are observed to be obovate and nearly plane but soon cucullated at the lower portion. In this stage there are also observed two short rows of small bullae extending lengthwise between the meridional region and both margins, as shown in the juvenile stage of some species of *Laminaria*. As it grows larger, the rows of small bullae diminish and the wide and large cucullation on the lower portion becomes more

remarkable than in the early stage. When the tide is at its ebb, the concave side of the blade is observed to be usually faced heavenward and its convex one toward the substratum. As to the stipe, though it may be out of question when very short, it is generally standing upright.

In the paper by Prof. MIYABE and the author, YENDO's opinion was followed tentatively in the main as to the reference of the synonyms with the omission of a few, believed to be of different species. However, Prof. SETCHELL also disagreed with us as to the referring of *H. subsessile* to *H. Bongardianum* together with our plant. To put it briefly, the point of his disagreement is the non-formation of secondary rhizoids on the basal decumbent portions of the blade. On our specimens, the new rhizoidal formation was not ascertained, but some pseudo-rhizoidal protuberances were observed not only on the upper part of the stipe, but also to a small extent on the thickened marginal portion of the secondary stipe. This character was also ascertained by YENDO.

As to the scrolling of the partial blades, SETCHELL did not allude to the point in the description of his *H. subsessile* in his previous article, 'Note on Algae I' in *Zoe* vol. V and in his 'Algae of N. W. America,' jointly with GARDNER. But he stated the segments of the blade to be "somewhat rolled," in 'Mar. Algae of Pacific Coast of N. America III' written jointly with GARDNER. In the Kamchatkan plant, this character is not distinct on either of the plates of POSTELS and RUPRECHT's 'Illustrationes Algarum' although the figures are excellent, but it is distinct and well marked in SINOVA's account (Cfr. l. c. 1932, p. 21, fig. 1). In the Kurile plant, it is distinct both in our specimens and in YENDO's.

As to the length of stipe, the illustrations in POSTELS and RUPRECHT's work indicate it to be long in the case of f. *palmata* and rather short in f. *bifurcata*. *Laminaria Bongardiana* POST. et RUPR. includes apparently two distinct species. Forma *palmata* seems to belong to some digitate *Laminaria*, while f. *bifurcata* belongs to our species under consideration. YENDO remarked on the length of stipe as follows. (Cfr. l. c. 1914, p. 269). "Among the originals of f. *palmata* in the Herbarium of the Academy of Science in St. Petersburg, there are specimens with very short stipe, hardly 1 cm. in length, terete and broadened upwards. An authentic specimen of the same form, kept in the Berlin Herbarium is also a short-stiped

one." As for the latter he figured it in a sketch. The sketch by YENDO of the co-type of *Laminaria Bongardiana* f. *palmata* POST. et RUPR. kept in the Herbarium of the Botanical Museum of Berlin shows it to be that of a stage of f. *bifurcata* POST. et RUPR., which is now considered to be *Streptophyllum spirale*.

**Habitat and localities.** Growing on rocks in the littoral zone; in Uruppu Isl., found cast ashore.

*N. Kuriles.* Simusyu Isl.—Kataoka-wan, Tenzin-iwa. Paramusiru Isl.—Suribati-wan, Titose-wan, Murakami-wan, Arakawa, Kakumabetu.

*M. Kuriles.* Uruppu Isl.—Misima.

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

## 26. *Arthrothamnus* RUPRECHT, 1848

### Key to the species

- I. Stipe erect, long, terete; holdfast composed of branched hapteres which arise verticillately from the base of stipe as in *Laminaria* . . . . . *A. kurilensis* (1)
- II. Stipe decumbent, short, somewhat complanate; holdfast composed of branched hapteres which arise fasciculately from both margins of stipe. . . *A. bifidus* (2)

### 1. *Arthrothamnus kurilensis* RUPRECHT

Bemerk. d. Bau u. Wachsum Alg.-Stämme, (1848), p. 67, Taf. VI—DE TONI Syll. Alg. III, p. 369; Phyc. Jap. p. 53—MIYABE, Laminariaceae Hokkaido, p. 48, pl. XIX; in OKAMURA's Mar. Alg. Jap. p. 295—YENDO, Kaisan-Syokubutugaku, p. 407—OKAMURA, Nippon Sorui Meii, ed. 1, p. 136, ed. 2, p. 178; Icon. Jap. Alg. V, 6, p. 103, pl. CCXXVIII; Mar. Alg. Jap. p. 265—MIYABE & NAGAI, Laminariaceae Kuriles, p. 95—HIGASHI, Nihon Kaiso-zuhu, p. 35, 1 pl.—YAMADA, Mar. Alg. Urup, p. 19, fig. 8—TOKIDA, Phyc. Obs. III, pp. 60-66, fig. 1-5.

**Jap. name.** Tisima-nekoasikombu.

Plant erect, perennial; holdfast composed of rather stout, 3-4 times dichotomously branched hapteres, arising verticillately from the base of stipe, 3-6 cm. long; primitive stipe terete, becoming thickened and stout later, 1.5-11.5 cm. long, 6-8 mm. diam. at full maturity, dichotomously branched repeatedly at the apex every year; blade coriaceous, linear, dark brown, plane, slightly protruded and scrolled at a limited portion of each margin close to the transition region, 160-200 cm. long, 3-7 cm. wide; as plant becomes old, new

blades issue from the above limited portions close to the base of the old ones, which soon decay away from the base, leaving scars on the apex of the stipe, forming new dichotomous branching; mucilage lacunae in stipe more or less irregular in arrangement, in a certain part rather closely distributed being arranged in a row near the periphery in the subcortical layer, but in other parts quite absent, when present, more or less wide range in dimensions, nearly ovate in cross section; lacunae of blade round in cross section, arranged in a row rather near to the periphery in the subcortical layer; sori rare, formed in longitudinal patches on the under surface of the blade from the middle portion upward.

The present species grows vigorously by dichotomous branching of the stipe, on which new blades are borne in twins. The branching seems to occur generally once annually. Consequently the original stipe bears every year twice as many blades as in the previous year. Among the specimens at hand, one is presumably ten years of age, since it bears twenty blades on a single original stipe. In a young specimen, a row of mucilage lacunae is observed in a cross section of the stipe in the subcortical layer just beneath the periphery. However they seem to be rather irregular in arrangement. In a certain part, they are rather closely distributed, but in others quite absent. When the plant grows older, the elder stipes became dendric. In such a specimen, there are found no lacunae in the elder stipes, but a few are found in the youngest one.

**Habitat and localities.** Growing in the sublittoral zone on rocky or stony bottom, preferring open sea; the author himself observed the plant growing in a depth of ca. 1 fathom at ebb tide in Uruppu Isl.

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

*S. Kuriles.* Etorohu Isl.—Moyoro, Ukaboi, Wenbetu, Iriribusi, Tosirari, Sibetoro, Bettobu.

**Distrib.** Japan (the Middle Kuriles, limited to the range from Etorohu to Simusiru Isl. and an isolated region at the southernmost part of South Saghalien).

## 2. *Arthrothamnus bifidus* (GMELIN) J. AGARDH

Lamin. (1867), p. 28—DE TONI, Syll. Alg. III, p. 369; Phyc. Jap., p. 52—

MIYABE, Laminariaceae Hokkaido, p. 47, pl. XVIII; in OKAMURA's Mar. Alg. Jap. p. 295—OKAMURA, Nippon Sorui Meii, ed. 1, p. 136, ed. 2, p. 178; Icon. Jap. Alg. V, 6, p. 100, pl. CCXXVII; Mar. Alg. Jap. p. 264, fig. 147, 148—SETCHELL & GARDNER, Alg. N. W. Amer. p. 267; Mar. Alg. Pacific Coast N. Amer. III, p. 620—YENDO, *Hedophyllum spirale* and its Relation to *Thalassiophyllum* and *Arthrothamnus*, p. 169, pl. VI, fig. 9-11; Kaisan-Syokubutugaku, p. 407, fig. 127—SINOVA, Alg. Kamtschatka, p. 26—MIYABE & NAGAI, Laminariaceae Kuriles, p. 95—HIGASHI, Kaiso-zuhu, p. 36, 1 pl.—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206—YAMADA, Observ. on *Arthrothamnus bifidus*, pp. 113-118, fig. 1-5.

*Fucus bifidus* GMELIN, Hist. Fuc. (1768), p. 201, pl. XXIX, fig. 2—AGARDH, Sp. Alg. I, 1, p. 122.

*Laminaria bifida* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 10, pl. XV—J. AGARDH, Sp. Alg. I, p. 131.

*Arthrothamnus radicans* RUPRECHT, Bemerk. d. Bau u. Wachstum Alg.-Stämme, (1848), p. 68; Tange Och. Meeres, p. 410.

**Jap. name.** Nekoasikombu.

Recent knowledge of the development of the present species owes much to both YENDO and YAMADA who studied respectively from their standpoints. YENDO states much in detail on the rejuvenation mode of this plant by the formation of new blades and advances further an opinion on the systematic position of the genus in relation to *Hedophyllum* and *Thalassiophyllum*. Prof. YAMADA made minute observations on the initial stage, especially on the rejuvenating state of the plant. He reported also the mode of sori formation on the blade. According to him, it seems not to occur in the season from June to November at Akkesi, Hokkaido, but is seen in march. The present author observed also the bullation, as described by the above authors, on the young specimens from Sikotan Isl.

**Habitat and localities.** Growing in the sublittoral zone, in a depth more than 4 fathoms in the southern islands, but gregariously on rocky bottom just below low-water mark in the northern islands.

*N. Kuriles.* Araiō Isl.—Minami-ura, Uomizaki. Simusyu Isl.—Kataokawan, Tenzin-iwa, Kosekigawa. Paramusiru Isl.—Suribatowan, Titose-wan, Kamogawa, Kurosaki, Kakumabetu.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Minamizima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari. Uruppu Isl.—locality unknown (Herb. Fac. of Agr.).

*S. Kuriles.* Etorohu Isl.—Rubetu, Poroporo, Kamuikotan, Naibo. Sikotan Isl.—Syakotan, Tiboi, Aimizaki, Notoro. Kunasiri Isl.—Atoiya, Idasibenai, Rebun-iso, Tinomizi, Tomari (?).

**Distrib.** Aleutian Isls., Kamchatka (Okhotsk Sea and Bering Sea sides) and Japan (Hokkaido and the Kuriles).

## 27. *Thalassiophyllum* POSTELS et RUPRECHT, 1840

### *Thalassiophyllum Clathrus* POSTELS et RUPRECHT

Ill. Alg. (1840), p. 11, pl. XVIII, XIX—J. AGARDH, Sp. Alg. I, p. 139—KÜTZING, Sp. Alg. p. 581—KJELLMAN, Beringhafv. Algfl. p. 42—DE TONI, Syll. Alg. III, p. 336; Phyc. Jap. p. 52—SETCHELL, Alg. Pribilof Isl. p. 592; Post-emb. Stages, p. 123, pl. XIII, fig. 6-13; Kelps U.S. & Alaska, p. 156—MIYABE, Laminariaceae Hokkaido, p. 60, pl. XXVIII; in OKAMURA's Mar. Alg. Jap. p. 294—OKAMURA, Nippon Sorui Meii, ed. 1, p. 129, ed. 2, p. 168; Icon. Jap. Alg. V, 6, p. 104, pl. CCXXIX; Alg. fr. Alaska, p. 87; Mar. Alg. Jap. p. 263, fig. 145, 146—SETCHELL & GARDNER, Alg. N. W. Amer. p. 266; Mar. Alg. Pacific Coast N. Amer. III, p. 613, pl. LXXII—SINOVA, Alg. Kamtschatka, p. 25—MIYABE & NAGAI, Laminariaceae Kuriles, p. 96—HIGASHI, Nihon Kaiso-zuhu, p. 26, 1 pl.—OKADA, Kaiso-zuhu, p. 42, pl. XXXIX—YAMADA, Mar. Alg. Urup, p. 17.

*Fucus Clathrus* GMELIN, Hist. Fuc. (1768), p. 211, pl. XXXIII—AGARDH, Sp. Alg. I, 1, p. 123.

#### **Jap. name.** Kikuisi-kombu.

The present species is one of the most highly developed alga among the Laminariales. In complexity of development and outer morphological characters, there are no others so remarkable as this species. For knowledge of the post-embryonal stages of this plant science owes much to SETCHELL. According to him, the primitive blade is rather plane, laterally broadened with more or less irregular outlines at the apex and irregular kidney-shaped in general outlines. The shape of the frond in this stage is generally similar to that of the members of the genus *Laminaria* in the simplicity of its shape, though there exist a few differences between them, the young frond in the species in question being broadened laterally and not elongated lengthwise as in the species of *Laminaria*. In respect of the shape observed in this stage, it is similar to the early blade of *Streptophyllum spirale*. The blade then becomes slightly unrolled from both basal portions toward the center and eroded from the apex downward to the base, dividing into two blades. Such erosion of the blade lengthwise in the meidan part strongly recalls the old stage of

*Streptophyllum spirale*. In the further development, the peculiar characters limited to this genus are observable. As to the perforation of the blade, the present genus is related to *Agarum*, but is more complex being usually finely fimbriated with short processes and slight reflexion toward the outer surface.

**Habitat and localities.** Growing in the sublittoral zone, on rocky bottom just below the lower water mark, forming a veritable thicket, frequently where tide flows rather swiftly.

*N. Kuriles.* Araido Isl.—Uomizaki. Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Suribati-wan, Titose-wan, Murakami-wan, Kamogawa.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Matuwa Isl.—Yamato-wan. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima, Minamizima. Kotoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari, Simusiru-wan. Uruppu Isl.—Kobune, Tokotan, Ahunruimoi.

**Distrib.** Alaska, Strait of Juan de Fuca, Bering Isl., Kamchatka and Japan (the Kuriles).

## 28. *Alaria* GREVILLE, 1830

### Key to the species

- I. Midrib fistulose at intervals ..... *A. fistulosa* (1)
- II. Midrib solid.
  - A. Mature sporophylls entirely soriferous.
    - 1. Sporophylls rather closely formed in pinnate arrangement in a short rhachis.
      - a. Sporophylls linear-oblong with round apices... *A. praelonga* (2)
      - b. Sporophylls linear-cuneate or ovato-lanceolate with tapering apices, larger than in the previous species... *A. macroptera* (3)
    - 2. Sporophylls pinnately formed in a rather long rhachis ..... *A. dolichorhachis* (4)
  - B. Mature sporophylls bearing foliose sterile portions at the apices.
    - 1. Sporophylls sparsely formed in pinnate arrangement..... *A. tenuifolia* f. *typica* (5)
    - 2. Sporophylls fasciculately formed in a short, slightly expanded rhachis.
      - a. Sporophylls linear-lanceolate with acute or tapering apices, short ..... *A. taeniata* (6)
      - b. Sporophylls linear or linear-lanceolate with round or acute apices, very long ..... *A. angusta* (7)

11. *Alaria fistulosa* POSTELS et RUPRECHT

Ill. Alg. (1840), p. 11, Tab. XVI—J. AGARDH, Sp. Alg. I, p. 144—KÜTZING, Sp. Alg. p. 579—HARVEY, Ner. Bor.-Amer. I, p. 89—KJELLMAN, Beringhafv. Algfl. p. 40—DE TONI, Syll. Alg. III, p. 332; Phyc. Jap. p. 52—SAUNDERS, Alg. Harriman Exp. p. 426, pl. LVII—MIYABE, Laminariaceae Hokkaido, p. 52, pl. XXI; in Proc. 3rd Pan-Pacific Sci. Congr. p. 957; in OKAMURA's Mar. Alg. Jap. p. 296—OKAMURA, Nippon Sorui Meii, ed. 1, p. 126, ed. 2, p. 164; Mar. Alg. Jap. p. 275, fig. 154—SETCHELL & GARDNER, Alg. N. W. Amer. p. 275; Mar. Alg. Pacific Coast N. Amer. III, p. 613, pl. LXXII—YENDO, Kaisan-Syokubutugaku, p. 405; Monogr. Alaria, p. 76, pl. I—SETCHELL, Kelps U.S. & Alaska, p. 163—KIBBE, Structure of *Alaria fistulosa*, pp. 43-57, pl. VII-IX—SINOVA, Alg. Kamtschatka, p. 18—MIYABE & NAGAI, Laminariaceae Kuriles, p. 96—YAMADA, Mar. Alg. Urup, p. 15—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204.

*Phasganon fistulosum* RUPRECHT, Tange Och. Meeres, (1851), p. 355.

**Jap. name.** Oniwakame.

**Key to the forms**

- I. Sporophylls short, obovate ..... f. *stenophylla*  
 II. Sporophylls long, narrow ..... f. *platyphylla*

**f. *stenophylla* SETCHELL**

in SETCHELL & GARDNER, Alg. N. W. Amer. (1903), p. 276; Mar. Alg. Pacific Coast N. Amer. III, p. 645—MIYABE, l.c. p. 297.

**f. *platyphylla* SETCHELL**

in SETCHELL & GARDNER, Alg. (1903), p. 277; Mar. Alg. p. 645—MIYABE, l.c. p. 297.

The present species is a distinct and well marked one. It is fairly different from the allied species in its fistulose midrib, large blade and well developed conic hapteres. As far as has been observed, the present species is the largest alga in Japan. In the Kuriles, northward from the eastern coast of Etorohu Isl., large associations of the present plant which grows vigorously not far from the shore were often observed by the writer here and there. In this case, the upper parts of the blades, when the tide is low, float abundantly on the surface of the water and afford resting buoys for sea-otters and other marine fur-animals.

**Habitat and localities.** Growing gregariously on the stony or rocky bottom in a depth of 5-10 or more fathoms in the sublittoral

zone. Of the two forms, *f. stenophylla* prefers a rather more shallow bottom than *f. platyphylla*. The latter is often found in the Kuriles stranded upon the beach with blades interwoven with each other in a large mass. The specimens from Sikotan Isl. were found cast ashore.

*N. Kuriles.* Araido Isl.—Minami-ura. Simusyu Isl.—Kosekigawa. Paramusiru Isl.—Suribati-wan, Titose-wan, Murakami-wan, Kakumabetu.

*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. 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.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Tosimoe, Wenbetu, Guya, Iribusi, Tosirari, Naibo. Sikotan Isl.—Tiboi, Notoro.

*f. stenophylla.*

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

*M. Kuriles.* Usisiru Isl.—Kitazima. Uruppu Isl.—Tokotan.

*S. Kuriles.* Etorohu Isl.—Moyoro. Sikotan Isl.—Tiboi.

*f. platyphylla.*

*N. Kuriles.* Araido Isl.—Minami-ura. Paramusiru Isl.—Kakumabetu.

*M. Kuriles.* Matuwa Isl.—Yamato-wan. Simusiru Isl.—Broughton Bay.

**Distrib. Sp.**—Alaska, Aleutian Isls., Bering Isl., Kamchatka and Japan (the Kuriles as far south as the eastern coast of Etorohu Isl. and an isolated spot at the southernmost point of Notoro peninsula of South Saghalien); *f. stenophylla* and *f. platyphylla*—Bering Sea, Alaska and Japan (the Kuriles).

## 2. *Alaria praelonga* KJELLMAN

Beringhafv. Algfl. (1889), p. 38, Tab. IV—DE TONI, Syll. Alg. III, p. 330—YENDO, Monogr. Alaria, p. 86, pl. IV—SINOVA, Alg. Kamtschatka, p. 18—OKAMURA, Mar. Alg. Jap. p. 277—MIYABE, in OKAMURA'S Mar. Alg. Jap. p. 297—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204.

*Alaria esculenta* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 11 (p. p.).

*Phasganon alatum* RUPRECHT, Tange Och. Meeres, (1851), pp. 355, 359 (p. p.).

*P. alatum* var. *latifolium* RUPRECHT, l.c. (1851), p. 355 (p. p.).

*A. yezoensis* MIYABE, Laminariaceae Hokkaido, (1902), p. 54, pl. XXIII—OKAMURA, Nippon Sorui Meii, ed. 1, p. 127, ed. 2, p. 165—YENDO, Kaisan-Syokubutugaku, p. 404—UEDA, Suisan-Syokubutugaku, p. 255—OKADA, Kaiso-zuhu, p. 36, pl. XXXIII.

*A. macroptera* MIYABE et NAGAI (not YENDO), Laminariaceae Kuriles, (1934), p. 99 (p. p.).

**Jap. name.** Ainu-wakame.

Holdfast composed of small, a few times branched hapteres, 1–2.5 cm. long; stipe 8–20 cm., mostly 8–12 cm. long, subterete below, 3–4 mm. diam., gradually flattened above, abruptly narrowed at the transition region; blade linear, commonly 216–325 cm. long, 4–7 cm. wide, membranaceous, slightly corrugate, splitting obliquely toward the midrib or even frayed away leaving the midrib behind in upper portion, narrow-cuneate at the base; midrib smooth, complanate, 3–6 mm. wide, elevated equally on both surfaces above the blade with roundish edges; sporophylls holosoric, 16–26 in number, pinnately arranged in a short rhachis (1–2.5 cm. long), linear-oblong with round tips, 6–21 cm., mostly 7–14 cm. long, 1.4–3.5 cm., mostly 1.4–2.5 cm. wide; sori formed on both surfaces of each sporophyll, occupying the entire surface except a narrow border along the margin.

This species was first described by KJELLMAN. According to him, the present species has a long blade reaching to a length of 7 m. but such a long one could not be found among the specimens at hand. The shape of the base of the blade is usually cuneate or even sometimes narrow-acute. The shape of the sporophylls, according to KJELLMAN, is normally lanceolate-oblong or elongate obovate, but in others intermediately oblong, ovate or broad spade-shaped. The measurement is also given by him as being 8 to 10 cm. long, 1 to 2 cm. wide. In comparing the original description of KJELLMAN with that in YENDO's monograph, there seems to be some divergency between them. YENDO gives the measurement as 6–20–30 cm. long, 1.5–2.5 cm. wide. During the preparation of the specimens of *Alaria* from the Kuriles and the eastern coast of Hokkaido, much trouble was experienced by the present writer in forming an exact conception as to the limitation of the specific characters between this and *Alaria macroptera* YENDO. But finally the specimens which in normal shape possess rather smaller, linear-oblong sporophylls with round tips were referred to the present species. Somewhat larger, linear-cuneate or ovate-lanceolate ones, which reach their maximum breadth at about two-thirds of the distance from the base and taper from that portion toward both ends were referred to *A. macroptera* YENDO.

**Habitat and localities.** Growing in the sublittoral zone, preferring rather open sea where waves are usually moving.

- N. Kuriles.* Simusyu Isl.—Kataoka-wan. Paramusiru Isl.—Suribati-wan.  
*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Ketoi Isl.—Minami-ura. Uruppu Isl.—Tokotan.  
*S. Kuriles.* Etorohu Isl.—Moyoro, Tosirari, Bettobu. Sikotan Isl.—Syakotan, Aimizaki. Kunasiri Isl.—Atoiya, Tinomizi, Rurui.

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

### 3. *Alaria macroptera* (RUPRECHT) YENDO

Monogr. *Alaria*, (1919), p. 79, pl. II—MIYABE & NAGAI, Laminariaceae Kuriles, p. 99—YAMADA, Mar. Alg. Urup, p. 16—OKAMURA, Mar. Alg. Jap. p. 276—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 297—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204.

*Phasganon macropteron* RUPRECHT, Tange Och. Meeres, (1851), p. 353.

*Alaria corrugata* MIYABE, Laminariaceae Hokkaido, (1902), p. 55, pl. XXIV—OKAMURA, Nippon Sorui Meii, ed. 1, p. 127, ed. 2, p. 165—YENDO, Kaisan-Syokubutugaku, p. 405.

*A. macrophylla* MIYABE, l.c. (1902), p. 56, pl. XXV—OKAMURA, l.c. ed. 1, p. 127, ed. 2, p. 166.

**Jap. name.** Tisima-wakame.

Holdfast composed of small, slender, 3 or 4 times dichotomously branched hapteres, 1.5–3 cm. long; stipe 3.5–11 cm. long, cylindrical below, 2–4 mm. diam., terete and more or less broadened above, but complanate in the portion of the rhachis, narrowed below the transition region; blade linear- or broad-lanceolate, 155–450 cm. long, 8–22 cm.; mostly 9–13 cm. wide, dark olive brown, membranaceous, scarcely or much corrugated transversely toward the midrib, slightly undulated or richly crisped on the margin, splitting in the upper portions obliquely toward the midrib, narrow-cuneate or acute with round outline at the base, without cryptostomata; midrib smooth, complanate, 3–6 mm. wide, elevated equally on both surfaces above the blade with round edges; sporophylls holosoric, 12–32 in number, pinnately arranged in a short (1–3 cm. long) rhachis or often fasciculate, lanceolate or often linear-cuneate with attenuate tip, attaining maximum breadth mostly at about 2/3 of the distance upward from the base, tapering gradually toward both ends, nearly

obtuse or rarely rounded at the apices, 11.5–33 cm. long, 2–3.5–6 cm. wide; sori formed in a continuous patch on both surfaces of each sporophyll, generally occupying the entire area of the surface except a narrow border along the margin, but sometimes leaving a short area of the upper part sterile and membranaceous.

In his monograph on the genus *Alaria*, YENDO describes the arrangement of the sporophylls of the present species as "... pinnately arranged on both margins of the terete part of the stipe, a few lowermost ones more or less apart, but the middle and upper ones close together." Judging from the figure in plate II of his account, the rhachis seems to be far shorter than those of the other pinnately arranged sporophyll bearing species. In most of the specimens now at hand, the sporophylls are formed nearly fasciculately as in the plant from Uruppu Isl. reported by YAMADA, and only in a small number of cases are they arranged pinnately with slight alienation in a rather short rhachis, of 1–3 cm. length. They are mostly lanceolate or linear-cuneate with more or less wide tapering apices, broadened at about two-thirds of the distance upward from the base and tapering gradually toward both ends. They measure 11.5 to 33 cm. long and 2 to 4.5 cm. wide. In a specimen from the eastern coast of Kunasiri Isl., however, the sporophylls are not much similar to the above, but oblong or oblong-elliptic with round tips. They measure 15 to 22 cm. long and 3 to 6 cm. wide. These resemble closely the description and the figure of *Alaria macrophylla* of MIYABE. In the description of *Phasganon alatum* f. *macropterum*, RUPRECHT stated on the sporophylls, "Die Fiedern stehen gedrängt, sind auffallend gross und am Ende sehr breit; ich sah welche von 1 Fuss Länge und 3 Zoll Breite am Ende, es waren aber noch nicht die grössten: 1/3–2/3 des Fiederblattes ist gegen den Stiel zu verdickt: der übrige Theil, so wie das Endblatt ist äusserst zart und dünn, beim Trocknen oft in Stücke zerreissend." According to the above description, it seems to the present writer that the plant identified by RUPRECHT has large, especially broad sporophylls. But their shape is not specially mentioned. Comparing YENDO's description with the above, his plant seems to be somewhat different in the dimensions, especially in its breadth, from RUPRECHT's plant. In the specimens at hand, as above stated, there are two forms, the one very similar to that of YENDO, the other similar not only to those of RUPRECHT in dimensions but also to *Alaria macroptera* of MIYABE in shape. In

the present paper, they are treated provisionally under the present species.

**Habitat and localities.** Growing in the upper part of the sublittoral zone, on the rocky bottom.

- N. Kuriles.* Paramusiru Isl.—Titose-wan.  
*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune, Misima, Iema (YAMADA).  
*S. Kuriles.* Etorohu Isl.—Moyoro, Ukaboi, Kamuikotan, Tosirari, Sibetoro, Bettobu, Syana, Arimoe, Rubetu, Kamuikotan, Naibo. Sikotan Isl.—Syakotan, Tiboi, Notoro. Kunasiri Isl.—Atoiya, Idasibennai, Tinomiti.

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

#### 4. *Alaria dolichorhachis* KJELLMAN

Alg. Arct. Sea, (1883), p. 217.

**Jap. name.** Enaga-wakame.

##### Key to the forms

- I. Stipe short, up to 20 cm. long..... f. *typica*  
 II. Stipe long, 30–50 cm. long..... f. *longipes*

##### f. *typica* MIYABE et NAGAI, f. nov.

*Alaria dolichorhachis* KJELLMAN, Alg. Arct. Sea, (1883), pl. XX, XXI, pl. XXV, fig. 11–18; Beringhafv. Algfl. p. 36—DE TONI, Syll. Alg. III, p. 328—SETCHELL & GARDNER, Alg. N. W. Amer. p. 272; Mar. Alg. Pacific Coast N. Amer. III, p. 642—SETCHELL, Kelps U.S. & Alaska, p. 162—YENDO, Monogr. Alaria, p. 89, pl. V—MIYABE & NAGAI, Laminariaceae Kuriles, p. 99—OKAMURA, Mar. Alg. Jap. p. 277—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 298.

*Alaria elliptica* KJELLMAN, Alg. Arct. Sea, (1883), p. 221, pl. XXIII, pl. XXV, fig. 25, 26—DE TONI, l.c. p. 329.

*A. crispa* KJELLMAN, Beringhafv. Algfl. (1889), p. 37, Tab. III, fig. 5–7—DE TONI, l.c. p. 330.

*A. taeniata* SETCHELL (not KJELLMAN), Kelps. (1912), p. 162.

Stipite tereti, supra leviter complanato, 3–5 mm. diam., 9–24 cm. longo; rhachide 2–4 cm. longa; lamina lineari-, raro ovato-lanceolata, basi cuneata, raro rotundata; costa media levi; sporophyllis lineari-labiformibus, 12–32. numerosis.

*f. longipes* MIYABE

in Proc. 3rd Pan-Pacific Sci. Congr. 1926, (1928), p. 597—MIYABE & NAGAI, l.c. p. 99—TOKIDA, Mar. Alg. Robben Isl. (Suppl. Rept.), p. 18—YAMADA, Mar. Alg. N. Kuriles, p. 345—OKAMURA, l.c. p. 277—MIYABE, l.c. p. 298.

*Phasganon alatum* var. *longipes* RUPRECHT, Tange Och. Meeres, (1851), p. 353.

It is not very difficult to identify the present species because it has some prominent characters. This species is easily separable from its allies in the point of the long rhachis on which linear-linguiform sporophylls are usually borne in pinnate arrangement. In the specimens at hand, the rhachises on which sporophylls are formed, are mostly 2–4 cm. long, but in the case of including the lower portion where the cicatrices remain, they sometimes reach to a length of 15 cm. According to KJELLMAN, the blade is linear-lanceolate, while YENDO says, ovate-lanceolate. The shape of the blade in the specimens at hand, is often linear-lanceolate with acute or more or less broad-cuneate base, measuring 5 to 18 cm. wide. In some cases, however, it becomes broader and measures 20 to 45 cm. wide. These specimens are ovate-lanceolate with rounded base. Judging from the distribution of the species, the broader form may be growing in rather calm waters, the narrower in waters where the waves are usually rough. As to the nature of the sporophylls whether holosoric or metasoric, YENDO has given it as holosoric with query. The fully matured sporophylls in the specimens at hand, however, show it to be holosoric.

As to *f. longipes*, it is distinguished from *f. typica* in having long stipe. In his monograph on the genus *Alaria*, YENDO referred *Phasganon alatum* var. *longipes* RUPR. to *Alaria macroptera* YENDO. But the present writer believes now that it may be better referred to *f. longipes* of the present species than to that species on account of its long stipe.

**Habitat and localities.** Growing in the sublittoral zone on rocky or rarely on pebbly bottom in a depth of ca. 2–3 fathoms.

*f. typica.*

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

*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Harumukotan Isl.—Harumukotan-byoti. Usisiru Isl.—Minamizima. Uruppu Isl.—Misima, Tokotan.

*S. Kuriles.* Etorohu Isl.—Tosimoe, Tosirari, Sibetoro, Bettobu, Syana, Arimoe, Rubetu.

*f. longipes.*

*N. Kuriles.* Simusyu Isl.—Tenzin-iwa. Paramusiru Isl.—Kurosaki.

*S. Kuriles.* Etorohu Isl.—Wenbetu, Rubetu.

**Distrib.** *Sp.*—Arctic Ocean, Alaska, Aleutian Isls., Bering Sea (Konyam Bay), Kamchatka and Japan (the Kuriles); *f. longipes*—Okhotsk Sea and Japan (Saghalien and the Kuriles).

### 5. *Alaria tenuifolia* SETCHELL

in COLLINS, HOLDEN & SETCHELL, Phyc. Bor.-Amer. (Exsicc.), Fasc. I, No. 45—SETCHELL & GARDNER, Alg. N. W. Amer. p. 272; Mar. Alg. Pacific Coast N. Amer. III, p. 638—SETCHELL, Kelps U.S. & Alaska, p. 162—MIYABE & NAGAI, Laminariaceae Kuriles, p. 100—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 298.

*f. typica* SETCHELL

in COLLINS, HOLDEN & SETCHELL, l.c.—SETCHELL & GARDNER, Alg. N. W. Amer. p. 273, pl. XXII; Mar. Alg. p. 638—NAGAI, Meeresalg. Kamtschatka, p. 15—MIYABE & NAGAI, l.c. p. 100—MIYABE, l.c. p. 298.

**Jap. name.** Maruba-wakame.

Holdfast composed of rather small, a few times branched hap-teres, 1–2 cm. long; stipe 7–12 cm. long, subterete at the base, becoming much flattened and gradually broadened upward, ca. 3 mm. diam. at the base, suddenly narrowed at the transition region; blade linear-oblong, often not long, 50–220 cm. long, 8–20 cm., mostly 10–15 cm. wide, subcoriaceous, much corrugated, splitting obliquely or transversely toward the midrib, or often frayed away leaving the midrib behind, broad-cuneate, rarely rounded at the base, with plentiful cryptostomata; midrib smooth, complanate, 4–6 mm. wide, equally prominent above the blade on both surfaces with roundish edges; sporophylls metasoric, 14–30 in number, disposed more or less separately from each other in alternate or subopposite arrangement on the rhachis (2.5–5 cm. long), linguiform to obovate, tapering evenly toward the bases, round or obtuse at the apices, 6–26 cm., mostly 10–15 cm. long, 2–5 cm. wide; sori formed on both surfaces of each

sporophyll, occupying the lower half or two-thirds of the full length, and leaving the upper part and the narrow border sterile.

The present species is easily distinguishable from the other members of the genus in our waters by its rather short and moderately wide blade, as well as by the metasoric, linguiform to obovate sporophylls which are borne rather separately in alternate or subopposite arrangement on both margins of the rhachis. As far as the author is aware, the species that bears the above characters, is represented by *Alaria Pylaii* GREV. according to YENDO's monograph. In his account, YENDO inserted many synonyms under *A. Pylaii*, from among which he maintained that *A. tenuifolia* SETCH. and its forms should be omitted. They were treated as different species later by SETCHELL and GARDNER in their "Marine Algae of Pacific Coast of N. America, III." It is not proposed to touch here upon all these synonyms. But there seem to be some divergencies in the measurements of the plant among them, although in the important characters the plants are similar to each other. From the measurements as well as other characters, it seems probable that the present specimens should be referred to *Alaria tenuifolia* f. *typica* SETCHELL for the time being.

**Habitat and localities** of f. *typica*. Growing on the stony bottom in the upper sublittoral zone, in Broughton Bay, Simusiru Isl.

*N. Kuriles*. Araido Isl.—Minami-ura. Paramusiru Isl.—Titose-wan, Murakami-wan.

*M. Kuriles*. Onnekotan Isl.—Nemo-wan, Odomari. Harumukotan Isl.—Harumukotan-byoti. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Misima.

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

**Distrib.** Alaska, Kamchatka and Japan (the Kuriles).

## 6. *Alaria taeniata* KJELLMAN

Beringhafv. Algfl. (1889), p. 36, pl. VII—YENDO, Monogr. *Alaria*, p. 127, pl. XVI—OKAMURA, Mar. Alg. Jap. p. 278—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 299.

*Alaria esculenta* a *angustifolia* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 11. (p. p.).

**Jap. name.** Kusiro-wakame.

Holdfast composed of rather small, a few times branched hapteres, 1–1.5 cm. long; stipe 6–9 cm. long, terete, suddenly flattened

upward near the rhachis; blade linear, 50–125 cm. long, 3–4 cm. wide, coriaceous, splitting obliquely or transversely toward the midrib in the upper end, acute or narrow-cuneate at the base, with cryptostomata; midrib smooth, complanate, 3.5–4 mm. wide, prominent above the blade equally on both surfaces with round edges; sporophylls metasoric, 16–46 in number, fasciculately arranged in a short, expanded rhachis (ca. 1 cm. long), near the upper end of stipe, linear-lanceolate or linear, 5–18 cm. long, 2–8 mm. wide, attenuated toward the bases ending in filiform petioles, acute or tapering at the apices; sori occupying the greater part of the surface of sporophyll, leaving a terminal portion and a narrow border along the margin sterile.

Although YENDO states that the present species is often found along the Kurile Islands as far south as Hidaka province in Hokkaido, the present writer could not often find specimens referable with confidence to this species. Only a few specimens are referred with some hesitation to this species, on which numerous, small, slender and attenuate sporophylls are observed being rather fasciculately arranged within a short length limited to the upper portion of the stipe. As to the cryptostomata, YENDO states them as wanting, but the present writer observed them disposed abundantly on the blade in the fresh materials from Musiru islet. However they became not easily detectable after the specimens were dried.

**Habitat and localities.** Growing on rocks in the lower littoral zone, together with *A. angusta* in Musiru Islet.

*N. Kuriles.* Araido Isl.—Sekinezaki. Simusyu Isl.—Kataoka-wan.

*M. Kuriles.* Onnekotan Isl.—Odomari. Musiru Islet.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tosirari.

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

### 7. *Alaria angusta* KJELLMAN

Beringhafv. Algfl. (1889), p. 38, Tab. III, fig. 1–4—YENDO, Monogr. Alaria, p. 123, pl. XV—MIYABE & NAGAI, Laminariaceae Kuriles, p. 97—YAMADA, Mar. Alg. Urup, p. 16—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 204—OKAMURA, Mar. Alg. Jap. p. 278—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 299.

*Alaria esculenta* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 11. (p. p).

*A. lanceolata* KJELLMAN, l.c. (1889), p. 39, Tab. V, fig. 1–3—SAUNDERS, Alg. Harriman Exp. p. 426, pl. LIII—SETCHELL & GARDNER, Alg. N. W. Amer. p. 275; Mar. Alg. Pacific Coast N. Amer. III, p. 642—SETCHELL, Kelps. U.S. & Alaska, p. 162—YENDO, l.c. p. 129, pl. XVII—MIYABE, in Proc. 3rd Pan-Pacific Sci. Congr. Tokyo, 1926, p. 958—OKAMURA, Mar. Alg. Jap. p. 278.

*A. laticosta* KJELLMAN, l.c. (1889), p. 40, Tab. VI—DE TONI, Syll. Alg. III, p. 331—SAUNDERS, l.c. p. 524, pl. LV.

*A. dolichorhachis* COLLINS, HOLDEN & SETCHELL, Phyc. Bor.-Amer. (Exsicc.), Fasc. I, No. 41 (not KJELLMAN).

**Jap. name.** Hosoba-wakame.

In 1889, KJELLMAN reported on nine species of *Alaria* in "Beringhafvets Algflora." Among these species, are noted *Alaria angusta* KJELLM. which bears narrow, metasoric and fasciculate sporophylls and also *A. lanceolata* KJELLM., similar to the former, but having longer sporophylls. According to KJELLMAN, the blade of the former species is narrow lanceolate, measuring 1 m. long, only 7 cm. wide, while that of the latter is lanceolate, and 1.25 m. long and 15 cm. wide, in one specimen of each species. The sporophylls of the former are characteristic in slenderness measuring 10 to 15 cm. long in ordinary sizes, and never exceeding 1 cm. wide. They are lanceolate, linear-spathulate in shape, petiolate at the bases and having rather long sterile portions above. In the latter species, they are usually very long, and comparatively narrow, and in measurement, they reach even to 1 m. in length and 3 to 4 cm. in width. The sporophylls are covered with sori on nearly the whole surface except the terminal portion and the narrow border along the margin. These species are numerated by YENDO in his monograph on the genus *Alaria* as growing also in the North Kuriles. From the North down to the South Kuriles, but limited to the region washed by the cold current, the present writer also found an *Alaria* that bears fasciculate narrow sporophylls growing on the reefs exposed at ebb-tide. The blade is linear or linear-lanceolate with acute or cuneate base, and much narrower, but rather shorter than in the other species. It often splits and is sometimes decaying in the upper portion, leaving the midrib behind. The stipe is short. The sporophylls are linear or rarely linear-lanceolate, narrow, usually fasciculate, and having sterile portions above. These sterile portions are rather long and sometimes attain even to one half or two-thirds of the full length of the sporophylls, but rarely do the sori extend further upward, with the result that rather short sterile portions are left on the tip. The sporophylls are at least 11 cm., mostly 20 to 50 cm. and rarely up to 75 cm. long. In width they measure mostly 1.5 to 3 cm., but sometimes in the younger specimens 4 to 5 mm. wide even at the broadest

parts. Among the abundant specimens from the Kurile Islands, there are found many individuals which accord well with *A. angusta*, as well as with *A. lanceolata*. Forms intermediate between them are also found. After consideration, Prof. MIYABE and the present writer have come to the conclusion that these two species should better be amalgamated into one species. As to the other synonyms, here, the opinion of YENDO, and SETCHELL and GARDNER is tentatively followed.

**Habitat and localities.** Growing on the rocks, forming associations, in the lower littoral zone in the North Kuriles, while rather sparsely in the same habitat in the South Kuriles; in Sikotan Isl. found east ashore.

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

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

*S. Kuriles.* Etorohu Isl.—Ukaboi, Tikohai, Wenbetu, Iriribusi, Bussomisaki, Kamuiwakka, Tosirari, Syana. Sikotan Isl.—Tiboi.

**Distrib.** Alaska, Aleutian Isls., Bering Isl. and Japan (the Kuriles, the western coast of the southernmost point of Notoro peninsula of South Saghalien and Soya Strait).

## 29. *Pleuropterum* MIYABE et NAGAI, 1932

### *Pleuropterum paradiseum* MIYABE et NAGAI

*Pleuropterum paradiseum*, New Genus & Species Alarieae fr. N. Kuriles, (1932), p. 127, fig. 1, 2; Laminariaceae Kuriles, p. 100—OKAMURA, Mar. Alg. Jap. p. 279, fig. 156—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 300.

**Jap. name.** Hutyo-wakame, Araido-wakame.

Holdfast compresso-hemispherical in general outline, consisting of a whorl of ca. a dozen cylindrical or somewhat complanate rhizines of 2.5–4 cm. length, which are several times dichotomously branched; stipe long or short, terete or subterete at the base, becom-

ing flattened and broadened above, abruptly narrowed at the transition region; blade linear to linear-lanceolate, membranaceous, not very corrugate, splitting obliquely or transversely toward the midrib at the apex, with a prominent midrib; midrib smooth, complanate, elevated above the blade equally on both surfaces with round edges; pinnae composed of 2 kinds, fertile (sporophylls) and sterile; fertile pinnae short, linear-oblong to linear with round apices, with inconspicuous midrib, soriferous on the whole surface or rarely leaving the upper portion sterile; sterile pinnae long, linear, membranaceous with evident percurrent midrib like the main blade, generally leaving the whole surface sterile, or sometimes soriferous only at the basal portion in those which are situated nearer to the former; both sorts of pinnae arranged pinnately or fasciculately on both margins of rhachis; sori formed on the whole surface of the fertile pinnae, rarely leaving their upper portion sterile, sometimes also at the basal portion of the sterile pinnae.

**Key to the forms**

- I. Stipe long, 40–60 cm. long..... f. *typicum*
- II. Stipe short, 2.5–15 cm. long.
  - A. Both sporophylls and sterile pinnae formed rather closely in pinnate manner on the stipe ..... f. *brevipes*
  - B. Both sporophylls and sterile pinnae formed fasciculately on the stipe ..... f. *fasciculatum*

**f. *typicum* MIYABE et NAGAI**

(Pl. III, fig. 9)

Laminariaceae Kuriles, (1933), p. 101—MIYABE, in OKAMURA's Mar. Alg. Jap. p. 300.

Stipe stout, long, 40–60 cm. long, 7–11 mm. diam.; rhachis 3–9 cm. long; blade linear-lanceolate, cuneate at the base, 80–135 cm. long, 7–15 cm. wide; midrib 4–5 mm. wide; pinnae 32–72 in number; fertile pinnae 8–14 cm. long, 7–15 mm. wide; sterile pinnae 20–90 cm. long, 1.5–3 cm. wide, often soriferous only at the basal portion of ca. 3–7 cm. length; both sorts of pinnae formed contiguously in pinnate arrangement on both margins of the rhachis.

**f. *brevipes* MIYABE et NAGAI**

l.c. (1933), p. 101—MIYABE, l.c. p. 300.

Stipe short, up to 15 cm. long, ca. 4–5 mm. diam. near the base, 7–9 mm. wide at the upper portion; rhachis short, 2–3 cm. long; blade linear-lanceolate, broad-cuneate at the base, 3–3.7 m. long, 15–17.5 cm. wide; midrib broad, 6–14 mm. wide; pinnae ca. 32–36 in number; fertile pinnae 9–22 cm. long, 12–21 mm. wide; sterile pinnae ca. 35–42 cm. long, ca. 10–12 mm. wide, soriferous only at the basal part and leaving the upper portions sterile; both sorts of pinnae formed rather closely in pinnate arrangement in a short rhachis.

f. *fasciculatum* (YAMADA) MIYABE et NAGAI

MIYABE, in OKAMURA's Mar. Alg. Jap. (1936), p. 300.

*Pleuropterum fasciculatum* YAMADA, Mar. Alg. Urup, (1935), p. 16, pl. V—OKAMURA, l.c. p. 280.

Stipe short, 2.5–4 cm. long, ca. 8–10 mm. wide; blade linear or linear-lanceolate, narrow-cuneate at the base, 3 m. or more long, 6.5–19 cm. wide; midrib broad, 10–12 mm. wide; pinnae 20–30 in number; fertile pinnae 7–12 cm. long, 12–22 mm. wide; sterile pinnae 15–50 cm. long, 13–28 mm. wide, soriferous only at the basal part and leaving the upper portions sterile, sometimes completely sterile on the whole surface; both pinnae densely fasciculate on both edges of the short rhachis.

After the first description of this species from Araidō Isl., the second species, *P. fasciculatum*, was in 1934 reported by Prof. YAMADA from Uruppu Isl. He describes his plant in detail with a fine photograph and maintains that it differs from the Araidō plant in three points, viz., the fasciculate arrangement of sporophylls, the shortness of stipe and the greater width of midrib. As YAMADA says, his plant is apparently different from the typical form in the above characters, but is somewhat closely allied to f. *brevipes*, from which it differs, however, to a certain extent in the first character. After consideration, it seems to the writer that *P. fasciculatum* should better be accorded the rank of a form for the present, coordinate with f. *typicum* and f. *brevipes*.

**Habitat and localities.** Growing on the rocky bottom in a depth of ca. 1 fathom at ebb-tide, in the upper sublittoral zone, in Nemo-wan, Onnekotan Isl.; according to Prof. YAMADA, f. *fasciculatum* found growing in the upper sublittoral zone together with *Alaria macroptera*.

f. *typicum*.

*N. Kuriles*. Araido Isl.—Sekinezaki, Minami-ura.

*M. Kuriles*. Onnekotan Isl.—Nemo-wan, Odomari. Usisiru Isl.—Kitazima, Minamizima. Uruppu Isl.—Tokotan.

f. *brevipes*.

*M. Kuriles*. Harumukotan Isl.—Harumukotan-byoti. Simusiru Isl.—Broughton Bay.

f. *fasciculatum*.

*M. Kuriles*. Uruppu Isl.—Iema (YAMADA).

**Distrib.** Endemic (the Kuriles).

## Order IX. Fucales

Family 18. *Fucaceae*

## Key to the genera

- I. Frond flattened; branching dichotomous.
  - A. Frond with distinct percurrent midrib ..... *Fucus* (30)
  - B. Frond without midrib ..... *Pelvetia* (31)
- II. Frond not flattened; branching lateral.
  - A. Branches borne directly from the main axis ..... *Cystophyllum* (32)
  - B. Branches borne in the axils of leaflets on the main axis.....  
..... *Sargassum* (33)

30. *Fucus* (LINNAEUS 1737) emend DECAISNE et THURET, 1845*Fucus evanescens* AGARDH

Sp. Alg. I, 1, (1820), p. 92; Icon. Alg. Ined. Fasc. q. Exst. Duo, ed. nova, Tab. XIII—KJELLMAN, Spetsb. Thall. II, p. 3; Alg. Arct. Sea, p. 202—DE TONI, Syll. Alg. III, p. 201—OKAMURA, Nippon Sorui Meii, ed. 1, p. 137; Mar. Alg. Jap. p. 302—SETCHELL & GARDNER, Alg. N. W. Amer. p. 281; Mar. Alg. Pacific Coast N. Amer. III, p. 681—YENDO, Fucac. Japan, p. 14, pl. I, fig. 1, 2; Kaisan-Syokubutugaku, p. 435, fig. 16, 134; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 189—GARDNER, Genus *Fucus*, p. 36, pl. I, fig. 2—SINOVA, Alg. Mer Ochotsk. p. 103; Alg. Kamtschatka, p. 23—YAMADA, Mar. Alg. N. Kuriles, p. 346, fig. 1; Mar. Alg. Urup, p. 20—NAGAI, Jap. Form. v. *Fucus evanescens*, p. 324—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206—TAYLOR, Mar. Alg. N.-E. Coast N. Amer. p. 207, pl. XXIII, fig. 4, pl. XXIV, fig. 2.

**Jap. name.** Hibamata.

## Key to the forms

- I. Frond mostly foliaceous; segments broad, mostly more than 1 cm. wide.
- A. Receptacles acuminate, slightly acute or nearly blunt at apices.
1. Receptacles acuminate, bi- or tri-furcate, rarely decompositely divided; divided parts of receptacle short, not widely spread..... f. *rudis* (1)
  2. Receptacles slightly acute or nearly blunt.
    - a. Receptacles not large, more or less deeply bifurcate.
      - i. Divided parts of receptacle narrow, mostly acute ..... f. *intermedius* (2)
      - ii. Divided parts of receptacle broad, mostly ovate, rarely linear-acuminate ..... f. *typicus* (3)
    - b. Receptacles very large, mostly slightly bifurcate; divided parts of receptacle broad, somewhat widely spread... f. *magnificus* (4)
- B. Receptacles blunt or rounded at apices.
1. Receptacles mostly blunt.
    - a. Receptacles mostly bifurcate.
      - i. Receptacles mostly slightly furcate; divided parts of receptacle short and broad..... f. *paramushirensis* (5)
      - ii. Receptacles mostly deeply furcate; divided parts of receptacle ovate, fusiform or somewhat oblong..... f. *pergrandis* (6)
    - b. Receptacles mostly simple, fusiform, rarely bifurcate..... f. *fusiformis* (7)
  2. Receptacles usually rounded ..... f. *macrocephalus* (8)
- II. Frond slender, not foliaceous; segments narrow, mostly less than 1 cm. wide.
- A. Receptacles acuminate at apices ..... f. *cornutus* (9)
- B. Receptacles blunt or rounded at apices.
1. Receptacles slightly compresso-terete or compresso-narrow-fusiform.
    - a. Receptacles large, 2-5×0.4-0.7 cm., with abundant conceptacles on the whole surface ..... f. *cylindricus* (10)
    - b. Receptacles small, 1.2-1.8×0.4-0.6 cm., often without conceptacles on the margin ..... f. *marginatus* (11)
  2. Receptacles ovate, obovate or obcordate ..... f. *irregularis* (12)

1. f. *rudis* KJELLMAN

Beringhafv. Algfl. (1889), p. 34—DE TONI, Syll. Alg. III, p. 202—GARDNER, Genus Fucus, p. 53, pl. LVII—SETCHELL & GARDNER, Mar. Alg. Pacif. Coast III, p. 692—SINOVA, Alg. Och. p. 103; Alg. Kamtschatka, p. 28—NAGAI, Jap. Form. v. *F. evanescens*, p. 327, fig. 2.

*Fucus vesiculosus* POSTELS et RUPRECHT, Ill. Alg. (1840), p. 12, Taf. XXV.

Frond subcoriaceous, dichotomous or in part secund, 19-30 cm. high; segments subcuneate, 8-20 mm., mostly 10-15 mm. wide; midrib relatively broad, at times indistinct; cryptostomata absent or

5–15 per sq. cm. on the upper part of the segment; receptacles relatively large, bi-, rarely tri-furcate, sometimes decompositely divided, acute, 2.5–4.5 cm., mostly 2.5–3 cm. long, 6–25 mm., mostly 9–12 mm. wide, not definitely delimited; conceptacles abundant, prominent; oogonia  $114\text{--}180 \times 78\text{--}135 \mu$ ; antheridia  $36\text{--}51 \times 10.5\text{--}21 \mu$ .

### 2. f. *intermedius* GARDNER

l.c. (1922), p. 44, pl. XLIV—SETCHELL & GARDNER, Mar. Alg. III, p. 688—NAGAI, l.c. p. 329, fig. 3.

Frond foliaceous, 10–14 cm., rarely up to 33 cm. high, dichotomous; segments cuneate to sublinear, 9–16 mm. wide; midrib relatively broad, distinct in the greater part of the frond, evanescent at apices; alae relatively broad; cryptostomata ca. 15 per sq. cm.; receptacles slightly or deeply furcate, broadened below, acute at apices, 2–3 cm. long, 9–12 mm. wide; conceptacles abundant, prominent; oogonia  $96\text{--}151.2 \times 72\text{--}103.2 \mu$ ; antheridia  $31.2\text{--}43.2 \times 12\text{--}15.6 \mu$ ; paraphyses  $120\text{--}216 \times 8.4\text{--}9.6 \mu$ .

### 3. f. *typicus* KJELLMAN

Spetsb. Thall. II, (1877), p. 3; Alg. Arct. Sea, p. 202—GARDNER, l.c. p. 51, pl. LVI—SETCHELL & GARDNER, Mar. Alg. p. 683—NAGAI, l.c. p. 330, fig. 4.

Frond coriaceous, dichotomous, ca. 16 cm. high; segments sub-linear to cuneate, mostly 6–9 mm. wide; midrib relatively broad, distinct in the greater part of the frond, evanescent at apices; cryptostomata few, 10–15 per sq. cm.; receptacles deeply furcate, obovate or somewhat linear-acuminate, 2.1–3 cm. long, 7–12 mm. wide; conceptacles abundant, prominent; oogonia  $129\text{--}165 \times 96\text{--}120 \mu$ ; antheridia  $42\text{--}57 \times 12\text{--}16.5 \mu$ .

### 4. f. *magnificus* GARDNER

l.c. (1922), p. 48, pl. LI, LII—SETCHELL & GARDNER, Mar. Alg. p. 686—NAGAI, l.c. p. 331, fig. 5.

Frond foliaceous, repeatedly dichotomous or in part secund, 15–30 cm. high; segments linear to subcuneate, 7–13 mm. wide; midrib relatively broad, somewhat distinct, evanescent at apices;

cryptostomata variable, few to 50 per sq. cm. or quite absent; receptacles definitely delimited, large, inflated or compressed furcate, rarely decompositely furcate, blunt or rarely acute, 2.5–5 cm. long, 10–28 mm. wide; conceptacles abundant, prominent; oogonia 120–180 × 84–102  $\mu$ ; antheridia ca. 39 × 10.2–13.5  $\mu$ .

#### 5. f. *paramushirensis* NAGAI

l.c. (1935), p. 332, fig. 6.

Fronde foliaceous, subcoriaceous, dichotomous, 12–20 cm. high; segments linear-cuneate, 7–10 mm. wide; midrib relatively broad, somewhat distinct in the greater part of the frond, evanescent at apices; cryptostomata absent or few, rarely ca. 15 per sq. cm.; receptacles definitely delimited, obovate, slightly or deeply furcate or decompositely furcate, blunt, 2–3 cm. long, 10–15 mm. wide; conceptacles abundant, prominent; oogonia 105–159 × 69–96  $\mu$ ; antheridia 33–55.5 × 10.5–18  $\mu$ .

#### 6. f. *pergrandis* KJELLMAN

Spetsb. Thall. II, (1877), p. 3; Alg. Arct. Sea, p. 202—DE TONI, l.c. p. 203—GARDNER, l.c. p. 46, pl. XLVII, XLVIII—SETCHELL & GARDNER, Mar. Alg. p. 685—NAGAI, l.c. p. 334, fig. 7.

?*Fucus evanescens* f. *macrocephalus* YENDO (not KJELLMAN), Fucac. Japan, (1907), p. 16.

Fronde subcoriaceous, repeatedly dichotomous, mostly 15–20 cm. high; segments linear to linear-cuneate, 8–16 mm. wide; midrib relatively broad, somewhat distinct in the greater part of the frond; cryptostomata absent or few; receptacles abundant, simple or bifurcate, divided portions ovate, fusiform or oblong, blunt at apices, 1.5–4.5 cm., mostly 2–3 cm. long, 8–17 mm. wide; conceptacles abundant, prominent; oogonia 117–210 × 75–125  $\mu$ ; antheridia 36–54 × 12–18  $\mu$ .

#### 7. f. *fusiformis* NAGAI

l.c. (1935), p. 336, fig. 8.

?*Fucus evanescens* f. *nana* & *bursigera* YENDO (not KJELLMAN), Fucac. Japan, (1907), p. 16, pl. I, fig. 2.

Fronde foliaceous, membranaceous, dichotomous or in part subsecund, 16–28 cm. high; segments linear above, cuneate below, 7–14 mm., rarely up to 25 mm. wide, sometimes relatively broad; midrib relatively broad, somewhat distinct in the greater part of the frond, evanescent at apices; cryptostomata abundant, 20–50 per sq. cm.; receptacles definitely delimited, 2.3–4 cm. long, 8–12 mm. wide; conceptacles abundant, prominent; oogonia  $120\text{--}174 \times 90\text{--}114 \mu$ ; antheridia  $36\text{--}60 \times 10.5\text{--}15 \mu$ .

#### 8. f. *macrocephalus* KJELLMAN

Beringhafv. Algfl. (1889), p. 34—DE TONI, l.c. p. 202—SAUNDERS, Alg. Harriman Exp. p. 432, pl. LXII, fig. 1—GARDNER, l.c. p. 45, pl. XLV, XLVI—SETCHELL & GARDNER, Mar. Alg. p. 684—SINOVA, Alg. Kantsch. p. 28—NAGAI, l.c. p. 338, fig. 9.

Fronde subcoriaceous, repeatedly dichotomous, 12–20 cm. high; segments relatively narrow, linear to linear-cuneate, 5–10 mm., mostly 6–8 mm. wide; midrib relatively narrow, somewhat distinct in the greater part of the frond, evanescent at apices; cryptostomata absent or few; receptacles abundant, definitely delimited, simple, slightly or somewhat deeply furcate, ovate, obcordate, rounded at apices, rarely accompanying somewhat acute ones, 1–2.5 cm. long, 10–18 mm. wide; conceptacles abundant, prominent; oogonia  $114\text{--}141 \times 90\text{--}105 \mu$ ; antheridia  $36\text{--}48 \times 12\text{--}18 \mu$ ; paraphyses 10.5–12  $\times$  204–300  $\mu$ , composed of a row of 5–6 cells.

#### 9. f. *cornutus* KJELLMAN

Beringhafv. Algfl. (1889), p. 34—DE TONI, l.c. p. 202—GARDNER, l.c. p. 50, pl. LV—SETCHELL & GARDNER, Mar. Alg. p. 692—SINOVA, Alg. Och. p. 104; Alg. Kantsch. p. 28—NAGAI, l.c. p. 341, fig. 11—TAYLOR, l.c. p. 207.

Fronde slender, subcoriaceous, dichotomous, 14–25 cm. high; segments linear to linear-cuneate, 4–8 mm. wide; midrib somewhat narrow, somewhat distinct in the greater part of the frond, evanescent at apices; cryptostomata few, small; receptacles abundant, definitely delimited, furcate or decompositely furcate, often acuminate, rarely somewhat blunt, with slightly laterally reflexed apices, 2–3 cm. long, 5–11 mm. wide; conceptacles abundant; oogonia  $111\text{--}180 \times 78\text{--}111 \mu$ ; antheridia  $31.5\text{--}52.5 \times 12\text{--}18.7 \mu$ .

10. *f. cylindricus* NAGAI

l.c. (1935), p. 343, fig. 12.

*Fucus inflatus f. edentatus* YENDO (not ROSENVINGE), *Fucac.* Japan, (1907), p. 17, pl. I, fig. 3; in OKAMURA's *Nippon Sorui Meii*, ed. 2, p. 189 (sub variety)—OKAMURA, *Mar. Alg. Jap.* p. 303.

?*F. evanescens f. cornuta* YENDO (not KJELLMAN), l.c. (1907) p. 16.

?*F. evanescens* HIGASHI (not AGARDH), *Nippon Kaiso-zuhu*, (1934), p. 37, 1 pl.

?*F. evanescens* OKAMURA (not AGARDH), *Mar. Alg. Jap.* (1936), fig. 159.

Fronde slender, caulescent, rigid, subcoriaceous, dichotomous or in part subsecund, 11–33 cm. high; segments relatively narrow, linear, rarely linear-cuneate, 4–9 mm. wide; midrib narrow, sometimes somewhat distinct to the apices; cryptostomata mostly absent; receptacles abundant, cylindrical or narrowly fusiform, simple or deeply bifurcate, definitely delimited, blunt or rarely nearly blunt, 2–5 cm. long, 4–7 mm. wide; conceptacles prominent; oogonia 96–168 × 69–126  $\mu$ ; antheridia 39–66 × 12–15  $\mu$ .

11. *f. marginatus* GARDNER

l.c. (1922), p. 42, pl. XLII—SETCHELL & GARDNER, *Mar. Alg.* p. 690—NAGAI, l.c. p. 346, fig. 13.

*Fucus evanescens f. dendroides* NAGAI (not STÖMFELT), *Meeresalg. aus Kamtschatka*, (1933), p. 16.

?*F. evanescens f. angusta* YENDO (not KJELLMAN), *Fucac.* Japan, (1907), p. 16, pl. I, fig. 1.

Fronde slender, caulescent, rigid, subcoriaceous, regularly dichotomous, 14–21 cm. high; segments linear to linear-cuneate, narrow, long, 3–15 mm. wide; midrib prominent, narrow, rarely somewhat distinct to the apices; cryptostomata few or sometimes quite absent; receptacles abundant, narrowly fusiform, simple or deeply furcate, blunt, 1.2–1.8 cm. long, 4–6 mm. wide; conceptacles small, prominent; oogonia 105–165 × 69–114  $\mu$ ; antheridia 30–46.5 × 9–16.5  $\mu$ .

12. *f. irregularis* KJELLMAN

Beringhafv. *Algfl.* (1889), p. 35—DE TONI, l.c. p. 203—GARDNER, l.c. p. 54—SETCHELL & GARDNER, *Mar. Alg.* p. 693—SINOVA, *Alg. Kamtsch.* p. 29—NAGAI, l.c. p. 348, fig. 14.

Fronde small, subcoriaceous, more or less irregularly dichotomous, twisted, 6–11 cm. high; segments narrow, linear, ca. 2.5–4 mm. wide; midrib narrow, sometimes distinct to the apices; cryptostomata absent or few; receptacles small, simple or furcate, ovate, obovate, obcordate, definitely delimited, 1–1.4 cm. long, ca. 5 mm. wide; conceptacles small, prominent; oogonia  $155\text{--}210 \times 90\text{--}141 \mu$ ; antheridia  $27\text{--}54 \times 15\text{--}19.5 \mu$ ; paraphyses  $240\text{--}330 \times 12\text{--}15\text{--}24 \mu$ .

The present writer has previously described 14 forms of the present species from Japan, among which twelve were found in the Kuriles. They are divided into two groups, the one having foliaceous fronds in most cases and the segments being often more than 1 cm. in width, the other having somewhat slender and not foliaceous fronds and the segments being narrow, often less than 1 cm. in width. In the former group, the midrib is distinct on the greater part of the segments, but vanishes usually at their apices, while in the latter group, except f. *cornutus*, it is somewhat distinct often up to the apices.

**Habitat and localities.** Growing on boulders or rocks in the littoral zone.

f. *rudis* KJELLM.

M. Kuriles. Onnekotan Isl.—Nemo-wan. Matuwa Isl.—Yamato-wan. Simusiru Isl.—Simusiru-wan. Uruppu Isl.—Kobune, Misima, Tokotan.

S. Kuriles. Etorohu Isl.—Wenbetu, Bettobu, Rubetu. Sikotan Isl.—Aimizaki, Notoro. Kunasiri Isl.—Wennai, Kotankesi.

f. *intermedius* GARDN.

S. Kuriles. Etorohu Isl.—Tosimoe, Arimoe.

f. *typicus* KJELLM.

N. Kuriles. Araido Isl.—Uomizaki.

f. *magnificus* GARDN.

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

M. Kuriles. Onnekotan Isl.—Nemo-wan, Odomari. Rasyuwa Isl.—Sonrakuwan. Usisiru Isl.—Kitazima. Kotoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune, Misima.

S. Kuriles. Etorohu Isl.—Wenbetu, Syana. Sikotan Isl.—Notoro.

f. *paramushirensis* NAGAI.

N. Kuriles. Paramusiru Isl.—Kakumabetu.

S. Kuriles. Kunasiri Isl.—Kotankesi.

f. *pergrandis* KJELLM.

- N. Kuriles.* Paramusiru Isl.—Suribati-wan, Murakami-wan.  
*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Rasyuwa Isl.—Sonraku-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Yosinohama, Kobune, Misima, Tokotan, Iema (Herb. OKAMURA).  
*S. Kuriles.* Etorohu Isl.—Wenbetu, Syana, Kamuikotan. Sikotan Isl.—Notoro. Kunasiri Isl.—Kotankesi, Ponkotan.

f. *fusiformis* NAGAI.

- N. Kuriles.* Simusyu Isl.—Tenzin-iwa.  
*M. Kuriles.* Onnekotan Isl.—Nemo-wan, Odomari. Usisiru Isl.—Kitazima. Simusiru Isl.—Nakadomari. Uruppu Isl.—Tokotan.  
*S. Kuriles.* Kunasiri Isl.—Atoiya, Rebun-iso, Seseiki near Wennai, Sokobetu.

f. *macrocephalus* KJELLM.

- N. Kuriles.* Paramusiru Isl.—Titose-wan, Murakami-wan.  
*M. Kuriles.* Onnekotan Isl.—Nemo-wan. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Ahunruimoe.  
*S. Kuriles.* Etorohu Isl.—Tikohai, Syana. Sikotan Isl.—Syakotan, Aimi-zaki. Kunasiri Isl.—Ponkotan, Tomari (cast ashore).

f. *cornutus* KJELLM.

- N. Kuriles.* Araido Isl.—Minami-ura. Paramusiru Isl.—Suribati-wan, Murakami-wan, Kakumabetu.  
*M. Kuriles.* Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay. Uruppu Isl.—Kobune.  
*S. Kuriles.* Etorohu Isl.—Syana, Rubetu. Sikotan Isl.—Syakotan.

f. *cylindricus* NAGAI.

- M. Kuriles.* Matuwa Isl.—Yamato-wan.  
*S. Kuriles.* Etorohu Isl.—Iriribusi, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan.

f. *marginatus* GARDN.

- N. Kuriles.* Simusyu Isl.—Kataoka-wan (Herb. Okamura).  
*M. Kuriles.* Onnekotan Isl.—Odomari. Usisiru Isl.—Kitazima. Ketoi Isl.—Minami-ura. Simusiru Isl.—Broughton Bay, Nakadomari.  
*S. Kuriles.* Etorohu Isl.—Wenbetu, Bettobu, Kamuikotan.

f. *irregularis* KJELLM.

- M. Kuriles.* Ketoi Isl.—Minami-ura. Uruppu Isl.—Tokotan.  
*S. Kuriles.* Etorohu Isl.—Moyoro, Tikohai, Bettobu.

**Distrib.** *Sp.*—Arctic Ocean, Atlantic Ocean (American side), Bering Sea, Alaska to Oregon, Kamchatka, Okhotsk Sea and Japan

(Honsyu, Hokkaido, Saghalien and the Kuriles); f. *rudis*—Bering Sea, Alaska, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles); f. *intermedius*—Washington and Japan (Hokkaido, Saghalien and the Kuriles); f. *typicus*—Arctic Ocean, Alaska, Kamchatka and Japan (Hokkaido and the Kuriles); f. *magnificus*—Alaska to Washington and Japan (the Kuriles); f. *paramushirensis*—endemic (the Kuriles); f. *pergrandis*—Arctic Ocean, Alaska to Washington and Japan (Hokkaido, Saghalien and the Kuriles); f. *fusiformis*—Japan (Hokkaido, Saghalien and the Kuriles); f. *macrocephalus*—Bering Isl., Alaska, Kamchatka and Japan (the Kuriles); f. *cornutus*—Atlantic Ocean, Bering Isl., Alaska, Kamchatka, Okhotsk Sea and Japan (Hokkaido, Saghalien and the Kuriles); f. *cylindricus*—Japan (Honsyu, Hokkaido and the Kuriles); f. *marginatus*—Alaska, Kamchatka and Japan (Saghalien and the Kuriles); f. *irregularis*—Bering Isl., Kamchatka and Japan (the Kuriles).

### 31. *Pelvetia* DECAISNE et THURET, 1845

#### *Pelvetia Wrightii* YENDO

Fucac. Japan, (1907), p. 20, pl. I, figs. 4, 5; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 189—OKAMURA, Icon. Jap. Alg. V, 10, p. 183, pl. CCXLVIII; Mar. Alg. Jap. p. 303, fig. 160—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206.

**Jap. name.** Yezo-isige.

#### Key to the forms

- I. Vesicles normally absent; receptacles lanceolate, frequently bifurcate, compressed to slightly inflated ..... f. *typica*
- II. Vesicles usually present.
  - A. Vesicles oblong, compressed to slightly inflated; receptacles simple or bifurcate, linear, complanate, large, 25–35 × 3–4 mm. .... f. *Babingtonii*
  - B. Vesicles obovate to oblong-ovate, or bilobed, inflated; receptacles simple or furcate, linear, complanate, truncate, small, 6–16 × 2.5–3 mm. .... f. *japonica*

#### f. *typica* YENDO

Fucac. Japan, (1907), p. 21, pl. I, fig. 4; in OKAMURA's Sorui Meii, ed. 2, p. 189—OKAMURA, Icon. V, 10, p. 184, pl. CCXLVIII, fig. 1, 2; Mar. Alg. Jap. p. 304, fig. 160 (1).

*Fucus Wrightii* HARVEY, Char. New Alg. (1859), p. 328—DE TONI, Syll. Alg. III, p. 209.

*Pelvetia Wrightii* OKAMURA, Nippon Sorui Meii, ed. 1, (1902), p. 138.

f. *Babingtonii* YENDO

l.c. (1907), p. 22 ;in OKAMURA's Sorui Meii, ed. 2, p. 189—OKAMURA, Icon. V, 10, p. 185; Mar. Alg. Jap. p. 305.

*Fucus Babingtonii* HARVEY, l.c. (1859), p. 329.

*Pelvetia Babingtonii* DE TONI, Syll. Alg. III, p. 216; Phyc. Jap. No., p. 48.

f. *japonica* YENDO

l.c. (1907), p. 23, pl. I, fig. 5; in OKAMURA's Sorui Meii, ed. 2, p. 190—OKAMURA, Icon. V, 10, p. 185, pl. CCXLVIII, fig. 3; Mar. Alg. Jap. p. 305, fig. 160 (3).

It is sometimes not very easy to separate the specimens into the above forms with sharp distinction, though the writer followed YENDO's classification. According to YENDO, f. *typica* is characteristic in the normal case in the lacking of the vesicles, by which character it differs from the other forms. In the specimens of this form, the receptacles are of intermediate size among those of the three forms. In f. *japonica*, the vesicles are oblong-ovate and the receptacles are shown to be the smallest in size. In f. *Babingtonii*, the vesicles are oblong, and the receptacles are the largest in the writer's specimens.

**Habitat and localities.** Growing on rocks in the littoral zone; in Uruppu Isl. found cast ashore.

f. *typica*.

M. Kuriles. Uruppu Isl.—Tokotan.

S. Kuriles. Etorohu Isl.—Bettobu. Kunasiri Isl.—Rebun-iso, Hurukamappu, Kotankesi.

f. *Babingtonii*.

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

f. *japonica*.

S. Kuriles. Etorohu Isl.—Moyoro, Tosimoe, Tosirari. Sikotan Isl.—Aimizaki. Kunasiri Isl.—Atoiya, Rebun-iso, Wennai, Hurukamappu, Sokobetu, Rurui, Sibetoro, Nikisiro.

**Distrib. Sp.**—Japan (Honsyu, Hokkaido, Saghalien and the Kuriles); f. *Babingtonii* and f. *japonica*—Hokkaido and the Kuriles.

32. *Cystophyllum* J. AGARDH, 1848

## Key to the species

- I. Air-vesicles often solitary ..... *C. geminatum* (1)  
 II. Air-vesicles often seriate.  
 A. 2 Air-vesicles connected by short, delicate link, in chain .....  
 ..... *C. crassipes* (2)  
 B. 2-5 or more air-vesicles connected closely in moniliform series.....  
 ..... *C. hakodatense* (3)

1. *Cystophyllum geminatum* (AGARDH) J. AGARDH

Sp. Alg. I, (1848), p. 232—DE TONI, Syll. Alg. III, p. 156—SETCHELL & GARDNER, Alg. N. W. Amer. p. 285; Mar. Alg. Pacific Coast N. Amer. III, p. 706—OKAMURA, Nippon Sorui Meii, ed. 1, p. 139; Mar. Alg. Jap. p. 309—YENDO, Fucac. Japan, p. 28; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 192—SINOVA, Alg. Mer Ochotsk, p. 104—TOKIDA, Mar. Alg. Robben Isl. p. 11—YAMADA, Mar. Alg. Urup, p. 20—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206.

*Cystoseira geminata* AGARDH, Syst. Alg. (1824), p. 286.

*C. thyrigera* POSTELS et RUPRECHT, Ill. Alg. (1804), Taf. XXXVIII, fig. i—RUPRECHT, Tange Och. Meeres, p. 347.

*Sirophysalis geminata* KÜTZING, Sp. Alg. (1849), p. 602.

*Cystoseira Lepidium* RUPRECHT, Tange Och. Meeres, (1851), p. 347—KÜTZING, Tab. Phyc. X, p. 19, Tab. 52, fig. I.

*Cystophyllum Lepidium* HARVEY, Coll. Alg. Vancouver Isl. (1862), p. 163—DE TONI, Syll. Alg. III, p. 156—SAUNDERS, Alg. Harriman Exp. p. 432.

**Jap. name.** Yezo-moku.

Frond up to ca. 1 m. high, arising from a solid, subconical holdfast, of 1-1.8 cm. diam.; stipe 2.5-3 mm. diam., ca. 3-8 cm. long, with a number of branches near the apex, of which some are normal, erect and slender, while others remain as short (2-3 cm. long), degenerate, nearly oblong-fusiform ones; main erect branches cylindrical, filiform in the greater part and becoming slightly oblong-fusiform at the lower part, long, ca. 1-1.5 mm. diam., with many lateral branches at intervals; lateral branches 9-20 cm. long, filiform, single or often in pairs at the attaching point, with alternate branchlets on which leaves or vesicles are formed; leaves on the lateral branches in lower position linear-lanceolate, acute at apices, tapering below into short, flat petioles, ribless, 6-20 mm. long, 1-4 mm. wide; air-vesicles spherico-ellipsoid, at first apiculate, often solitary, very rarely seriate with 2 individuals connected by a short, delicate link at the top of short filiform stipes, 1.5-3 × 1-1.8 mm.;

receptacles simple, lanceolato-cylindrical, developed from the apiculate portion of the vesicle, sometimes solitary with filiform stipes in the upper portions of the branches.

In our Herbarium, there have been deposited many specimens of *Cystophyllum* which were determined by YENDO during his studies on the Japanese Fucaceae. The writer's specimens were compared with these specimens in determination. As far as the writer's observation shows, the present species is rather closely related to *C. crassipes* J. AG. among three species of *Cystophyllum* from the Kuriles. Though there are observed single and seriate vesicles in both species, the occurrence of the single vesicle is more often found in the present species and that of the seriate ones in *C. crassipes* J. AG.

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

*M. Kuriles.* Uruppu Isl.—Yosinohama, Tokotan, Iema (YAMADA).

*S. Kuriles.* Etorohu Isl.—Moyoro, Iriribusi, Tosirari, Sibetoro, Bettobu, Syana, Rubetu, Kamuikotan. Sikotan Isl.—Syokatan, Tiboi. Kunasiri Isl.—Atoiya, Idasibenai, Seseki near Wennai, Tohtu, Tosyoro.

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

## 2. *Cystophyllum crassipes* J. AGARDH

Sp. Alg. I, (1848), p. 232—DE TONI, Syll. Alg. III, p. 155—YENDO, Fucac. Japan, p. 29, pl. II, fig. 9-12; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 191—OKAMURA, Mar. Alg. Jap. p. 307—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206.

*Fucus crassipes* MERTENS, in TURNER's Fuci, II, (1809), p. 154, pl. CXXXI.

*Cystoseira crassipes* AGARDH, Sp. Alg. I, 1, (1820), p. 69; Syst. Alg. p. 286.

*Sirophysalis crassipes* KÜTZING, Sp. Alg. (1849), p. 602; Tab. Phyc. X, Tab. 56, fig. I—MARTENS, Preus. Exp. Tange, p. 128.

**Jap. name.** Nebuto-moku.

Frond up to 2 m. high, arising from a solid, hemispherical or subconical holdfast, of 1-1.5 cm. diam.; stipe 3-4 mm. diam., ca. 4-5 cm. long, with a number of branches near the apex, of which some are normal, erect and slender, while others remain as short (ca. 3 cm. long), degenerate, nearly oblong-fusiform ones; main erect branches cylindrical, filiform in the greater part and becoming

slightly oblong-fusiform at the lower part, long, ca. 1 mm. diam., with many lateral branches at intervals; lateral branches 10–25 cm. long, filiform, formed often in pairs at the attaching point, with alternate or fasciculate branchlets on which leaves or vesicles are formed; leaves on the lateral branches in lower position linear-lanceolate, acute at apices, tapering below into short, flat petioles, ribless, 8–18 mm. long, 1–1.5 mm. wide; air-vesicles spherico-ellipsoid, at first apiculate, solitary or often seriate with 2 individuals connected by a short, delicate link at the top of the short, filiform stipes,  $2-4 \times 1.5-2$  mm.; receptacles simple, lanceolato-cylindrical, developed from the apiculate portions of the vesicles, sometimes solitary on the upper portions of the branches.

YENDO identified his specimens with the present species with good judgement from the illustrations of TURNER in Fuci and those of KÜTZING in *Tabulae Phycologicae*. In Fuci, II, p. 154, TURNER describes the air vesicles of the present species as "...placed in the smaller branches, principally in the central ones, and towards the center of them, immersed in their substance, between elliptical and spherical, of the size of vetch-seed, generally two or three in each branch, arranged in a moniliform manner, each separated from the other by an interval of a line or two, the ultimate one constantly mucronated by the end of the branch extending beyond it." In the writer's specimens, the vesicles are mostly found in moniliform state, being separated sharply and distinctly one from another by a short and delicate link. However, a few vesicles are solitary as in the typical case of *C. geminatum*. Such a case is also shown in the illustrations of the above authors. The present species appears to prefer more southern regions than *C. geminatum* in distribution.

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

*M. Kuriles.* Uruppu Isl.—Anama.

*S. Kuriles.* Etorohu Isl.—Wenbetu, Tosirari, Sibetoro, Rubetu, Kamuikotan. Sikotan Isl.—Syakotan, Aimizaki, Notoro. Kunasiri Isl.—Idasibenai, Tokaisen, Rebun-iso, Hurukamappu, Tohutu, Sokobetu, Sibetoro, Tosyoro, Kotankesi, Tomari.

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

### 3. *Cystophllum hakodatense* YENDO

Fucac. Japan, (1907), p. 32, pl. II, fig. 13–16; Kaisan-Syokubutugaku, p. 446,

fig. 137; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 191—OKAMURA, Icon. Jap. Alg. V, 3, p. 43, pl. CCXI; Mar. Alg. Jap. p. 308, fig. 162.

*Cystophyllum crassipes* OKAMURA (not J. AGARDH), Nippon Sorui Meii, ed. 1, (1902), p. 139. (excl. syn.).

**Jap. name.** Ugano-moku.

Fronde up to 2 m. high, arising from a solid, scutate holdfast, of ca. 6 mm. diam.; primary stipe terete, ca. 2.5 mm. diam., ca. 8 mm. long, with a number of branches near the apex, of which only a few are normal, erect and slender, while others remain as short (1–2 cm. long), fusiform ones; main erect branches cylindrical, filiform, long, ca. 1.5 mm. diam., with alternate lateral branches; lateral branches 15–40 cm. long, filiform, with alternate or distichous branchlets on which leaves or vesicles are formed; leaves on the lower parts of the lateral branches linear-lanceolate, acute at apices, tapering below into short, flat petioles, ribless, 8–16 mm. long, 1–2 mm. wide; air-vesicles ellipsoid or ovoid, occasionally fusiform, solitary or often seriate with 2–5 or more individuals connected closely in moniliform manner on short, filiform stipes which are arranged on the lateral branches from the middle part upwards, 3.5–6 × 2–3 mm. in the ones disposed on the lower branches, constrictions between successive vesicles not deep, seldom stalk-like; receptacles lanceolato-cylindrical, verrucose, acuminate, with short, filiform stipes below, formed mostly on the upper parts of the branches, sometimes single at the top of the vesicles.

This is a quite different species from the former two in the possession of closely arranged moniliform vesicles. The constrictions between the successive vesicles are not sharp, but loose and seldom stalk-like. This is characteristic in this species. The present species is generally found in Hokkaido, but not widely in the Kuriles.

**Habitat and localities.** Found cast ashore.

*M. Kuriles.* Simusiru Isl.—Simusiru-wan.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tosimoe. Sikotan Isl.—Notoro. Kuna-siri Isl.—Tohutu, Tomari.

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

33. *Sargassum* J. AGARDH, 1820Subgenus *Bactrophycus*

## Key to the species

- I. Leaves alternately pinnatisected ..... *S. Horneri* (1)
- II. Leaves entire or slightly dentate.
  - A. Leaves consisting of 2 kinds, basal and upper; basal leaves remarkably large, 2.5-5×0.7-1.2 cm. .... *S. confusum* (2)
  - B. Leaves not consisting of 2 kinds, but increasing in size as they approach toward the base.
    - 1. Lateral branches generally very short, 0.7-3 cm. long ..... *S. Thunbergii* (3)
    - 2. Lateral branches longer than the above.
      - a. Receptacles formed within each axil of scale-like leaves; air-vesicles subglobose, pyriform or obovoid (except the upper small ones) ..... *S. Kjellmanianum* (4)
      - b. Receptacles formed mostly within each axil of vesicles or on their petioles; air-vesicles elliptic or fusiform....*S. Miyabei* (5)

1. *Sargassum Horneri* (TURNER) AGARDH

Sp. Alg. I, 1, (1820), p. 38; Syst. Alg. p. 307—J. AGARDH, Sp. Alg. I, p. 290; Spec. Sarg. Austr. p. 57—DE TONI, Syll. Alg. III, p. 20; Phyc. Jap. Nov. p. 43—OKAMURA, Nippon Sorui Meii, ed. 1, p. 144; Icon. Jap. Alg. V, 1, p. 3, pl. CCII; Mar. Alg. Jap. p. 328—COTTON, Mar. Alg. fr. Corea, p. 367; Some Chinese Mar. Alg. p. 109—YENDO, Fucac. Japan, p. 74, pl. X; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 198—TSENG, Mar. Alg. fr. Amoy, p. 29.

*Fucus Horneri* TURNER, Fuci, I, (1808), p. 34, pl. XVII.

**Jap. name.** Aka-moku.

The specimens at hand are identifiable with the present species by having the alternately pinnatisected leaflets both on the lateral branches and at the tips of the vesicles, judging from TURNER's illustration in Fuci. However there appears to be a difference of sex between the two plants. The writer's specimens are all female, while TURNER's plant appears to be male judging from the shape of the receptacles. The reddish brown color of the frond upon drying is also characteristic for this species, in comparison with the other members of the Kuriles.

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

*S. Kuriles.* Sikotan Isl.—Tiboi. Kunasiri Isl.—Atoiya.

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

## 2. *Sargassum confusum* AGARDH

Syst. Alg. (1824), p. 301—J. AGARDH, Sp. Alg. I, p. 294; Spec. Alg. Austr. p. 127—KÜTZING, Sp. Alg. p. 160—DE TONI, Syll. Alg. III, p. 115; Phyc. Jap. Nov. p. 46—OKAMURA, Nippon Sorui Meii, ed. 1, p. 158; Mar. Alg. Jap. p. 335—YENDO, Fucac. Japan, p. 106, pl. XIV, fig. 1-12; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 201—COTTON, Some Chinese Mar. Alg. p. 110.

**Jap. name.** Husisuzi-moku.

The specimens at hand were easily identifiable with the present species by having the two kinds of leaves, large on the basal part and small on the middle to the upper portions of the frond. According to YENDO, f. *valida* is separated from the type form by its basal leaves which are mostly lanceolate, irregularly serrated on margin and provided with a midrib extending nearly to the tip. The present form is often found in Hokkaido, but the writer's specimens from the Kuriles are all referable to the typical form by virtue of having the linear-spathulate or obovate basal leaves, of which the midribs are evanescent at the apices and of which the margins are sparingly dentate or even entire. The present species is not widely distributed in the Kuriles, though it is common in Hokkaido.

**Habitat and localities.** Growing on rocks in the upper sublittoral zone on the western coast of Kunasiri Isl.; found east ashore in the islands of Etorohu and Sikotan.

*S. Kuriles.* Etorohu Isl.—Moyoro, Tosimoe, Sibetoro, Rubetu. Sikotan Isl.—Tiboi, Aimizaki. Kunasiri Isl.—Tohutu, Sokobetu, Sibetoro, Kotankesi.

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

## 3. *Sargassum Thunbergii* O. KUNTZE

Revisio Sarg. (1880), p. 215; Revisio Gen. Plant. III, 2, p. 427—YENDO, Fucac. Japan, p. 114, pl. XV, fig. 5; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 203—OKAMURA, Icon. Jap. Alg. V, 1, p. 6, pl. CCIII; Mar. Alg. Jap. p. 337—TSENG & LI, Some Mar. Alg. fr. Tsingtao & Chefoo, p. 214—TSENG, Mar. Alg. fr. Amoy, p. 31.

*Fucus Thunbergii* MERTENS, in ROTH Cat. Bot. III, (1806), p. 104, Tab. III, fig. a, c-e—TURNER, Fuci, II, p. 158, pl. CXXXIII.

*Cystophyllum Thunbergii* J. AGARDH, Sp. Alg. I, (1848), p. 233—DE TONI, Syll. Alg. III, p. 157—COTTON, Mar. Alg. fr. Corea, p. 368; Some Chinese Mar. Alg. p. 110—COLLINS, Chinese Mar. Alg. p. 205—HOWE, Chinese Mar. Alg. p. 137.

*Myagropsis Thunbergii* KÜTZING, Sp. Alg. (1849), p. 635; Tab. Phyc. X, Tab. 93, fig. II.

**Jap. name.** Umitoranowo.

#### f. *typicum* YENDO

Fucac. Japan, (1907), p. 115; in OKAMURA's Sorui Meii, ed. 2, p. 203—OKAMURA, Icon. V, 1, pl. CCIII, fig. 1; Mar. Alg. Jap. p. 338.

*Fucus Thunbergii* TURNER, Fuci, II, l.c.

The specimens at hand are of simple, erect fronds which are beset closely with many leaflets, air-vesicles and a few short lateral branches. They are referable to f. *typicum* YENDO.

**Habitat and localities** of f. *typicum*. Growing on rocks in the upper sublittoral zone.

*S. Kuriles.* Kunasiri Isl.—Sokobetu, Nikisiro.

**Ditsrib.** China and Japan (Korea, Kyusyu, Sikoku, Honsyu, Hokkaido, Saghalien and the Kuriles).

#### 4. *Sargassum Kjellmanianum* YENDO

Fucac. Japan, (1907), p. 102, pl. XV, fig. 1-4; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 202—OKAMURA, Icon. Jap. Alg. V. 3, p. 45, pl. CXCII; Mar. Alg. Jap. p. 339.

**Jap. name.** Hahaki-moku.

Frond arising from a small scutate holdfast; stipe short, bearing several branches fasciculately at the top; branches at an early stage bud-like with numerous, fulcrant leaves which are oblong-obovate, ribless, with obtuse apices and sparingly serrate margin, 10-18 mm. long, 1.5-3 mm. wide; main erect branches more than 90 cm. long, with many lateral branches; lateral branches 5-10 cm. long, repeatedly branched into branchlets; upper leaves small, linear-lanceolate, ca. 8 mm. long, ca. 0.6 mm. wide, ribless; air-vesicles formed on the upper branchlets and also lateral branches, subglobose or pyriform,

or obovoid, (upper small ones often fusiform), apiculate, sparingly dotted with minute cryptostomata, 3–5 mm. long, 1.5–3 mm. diam., with short petioles below; receptacles cylindrical, attenuate, with short petioles below, solitary at the base of subulate, filiform or linear-lanceolate bractlets which are arranged racemosely on the subterminal portions of the upper branchlets.

After the examination of the Herbarium specimens, determined by YENDO, a few specimens at hand are referred to the present species. This is common in Hokkaido but not widely distributed in the Kuriles. It is found only in the South Kuriles.

**Habitat and localities.** Growing on rocks in the upper sublittoral zone on the western coast of Kunasiri Isl.; in Etorohu Isl. found east ashore.

*S. Kuriles.* Etorohu Isl.—Syana, Arimoe. Kunasiri Isl.—Atoiya, Nisiura, Tomari.

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

##### 5. *Sargassum Miyabei* YENDO

Fucac. Japan, (1907), p. 112, pl. XIV, fig. 13–14; in OKAMURA's Nippon Sorui Meii, ed. 2, p. 205—OKAMURA, Mar. Alg. Jap. p. 340—KAWABATA, List Mar. Alg. Isl. Shikotan, p. 206.

**Jap. name.** Miyabe-moku.

Frond 50–130 cm. high, arising from a small, depressed, conical holdfast, of ca. 6–8 mm. diam.; primary stipe subterete, ca. 5 mm. long, ca. 1–1.5 mm. diam., bearing several branches fasciculately at the top; main erect branches long, with many lateral branches; lateral branches 4–8 cm. long, repeatedly branched into branchlets; lower leaves ca. 5 mm. long, ca. 1 mm. wide, oblong-obovate or lanceolate, entire or sparingly serrate on margin, ribless, upper leaves small, up to 4 mm. long, ca. 0.5 mm. wide, linear-lanceolate, ribless; air-vesicles formed racemosely on the upper branchlets and also the lateral branches, ellipsoid or fusiform, apiculate, 1.5–3 mm. long, ca. 1–1.5 mm. diam., with short petioles; receptacles cylindrical, attenuate, with short petioles below, solitary on the stipes of the vesicles or terminal on the branchlets.

In the "Fucaceae of Japan," p. 113, YENDO thus describes the disposition of the air-vesicles of the present species: "They are

disposed racemosely on the lateral branches on which not a single leaf, except the fulcrant leaf, is usually to be found. And on the ultimate ramulets the fulcrant leaf itself is always transformed into a vesicle. Hence when a plant is sterile there is danger of its being mistaken for a *Cystophyllum*." These characters were considered by YENDO as being important in the differentiation of the present species from the allied members, such as *S. confusum*, *S. Thunbergii*, *S. Kjellmanianum*, etc. But the character, that 'not a single leaf, except the fulcrant leaf, is usually to be found,' is not usually observed so remarkably in every part of the branches in the writer's specimens. However, there are observed a few leaflets besides the fulcrant leaves in the upper branchlets of one and the same frond, though such a case does not occur more often than the above mentioned character according to YENDO. The present writer felt much trouble to determine to which species, whether *S. Kjellmanianum* or *S. Miyabei*, the specimens should better be referable. However he referred his specimens finally to the present species because of the scarce formation of the fulcrant leaves, and, if present, their smaller size and linear-lanceolate shape, as well as because of the possession of the ellipsoid or fusiform air-vesicles.

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

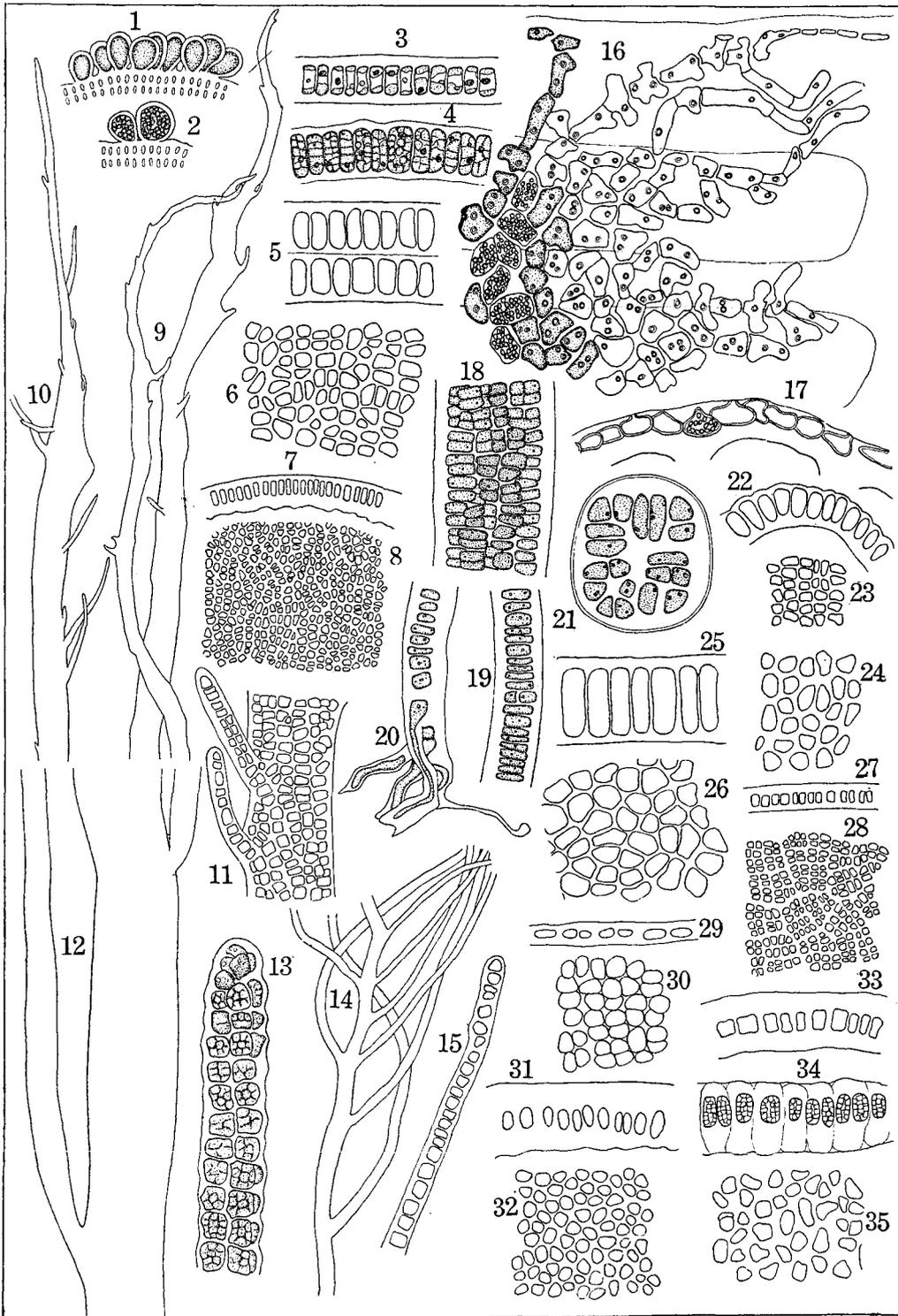
*S. Kuriles.* Sikotan Isl.—locality unknown (KAWABATA). Kunasiri Isl.—Atoiya, Wennai, Sokobetu, Rurui, Sibetoro, Tosyoro, Nikisiro, Kotankesi, Ponkotan, Tyasitu.

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

**PLATE I**

## Explanation of Plate I

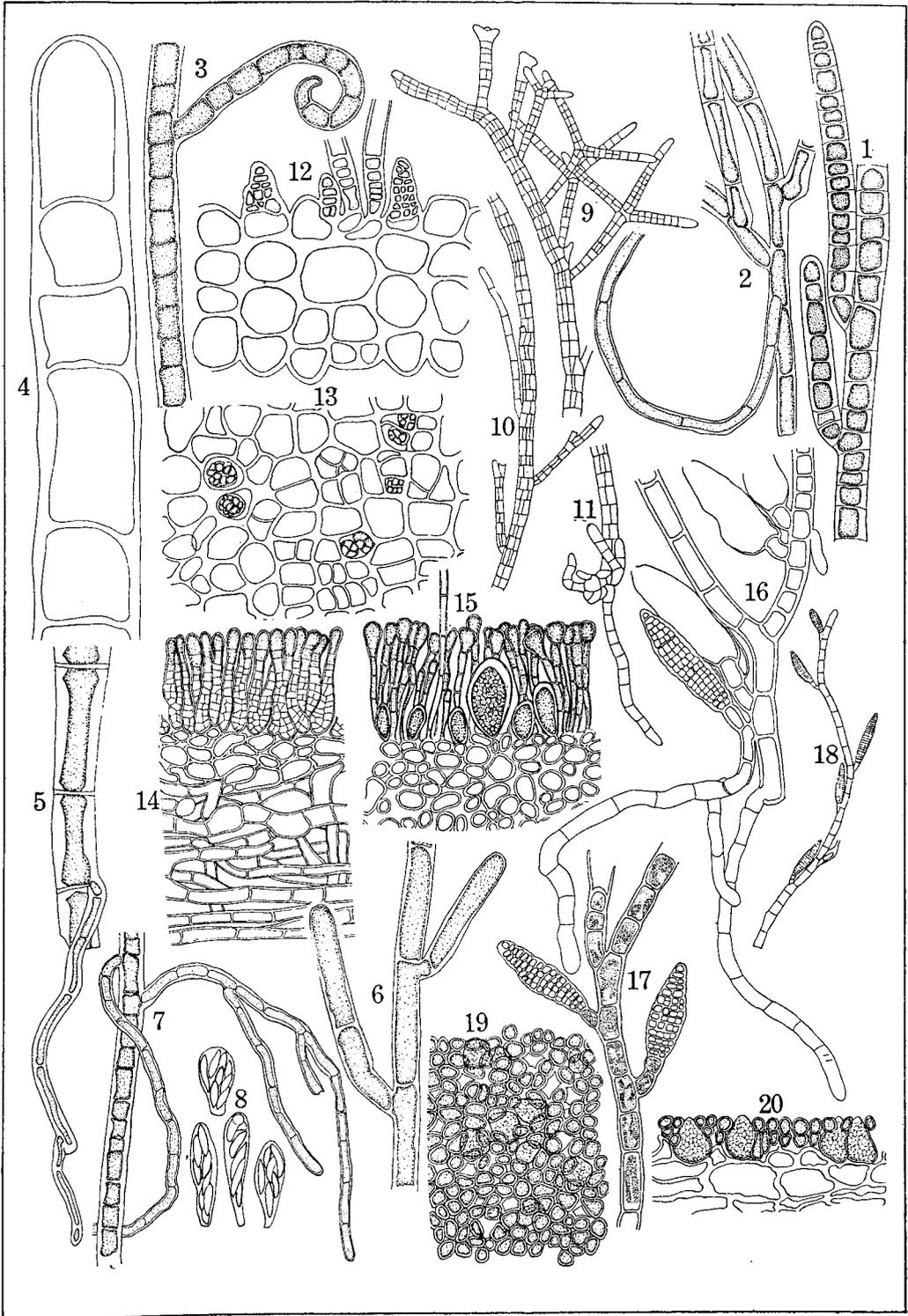
- Dermocarpa pacifica* S. et G. Fig. 1—Plants in position on host.  $\times 220$ . Fig. 2—Two gonidangia with numerous gonidia.  $\times 220$ .
- Ulothrix pseudoflaccida* WILLE. Fig. 3—Vegetative filament.  $\times 220$ . Fig. 4—Filament with fertile cells.  $\times 220$ .
- Ulva fenestrata* P. et R. Fig. 5—Section at middle portion of thallus.  $\times 220$ . Fig. 6—Surface view at middle portion of thallus.  $\times 220$ .
- Enteromorpha micrococca* KÜTZ. Fig. 7—Section of membrane.  $\times 220$ . Fig. 8—Surface view of frond.  $\times 220$ .
- Enteromorpha micrococca* f. *subsalsa* KJELLM. Fig. 9—Upper portion of thallus.  $\times 38$ .
- Enteromorpha prolifera* (MUELL.) J. AG. Fig. 10—Upper portion of thallus.  $\times 38$ . Fig. 11—Portion of branch showing arrangement of cells.  $\times 220$ .
- Enteromorpha clathrata* (ROTH) GREV. Fig. 12—Portion of thallus.  $\times 38$ . Fig. 13—Terminal portion of branch with fertile cells showing multicellular series at summit.  $\times 220$ .
- Enteromorpha plumosa* KÜTZ. Fig. 14—Habit sketch.  $\times 38$ . Fig. 15—Terminal portion of main axis showing a single series of cells at summit.  $\times 220$ .
- Entocladia Pterosiphoniae* NAGAI. Fig. 16—Surface view of a portion of thallus.  $\times 220$ . Fig. 17.—Section through host showing a mature sporangium (?) and empty ones.  $\times 220$ .
- Gayella polyrhiza* ROSENV. Figs. 18, 19—Portions of filaments.  $\times 380$ . Fig. 20—Basal portion of filament with rhizoidal projections from lower cells.  $\times 380$ . Fig. 21—Section of filament showing arrangement of cells.  $\times 380$ .
- Monostroma groenlandicum* J. AG. Fig. 22—Section of membrane.  $\times 220$ . Figs. 23, 24—Surface view at lower (23) and upper (24) portion of thallus.  $\times 220$ .
- Monostroma fuscum* var. *splendens* (RUPR.) ROSENV. Fig. 25—Section of thallus.  $\times 220$ . Fig. 26—Surface view of thallus.  $\times 220$ .
- Monostroma zostericola* TILDEN. Fig. 27—Section of thallus.  $\times 220$ . Fig. 28—Surface view of thallus showing groupings of cells.  $\times 220$ .
- Monostroma Grevillei* (THUR.) WITTR. Fig. 29—Section of thallus.  $\times 220$ . Fig. 30—Surface view of thallus.  $\times 220$ .
- Monostroma arcticum* WITTR. Fig. 31—Section of thallus.  $\times 220$ . Fig. 32—Surface view of thallus.  $\times 220$ .
- Monostroma ochotensis* NAGAI. Figs. 33, 34—Section of thallus through parts with vegetative (33) and fertile cells (34).  $\times 220$ . Fig. 35—Surface view of thallus.  $\times 220$ .



**PLATE II**

## Explanation of Plate II

- Spongomorpha duriuscula* var. *tenuis* YAMADA. Fig. 1—Portion of filament.  $\times 38$ .  
Fig. 2—Lower portion of filament with one rhizoidal branch and normal branches.  $\times 38$ .
- Spongomorpha Mertensii* (RUPR.) S. et G. Fig. 3—Portion of filament with a hooked branch.  $\times 38$ .
- Spongomorpha Hystrix* STROEMF. Fig. 4—Upper portion of filament.  $\times 38$ . Fig. 5—Lower portion of filament with a rhizoidal branch.  $\times 38$ .
- Spongomorpha saxatilis* (RUPR.) COLLINS. Fig. 6—Portion of filament with two branches.  $\times 38$ . Fig. 7—Lower portion of filament with rhizoidal branches.  $\times 38$ .
- Guignardia Alaskana* REED, a parasitic fungus on *Prasiola borealis* REED. Fig. 8—Asci and ascospores.  $\times 380$ .
- Sphacelaria subfusca* S. et G. Fig. 9—Branch with propagula.  $\times 60$ . Fig. 10—Branch with two branchlets and one hair.  $\times 60$ . Fig. 11—Basal portion of an erect filament with rhizoidal hairs.  $\times 60$ .
- Punctaria flaccida* NAGAI. Fig. 12—Section of fruiting frond showing gametangia and hairs.  $\times 220$ . Fig. 13—Surface view of fruiting frond.  $\times 220$ .
- Heterochordaria Gunjii* (YENDO) TOKIDA. Fig. 14—Longitudinal section of gametangial frond.  $\times 220$ . Fig. 15—Cross section of zoosporangial frond showing zoosporangia, paraphyses and a hair.  $\times 220$ .
- Ectocarpus fusiformis* NAGAI. Fig. 16—Erect filament with one mature gametangium and three empty ones, and rhizoidal filaments.  $\times 220$ . Figs. 17, 18—Erect filaments with gametangia. f. 17  $\times 220$ , f. 18  $\times 60$ .
- Coilodesme fucicola* (YENDO) NAGAI. Fig. 19—Surface view of fruiting frond.  $\times 220$ . Fig. 20—Section of fruiting frond.  $\times 220$ .



**PLATE III**

### Explanation of Plate III

- Ulva fenestrata* P. et R. Fig. 1—Whole plant.  $\times$ ca. 1/5.
- Monostroma ochotensis* NAGAI. Fig. 2.—Group of plants in position on host.  $\times$ ca.  $\frac{1}{2}$ .
- Prasiola borealis* REED. Fig. 3—Group of plants.  $\times$ ca.  $\frac{1}{2}$ . Fig. 4—Section of a portion with two perithecia (a. immature and b. mature) of a parasitic fungus, *Guignardia Alaskana* REED, on thallus.  $\times$ 50. Fig. 5—Surface view of thallus showing arrangement of cells.  $\times$ 50.
- Aegagropila kurilensis* NAGAI. Fig. 6, a—Whole plants in various stages; b—Section of plant with two layers, containing a pebble within a hollow center; c—Section of plant with two layers, containing a small thallus within hollow center.  $\times$ ca. 1/5.
- Punctaria flaccida* NAGAI. Fig. 7—Group of plants in position on host.  $\times$ ca.  $\frac{1}{2}$
- Heterochordaria Gunjü* (YENDO) TOKIDA. Fig. 8—Series of plants.  $\times$ ca.  $\frac{1}{2}$ .
- Pleuropterum paradiseum* f. *typicum* MIYABE et NAGAI. Fig. 9—Whole plant.  $\times$ ca. 1/10.
- Laminaria sikotanensis* MIYABE et NAGAI. Fig. 10—Whole plant.  $\times$ ca. 1/20.
- Cymathaere japonica* MIYABE et NAGAI. Fig. 11—Upper side view of whole plant.  $\times$ ca. 1/20.
- Cymathaere fibrosa* NAGAI. Fig. 12, a—Whole plant; b—Under side view of lower portion.  $\times$ 1/6.
- Streptophyllum spirale* (YENDO) MIYABE et NAGAI. Fig. 13—Plant in old stage.  $\times$ 1/6. Fig. 14—Group of plants in young stage.  $\times$ 1/6.

