THE MARINE ALGAE OF SOUTHERN SAGHALIEN

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INTRODUCTION

Historical survey. The first scientific record on the marine vegetation along the coast of the Island of Saghalien is found in the description by Milet-Mureau in the report on the expedition under the French Commander La Perouse in 1787 (cf. Ruprecht, 1851, p. 204). In his description, special attention was paid to the marine plants in connection with the solution of the interesting and important problem, whether Saghalien is an island or a peninsula. It is mentioned that, if Saghalien be an island, the marine area laying between the mouth of the Amur and de-Castri Bay is so shallow that the bottom covered by sea-grasses is readily exposed to the air in ebb-tide, and only while the tide is high one can row a small boat pushing its way through or over the heavy bush of the sea-grasses. It is also mentioned that a rich vegetation of various kinds of seaweeds is found in this arm of the sea. Bory de St. Vincent (1828) gives brief notes about the marine vegetation of the western coast of Saghalien on the basis of the materials and specimens brought back by the expedition under La Perouśe, which he had the opportunity to examine, and also notes about that of the eastern coast on the basis of the report of the expedition under the Russian Commander Krusenstern in 1805. In his notes, which are cited by Ruprecht (1851, p. 204), nothing is said about individual species. Krusenstern, Captain of the Nadeshda, arrived at Nagasaki on October 9, 1804. On his return way from Nagasaki to Kamtschatka, he passed the Strait of La Perouse (Sôya) from west to east on April 3, 1805, sailed the Nadeshda into Aniwa Bay and landed at Ōtomari. Next day he weighed anchor and went round the Cape of Nakashiretoko northward, landing on his way at Airup (Airô) and on the coast of Patience Bay (Taraika-Wan). Continuing his voyage northward along the eastern coast of the island, he arrived at last at Petropavlovsk on April 26. Tilesius and Horner, who had joined this expedition as scientists, made collections of seaweeds at those landing spots in Saghalien. Their specimens from Saghalien were classified and published together with those from other localities by Turner (1809), C. Agardh (1812, 1822), Postels & Ruprecht (1840) and Ruprecht (1851). The following seven species and one variety were the whole of the marine algae which had been known from Saghalien up to the time of Ruprecht :

1. *Tichocarpus crinitus* (Gmelin) Ruprecht (Syn. *Fucus crinitus* Gmel.). According to Ruprecht (1851, p. 320), "Ein Exemplar von Tilesius (dem Reisegefährten Horners) in Stephan's Herbarium ist mit "Sachalin" bezeichnet und dieser Ort ist

in Agardh's Algen-Decaden für dieselbe Pflanze von Tilesius aufgefürt,...."

2. *Fucus evanescens* Ag. As to the habitat of his species, Agardh (1820, p. 920) writes: "Ad Sachalien, Tilesius: ad Kamtschatka, Chamisso."

3. *Chondrus platynus* (Ag.) J. Ag. Under the name *Halymenia platyna* Ag., Agardh (1822, p. 206) states: "Ad insulam Sachalien invenit Tilesius, qui specimen misit." It is also stated by Ruprecht (1851, p. 315) that, "Als *Halymenia platyna* Ag. sind in Mertens' Herb. X, 289 drei Exemplare aufbewahrt; eines scheint aus derselben Quelle (Tilesius) abzustammen; die zwei anderen von Horner aus Kamtschatka (ob nicht auch aus Sachalin?) sind als *Fucus cariolosus* Mert. bezeichnet,...."

4. *Odonthalia corymbifera* (Gmel.) J. Ag. Ruprecht (1851, p. 412) states: "In Mertens' Herbarium (XV, 426, B) fand ich später zwei Rasen der *Atomaria corymbifera* Gmel. mit beiderlei Früchten unter dem Namen *Fucus calamistratus* Wormsk. aus Kamtschatka (also Awatschabai) von Horner mitgebracht .... Ich vermuthe, daß diese Exemplare, so wie jene von *Tichocarpus*, aus Sachalin stammen."

5. *Alaria fistulosa* Post. et Rupr. Postels & Ruprecht (1840, p. 11) state: "Secundum observationes Tilesii quoque obvenit ad Kamtschatka prope candelabrum marinum (majak) et in sinu cancrorum (rakowaja buchta), item juxta insulas Kuriles ad Sachalin usque."

6. *Cystophyllum geminatum* (Ag.) J. Ag. Ruprecht (1851, p. 347) states: "die in Mertens' Herbarium V, 124 (*Fucus Lepidium* Mert.) mit der Bezeichnung 'e mari glaciali' und 'Insul. Kuril.' sich vorfindenden Exemplare, scheinen von Krusenstern's Reise und eher aus Sachalin abzustammen."

7. *Halosaccion saccatum* Kütz. Under the name *Dumontia hydrophora* Post. et Rupr., Postels & Ruprecht (1840, p. 19) state: "Ad Kamtschatka vulgaris in conchis et saxis; etiam ad insulam Sachalin sec. Tilesius."

7a. *Halosaccion glandiforme* var. *crassum* Rupr. As to the habitat of his variety, Ruprecht (1851, p. 292) writes: "M. Ochot. Kamtsch. orient.-Sachalin?"

In 1889, J. G. Agardh reported the following three species of Sargassum which are said to have been collected by Navarcha Fenger in Saghalien Island near the mouth of the Amur:

8. *Sargassum patens* Ag. J. Agardh (1889, p. 56) states: "In mari Japonico; ad insulam Sachalin extra ostia Amuris: Navarcha Fenger."

9. *Sargassum Horneri* Ag. Under the names *Sargassum spathulatum* J. Ag. and *Sargassum Fengeri* J. Ag., J. Agardh (1889, p. 58 & 59) states respectively: "Corea, Insula Sachalin, Japonia", and "ad insulam Sachalin extra ostia Amuris legit Navarcha Fenger."

10. *Sargassum Ringgoldianum* Harv. Under the name *Sargassum Coreanum* J. Ag., J. Agardh (1889, p. 58–59) states: "ad oras Coreae (Herb. Crouan) ad ostis Amuris Navarcha Fenger."

Of these ten species, which seem to have been the whole of the marine algal species known from Saghalien at the end of the nineteenth century, *Sargassum patens* and *S. Ringgoldianum* are warm-temperate species, being distributed along the Japan Sea coast of Honshû as far north as Prov. Mutsu and Ugo respectively. The latter is known to be distributed also in the Pacific side as far north as Prov. Kushiro, Hokkaido, the former has not yet been reported from Hokkaido. As compared with them, *Sargassum Horneri* seems to be more adaptable to colder waters and is fairly common in Hokkaido ; but it is not represented in the collections of Saghalien algae in the writer's hand. The specimens of these three species of Sargassum collected by Fenger near the mouth of the Amur must have been floating detached ones, conveyed there by currents far from their growing grounds in certain southern localities. Excepting them, the remaining seven species are considered to be colder temperate or subarctic species and are more or less widely spread in southern Saghalien.

It was in the year 1906 that a botanizing expedition covering nearly the whole coast of southern Saghalien was undertaken in summer by the late Dr. K. Miyabe, as one of those who were then on the special scientific staff of the Saghalien Civil Government. So far as the algal collection is concerned, this may be said to be the first extensive one made in the southern half of the island of Saghalien. The stations explored were about thirty six in total number, of which twelve are on the western coast from Pilevo, situated a little north of 50 °N. L., to Cape Nishinotoro, eight on the coast of Aniwa Bay, from Chishiya to the western side of Cape Nakashiretoko, and the remaining fourteen on the eastern coast from Airô to Kitafunakoshi (Sorenuiya) in Kitashiretoko Peninsula. In the same year, a considerable number of interesting specimens of seaweeds were collected by four other persons : by Mr. Tsutome Miyake, the co-worker of Dr. Miyabe, at the island of Kaiba-tô and several other localities on the eastern coast of Saghalien, by Mr. Ryu Nakamura at the Danger Reef or "La Dangereuse" as called by La Perouse or Nijô-iwa in Japanese in the Strait of La Perouse or Sôya and other stations, by Mr. Rainosuke Kubo at Robben Island (Kaihyô-tô), and by Mr. Idzumiyama at Ōtomari and elsewhere. Nearly all the specimens collected by these gentlemen have been deposited in the Herbarium of the Faculty of Agriculture, Hokkaido University. A preliminary report on the important land plants and seaweeds collected in the expedition of southern Saghalien in 1906 was published in 1907 by Dr. Miyabe and his collaborator Mr. Miyake. Excepting some economic seaweeds, most of the specimens of marine algae were left untouched for a future study. A certain number of the species of the collection which belong to the Ord. Fucales and the genus Alaria were afterwards studied and published by Dr. K. Yendo in his excellent monographs in 1907 and in 1919 respectively. In 1926, these valuable speciemns of the Saghalien algae were placed in the writer's hand by Prof. Miyabe to be worked up for preparing his graduation thesis. Since that year, the writer has been engaged continually in the investigation of the marine algae of southern Saghalien under the guidance of Prof. Emer. Miyabe. He undertook botanizing excursions ten times in all from 1926 to 1943, namely, in April of 1937, in July of the years 1931 and 1941, in July–August of the years 1926, 1930, 1932 and 1935, in August–September of the years 1927 and 1929, and in September–October of 1943. Materials were also added through the kindness of the members of the staff of the Fisheries Department of the then Saghalien Government, especially of Mr. Yoshika Saito, and also of those in the Fisheries Department of the then Saghalien Central Experimental Station, especially of Mr. Shiro Ishii, ex-Director of the Department. The late Prof. Risuke Kanno and Mr. Hikoei Ohmi of the then Hakodate College of Fisheries, Mr. Shosuke Matsubara of the then Karafuto Kanten Company, Mr. Tadao Morimoto and Mr. Masao Nakashima who were in Saghalien in those days — these various persons also placed their valuable collections from various localities in Saghalien at the writer's disposal. The results of the writer's study on these materials have previously been reported in part either fragmentally in his "Phycological Observations, I–V" (1934–42) and other papers, or in short articles such as "The Marine Algae from Robben Island" (1932 and a supplementary report in 1934) and "List of the Marine Algae of Tôbuchi Lake, Saghalien" (1941).

In the present contribution the writer proposes to enumerate all the species belonging to the classes of Phaeophyceae and Rhodophyceae, and also most of the Chlorophyceae, which are determined to occur on the coast of the southern half of the Island of Saghalien south of the line of north latitude 50° including both the Island of Kaiba-tô and the Islet of Kaihyô-tô. All the other species except only one belonging to the Cyanophyceae are left undetermined at present for some future study. The species of these four classes treated in this paper number 182 in all, of which 28 belong to Chlorophyceae, 66 to Phaeophyceae, 87 to Rhodophyceae, and 1 to Cyanophyceae.

Acknowledgement. The writer is very pleased to express his heartiest thanks at this opportunity to the late Prof. Emer. Kingo Miyabe, under whose guidance the present work was carried on ; Prof. Miyabe kindly placed in the writer's hand all the specimens he gathered in many years, and gave permission to use his library freely, and moreover he kindly read the manuscript of the present work. The writer desires further to make acknowledgement of his indebtedness to Prof. Emer. Seiya Ito and Prof. Yoshihiko Tochinai for their kind advices and encouragement throughout the course of the present investigation. To Prof. Yukio Yamada, the writer is much indebted for his kind permission to make free use of his library. He feels very grateful to the late Prof. W. A. Setchell of Berkeley and to the late Prof. H. Kylin of Lund for examining certain specimens and returning notes for his guidance, and also to Dr. Elena S. Sinova of Leningrad and to Dr.T. Arwidsson of Stockholm, both of whom were generous enough to share some of their valuable specimens. To all the gentlemen who were before the end of the recent war connected with the Fishery Department of Saghalien Government and of the Saghalien Central Experimental Station and also of the Karafuto Kanten

Company, as well as to Mr. Tadao Morimoto and Mr. Masao Nakashima, who helped the writer in various ways for acquiring rich materials, he returns his most sincere thanks. His cordial thanks are also due to the late Prof. Emer. Shigeo Sasa of the then Hakodate College of Fisheries, Prof. Emer. Koji Miyake of our University, Mr. Sataro Murayama, Mr. Shiro Ishii (both ex-Directors of the Fisheries Department of the just-mentioned Station), and Mr. Chôsaku Suzuki (Director of the Karafuto Kanten Company), who all afforded the writer many facilities for his botanizing trips in Saghalien. For pecuniary aid by which the expeditions in 1935, 1941 and 1943 were supported, the writer's cordial thanks are due to the Hattori Hôkô Kai, the Education Ministry, and to the Science Promoting Society respectively. Thanks are also due to Dr. Misao Tatewaki, the late Mr. Risuke Kanno, Dr. Masaji Nagai, Mr. Takeshi Hattori, Dr. Hiroyuki Hirose, Mr. Hikoei Ohmi, Mr. Tomitaro Masaki, Mr, Hiroshi Yabu and other colleagues for assistance at many points. To all of these getlemen, the writer offers his sincere thanks.

GENERAL PART

1. Localities

The localities where the materials of the present work were collected are 67 in total number, of which one, Pilevo, is exceptionally situated a little north beyond 50° N. L. The following table shows their names, arranged for convenience' sake in a geographical order from north to south on the Japan Sea coast, from west to east on the coast of Aniwa Bay, and from south to north on the Ochotsk Sea coast. The site of these localities is shown in Fig. 1.

Table I. List of the names of the collecting localities in the current designations,[1] accompanied with the Japanese equivalents, original names, and those adopted in the map in FR. SCHMIDT's Flora Sachalinensis (1868).

Current designantions	Japanese equivalents	Original names[2]	Names in the map in Flora Sachalinensis
Japan Sea :			
Pilevo	ピ レ オ	Porokotan	Porokotan (Pil-wo)
Ambetsu	安 別	Amo-pesh	
Sokorai	ソコライ		
Nayoshi	名 好	Noya-ush-i	F. Najassi
Ushiro	鵜 城		
Kushunnai	久 春 内	Kushu-un-nai	P. Kussun-nai
Tomarioru	泊 居	Tomari-oro	F. Tomarioro-nai
Rakuma	楽 磨	Rak-ma-ka	
Maoka	真 岡	Ma-o-ka	Endungomo (Tunai, Mauka)
Hirochi	広 地	Piroro-chi	Pirotzi
Chinehira	知 根 平	Chinom-pira	
Honto	本 斗	Pon-to-kesh-i	
Minaminayoshi	南 名 好	Noya-ush-i	
Muitomari	武 意 泊	Moire-tomari	Moiri-tomari

Kaiba-tô (island)	海馬島	Todo-mosiri	M. Monneron (Tontomussire)
Yenchishi	遠知志	Wen-chish	C. Ven-tisse
Sôni	宗仁	So-un-i	Ssoni
Hishitoma	菱苫	Pesh-uturu-oma-nai	
Shiranushi	白主	Sirara-un-ush-i	Ssiranussi
Nishinotoro (cape)	西能登呂	Noto-oro	C. Notoro (Crillon)
Sôya Strait :		Strasse Laperouse :	
Nijô-iwa	二丈岩	Krilion Danger Reef or "La Dangereuse" (after La Perouse)	
Aniwa Bay :			
Ishihama	石浜	Chisu-yanke-nai	
Chishiya	知志谷	Chish-ya	
Nobori	登	Pesh-sam	C. Nubori-Endum
Dorokawa, Tomariwo	泥川, 泊尾	Tomari-onnai	
Ôtomari	大泊	Poro-an-tomari	
Merei	女麗	Me-rui	
Otai	小田井	Ota-i	
Nagahama	長浜	Chip-san-i	Tipessani
Tôbuchi-ko (lagoon)	遠淵湖	Tobutchi	B. Busse (Tobozji)
Kochôbetsu	蝴蝶別	Kochi-o-pet	Kotschubiss
Naion	内音	Nai-om-nai	
Akaiwa	赤岩	Fure-suma	
Yaman	弥満	Ya-oma-pet	
Sattô	札塔	Sat-to-po	
Shiraiwa	白岩		
Chikatomari	近泊		
Naka-Shiretoko[3](cape)	中知床	Sir-etoko	C. Ssire-toko (Aniwa)
Ochotsk Sea :			
Hota	保多	Pon-ota-nai	
Minabetsu	皆別	Mena-pet	
Airô	愛郎	Ai-rup	C. Tonyn (Airup)
Tonnai	富内	To-un-nai-cha	
Tôba-ko(marsh)	塔場湖	To-pa	
Ondo-ko(lagoon)	恩洞湖	Om-to	
Ochibo	落帆	O-cheh-pok-ka	Otschepoko
Rorei	譽礼	Rura-i	
Sakaehama	栄浜	Shuschu-ush-nai	
Naibuchi	内淵	Nai-buchi	
Higashishiraura	東白浦	Sirara-ka or Sirara-oro	Ssiraroro
Waare	輪荒	Wa-rewe-nai	
Maguntan	馬群潭	Mak-un-kotan	Magun-kotan
Mototomari	元泊	Mo-tomari	
Higashisôya	東宗谷	So-ya	
Kashiho	樫保	Kashpo-ush-i	Kaspi
Higashishirutoru	東知取	Sir-uturu	
Unetonnai	畝富内	Une-to-un-nai	
Nairo	内路	Nai-oro	Naioro
Shikuka	敷香	Si-ka	Ssiska
Taraika-ko (lagoon)	多来加湖	Tarai-ke	Taraika-See
Taraika	多来加	〃	
Jimutaki	仁滝	Jimudagei	
Noto	能登		
Chiriye	散江	Chiri-a-san	
Kitafunakoshi	北船越	Mun-ush-pe	
Kaihyô-tô (islet)	海豹島	Atui-ya-mosiri	Robben Insel
Kitashiretoko (cape)	北知床	Sino-siretoko	C. der Geduld (Ssino-Ssiretoku, Taraika etw.)
Yôman	用萬	Iomande-ush-i	

1) At the time before the end of the recent war.

2) All of these original names are of Aino origin, except "Jimudagei" which is of Gilyak and Orok origin.

3) The west side of Cape Nakashiretoko in the vicinity of Kirara-Saki (Suryugu) and Moi was explored by Prof. Miyabe in 1906.

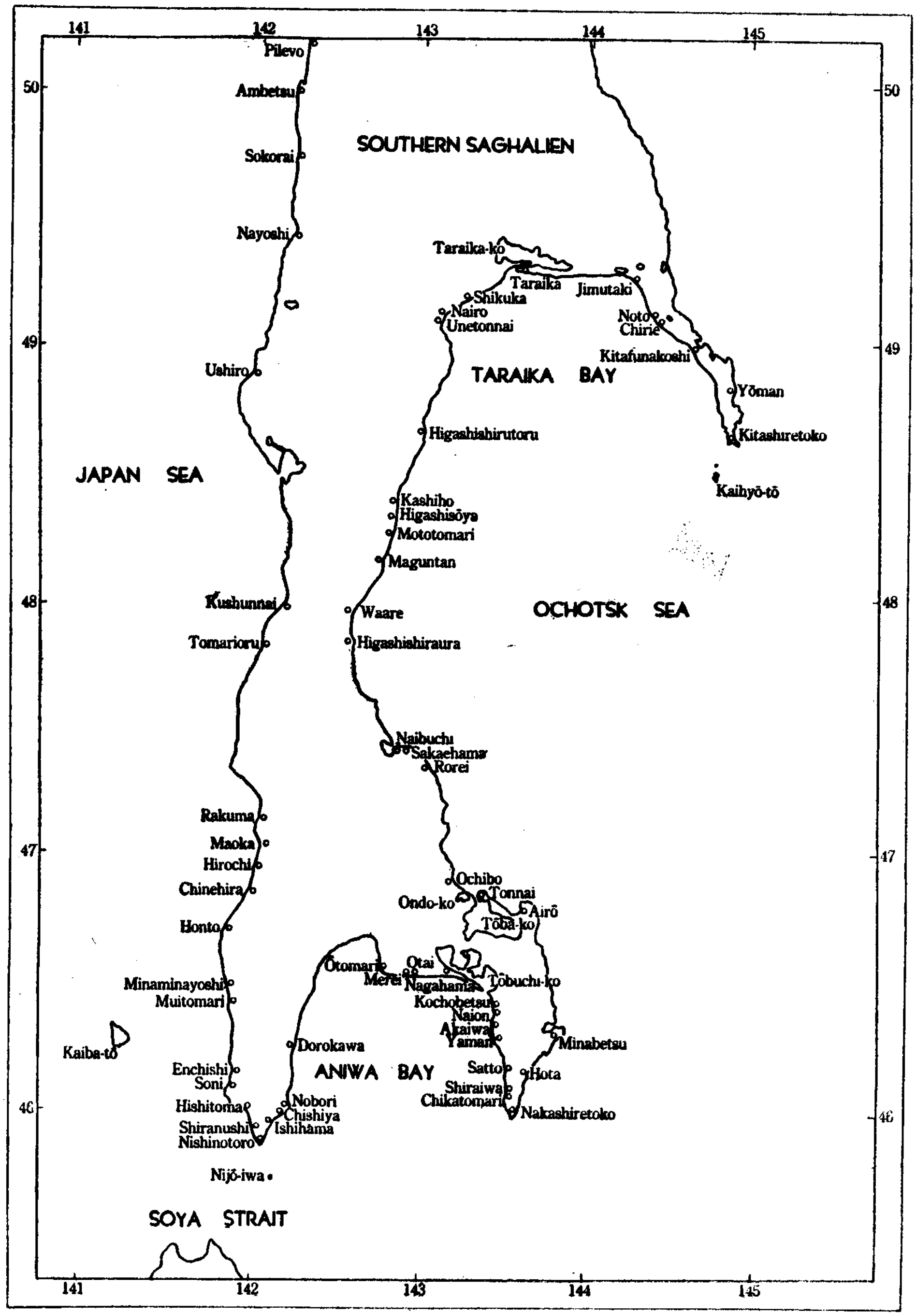

Fig. 1. Map showing the site of the collecting localities.

2. Topographical and Oceanographical Notes

The Island of Saghalien extends north and south between 45°53′30″ and 54°25′50″N. lat. and lies between 141°37′50″ and 144°45′E. long. The southernmost point is at Cape Nishinotoro, the northernmost at Cape Elizavetui, the westernmost at Cape Lyak near the narrowest portion of the Mamiya Strait, and the easternmost at Cape Kitashiretoko. The westernmost point in the southern half of the Island below 50°N. lat. is at Cape Kenushi, 141°48′50″E. long. The Island of Kaiba-tô lies between 141°13′ and 141°16′E. long. and the Krilion Danger Reef or Nijô-Iwa (or Nijô-Gan) in Sôya Strait at 45°47′40″N. lat.

Southern Saghalien is under the influence of three ocean currents, namely the Tsushima Warm Current, and the Liman and the Karafuto Cold Currents (cf. Fig. 2, A & B). The distal reaches of the Tsushima Current wash in summer the shore of Kaiba-tô, the western coast from Muitomari northward up to beyond the 50th degree's boundary, the shore of Aniwa Bay and the eastern coast as far north as Taraika Bay, while the current does not run across the Strait of Sôya in winter except along the Ochotsk Sea coast of Hokkaido. On the other hand, the

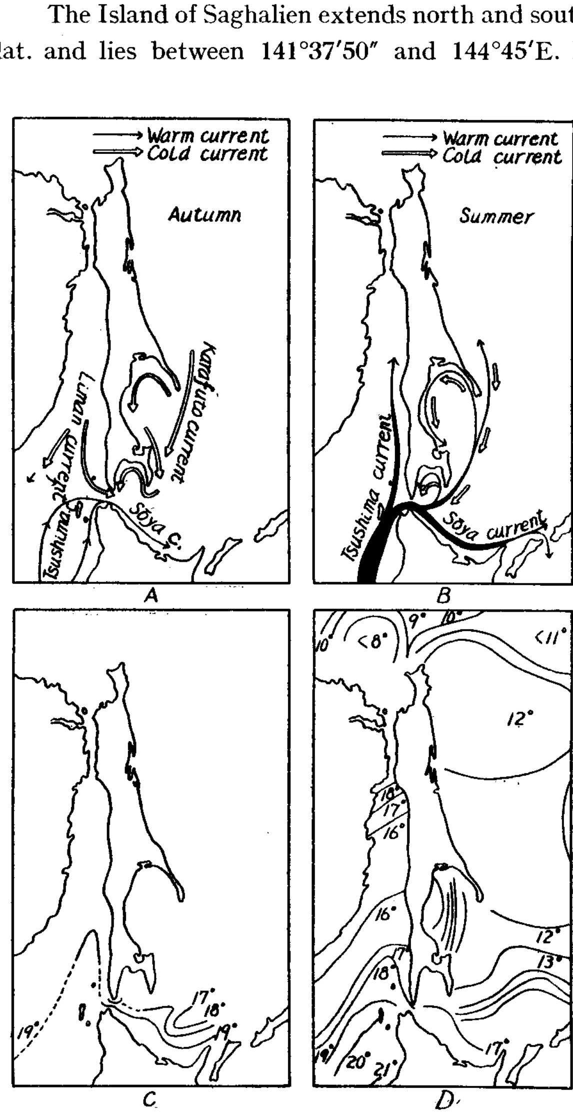

Fig. 2. Map showing the ocean currents in summer and autumn, and the isotherms of surface water in August
A. After Uda (1936, Fig. 29 b) and the map published bu the Saghalien Government.
B. After Uda (1935, Fig. 49 b) and the map published by the Saghalien Government.
C. After Uda (1935, Fig. 3 a).
D. After Makarov, 1894.

cold currents prevail of course along the whole coast in winter, while they become deep undercurrents in summer, being replaced by the warm current in surface layers. The deep cold under-currents appear to dash at coastal banks near the promontories of Cape Ushiro, Cape Nishinotoro and Cape Minabetsu, and upwelling cold water patches have been observed at these points. According to the observations of the Fishery Bureau of the Saghalien Government in July 1906 (Wada, 1907), the surface temperature of the sea-water near Cape Ushiro and Cape Minabetsu was 10°C. and 8–10°C. respectively, while it was 16°C. near Maoka and 16–18°C. in Taraika Bay. However, a special datum has not been known yet to prove the influence of the low temperature on the marine vegetation at these two capes, where the writer has had no chance to explore. On the other hand, the lowness of the surface temperature of the upwelling water patches in the vicinity of Cape Nishinotoro and the Krilion Danger Reef is more remarkable ; it is said to be 6–8°C. in midsummer (Wada, 1907, p. 14) or 3.8–6°C. in August (Matsudaira & Yasui, 1935, p. 498). This Krilion Cold Water Patch was first described by Makarov (1894), and has lately been fully explained by Matsudaira & Yasui (1935). Dr. Miyabe informed the writer that he had once witnessed during his tour around the coast of Saghalien in 1906, violent upwellings of the cold water from the lower layers off the south coast of Cape Nishinotoro, which must have orinigated from the under-current in the Japan Sea flowing toward the east. According to Matsudaira & Yasui (1935), the upwelling water (temperature 3.8–6°C., salinity 33.5% at 0 m.) between Cape Nishinotoro and the Nijô-

Table II. The average surface temperatures (°C.) of the sea-water for each month of certain years observed at several stations in southern Saghalien.

Station / Month	Maoka	Honto	Nishi-Notoro	Ōtomari	Tôbuchi-ko	Airô	Shikuka
Jan	-1.1	-0.7	-1.2	-1.4	-1.5	—	-1.8
Feb	-1.1	-1.0	-1.4	-1.4	-1.4	—	-1.3
Mar	0.48	0.6	-0.6	-1.0	—	—	-0.5
Apr	3.1	3.0	1.7	1.7	—	-0.05	2.3
May	6.4	5.5	4.0	5.0	4.5	4.0	6.7
Jun	9.9	8.4	8.0	10.2	10.1	9.9	10.5
Jul	15.2	13.6	10.8	15.3	10.1	13.6	15.6
Aug	17.7	16.9	13.3	17.6	16.5	15.4	17.3
Sep	15.7	14.5	12.7	16.2	16.9	12.6	14.6
Oct	9.4	9.8	8.7	10.9	10.0	7.4	7.6
Nov	4.6	4.8	4.3	4.9	3.1	1.6	1.3
Dec	1.3	1.3	1.5	-0.8	0.5	1.2	-1.5
Year	1938–1941	1938–1941	1933–1942	1932–1939	1930–1931	1940–1942	1937–1940
Max. temp. observed	22.8 in Aug. '38	22.6 in Aug. '38	16.0 Mean for Aug. '39	26.0 in Aug. '38	16.93 Mean for Sep. '30	17.3 Mean for Aug. '40	23.4 in Aug. '38
Literature	Jour. of Oceanogr.	Jour. of Oceanogr.	Oceanogr. Invest.	Jour. of Oceanogr.	Kanno & Matsubara 1932	Oceanogr. Invest.	Jour. of Oceanogr.

Iwa consists of five parts of the cold and highly saline water (10°C., 33.4–33.5 (—34.0)% at 50 m.) at the 25–50 m. layers of the Japan Sea and one part of the more cold and less highly saline water (0°C., 32.3% at 50 m.) at the 25–50 m. layers originating from the Karafuto Current. The lowness of the surface temperature of the sea-water around Cape Nishinotoro is also clearly shown in the isothermal figures given by Uda (1935, fig. 3a) and by Matsudaira & Yasui (1935, pl. 10 G), which are reproduced in Fig. 2(C) and Fig. 3 respectively. The unexpected occurrence of a certain number of the Kurile and Bering species of the Laminariaceae within this cold water region has already been reported and discussed by Miyabe in 1926 before the 3rd Pan-Pacific Science Congress held in Tokyo (Miyabe, 1928).

In Table II are shown the average surface temperatures of the seawater for each month at seven important stations, in view of giving a general idea of the temperature condition in southern Saghalien as well as the seasonal and spacial changes of the water temperature.

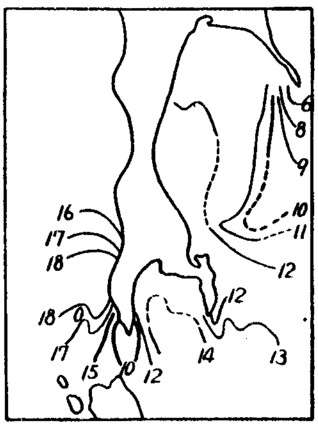

Fig. 3. Map showing the isotherms of surface water in August 1932. (After Matudarira & Yasui, 1935, pl. 10 G).

The isotherms of the surface water temperature in August around the Island of Saghalien are shown in Fig. 2 (C & D) and Fig. 3.

Considering from these temperature data, the coast of southern Saghalien may be divided into the following five sections: I. The western coast from Muitomari northward, including Kaiba-tô; II. The Aniwa Bay coast; III. The eastern coast as far north as Taraika Bay; IV. The eastern coast from Kaihyô-tô and Cape Kitashiretoko northward; V. The cold water region in the vicinity of Cape Nishinotoro.

The Sections I and II are situated between the isotheres of 15°C. and 20°C., III between 15°C. and 18°C., IV between 10°C. and 15°C., and V between 5°C. and 10°C. The Sections I, II and III are then considered to belong to the North Temperate Zone according to the division of oceans by Setchell (1915), IV to the Lower Boreal Zone, and V to the Upper Boreal Zone. Although the highest isotherms of the summer months in the Sections I, II and III are up to 18°C. or 20°C. as mentioned above, the influence of the cold currents, which must be of course quite remarkable in other seasons, is considered to play an important role in characterizing the marine vegetation of these Sections. On the other hand, the temperature of the shallow and calm waters on the rocky reefs which border the larger part of the coast of southern Saghalien, may often become in warmer seasons higher than in the open sea and help the growth of certain species adapted to higher temperature. Cape Nishinotoro is situated, generally speaking, between the isotheres of 5°C. and 10°C., but the data cited in Table II show that the water temperature observed at the eastern shore just beneath the Light House may rise in summer months to 10.5–13.5°C. or occasionally even up to more than 15.5°C.

Table III. Number of genera, species, subspecies, varieties, subvarieties, forms and subforms in the families of the algal flora of southern Saghalien.

Name of Families	Genera	Species	Subsp.	Var.	Subv.	Forms	Subf.
Chlorophyceae	(14)	(28)	(1)	(7)	(1)	(3)	(0)
Ulotrichaceae	1	1	—	—	—	2	—
Cladophoraceae	6	11	—	1	—	1	—
Ulvaceae	2	6	—	2	—	—	—
Monostromaceae	1	6	—	3	—	—	—
Prasiolaceae	1	1	1	—	—	—	—
Chlorochytriaceae	1	1	—	—	—	—	—
Caulerpaceae	1	1	—	—	—	—	—
Codiaceae	1	1	—	1	1	—	—
Phaeophyceae	(39)	(66)	(0)	(1)	(0)	(24)	(2)
Sphacelariaceae	2	4	—	—	—	—	—
Ectocarpaceae	3	3	—	—	—	1	—
Lithodermataceae	1	2	—	—	—	—	—
Elachistaceae	3	3	—	1	—	—	—
Leathesiaceae	1	3	—	—	—	—	—
Chordariaceae	6	8	—	—	—	3	—
Acrothricaceae	1	1	—	—	—	—	—
Desmarestiaceae	1	4	—	—	—	—	—
Punctariaceae	1	1	—	—	—	—	—
Asperococcaceae	1	1	—	—	—	—	—
Striariaceae	1	1	—	—	—	—	—
Scytosiphonaceae	3	3	—	—	—	8	2
Coilodesmaceae	1	3	—	—	—	1	—
Dictyosiphonaceae	1	2	—	—	—	—	—
Chordaceae	1	1	—	—	—	—	—
Laminariaceae	6	13	—	—	—	8	—
Dictyotaceae	2	2	—	—	—	—	—
Fucaceae	2	2	—	—	—	—	—
Sargassaceae	2	9	—	—	—	3	—
Rhodophyceae	(56)	(87)	(0)	(3)	(0)	(30)	(3)
Porphyridiaceae	1	1	—	—	—	—	—
Bangiaceae	3	7	—	—	—	3	—
Helminthocladiaceae	1	1	—	—	—	—	—
Gelidiaceae	1	2	—	—	—	1	—
Dumontiaceae	5	6	—	—	—	—	—
Squamariaceae	1	1	—	—	—	—	—
Corallinaceae	3	3	—	—	—	—	—
Grateloupiaceae	1	3	—	—	—	—	—
Endocladiacae	1	1	—	—	—	1	—
Tichocarpaceae	1	1	—	—	—	—	—
Callymeniaceae	4	4	—	1	—	3	—
Nemastomaceae	1	1	—	—	—	—	—
Solieriaceae	1	1	—	—	—	—	—
Rhodophyllidaceae	1	2	—	—	—	—	—
Gracilariaceae	1	1	—	—	—	—	—
Phyllophoraceae	2	2	—	1	—	—	—
Gigartinaceae	4	7	—	—	—	8	2
Rhodymeniaceae	2	4	—	1	—	7	1
Champiaceae	1	1	—	—	—	—	—
Ceramiaceac	4	12	—	—	—	6	—
Delesseriaceae	9	10	—	—	—	1	—
Rhodomelaceae	8	16	—	—	—	—	—
Cyanophyceae	(1)	(1)	(0)	(0)	(0)	(0)	(0)
Pleurocapsaceae	1	1	—	—	—	—	—
Total sum	111	182	1	11	1	57	5

3. Phytogeographical Distribution of the Algae of Southern Saghalien

a. Survey of the Composition of the Algal Flora of Southern Saghalien

As shown in Table III, the total number of the species of the algal flora of southern Saghalien so far investigated are 182, belonging to 111 genera and 50 families, of which 28 species, 14 genera and 8 families belong to Chlorophyceae, 66 species, 39 genera and 19 families to Phaeophyceae, 87 species, 56 genera and 22 families to Rhodophyceae, and one species, one genus and one family to Cyanophyceae. The largest family is the Rhodomelaceae, which have 16 species in 8 genera. Next come the Laminariaceae, having 13 species in 6 genera, and then follow the Cladophoraceae with 11 species in 6 genera, the Ceramiaceae with 12 species in 4 genera, the Delesseriaceae with 10 species in 9 genera, the Sargassaceae with 9 species in 2 genera, the Chordariaceae with 8 species in 6 genera, the Bangiaceae with 7 species in 3 genera and the Gigartinaceae with 7 species in 4 genera. The Ulvaceae, Monostromaceae and Dumontiaceae have 6 species respectively.

b. Floristic Relationships between Southern Saghalien and Other Regions

The following two tables (IV & V) are prepared with the view of showing the relationships between the algal flora of southern Saghalien and those of other regions on the whole surface of the globe.

From these data we can summerize the relationships under consideration as follows :

1. The species common to Hokkaido are 141 in number or 77% of the total number of species, showing the largest number among those common to other regions. That number includes the following 16 species which are found in Saghalien restrictively at Kaiba-tô.

Ralfsia verrucosa	*Gelidium vagum*
Chordaria firma	*Grateloupia prolongata ?*
Dictyota dichotoma	*Schizymenia Dubyi*
Dictyopteris divaricata	*Antithamnion nipponicum*
Sargassum serratifolium	*Branchioglossum nanum*
Bangia fusco-purpurea	*Acrosorium Yendoi*
Nemalion vermiculare	*Laurencia nipponica*
Gelidium Amansii	*Janczewskia Morimotoi*

The Island of Kaiba-tô is to be considered to belong to Hokkaido rather than to

Saghalien from the phytogeographical point of view, being closely linked with two islands, Rebun and Rishiri. That the Island of Kaiba-tô is situated between the same isotheres as these two islands of Hokkaido is clearly shown in Fig. 2 (C & D). If we exclude these 16 species from the total, the species common to Hokkaido become 125 in number or 75.3% of the remaining 166 species, still showing the largest number.

2. The species common to the Kuriles are 113[1] in number or 62% of the total number of the species. This percentage rises to 67.2% if we compare this number with 167 gained by deducting from the total the number of the above mentioned species from Kaiba-tô excluding *Dictyopteris divaricata*, which occurs also in the South Kuriles. As already pointed out by Nagai (1941, p. 255) the marine floras of Saghalien, Hokkaido and the Kuriles are to be said, on the whole, as very similar to each other. Here the writer will make a comparison between the algal flora of southern Saghalien and that of the Kurile Islands; the latter has been thoroughly studied by Dr. Nagai (1940, 1941). We have larger numbers of the families and genera in Saghalien than in the Kuriles, namely 50 families and 111 genera in the former while 43 families and 93 genera in the latter. On the contrary, the number of species is larger in the Kuriles than in Saghalien, namely 187 in the former and 182 in the latter. The species common to both of these regions are 113 in number and amount to 30.6% of the total sum (369) of the species. The species peculiar to either of the regions are similar in number, namely 74 or 20% of the total sum of the species to the Kuriles and 66 or 17.9% to Saghalien. Of the 74 species which occur in the Kuriles but not in Saghalien, 15 belong to Chlorophyceae, 28 to Phaeophyceae, 30 to Rhodophyceae, and one to Cyanophyceae. The largest family is the Laminariaceae which have 20 species including 8 *Laminaria* spp., 4 *Alaria* spp., etc. Next come the Rhodomelaceae and Ceramiaceae which have 8 and 5 species respectively. The richness in the genera and species of the Laminariaceae may be said to characterize the marine flora of the Kurile Islands.

3. The species common to Honshû are 98 in number or 53.8% of the entire flora, of which 94 are also common to Hokkaido and 64 to the Kuriles.

4. The species common to Kyûshû and Shikoku are 32 in number or 17.5% of the entire flora. All of them except only one are also common to Honshû.

5. The species common to Korea and Kwantung are 38 in number or 20.8% of the entire flora. All of them except two are also common to Honshû.

6. The species common to the Ogasawara Islands are only 3 in number or 1.6% of the entire flora. They are all likewise common to Kyûshû and Shikoku.

7. The species common to the Ryûkyû Islands are 7 in number or 3.8% of the entire flora. They are all likewise common to Honshû.

8. The species common to Formosa are 12 in number or 6.5% of the enitre flora.

1) These numbers are the balanced ones in accordance with the alterations of the classification adopted in the present work.

All of them are also common to Honshû.

9. Among the regions outside the vicinity of the Japan Archipelago, the Bering Sea (the Aleutian Islands and Alaska) stands first in the number of the common species. The species common to that region are 67 in number or 36.7% of the entire flora, of which 61 are also common to the Kuriles.

10. Next comes the Pacific coast of North America. The species common to this region are 64 in number or 35.1% of the entire flora, of which 49 are also common to Hokkaido and 50 to the Kuriles.

11. The species common to the Atlantic coast of Europe are 60 in number or 32.9% of the entire flora, of which 36 are common to the Kuriles and 43 to Hokkaido.

12. The species common to the Atlantic coast of North America are 58 in number or 31.8% of the entire flora, of which 44 are also common to Hokkaido and 37 to the Kuriles.

13. The species common to Kamtschatka are 54 in number or 29.6% of the entire flora, of which 50 are also common to the Kuriles and 44 to Hokkaido.

14. The species common to the Arctic Ocean are 49 in number or 26.9% of the entire flora, of which 36 are also common to Hokkaido and 35 to the Kuriles.

15. The species common to the Ochotsk Sea are 42 in number or 23% of the entire flora, of which 37 are also common to the Kuriles and 35 to Hokkaido.

16. The species common to the North Sea are 43 in number or 23.6% of the entire flora, of which 31 are also common to Hokkaido, 24 to Honshû, and 23 to the Kuriles.

17. The species common to the Japan Sea coast of Siberia are 36 in number or 19.7% of the entire flora, of which 34 are also common to Hokkaido, 33 to the Kuriles, 25 to Honshû, and 15 to Korea and Kwantung.

18. The species common to the Baltic Sea are 36 in number or 19.7% of the entire flora, of which 28 are also common to Hokkaido and 24 to both the Kuriles and Honshû.

19. The species common to China are 31 in number or 17% of the entire flora, of which 32 are also common to both Hokkaido and Honshû and 25 to the Kuriles.

20. The species common to the Mediterranean and Adriatic Seas are 27 in number or 14.8% of the entire flora, of which 22 are also common to Hokkaido, 21 to Honshû, and 13 to the Kuriles.

21. The species common to the Atlantic coast of South America are 19 in number or 10.8% of the entire flora, of which 17 are also common to Honshû, 16 to Hokkaido, and 13 to the Kuriles.

22. The species common to the Pacific coast of South America are 13 in number or 7.1% of the entire flora, of which 11 are also common to both Hokkaido and the Kuriles and 10 to Honshû.

23. The species common to Oceania are 12 in number or 6.5% of the entire flora, of which 10 are also common to both Honshû and Hokkaido, and 7 to both the Kuriles and China.

24. The species common to the Indian Ocean are 7 in number or 3.8% of the entire flora, all of which are also common to Hokkaido, and 5 to Honshû.

25. The species common to the Malay Archipelago and the Philippine Islands are 5 in number or 2.7% of the entire flora, all of which are also common to Hokkaido, Honshû, Formosa and China.

26. The species common to the Red Sea are 4 in number or 2% of the entire flora, all of which are also common to Honshû, and 2 to the Kuriles, Hokkaido, Formosa and China.

27. The species peculiar to southern Saghalien are 9 in number or 4.9% of the entire flora, all of which are those described by the writer as new to science, as follows :

Aegagropila Kannoi	*Antithamnion sparsum*
Monostroma crassidermum	*Polycoryne denticulata*
Streblonema Eudesmide	*Membranoptera robbeniensis*
Heterosaundersella Hattoriana	*Janczewskia Morimotoi*
Pugetia palmatifolia	

The genus *Heterosaundersella* is at present to be said as peculiar to southern Saghalien. The following three genera, *Streblonema, Polycoryne* and *Janczewskia,* have not yet been known from other regions in the vicinity of Japan. However, it may be natural to expect the future discovery of these species and genera in some of the adjacent regions of Saghalien. Our region is, after all, so closely related in the general aspect of the algal flora with its adjacent regions that it should be taken as a part of "the Japanese Region", one of the five regions of the Pacific Ocean divided by Okamura (1932) in view of the oceanic distribution of the marine algae.

c. Composition of the Algal Vegetation in the Five Sections of the Coast of Southern Saghalien (Cf. Fig. 4)

As already mentioned above under the topic of "Topographical and Oceanographical Notes", the coast of southern Saghalien, considering from the data on the surface temperature of the sea-water, may be divided into five Sections as shown in Fig. 4. As shown in the following analysis of the species, the composition of the algal vegetation in each of these Sections differs to a certain extent from each other in accordance possibly with the differences in the topographical and oceanographical conditions. It may be said, however, that the algal materials obtained up to the present are by no means satisfactorily enough to make a thorough discussion on the comparison of the algal composition of these Sections. Some stations in each Section such as Kaiba-tô in Section I, Chishiya, Nobori and Tôbuchi-ko in Section II, Ariô and Sakaehama in Section III, Kaihyô-tô and Yôman in Section IV, and Shiranushi and Nishinotoro in Section V, have been fairly well explored, but others, especially in Section IV, are left incompletely or not at all explored yet.

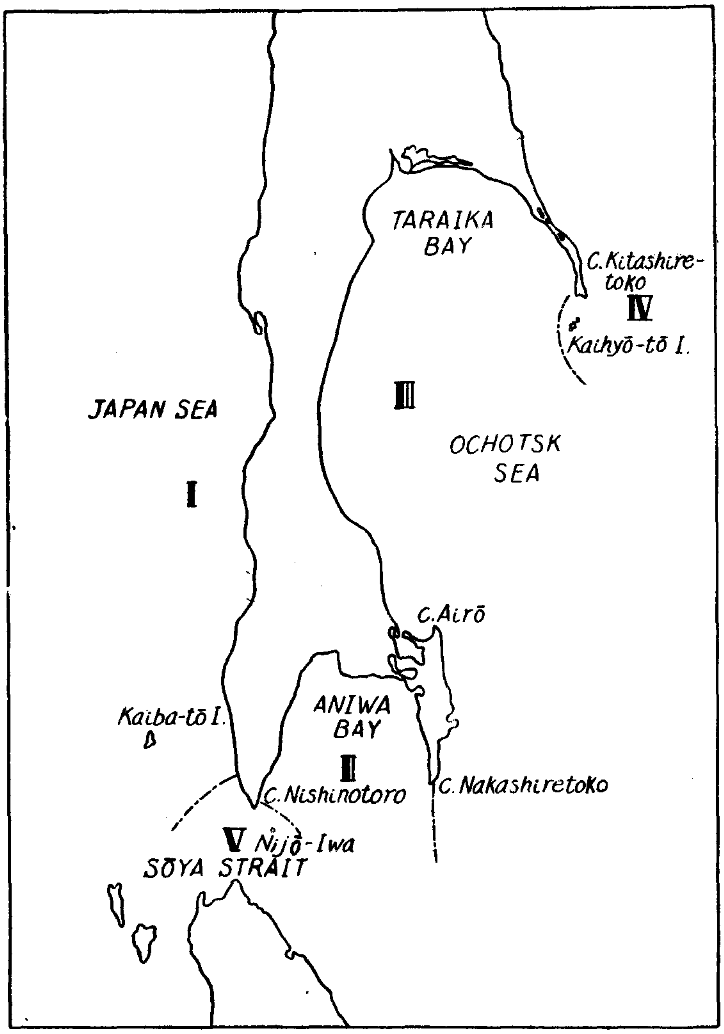

Fig. 4. Map showing the division of the coast of Southern Saghalien into five Sections

From the data shown in Table III we can analyse the species as follows:

1. Species peculiar to a certain single section.

Section I (Those marked with stars are the species peculiar to Kaiba-tô) —

**Cladophora Stimpsonii*	**Chordaria firma*
**Ralfsia verrucosa*	**Dictyota dichotoma*
**Dictyopteris divaricata*	**Grateloupia prolongata* ?
**Sargassum serratifolium*	**Schizymenia Dubyi*
Erythrotrichia carnea	**Antithamnion nipponicum*

**Bangia fusco-purpurea*
Porphyra pseudolinearis
**Nemalion vermiculare*
**Gelidium Amansii*
**G. vagum*
**Branchioglossum nanum*
**Acrosorium Yendoi*
**Laurencia nipponica*
**Janczewskia Morimotoi*
Odonthalia dentata

Section II (All of the species except those starred are from Tôbuchi-ko) —

Chaetomorpha Linum
**Enteromorpha nana var. subsalsa*
E. intestinalis
Sphacelaria variabilis
Streblonema Eudesmide
Leptonema fasciculatum
Halothrix ambigua
Sphaerotrichia japonica
Stictyosiphon tortilis
Laminaria saccharina f. *membranacea*
**Laminaria diabolica* f. *genuina*
Rhododermis Georgii
Gymnogongrus Griffithsiae
Ahnfeltia plicata var. *tobuchiensis*
Halosaccion ramentaceum f. *ramosum*
Antithamnion sparsum
A. corticatum

Section III —

Aegagropila Kannoi
Sphacelaria subfusca
Ectocarpus confervoides
Gonodia Sargassi
Leathesia umbellata
Desmarestia aculeata
Laminaria longipes
Alaria macroptera
Hyalosiphonia caespitosa
Pugetia palmatifolia
Rhodophyllis capillaris
Rhodoglossum pulchrum f. *luxurians*

Section IV —

Spongomorpha duriuscula var. *cartilaginea*
S. Mertensii f. *tenuis*
Monostroma angicava
Heterosaundersella Hattoriana
Coilodesme bulligera
Porphyra ochotensis
Callymenia reniformis
Callophyllis rhynchocarpa f. *obtusiloba*
Antithamnion Corallina
Ptilota californica

Section V —

Ulothrix pseudoflacca f. *major*
f. *minor*
Hormiscia Wormskioldii
Dictyosiphon hippurioides
Laminaria dentigera
Kjellmaniella crassifolia
Arthrothamnus kurilensis
Dumontia simplex
Rhodymenia palmata var. *sobolifera*
Xenococcus pyriformis

2. Species common to certain two Sections.

Section I & II —

Desmarestia media
D. ligulata
Sargassum confusum f. *validum*
Goniotrichum Alsidii
Chondrus armatus
Lomentaria hakodatensis
Ceramium cimbricum
C. japonicum
Chondria dasyphylla
Polysiphonia Morrowii

Section I & III —

Grateloupia divaricata

Section I & V —

Hormiscia penicilliformis

Section II & III —

Chaetomorpha aerea
Chlorochytrium inclusum
Sphacelaria plumigera
Halopteris scoparia
Leathesia sphaerocephala
Eudesme virescens
Acrothrix pacifica
Punctaria plantaginea
Chorda Filum
Cystophyllum geminatum
Callophyllis rhynchocarpa f. *incisa*
Gracilaria verrucosa

Section II & IV —

Prasiola crispa

Section II & V —

Monostroma undulatum
M. arcticum
Scytosiphon Lomentaria f. *cylindricus* subf. *nanus*
Ilea Fascia f. *caespitosa*
Coilodesme japonica
Laminaria diabolica f. *longipes*
Sargassum Thunbergii f. *latifolium*
Iridophycus subdichotomum

Section III & IV —

Rhodophyllis dichotoma
Membranoptera robbeniensis
Myriogramme yezoensis
Polycoryne denticulata

Section IV & V —

Heterochordaria abietina f. *simplex*
Alaria dolichorhachis f. *longipes*
Chondrus pinnulatus f. *cervicornis*
Pseudophycodrys Rainosukei

3. Species common to certain three Sections.

Section I, II & III —

Enteromorpha prolifera
Monostroma fuscum var. *splendens*
Codium dichotomum
Leathesia difformis
Colpomenia sinuosa f. *typica*

Laminaria ochotensis
Cystophyllum hakodatense
Ahnfeltia plicata
Chondrus pinnulatus
f. *longicornis*
Halosaccion ramentaceum
f. *robustum*
f. *densum*
Laurencia glandulifera

Section I, II & V —

Chaetomorpha moniligera
Cladophora glaucescens
Enteromorpha plumosa
Bryopsis hypnaeoides
Colpomenia sinuosa
f. *deformans*
Alaria fistulosa
Sargassum confusum
Halosaccion ramentaceum
f. *Tilesii*
Polysiphonia hakodatensis

Section II, III & IV —

Enteromorpha nana var. minima
Chordaria flagelliformis
f. *chordaeformis*
Rhodymenia pertusa
Phycodrys rubens

Section II, III & V —

Pylaiella littoralis
Myelophycus intestinale
Coilodesme Cystoseirae
Laminaria saccharina
f. *bullata*
Porphyra umbilicalis
f. *vulgaris*
Porphyra variegata
Grateloupia turuturu
Chondrus pinnulatus
f. *flabellatus*
f. *ciliatus* subf. *angustus*

Section II, IV & V —

Porphyra amplissima
Monostroma crassidermum

Section III, IV & V —

Ralfsia fungiformis
Constantinea Rosa-marina
Callophyllis rhynchocarpa
f. *cristata*
Chondrus pinnulatus
f. *ciliatus* subf. *latus*

4. Species common to four Sections. (The Section, in which the species is lacking, is shown within brackets).

Rhizoclonium tortuosum (IV)
Enteromorpha Linza (IV)
Chordaria Nagaii (I)
Saundersella simplex (IV)
Desmarestia viridis (IV)
Dictyosiphon foeniculaceus (III)
Costaria costata (IV)
Fucus evanescens (IV)
Pelvetia Wrightii (IV)
Sargassum Miyabei (IV)
Dumontia incrassata (I)
Neodilsea Yendoana (IV)

Heteroderma zostericola (*IV*)
Amphiroa cretacea (*IV*)
Corallina pilulifera (*IV*)
Gloiopeltis furcata (*IV*)
Euthora fruticulosa (*II*)
Callophyllis rhynchocarpa (*I*)
Gigartina ochotensis (*IV*)
Iridophycus cornucopiae (*IV*)
Rhodoglossum pulchrum
f. *typicum* (*IV*)
Rhodymenia palmata
f. *prolifera* (*II*)
Halosaccion saccatum (*I*)
H. ramentaceum (*IV*)
f. *Tilesii* subf. *proliferum* (*IV*)
Campylaephora hypnaeoides (*IV*)
Rhodomela Larix (*IV*)
R. macracantha (*I*)
Odonthalia corymbifera (*IV*)
O. kamtschatica (*V*)
O. floccosa (*IV*)

5. Species common to all the Sections.

Spongomorpha duriuscula
Ulva pertusa
Monostroma zostericola
Heterochordaria abietina
Scytosiphon Lomentaria
f. *typicus*
Laminaria saccharina
f. *linearis*
Agarum cribrosum
Alaria ochotensis
A. dolichorhachis f. *typica*
Cystophyllum crassipes
Porphyra umbilicalis
f. *laciniata*
Farlowia irregularis
Tichocarpus crinitus
Turnerella Mertensiana
Chondrus pinnulatus
f. *typicus*
Gigartina pacifica
Rhodymenia palmata
f. *typica*
f. *sarniensis*
Ptilota pectinata
P. asplenioides
Ceramium Kondoi
Laingia pacifica
Phycodrys fimbriata
Hypophyllum Middendorffii
Pterosiphonia bipinnata
Odonthalia aleutica

The species peculiar to Section I are 20 in number, all of which except *Odonthalia dentata* are considered to be of temperate origin. The species peculiar to Section II are 17 in number including one variety and 4 forms, of which the following 7 or 8 are considered to be of temperate origin, while the remaining 10 or 9 are of arctic origin: *Chaetomorpha Linum*, *Enteromorpha nana* var. *subsalsa*, *E. intestinalis*, *Sphacelaria variabilis*, *Halothrix ambigua*, *Sphaerotrichia japonica*, *Rhododermis Georgii* and *Antithamnion corticatum*. The species peculiar to Section III are 12 in number including one form, of which the following 5 are considered to be of temperate origin, while the remaining 7 are of arctic origin: *Sphacelaria subfusca*, *Ectocarpus confervoides*, *Gonodia Sargassi*, *Leathesia umbellata*, and *Hyalosiphonia caespitosa*. The species peculiar to Sections IV and V are 10 in number including 2 forms and 9 including one variety and 2 forms respectively, all of which except *Monostroma angicava*, *Kjellmaniella crassifolia* and *Dumontia simplex* are of arctic origin. Further considerations on the species common to two or three Sections show clearly that the Sections I, II and III are comparatively rich in the species of temperate origin, while the Sections IV and V are rich in those of arctic origin. The species common to four Sections are 30 in number including 2 forms and one subform, of which 22 are not represented in our collections from Section IV. However, those 22 species as well as the remaining 8 will be most probably be proved in future to be ubiquitous in southern Saghalien. The species common to all the Sections are 25 in number including 7 forms, of which the following 12 are considered to be of temperate origin, while the remaining 13 are of arctic origin : *Ulva pertusa*, *Monostroma zostericola*, *Heterochordaria abietina*, *Scytosiphon Lomentaria* f. *typicus*, *Agarum cribrosum*, *Cystophyllum crassipes*, *Tichocarpus crinitus*, *Chondrus pinnulatus* f. *typicus*, *Gigartina pacifica*, *Rhodymenia palmata* f. *typica* and f. *sarniensis*, *Ptilota pectinata*, and *Ceramium Kondoi*. The number of the species common to all the Sections, i.e. 25, corresponds to ca. 14% of the total number of the species. This percentage rises to 30.7 if we add here those common to four Sections.

The results of the above survey on the composition of the algal vegetation of these five Sections can be summarized as follows :

1. Generally speaking, the algal flora of southern Saghalien is composed of a mixture of nearly the equal number of the species of temperate origin and those of arctic origin.

2. Section I is most rich in the species of temperate origin, of which those peculiar to this Section are proving that the influence of the distal reach of the Tsushima Current is still remarkable in this district. The island of Kaiba-tô is interesting from the phytogeographical point of view as it seems to be situated at the northernmost boundary of the distribution of a certain species of temperate origin. It is worthy to mention, above all, that *Gelidium* species grow in a small amount on the shallow reefs around this island, while they enjoy a rather vigorous growth at Rebun and Rishiri on one hand but are entirely absent from Saghalien Island proper on the other.

3. Section II is fairly rich in the species of temperate origin. The most thoroughly examined locality in this Section is the Lake of Tôbuchi (cf. Ohmi, 1941, and Tokida & Ohmi, 1941) where we find a certain number of temperate species which have not been collected elsewhere in Saghalien. The most characteristic vegetation here developed is that of *Ahnfeltia plicata* var. *tobuchiensis*.

4. Section III is still inhabited by some temperate species which answer to the presence of the distal reach of the Sôya Current and to the fact that the summer maximum of the water temperature is beyond 15°C. The increase in the number of arctic species in this Section answers to the influence of the Karafuto Current and to

the prevalence of lower temperatures in the larger part of the year. It is to be noted that *Laminaria ochotensis* disappears in the northern part of this district at least from Airô northward, while *Laminaria saccharina* flourishes here more luxuriantly than in the preceding Sections. It is very interesting to note that *Laminaria longipes* which is commonly distributed in the Middle and North Kuriles was once collected by T. Miyake at Rorei in this district.

5. In Section IV the collections have been made at only three localities, namely Kaihyô-tô (Robben Island). Cape Kitashiretoko and Yôman, of which the first mentioned was most thoroughly studied (cf. TOKIDA, 1932 & 1934). There is of course no sharp difference between the present Section and the preceding one in the general aspect of the marine vegetation. The disappearance or decrease of some temperate species such as *Acrothrix pacifica, Chorda Filum* etc. on one hand and the increase of some arctic species such as *Spongomorpha Mertensii, Callymenia reniformis. Antithamnion Corallina* etc. on the other seem to constitute the characteristics of this district. It will be worthy to mention that such a dense association of *Halosaccion saccatum* as often observed on the rocks between the tidal marks in the Middle and North Kuriles has once been met with on littoral rocks at the Cape of Kitashiretoko.

6. Section V corresponds to the cold water region of Nishinotoro Peninsula specially investigated and discussed by Dr. MIYABE (1928). The writer explored this district several times, mostly in summer but once in April. The species of the genera *Hormiscia* and *Monostroma* (except *M. zostericola*) were obtained in the spring collection. The present Section is in sharp contrast with the others in the feature of the sublittoral vegetation, which consists principally of the most characteristic species of the Laminariaceae such as *Laminaria diabolica* f. *longipes, L. dentigera, Kjellmaniella crassifolia, Arthrothamnus kurilensis* and *Alaria fistulosa*. Of these speies, *Laminaria dentigera, Arthrothamnus kurilensis* and *Alaria fistulosa* are supposed to have been derived from the Kurile Islands, being transported by the cold under-currents in the form of spores or of embryos. The long-stiped form of *Laminaria diabolica* is possibly developed here under the influence of the swift flow of the under-current or of the upwelling water. On the other hand, the distribution of *Kjellmaniella crassifolia* is very interesting. It has been known to be distributed from Prov. Mutsu northward along the eastern coast of Hokkaido from Hakodate to Muroran. It is also said to be found at Kunashiri Island in the South Kuriles, but no authentic specimen has reached us yet. To find this species in such a remote place under a different condition of the temperature as in our district is quite unexpected and unexplainable in the present state of our knowledge.

4. Economic Possibilities of the Algae of Southern Saghalien

Of 182 species of the algae in southern Saghalien, the following 75 species or

42.4% of the total can be reckoned as the useful algae employed for food or for other purposes among our countrymen. The edible species, which are shown by starring, are 46 in number. This corresponds to 25% of the entire flora and 61.3% of the number of useful algae.

Chlorophyceae

Enteromorpha prolifera
E. intestinalis
E. Linza
Ulva pertusa
Monostroma arcticum
Monostroma angicava
M. crassidermum
M. fuscum
Codium dichotomum

Phaeophyceae

Chordaria flagelliformis
C. firma
C. Nagaii
Sphaerotrichia japonica
Heterochordaria abietina
Saundersella simplex
Heterosaundersella Hattoriana
Acrothrix pacifica
Scytosiphon Lomentaria
Ilea Fascia
Chorda Filum
Laminaria saccharina
L. ochotensis
L. diabolica
Kjellmaniella crassifolia
Agarum cribrosum
Costaria costata[1]
Arthrothamnus kurilensis
Alaria fistulosa
A. macroptera
A. ochotensis
A. dolichorhachis
Fucus evanescens
Pelvetia Wrightii[1]
Cystophyllum geminatum
C. crassipes
C. hakodatense
Sargassum Horneri
S. serratifolium
S. confusum
S. Thunbergii
S. Kjellmanianum
S. Miyabei

Rhodophyceae

Bangia fusco-purpurea
Porphyra umbilicalis
P. pseudolinearis
P. ochotensis
Nemalion vermiculare
Gelidium Amansii
G. vagum
Dumontia incrassata
Neodilsea Yendoana
Grateloupia divaricata
Gloiopeltis furcata
Turnerella Mertensiana

1) Young fronds of *Costaria costata* and *Pelvetia Wrightii* are not generally used as food among us except the Koreans.

**Gracilaria verrucosa*	**Campylaephora hypnaeoides*
Gymnogongrus Griffithsiae	*Polysiphonia Morrowii*
**Ahnfeltia plicata*	*Pterosiphonia bipinnata*
Chondrus armatus	*Rhodomela Larix*
C. pinnulatus	*R. macracantha*
Gigartina ochotensis	*Odonthalia corymbifera*
G. pacifica	*O. dentata*
**Iridophycus cornucopiae*	*O. aleutica*
**I. subdichotomum*	*O. kamtschatica*
**Rhodoglossum pulchrum*	*O. floccosa*
**Ceramium Kondoi*	

As a matter of fact, not all of these species were actually used in Saghalien. Comparatively only a small number of the species were treated in Saghalien as articles of commerce. They are the following species: *Heterochordaria abietina*, the species of the Laminariaceae excepting *Costaria costata* and *Agarum cribrosum*, *Porphyra* spp., *Gloiopeltis furcata*, *Gracilaria verrucosa*, *Ahnfeltia plicata*, *Chondrus* spp., *Iridophycus* spp., *Rhodoglossum pulchrum*, and *Campylaephora hypnaeoides*. Of the just-mentioned economic species, those of the Laminariaceae (excl. *Alaria* spp.) covered by the name "Kombu" stood first in annual production, which amounted in 1935 to 4,253,221 kg. and to a value of 1,139,464yen. Next came "Kanten"(agar-agar)prepared from *Ahnfeltia plicata* (143,115 kg. & 4,82,284 yen), and then followed "hoshinori"(*Porphyra*) (5,911 kg. & 8,824 yen), "ginnanso" (*Iridophycus* & *Rhodoglossum*) (23,580 kg, & 4,316 yen), and "funori" (*Gloiopeltis*) (8,232 kg. & 3,837 yen). In 1930, the total production of the main kinds of the economic seaweeds amounted to 98,251 yen which corresponded to 6% of the entire value (15,909,075 yen) of the whole aquatic products of southern Saghalien.

The "Kombu" industry. The following six kinds of brown algae belonging to the Laminariaceae were treated as "kombu" in Saghalien:

Laminaria ochotensis	*L. diabolica* f. *longipes*
L. saccharina	*Kjellmaniella crassifolia*
L. diabolica f. *genuina*	*Arthrothamnus kurilensis*

Among these species, the most valuable one was *Laminaria ochotensis*. The northern coast of Aniwa Bay stood first in the production of this species. "Nagahama-kombu" produced in the vicinity of Nagahama was especially famous for its superior quality. Next came *L. diabolica* and its form *longipes*, and then followed *L. saccharina*, *Arthrothamnus kurilensis* and *Kjellmaniella crassifolia* in order of importance. The following figures show the production of "kombu" in Japan in the year 1935. Saghalien was next to Hokkaido in the amount of production, which corresponded to about 7.5% in quantity and 15% in value of the entire production in the whole country.

	Saghalien	Hokkaido	Honshû	Korea	Total sum
Quantity (kg)	4,253,221	48,546,487	3,511,459	15,586	56,326,753
Value (yen)	1,139,464	5,776,988	640,448	3,133	7,560,033

In 1936, the production of "kombu" in Saghalien amounted to 7,163,727 kg. and 1,869,961 yen, of which 37% in quantity and 45% in value were produced at the villages under the jurisdiction of the Ôtomari Branch-Office of the then Saghalien Government, 35% in quantity and 31% in value at villages under that of the Honto Branch-Office, and 14% in quantity and 14% in value at the villages under that of the Maoka Branch-Office. Then followed the districts under the jurisdiction of the Rutaka, Mototomari, Tomarioru, Toyohara, and Ushiro Branch-Offices in the order of the amount of production.

"Sarumen". The harvesting of *Alaria* plants is also to be included in the "kombu" industry. The dried article prepared from *Alaria* spp. is called "sarumen" and used as a substitute for "Wakame" (*Undaria pinnatifida*).

The "Kanten" industry. The following seven kinds of seaweeds which are found in our region can be used as the raw materials of the "kanten" industry :

Ahnfelta plicata var. *tobuchiensis*
Gracilaria verrucosa
Gelidium Amansii
Gelidium vagum
Ceramium Kondoi
Campylaephora hypnaeoides

Of these algae, *Gelidium* spp. are the most important material for the manufacture of the ordinary "kanten" produced in Honshû. But they are found in southern Saghalien merely in a small quantity at the Island of Kaiba-tô, and were said to be used only by villagers to prepare "tokoroten" for home consumption. *Campylaephora hypnaeoides*, *Ceramium Kondoi* and *Gracilaria verrucosa* are useful as a mixing material in the manufacture of "kanten" from *Gelidium* spp. The first mentioned is fairly abundant in the lagoon at Minabetsu, whence a considerable amount of this alga was once sent to the "kanten" factories in Nagano Prefecture. The last-metnioned species is said to be also very abundant in that lagoon, and it was used by the Karafuto Kanten Company as the material for manufacturing a special kind of agar-agar. *Ceramium Kondoi*, on the other hand, is widely spread in southern Saghalien, but it was not utilized there on account possibly of its scanty amount.

The most important mateiral of the "kanten" industry in Saghalien was *Ahnfeltia plicata* var. *tobuchiensis*. The enormous abundance of this alga in the Lake of Tôbuchi was noticed by Dr. Miyabe during his botanizing tour in 1902. However, it had not been utilized by anyone, except some Russian residents near the shore of the lagoon who used it as a packing material of their log cabins, until Mr. Rokuya Sugiura, founder and the first Director of the Karafuto Kanten Company, succeeded in 1915 in the discovery of the method of manufacturing "kanten" from this alga. "Kanten" prepared from *Ahnfeltia plicata* differs in certain characters from that prepared from *Gelidium* spp. and was generally called "Karafuto-kanten" to distinguish it from the latter. It is said to be richer in galactose and consequently superior in the capacity of coagulation, and to be purer or, in other words, much smaller in the content of raw proteins and fibres. That the jelly is somewhat more brittle is a drawback to the "Karafuto-kanten".

In the next year following the memorable 1915, 16,000 pounds of the "Karafuto-kanten", manufactured from nearly 75,000 kg. of the dried raw material, appeared for the first time in the market. The following figures show the annual production of "Karafuto-kanten" from 1930 to 1936:

Year	Quantity	Value
1930	100,969 kg.	233,171 Yen
1931	65,723	160,017
1932	97,194	163,162
1933	117,814	297,292
1934	121,316	303,718
1935	143,115	482,284
1936	173,816	623,485

The annual consumption of the dried raw material for the manufacture of "kanten" was limited to about 750,000 kg., corresponding to ca. 10% of the presumed amount of the stock of *Ahnfeltia* in Lake Tôbuchi, with a view to preserve the stock permanently.

According to researches by the Company, the vegetative propagation of var. *tobuchiensis* is fairly vigorous and the increase of its stock seems to be at the rate of nearly 20% per annum. Of course, a special means was also devised by the Company for the preservation or even for the increment of the stock, as will be referred to below under the topic of Cultivation.

Although the principal material of "Karafuto-kanten" is the var. *tobuchiensis*, the typical form of *Ahnfeltia plicata* is also useful as the raw material. It occurs not only in Lake Tôbuchi but also on both the western and eastern coasts, nevertheless generally in a trifling amount except at Sakaehama, where it was discovered by the writer in 1932 to be growing in remarkable luxuriance.

Algal slime or glue. The following 12 species can be used in our region for preparing algal slime or glue:

Gloiopeltis furcata	*Iridophycus subdichotomum*
Chondrus armatus	*Rhodoglossum pulchrum*
C. pinnulatus	*Dumontia incrassata*
Gigartina ochotensis	*Neodilsea Yendoana*
G. pacifica	*Turnerella Mertensiana*
Iridophycus cornucopiae	*Gymnogongrus Griffithsiae*

The annual production of the main algae used as the algal slime in 1930–1936 is given in the following figures:

Year	Ginnanso		Funori		Tsunomata	
1930	14,175 kg	2,029 Yen	6,413 kg	1,800 Yen	—	—
1931	10,650	1,734	967	386	—	—
1932	37,875	4,326	3,139	548	—	—
1933	7,680	1,031	6,304	1,942	9,465 kg	126 Yen
1934	18.600	2,867	5,777	2,179	1,688	103
1935	23,580	4,316	8,232	3,837	—	—
1936	44,169	8,575	6,317	3,775	—	—

The name "Ginnanso" covers the species of *Iridophycus* and *Rhodoglossum*, "Funori" those of *Gloiopeltis*, and '"Tsunomata" those of *Chondrus*. Among those algae "Funori" is most valuable. Its price per one kilogram corresponds to 59.7 sen, while that of "Ginnanso" to 19.4 sen as calculated from the above figures for the year of 1936. *Neodilsea Yendoana* ("Akaba" or "Akahata") and *Turnerella Mertensiana* ("Ôbaso") have been utilized in Hokkaido for mixing with or as substitute material for "Ginnanso", since about 1934 and 1925 respectively. As they are widely distributed in southern Saghalien and especially the former is common on shallow reefs, the utilization of them in Saghalien may have been worth recommending. The same could have been said with respect to *Gigartina* spp. and *Gymnogongrus Griffithsiae*, notwithstanding the latter is restricted to Lake Tôbuchi.

The kelp industry. The manufacture of iodine and potash salts from the kelp-ash was once very active in Saghalien about the year 1914, and became active again during the recent war. The kelp-burning industry had its center at Shiranushi which is located in the cold water region of Nishinotoro Peninsula and was favoured by the abundance of the species of the Laminariaceae rich in the content of these salts. *Arthrothamnus kurilensis*, *Laminaria diabolica* f. *longipes*, *Alaria fistulosa* and other Alariae were thus utilized in large quantities for the present industry. It was known that the moist method had been adopted in the Saghalien factories for the manufacture of these salts with the object of obtaining valuable organic biproducts such as algin, mannit, etc. The following brown algae are also useful as the raw material of this industry, especially for the manufacture of potash salts :

Costaria costata
Agarum cribrosum
Cystophyllum spp.
Sargassum confusum
S. Thunbergii
Sargassum Miyabei
& other spp. of *Sargassum*
Fucus evanescens
Pelvetia Wrightii

Moreover, *Laminaria saccharina* was also available as a rich source of the material, especially on the eastern coast.

Algae as a source of bromine. In 1941, it was discovered by the chemists in the Muto Chemical Laboratory of the Kanegafuchi Kogyo Company in Kobe that *Rhodomela Larix* ("Fujimatsumo") is so unexpectedly rich in the content of bromine (ca. 3% of dry weight) that it can be used as the raw material for the manufacture of that element. Afterwards, analytical studies by several chemists, especially those of the Fisheries Institute of our University, have revealed that bromine is also richly contained in *Odonthalia* spp., *Symphiocladia gracilis*, and *Polysiphonia Morrowii*. The following 9 species are to be listed here as the promising materials for the bromine industry in Saghalien.

Rhodomela Larix	*Odonthalia floccosa*
R. macracantha	*O. dentata*
Odonthalia corymbifera	*Polysiphonia Morrowii*
O. aleutica	*Pterosiphonia bipinnata*
O. kamtschatica	

Odonthalia corymbifera is said to be superior to others in the content of bromine which reaches nearly 6% of its dry weight.

Algae as medicine. *Codium fragile* has been reputed to have efficacy as vermifuge for *Ascaris lumbricoides*. The sister species *C. dichotomum*, which occurs in southern Saghalien, is also supposed to have the same effect. *Grateloupia divaricata* is said to have been tried for the same remedial measures in a certain primary school in Hokkaido with a positive result. A special algal substance contained in the water-soluble extract from a certain species of red algae has been determined by some investigators, such as Elsner, Broser & Bürgel (1937), Kraul (1938), Oppers (1938), Elsner (1938), and Elsner, Liedmann & Oppers (1938), to have a suppressing effect on the coagulation of blood. Among the several species of red algae examined by Kraul (1938), *Delesseria sanguinea* is proved to possess such a remarkable suppressing effect that it can be said to be comparable with or even superior to "Heparin" (cf. also a comparative study by Elsner, Liedmann & Oppers, 1938). It is desirable to test the effect of a similar substance with our common species of the Delesseriaceae nearly allied with *Delesseria sanguinea*, such as *Laingia pacifica*, *Phycodrys rubens* and *P. fimbriata*. The remedial effect of a certain edible seaweed on patients suffering from the want of iodine (goiter) or of vitamin-C (scurvy) is also to be mentioned here. Iodine is richly contained in all the species of the Laminariaceae, while vitamin-C is present in every kind of algae in various quantities. Recently Koidzumi & Kakukawa (1942) published their study on the vitamin-C content of the marine algae of Onagawa Bay, comprizing 53 species of Rhodophyceae, 33 Phaeophyceae and 13 Chlorophyceae. The following figures show the average, maximum, and minimum value of the vitamin-C content (mg/g) of these classes of algae examined by the just mentioned authors :

	Rhodophyceae	Phaeophyceae	Chlorophyceae
Average	0.336	1.075	0.686
Maximum	1.381 in *Porphyra umbilicalis*	3.010 in *Dictyopteris divaricata*	2.028 in *Cladophora* sp.
Minimum	0.032 in *Ahnfeltia paradoxa*	0.055 in *Myelophycus caespitosum*	0.130 in *Enteromorpha compressa*

It is interesting to find the maximum content 3.010 mg/g in *Dictyopteris divaricata*, which has not been utilized in Japan in any way.

Seaweed Cultivation. Artificial reefs for the cultivation of *Porphyra* was once constructed by pouring cement over the natural rocky reefs at a few localities in southern Saghalien, which were four in number in 1936. One was situated in the district under the jurisdiction of the Ōtomari Branch-office of the Saghalien Government and three in the district under that of the Honto Branch-office. The total area of the cultivation grounds in that year was 1,784,710m². The species which enjoyed the most luxuriant growth upon the artificial reefs was *Porphyra pseudolinearis*. *P. umbilicalis* was also often found in a considerable amount.

For the propagation of *Laminaria ochotensis*, a considerable number of large rocks were sunk in the water every year at the end of the harvesting season of that species in the early autumn, as is the case in the important Laminaria-grounds in Hokkaido.

For the preservation of the stock of *Ahnfeltia plicata* var. *tobuchiensis* in Lake Tôbuchi, the algal fronds growing in the deeper muddy bottom of the lagoon were transplanted in May to the shallow gravelly bottom near the shore. According to Kanno & Matsubara (1936 & 1937), the growth of the alga estimated by the rate of increase in the number of new branches was almost doubled during about three summer months under the brighter light and higher temperature in the shallow water within the depth of 2 meters as compared with the growth in the more shaded and cooler places beyond the depth of 3 meters. The good circulation of the water in the shallower places was also considered to be favourable for the algal growth. The rate of growth was said to have been so much greater in the laboratory than in the field that the average number of branches at the end of three months culture during summer was four times as many as their original number. The plant was bright reddish purple or almost yellowish green in color in the shallow water while it was dark reddish purple in the deeper level. It became almost black in color and weakened in vitality when it was immersed in the deeper muddy bottom about the center of the lagoon. These black colored unhealthy frond are not suited for use as material in the "kanten" industry on account of their deficiency in the desirable constituents. Transplantation of the fronds to the shallow gravelly bottom prior to their complete decay was thus considered to be a suitable measure from the economic point of view for the propagation of the present alga. Break-up of the Aegagropiloid thallus of the alga into small pieces was said to be worth recommending to stimulate the growth of new branches. In putting this method of propagation into practice, special caution is necessary to avoid the action of the tidal currents and the waves which may prevail in the shallow water and readily throw ashore those small pieces of the alga transplanted there. The transplantation of *Ahnfeltia plicata* var. *tobuchiensis* from Tôbuchi-ko to other lagoons such as Ondo-ko was repeatedly attempted by the staff of the Fishery Experimental Station as well as by private individuals in Saghalien, but the results were unsatisfactory. In connection with this problem, it is worth mentioning that the growth of the alga was hindered when water from Ondo-ko had been used alone as the cultural medium while it was improved by the addition of the water of Tôbuchi-ko or of the river Sangô, one of the rivers pouring into Tôbuchi-ko, to the water from Ondo-ko. (Cf. Kanno & Matsubara, 1937, p. 36, Table 15). It was not examined what kind of substances which really had growth-promoting effect on the alga, was contained in the water of Tôbuchi-ko and lacking from that of Ondo-ko.

The propagation of *Gracilaria verrucosa* has been attempted in Tokyo Bay by the experts of the Central Fisheries Experimental Station. They put small pieces of the branches of the alga in the twist of ropes at intervals and placed them in the sheltered water favoured with rich nutirent substances. Their attempt has proved to be quite successful. The same method was put into practice by the Karafuto Kanten Company in the lagoon of Minabetsu-ko with a similar good result.

Algae used as food by the people of other countries. The following species are not used at present in Japan but are utilized as food by certain people of other countries.

Rhodymenia palmata is one of the commonest edible seaweeds in Europe and North America. It is called "dulse" in Scotland. On the storage substance of this alga, Rosenvinge (1931, p. 573) states: "The large medullary cells do not contain starch as a storage matter. On the other hand the frond contains a soluble carbohydrate which, according to Kylin (1918, p. 245), is trehalose and may amount to 14.8 p. c. of the dry weight." Rosenvinge also states (in the foot-note on p. 573): "According to a recent note by H. Colin and E. Gueguen the sweet principle of this alga is monogalactose of glycerol. (Acad. d. sciences, Paris, July 21, 1930; cited from Nature, N. 3176, Vol. 126)," The present alga is also known to be rich in content of vitamin-C which amounts to 24–27 mg/100 g (cf. Lunde, 1937). The present alga is also used as fodder and is called "söu-söll" in Norway and "goémon à vache" or "goémon à bestiaux" in Normandy and Bretagne.

Halosaccion glandiforme (*H. saccatum*), according to Ruprecht (1851, p. 281), is used as food in Kamtschatka, and called "Kuschutschitsch" among the Kamtschadals; *Fucus* sp. is also used by the Kamtschadals as food, and called "Messkunum" among them (p. 410). The following species are also used by them as food (Ruprecht, 1851, pp. 355, 374, 394, 410): *Alaria fistulosa* ("Kausam" or "Kauan"), *Chordaria flagelliformis* ("Nebbpett"), and *Porphyra umbilicalis* ("Nuru").

Hypophyllum Middendorffii, according to Okamura (1910, p. 119), is "known to the people inhabiting in the neighborhood of Cape Povorochini as an edible seaweed under the name of 'Chikaputsuro" or 'Setakemaa' ".

1) The original spelling of this name is "Ksuchutschitsch", which must be a misprint.

Table IV. List of the species of the algal flora of southern Saghalien and the outline of their distribution in the whole surface of the globe

Region / Name of Species	Red Sea	Indian Ocean	Oceania	Pacific Region																			Arctic Ocean	Atlantic Ocean			North Sea	Baltic Sea	Mediterranean & Adriatic Seas
				Malay Archipelago & Philippine Isls.	China	Formosa	Ryukyu Isls.	Ogasawara Isls.	Korea & Kwantung	Kyushu & Shikoku	Honshu	Hokkaido	Kurile Isls.	Southern Saghalien: W. coast	Southern Saghalien: Aniwa Bay	Southern Saghalien: E. coast	Ochotsk Sea	Japan Sea coast of Siberia	Kamtschatka	Bering Sea (Aleutian Isls. & Alaska)	Pacific coast of N. America	Pacific coast of S. America		Atlantic coast of N. America	Atlantic coast of S. America	Atlantic coast of Europe			
CHLOROPHYCEAE																													
Ulotrichaceae																													
Ulothrix pseudoflacca												+	+	+						+	+					+			
Cladophoraceae																													
Rhizoclonium tortuosum												+	+	+	+	+				+	+			+		+			
Hormiscia penicilliformis												+	+	+			+			+	+		+	+		+	+	+	
H. Wormskioldii														+							+		+	+			+	+	
Chaetomorpha Linum	+					+	+				+				+									+	+	+	+	+	+
C. aerea			+		+						+	+	+		+	+					+	+		+	+	+	+	+	+
C. moniligera											+	+	+	+	+														
Cladophora glaucescens											+	+	+	+	+						+		+	+		+	+	+	
C. Stimpsonii											+	+		+							+								
Aegagropila Kannoi																(+)													
Spongomorpha duriuscula													+	+	+	+	+			+									
S. Mertensii												+	+			+			+		+								
Ulvaceae																													
Enteromorpha nana											+	+	+		+	+			+	+	+		+	+	+	+	+	+	+
E. plumosa			+								+		+	+	+						+			+		+	+	+	+
E. prolifera			+		+					+	+	+	+	+	+	+					+	+		+		+	+	+	+
E. intestinalis			+		+		+				+	+	+		+				+		+	+		+	+	+	+		
E. Linza			+		+				+	+	+	+	+	+	+	+		+	+		+	+		+	+	+	+	+	
Ulva pertusa				+	+	+	+		+		+	+	+	+	+	+													
Monostromaceae																													
Monostroma zostericola											+	+	+	+	+	+					+			+					
M. undulatum											+	+		+	+								+	+		+			
M. arcticum											+		+	+	+					+			+			+			
M. angicava											+	+				+							+						
M. crassidermum														+	+	+													
M. fuscum									+				+	+	+	+			+	+	+		+	+		+		+	
Prasiolaceae																													
Prasiola crispa															(+)	(+)					(+)		+			(+)			
Chlorochytriaceae																													
Chlorochytrium inclusum													+	+	+	+	+			+	+		+	+		+			
Caulerpaceae																													
Bryopsis hypnoides											+	+		+	+						+			+		+			+
Codiaceae																													
Codium dichotomum	+	+	+	+		+	+		+		+	+		+	+	+		+						+	+	+			+
PHAEOPHYCEAE																													
Sphacelariaceae																													
Sphacelaria plumigera															+	+								+			+		
S. variabilis										+	+				+						+								
S. subfusca					+								+			+				+	+								
Halopteris scoparia			+									+			+	+	+						+	+		+	+	+	+
Ectocarpaceae																													
Pylaiella littoralis											+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+
Ectocarpus confervoides											+	+				+				+	+	+		+	+	+	+	+	+
Streblonema Eudesmidis															+														
Lithodermataceae																													
Ralfsia fungiformis												+	+	+		+				+			+	+					

(*Continued*)

R. verrucosa											+		+					+	+	+		+	+		+	+	+	+
Elachistaceae																													
Leptonema fasciculatum														+								+			+	(+)[1]		
Halothrix ambigua										+	+			+														
Gonodia Sargassii											+				+													
Leathesiaceae																													
Leathesia umbellata			+							+	+				+													+
L. sphaerocephala											+	+		+	+													
L. difformis					+				+	+	+	+	+	+	+		+		+	+		+	+		+	+	+	
Chordariaceae																													
Eudesme virescens											+	+		+	+				+		+	+	+		+	+	+	
Chordaria flagelliformis										+	+	+	+	+	+	+	+	+	+		+	+	+		+	+	+	
C. firma					+				+	+	+	+		+														
C. Nagaii											+	+	+	+	+													
Sphaerotrichia japonica									+	+	+	+		+														
Heterochordaria abietina										+	+	+	+	+	+		+	+	+	+								
Saundersella simplex											+	+	+	+	+				+	+								
Heterosaundersella Hattoriana															**+**													
Acrothricaceae																													
Acrothrix pacifica									+	+	+			+	+													
Desmarestiaceae																													
Desmarestia viridis					+				+	+	+	+	?	+	+	+		+		?			+	+		+	+	+	
D. media												+	+	+					+									
D. aculeata											+	+			+			+	+			+	+		+	+		
D. ligulata										+	+	+	+	+						+	+		+	+	+			
Punctariaceae																													
Punctaria plantaginea										+	+			+	+							+	+		+	+	+	
Asperococcaceae																													
Myelophycus intestinale											+		+	+	+	+		+	+									
Striariaceae																													
Stictyosiphon tortilis														+		+		+	+			+	+		+	+	+	
Scytosiphonaceae																													
Scytosiphon Lomentaria					+	+				+	+	+	+	+	+	+	+	+	+	+		+	+	+	+		+	+
Colpomenia sinuosa	+	+	+		+	+		+		+	+	+	+	+	+	+					+	+		+	+	+			+
Ilea Fascia			+	+	+	+				+	+	+		+	+		+		+	+	+		+	+		+	+	+	+
Coilodesmaceae																													
Coilodesme Cystoseirae											+	+	+	+	+	+			+									
C. japonica										+	+	+	+	+														
C. bulligera												+			+			+	+	+		+						
Dictyosiphonaceae																													
Dictyosiphon foeniculaceus										+	+	+	+	+	+	+	+	+	+	+		+	+		+	+	+	
D. hippurioides													+						+			+	+		+	+	+	
Chordaceae																													
Chorda Filum					+				+	+	+	+	+		+	+	+	+	+	+	+		+	+		+	+	+	
Laminariaceae																													
Laminaria longipes												+			+			+	+									
L. saccharina													+	+	+	+	+			+		+	+		+	+	+	
L. ochotensis									+		+	+	+	+	+													
L. diabolica											+	+	+	+			+											
L. dentigera												+	+					+	+									
Kjellmaniella crassifolia										+	+		+															
Agarum cribrosum									+		+	+	+	+	+		+	+	+	+		+	+					
Costaria costata									+		+	+	+	+	+		+	+	+	+								
Arthrothamnus kurilensis												+	+															
Alaria fistulosa											+	+	+	+				+	+									
A. macroptera											+	+			+	+		+	?									
A. ochotensis													+	+	+			+										
A. dolichorhachis												+	+	+	+			+	+			+						
Dictyotaceae																													
Dictyota dichotoma		(+)[3]	+	+	+	+	+	+	+	+	+	+		+						+					+	+	+		+
Dictyopteris divaricata					+				+	+	+	+	+	+														
Fucaceae																													
Fucus evanescens												+	+	+	+	+	+		+	+	+		+	+					
Pelvetia Wrightii									+		+	+	+	+	+	+		+											

(*Continued*)

Sargassaceae																													
Cystophyllum geminatum												+	+		+	+	+	+	+	+	+								
C. crassipes												+	+	+	+	+													
C. hakodatense									+		+	+	+	+	+	+													
Sargassum Horneri					+	+			+	+	+	+	+	(?)	(?)	(?)													
S. serratifolium		+			+		+			+	+	+		+															
S. confusum					+				+	+	+	+	+	+	+			+											
S. Thunbergii					+		+		+	+	+	+	+	+	+	?													
S. Kjellmanianum										+	+	+	+	(?)	(?)	(?)													
S. Miyabei											?	+	+	+	+	+													
RHODOPHYCEAE																													
Porphyridiaceae																													
Goniotrichum Alsidii	+				+						+	+	+	+	+						+	+		+	+	+	+		+
Bangiaceae																													
Erythrotrichia carnea		+										+		+		+				+				+		+	+	+	+
Bangia fusco-purpurea						+			+	+	+	+		+						+	+			+	+	+	+	+	+
Porphyra umbilicalis			+								+	+	+	+	+	+	+		+				+	+		+	+	+	+
P. pseudolinearis									+		+	+	+	+															
P. ochotensis													+			+	?												
P. variegata											+	+	+	+	+	+				+	+								
P. amplissima													+	+	+	+			+	+	+		+	+		+			
Helminthocladiaceae																													
Nemalion vermiculare					+				+	+	+	+		+															
Gelidiaceae																													
Gelidium Amansii						+			+	+	+	+		+															
G. vagum											+	+		+															
Dumontiaceae																													
Dumontia incrassata												+	+	+	+	+	+		+	+			+	+		+	+	+	
D. simplex									+		+	+	+	+															
Neodilsea Yendoana											+	+	+	+	+	+		?											
Farlowia irregularis												+	+	+	+	+													
Constantinea Rosa-marina												+	+	+		+			+	+									
Hyalosiphonia caespitosa					+				+	+	+	+				+													
Squamariaceae																													
Rhododermis Georgii												+												+		+	+		
Corallinaceae																													
Heteroderma zostericola					+				+		+	+		+	+	+													
Amphiroa cretacea											+	+	+	+	+	+		+	+	+	+								
Corallina pilulifera					+	+					+	+	+	+	+	+	+			+									
Grateloupiaceae																													
Grateloupia divaricata									+		+	+		+		+													
G. prolongata		+								+	+	+		?							+								
G. turuturu											+	+		+	+	+													
Endocladiaceae																													
Gloiopeltis furcata					+				+	+	+	+	+	+	+	+		+		+	+								
Tichocarpaceae																													
Tichocarpus crinitus									+		+	+	+	+	+	+	+	+	?										
Callymeniaceae																													
Euthora fruticulosa													+	+		+	+		+	+	+								
Callophyllis rhynchocarpa										+	+	+	+	+	+	+	+		+	+									
Pugetia palmatifolia																**+**													
Callymenia reniformis											+	+	?			+					+			+		+			
Nemastomaceae																													
Schizymenia Dubyi								+		+	+	+		+												+			+
Solieriaceae																													
Turnerella Mertensiana											+	+	+	+	+	+		+	+	+	+								
Rhodophyllidaceae																													
Rhodophyllis dichotoma																+	+		+	+			+	+		+			
R. capillaris												+	+			+													
Gracilariaceae																													
Gracilaria confervoides				+	+	+				+	+	+	+		+	+		+			+			+	+	+	+	+	+ 4)
Phyllophoraceae																													
Gymnogongrus Griffithsiae															+			+						+	+	+			+

(Continued)

Ahnfeltia plicata										+		+	+	+	+	+	+	+		+	+		+	+	+	+	+	+	+[5]
Gigartinaceae																													
Chondrus armatus											+	+		+	+														
C. pinnulatus									+		+	+	+	+	+	+		+											
Gigartina ochotensis									+		+	+	+	+	+	+	+		+										
G. pacifica											+	+	+	+	+	+	+			+									
Iridophycus cornucopiae									+		+	+	+	+	+	+		+	+										
I. subdichotomum												+	+	+	+														
Rhodoglossum pulchrum											+	+	+	+	+	+			+										
Rhodymeniaceae																													
Rhodymenia pertusa									+		+	+	+		+	+	+		+	+	+		+						
R. palmata									+		+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	
Halosaccion saccatum												+	+	+	+	+	+	+	+	+	+								
H. ramentaceum												+	+	+	+	+	+		+	+			+			+			
Champiaceae																													
Lomentaria hakodatensis					+						+	+		+	+														
Ceramiaceae																													
Antithamnion sparsum															**+**														
A. nipponicum											+	+		+															
A. Corallina												+				+	+						+			+			
A. corticatum												+			+														
Ptilota pectinata											+	+	+	+	+	+	+	+	+	+	?		+	+		(+)[6]	+		
P. californica																+		+			+								
P. asplenioides												+	+	+	+	+	+	+	+	+	+		+						
Ceramium cimbricum														+	+												(+)[7]		
C. Kondoi											+	+	+	+	+	+													
C. japonicum					+				+		+	+	+	+	+														
Campylaephora hypneoides					+				+	+	+	+	+	+	+	+		+											
C. crassa											+	+		+															
Delesseriaceae																													
Branchioglossum nanum												+		+															
Laingia pacifica									+			+	+	+	+	+	(+)[8]		+										
Membranoptera robbeniensis																**+**									+				
Pseudophycodrys Rainosukei													+	**+**		**+**				+									
Phycodrys rubens												+	(?)		+	+	+	+	+	+		?	+	+		+	+	+	
P. fimbriata												+	+	+	+	+	+						+						
Hypophyllum Middendorffii												+	+	+	+	+	+		+										
Myriogramme Yezoensis												+				+													
Polycoryne denticulata																**+**													
Acrosorium Yendoi										+	+	+		+															
Rhodomelaceae																													
Laurencia nipponica					+						+	+	+	+															
L. glandulifera											+	+	+	+	+	+													+
Janczewskia Morimotoi														**+**															
Chondria dasyphylla		+								+	+	+		+	+									+	+	+	+		+
Polysiphonia japonica											+	+	+	+	+														
P. urceolata											+	+	+			+							+	+		+	+	+	+
Enellitosiphonia hakodatensis											+	+		+	+														
Polysiphonia Morrowii					+						+	+	+	+	+														
Pterosiphonia bipinnata												+	+	+	+	+	+	+	+		+	+							
Rhodomela Larix											+	+	+	+	+	+	+	+		+	+	+	+						
R. macracantha												+	+	+	+	+			+	+	+								
Odonthalia corymbifera									+			+	+	+	+	+		+	+										
O. dentata														+			+		+	+	+		+	+		+		+	
O. aleutica												+	+	+	+	+	+	+	+	+									
O. kamtschatica												+	+	+	+	+			+	+	+								
O. floccosa												+	+	+	+	+				+	+		+						
CYANOPHYCEAE																													
Pleurocapsaceae																													
Xenococcus pyriformis														+							+								

1) Denmark ; 2) Black Sea ; 3) Natal, Africa ; 4) Cape of Good Hope ; 5) Antarctic Ocean ; 6) Faeröes ; 7) Denmark ; 8) Penjinskii Bay.

The mark **+** indicates that the plant is endemic to southern Saghalien, (+) the plant is terrestrial or in freshwatar, ? the identification is uncertain, and (?) the occurrence is probable.

Table V. Number of species in the classes of algae in the algal flora of southern Saghalien and of those common to other regions

Region / Name of Class				Pacific Region																				Atlantic Ocean					
														Southern Saghalien															
	Red Sea	Indian Ocean	Oceania	Malay Archipelago & Philippine Isls.	China	Formosa	Ryūkyū Isls.	Ogasawara Isls.	Korea	Kyūshū & Shikoku	Honshū	Hokkaidō	Kurile Isls.	W. coast	Aniwa Bay	E. coast	Ochotsk Sea	Jaapn Sea coast of Siberia	Kamtschatka	Bering Sea (Aleutian Isls. & Alaska)	Pacific coast of N. America	Pacific coast of S. America	Arctic Ocean	Atlantic coast of N. America	Atlantic coast of S. America	Atlantic coast of Europe	North Sea	Baltic Sea	Mediterranean & Adriatic Seas
CHLOROPHYCEAE	2	1	6	2	5	3	4	—	4	2	17	18	18	19	21	16	3	2	5	8	18	4	10	17	6	18	10	10	7
PHAEOPHYCEAE	1	3	5	2	14	5	3	2	14	17	33	50	43	41	45	41	14	14	22	30	20	6	22	23	6	21	19	16	9
RHODOPHYCEAE	1	3	1	1	12	4	—	1	20	13	48	73	52	68	55	57	25	20	27	29	25	3	17	18	7	21	14	10	11
CYANOPHYCEAE	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Total sum	4	7	12	5	31	12	7	3	38	32	98	141	113	129	121	114	42	36	54	67	64	13	49	58	19	60	43	36	27

The following species are not utilized at present in any way, but as they are fairly abundant in our region, it seems to be worth while to investigate what utilization can be made of them.

Farlowia irregularis	*Rhodophyllis dichotoma*
Tichocarpus crinitus	*Halosaccion ramentaceum*
Callymenia reniformis	*Ptilota pectinata*
Schizymenia Dubyi	*P. asplenioides*

SPECIAL PART

Division I. CHLOROPHYTA Pascher

in Ber. d. deut. bot. Ges., XXXII, 1914, p. 15; Smith, 1933, p. 9, 10.

Class CHLOROPHYCEAE Kützing

Phyc. Germ., 1845, p. 118; Smith, 1933, p. 271; Okamura, 1936, p. 1 (*s. lat.*).
Chlorospermeae Harvey, *in* Mackay, Fl. Hibern., III, 1836, p. 163; Harvey, 1838, p. 403.
Isokontae Blackman et Tansley, Revis. Class. Green Alg., 1902, p. 20 (*s. str.*); West & Fritsch, 1927, p. 51.

The classification of the Chlorophyceae here adopted is that given by Smith (1933, pp. 301–302), who divided the class into ten orders, of which the following five are represented on the coast of southern Saghalien.

Key to the Orders

I. Normal vegetative cell division present
  A. Thallus filamentous, consisting of a single series of cells
    1. Filaments simple or, more often, branched; cells usually uninucleate but may be multinucleate; chloroplast parietal .... **1. Ulotrichales**
    2. Filaments simple; cells uninucleate; chloroplast axile .... **3. Prasiolales**
  B. Thallus membranaceous
    1. Chloroplast parietal .... **2. Ulvales**
    2. Chloroplast axile .... **3. Prasiolales**
II. Normal vegetative cell division absent, but sometimes with a peculiar type of division
  A. Thallus of solitary cells or of nonfilamentous colonies; cells usually quite small, uninucleate or multinucleate .... **4. Chlorococcales**
  B. Thallus of a single, or sometimes secondarily multiseptate coenocytes, which often grow to form a structure of definite macroscopic shape .... **5. Siphonales**

Order 1. ULOTRICHALES (Blackman et Tansley) Fritsch

in West & Fritsch, Brit. Freshw. Alg., 1927, p. 142 (*s. lat.*); Smith, 1933, p. 371.

Frond of simple or branched filaments, sometimes modified to form a discoid or pseudoparenchymatous tissue or reduced to a few-celled structure or even to a single cell; cells usually uninucleate with a single, laminate, parietal chloroplast, but may be multinucleate with numerous discoid chloroplasts; multiplication by fragmentation, hypnogonidia, aplanogonidia, planogonidia, planospores, and by isogamous to oogamous gametes; parthenogenetic development of gametes sometimes observed; plants usually haplobiontic haplont, but sometimes diplobiontic or rarely even haplobiontic diplont.

Key to the Suborders

I. Cells usually uninucleate, with the exception of occasionally old cells ; chloroplast single, a parietal plate, entire or perforate .... **1. Ulotrichineae**

II. Cells always multinucleate ; chloroplast forming a reticulate sheet completely encircling the protoplast, or in the form of numerous discs, free from one another or united by delicate strands .... **2. Cladophorineae**

Suborder 1. ULOTRICHINEAE Smith

Fresh-Water Alg. U. S., 1933, p. 376.

Eu-ulotrichales Fritsch, *in* West & Fritsch, 1927, p. 150 (as a series ; *s. lat.*).

Ulotrichales Blackman et Tansley, Rev. Class. Green Alg., 1902, p. 137 ; West, 1916, p. 281 ; Setchell & Gardner, 1920*a*, p. 281.

Chaetophorales Wille, *in* Engler & Prantl, Natürl. Pflanzenfam., Nachtr. zum I Theil, 2 Abt., 1909, p. 3 ; Okamura, 1936, p. 6 (*s. lat.*).

Cells uninucleate, with a single parietal, entire or perforate, laminate chloroplast, solitary or united in colonies or to form simple or branched filaments, sometimes modified to form a subparenchymatous tissue ; asexual reproduction by hypnogonidia, aplanogonidia, and planogonidia ; gametophyte producing isogamous, anisogamous, or oogamous gametes, zygote on germination giving rise to four to many aplano- or planospores that developing to a new gemetophyte.

The suborder Ulotrichineae includes seven families, of which only one has the representatives to be treated here.

Family 1. Ulotrichaceae Borzi

Studi Algologici, 1883, p. 25 (as "Ulothriciaceae") (*s. lat.*) ; Okamura, 1936, p. 6.

Ulothricheae Kützing. Phyc. Gen., 1843*a*, p. 251.

Nearly ten genera are included in this family, of which *Ulothrix* alone is represented by a single species on our coast.

1. **Ulothrix** Kützing

Algolog. Mitth., 1833, p. 517 ; Okamura, 1936, p. 6.

Ulothrix pseudoflacca Wille

Stud. üb. Chloroph., 1901, p. 22, pl. 2, figs. 64 81 ; Setchell & Gardner, 1920*a*, p. 285 ; Nagai, 1940, p. 6, pl. 1, figs. 3 4 ; Yamada & Tanaka, 1944, p. 47.

Japanese name. Hoso-hibimidoro (Yamada & Tanaka).

There occur two forms of this species, f. *major* and f. *minor* of Wille in our region.

Key to the forms

I. Filaments 10–22μ diam. .... a. f. *major*
II. Filaments 8–16μ diam. .... b. f. *minor*

a. *Ulothrix pseudoflacca* f. *major* Wille

Plate VIII, Figs. 1–4

loc. cit., p. 23, pl. 2, figs. 64–66 ; Setchell & Gardner, *loc. cit.*, p. 285.

Habitat. Growing on rocks and other algae, in the littoral belt. W. coast : Shiranushi (T[1]., '37), Nishinotoro (T., '37).

Distribution. Saghalien ; Pacific coast of North America (from Alaska to California) ; Europe.

Filaments 15μ diam. while sterile, straight, light green, composed of short cells, 0.25–0.5 times as long as broad ; chromatophore a parietal incomplete ring, with one pyrenoid ; fertile filaments 19.5–22.5μ diam., 3 mm. or more long, somewhat contorted, composed of cells slightly swollen, from flattened to nearly globular in shape, 0.3–1 times as long as broad, containing eight swarmers.

Remarks. Our specimens were found growing on rocks together with *Hormiscia*, and also among the entangled masses of *Rhizoclonium* epiphytic on *Rhodomela Larix*. They agree in general characters with the diagnosis of *Ulothrix pseudoflacca* f. *major* Wille. However, a contorted filament, so far as the writer knows, has not been described in f. *major* . On the other hand, in f. *maxima* Setch. et Gardn. the filaments are described to be "somewhat contorted".

b. *Ulothrix pseudoflacca* f. *minor* Wille

loc. cit., p. 23, pl. 2, figs. 67–69 ; Setchell & Gardner, *loc. cit.*, p. 285.

Habitat. Growing in a stream on sandy beach. W. coast : In the vicinity of Shiranushi (T., '27).

Distribution. Saghalien ; Alaska ; Europe.

Filaments 6–14μ diam., composed of, while sterile, flattened to quadrate cells ; chromatophore a broken ring, with one pyrenoid ; fertile cells from flattened to globular in shape, containing about eight swarmers.

Suborder 2. CLADOPHORINEAE Smith

Fresh-Water Alg. U. S., 1933, pp. 376, 424.

Cladophorales Fritsch, Struct. Reprod. Alg., 1935, pp. 74, 229 (as an order, with a single family, *Cladophoraceae*).

1) Abbreviation of Tokida, the name of the collector.

Cells multinucleate, with a parietal reticulate chloroplast containing several pyrenoids or with numerous discoid chloroplasts free from one another or united by delicate strands ; thallus always filamentous, multicellular, simple or branched ; asexual reproduction by hypnogonidia, aplanogonidia and planogonidia ; gametophyte producing isogamous or oogamous gametes ; germinating zygote producing usually four zoospores, or zygote developing directly to a sporophyte which usully produces zoospores, but in some cases (*Cladophora glomerata* (L.) Ktg.) producing without meiosis planogonidia that develope again to a sporophyte which produces after meiosis planogametes.

The present suborder includes two families, viz., the Cladophoraceae and Sphaeropleaceae, of which the latter, being restricted to fresh wate in habitat, does not appear in the present account.

Family 2. Cladophoraceae (Hassall) De Toni

Syll. Alg., I, 1889, p. 264 ; Okamura, 1936. p. 45.

The key to the genera of the Cladophoraceae here adopted is a slight modification of that given by Taylor (1937, p. 77) which seems to the writer to be most adequate and convenient.

Key to the genera

I. Filaments unbranched, or with few short simple branchlets
  A. Filaments attached by a basal end
    1. Filaments usually rigid, not easily adhering to paper; cells very large 4. *Chaetomorpha*
    2. Filaments flaccid, adhering well to paper; cells moderately large, short. 3. *Hormiscia*
  B. Filaments free, or attached by lateral holdfasts
    1. Filaments coarse, symmetrical, a mass not collapsing on removal from water ; unbranched .... 4. *Chaetomorpha*
    2. Filaments more slender and irregular of contour, a mass collapsing on removal from water; unbranched or with a few lateral or rhizoidal spur branches. 2. *Rhizoclonium*

II. Filaments progressively, often abundantly, branched
  A. Filaments free or somewhat twisting together, but never held together by special rhizoidal or hooked branchlets .... 5. *Cladophora*
  B. Filaments held together by rhizoidal, hooked, or spine-like branchlets. 6. *Spongomorpha*
  C. Filaments densely intertwined with each other to form a ball .... 7. *Aegagropila*

2. **Rhizoclonium** Kützing

Phyc. Gen., 1843*a*, p. 261 ; Okamura, 1936, p. 74.

Only a single species is known from our coast.

Rhizoclonium tortuosum (Dillwyn) Kützing

Phyc. Germ., 1845, p. 205 ; Farlow, 1881, p. 49; Setchell & Gardner, 1903, p. 223; 1920*a*, p. 185 ; Collins, 1909, p. 328 ; Kawabata, 1936, p. 201 ; Taylor, 1937, p. 83 ; Nagai, 1940. p. 27 :

Yamada & Tanaka, 1944, p. 49.
Conferva tortuosa Dillwyn, Brit. Conf., Fasc. 6, 1805, p. 46 ; Harvey, 1846, pl. 54 A.
Chaetomorpha tortuosa Harvey, 1858, p. 88, pl. 46 B.
Ch. tortuosa Okamura, 1916, p. 243 ; 1936, p. 65.
? *Ch. confervicola* Yendo, 1917, p. 192 ; Okamura, 1936 p. 66.

Japanese name. Naga-motsure (Nagai).

Habitat. In entangled masses upon other algae, in the middle and upper littoral belts. W. coast : Sokorai (Miyabe, '06), Sôni (T., '27), Shiranushi (T., '37), Nishinotoro (T., '35). Aniwa Bay : Nobori (T., '26, '35), Chishiya (T., '35), Nagahama (T., '35), Tôbuchi-ko (Miyabe, '06 ; T., '35). E. coast : Sakaehama (T., '29), Higashi-shiraura (T., '31), Noto (T., '35).

Distribution. Hokkaido (?), Kuriles and Saghalien ; Pacific coast of North America (from Alaska to California) ; Atlantic coasts of North America and Europe.

"Filaments rigid, crispate and contorted, dark green, 40–70μ diam., forming woolly skeinlike or ropelike horizontal masses ; segments 1–2, up to 6 times as long as broad, wall thick, indistinctly lamellose; rhizoids short, few or more usually none."

Remarks. The diagnosis of the species given above is after Setchell & Gardner (1920*a*, p. 185). They have thoroughly discussed the relation between the two nearly allied species of Kützing, viz., *Rhizoclonium tortuosum* and *Chaetomorpha tortuosa*, both founded upon *Conferva tortuosa* Dillwyn. The writer follows the specific conception of the American authors in the present account. Our Saghalien specimens agree well, in general characters, with the diagnosis. The filaments are usually from 25μ to 70μ, or sometimes even to 80μ, in diameter. The specimens from Tôbuchi-ko are somewhat thinner, being from 17.5 to 55μ in diameter, rarely slightly greater or smaller. The writer is strongly tempted to refer them to some other species such as *Rh. implexum*. However, they do not show any concievable difference in general appearances, except dimentions, as compared with the typical specimens of *Rh. tortuosum* from other localities. The rhizoidal branches are entirely wanting in all of our specimens.

Kawabata (*loc. cit.*) has listed the present species in his report on the marine algae from the Island of Shikotan, Kuriles, stating that it was then a new addition to the Japanese flora. The name of *Rhizoclonium tortuosum* was, indeed, introduced for the first time by Kawabata to our knowledge of the Japanese marine flora, but the plant itself, in the writer's opinion, has long been known to us under the name of *Chaetomorpha tortuosa* (Dillw.) Kützing (1849, p. 376). For instance, the description and the localities given for the *Chaetomorpha tortuosa* in the works of Okamura (1916, p. 243 ; 1936, p. 65) are as well applicable to *Rhizoclonium tortuosum.*

Yendo (*loc. cit*). has reported *Chaetomorpha confervicola* (Rupr.) De Toni (1889, p. 268) from Prov. Hidaka, Hokkaido, to be found in large entangled masses on *Rhodomela Larix*, having referred his plant to that species after comparing with the type specimen of *Conferva confervicola* Ruprecht (1851, p. 397). Judging from his remarks, he seems to have laid stress on the length of cells in distinguishing that species from *Chaetomorpha tortuosa* (*Rhizoclonium tortuosum* of the present account). In *C. confervicola* the cells were described by Yendo to be 2–5 times as long as diameter, "and in no case as half short as, or nearly equal as diameter", while in *C. tortuosa* they had been diagnosed to be 1–2 times as long as diameter (cf. Collins, *loc. cit.*) The specific limitation of *Rhizoclonium tortuosum*, however, has been broadened thereafter to such an extent to comprise plants with longer segments, up to 6 times as long as diameter, which have been named f. *longiarticulatum* by Collins (Phyc. Bor.-Amer. (Exsicc.), no. 1735) (cf. Setchell & Gardner, 1920*a*, p. 187).

On the other hand, *Chaetomorpha confervicola* (Rupr.) De Toni, according to Setchell & Gardner (1920*a*, p. 205), is "a slender attached species growing on *C. melagonium* at Sitka (cf. Ruprecht, 1851, p. 397). This is suggested as being the young attached state of *Chaetomorpha tortuosa* (*Rhizoclonium tortuosum*) but it seems fully as probable that it may be the young and attached state of *C. cannabina*." Yendo (1917, p. 193) also suggests the identity between Kjellman's Bering specimen of *Chaetomorpha cannabina* Kjellman (1889, p. 55) and *C. confervicola*, although the former is, after Yendo, not fully identical with *Conferva cannabina* Areschoug (Alg. Sc. Ex., ed. 1, no. 14, 1840). Yendo's plant from Hokkaido, therefore, may be probably identical with either *Rhizoclonium tortuosum* (Dillw.) Kütz. or *Chaetomorpha cannabina* (Aresch.) Kjellm. in the definition of the current system, of which the latter species has not yet been reported from the Japanese waters.

3. **Hormiscia** Fries

Flora Scanica, 1835, p. 327.
Urospora Areschoug, Observat. Phyc., I, 1866, p. 15 ; Okamura, 1936, p. 69.

Key to the species

I. Filaments not over 200μ in diameter .... 1. *H. penicilliformis*
II. Filaments usually over 500μ up to 1 mm. or more in diameter .... 2. *H. Wormskioldii*

1. ***Hormiscia penicilliformis*** (Roth) Fries

loc. cit., p. 327 ; Collins, 1909, p. 368, pl. 15, fig. 133 ; Setchell & Gardner, 1920*a*, p. 191, pl. 9, fig. 4 ; Taylor, 1937, p. 78 ; Nagai, 1940, p. 27.

Conferva penicilliformis Roth, Cat. Bot., III, 1806, p. 272.

Urospora penicilliformis Areschoug, Observ. Phyc., II, 1866, p. 4 ; Kjellman, 1883, p. 315 ; 1889, p. 55 ; De Toni, 1889, p. 232 ; Yendo, 1915, p. 101 ; Sinova, 1930, p. 92 ; Okamura, 1936, p. 71.

Japanese name. Shirio-midoro (n. n.).

Habitat. Growing on rocks in the upper littoral belt. W. coast : Sôni (T., '29), Nishinotoro (T., '37), Kaiba-tô (Morimoto, '37. '38).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Bering Sea ; Pacific coast of North America (from Alaska to central California) ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. Our specimens from Sôni seem to represent a typical form of this species as defined by Setchell and Gardner (1920*a*, p. 191), in having fertile segments not over 100μ in maximum diameter. The thinner filaments of the specimens are 20–28μ diam. near the base, and up to 35μ (or more) diam. in the upper fertile segments, while the thicker ones 32-44μ diam. near the base, up to 72μ diam. (or more) in the fertile segments. On the other hand, among the specimens from Nishinotoro and Kaiba-tô we can find out not only the typical form of the present species but also a form of somewhat thicker filaments which have fertile segments beyond 100μ in maximum diameter. These thicker filaments are 35–50μ, or rarely up to 75μ diam. near the base, and 95–135μ, rarely up to even 200μ, diam. in the fertile segments. Otherwise they agree fairly well with the description of *Hormiscia penicilliformis* given by Setchell & Gardner (*loc. cit.*).

The *Hormiscia*-association, which is found prospering in early spring on littoral rocks at Hakodate, Hokkaido, is also a mixture of thinner and thicker filaments which show the characters identical to those of the plant of Nishinotoro. According to Kylin (1907, p. 18) and to Setchell & Gardner (*loc. cit.*, p. 196), *Hormiscia penicilliformis* occurs on the west coast of Sweden mixed with *Hormiscia grandis* (Kylin) Setch. et Gardn. and *Ulothrix flacca* (Dillw.) Thur. and on the west coast of North America with the same species and also with *H. Wormskioldii* (Mert.) Fries. In Saghalien it occurs mixed with *Ulothrix pseudoflacca* and *Hormiscia Wormskioldii.* The thicker filaments in our specimens may resemble closely *H. doliifera* Setch. et Gardn., but differ from that Californian species in having the chloroplast usually dense and almost continuous and in having not much swollen, never spherical, fertile segments.

2. ***Hormiscia Wormskioldii*** (Mert.) Fries

Plate I ; XII, Fig. D

Flora Scanica, 1835, p. 328 ("*Wormskjoldii*") ; Setchell & Gardner, 1920*a*, p. 196 ; Taylor, 1937, p. 79.

Conferva Wormskioldii Mertens, *in* Hornemann, Flora Danica, IX, 26, 1816, p. 6, pl. 1547.

Urospora Wormskioldii Rosenvinge, Vaextforhold, 1892, p. 57 & 64 ; Grönl. Havalg., 1893, p. 920, fig. 36.

Chaetomorpha Wormskioldii Kjellman, Alg. Arct. Sea, 1883, p. 313 ; De Toni, 1889, p. 277.

Japanese name. Ō-shiriomidoro (n. n.).

Habitat. Growing on rocks in the littoral belt. W. coast : Nishi-notoro (T., '37).

Distribution. Saghalien ; Pacific coast of North America (from Washington to California) ; Atlantic coast of North America ; Arctic Ocean (Greenland and Iceland) ;

North Sea ; Baltic Sea.

Filaments of a single series of segments, unbranched, 10–16 cm. high, distinctly clavate, attached at the base to rock by means of rhizoids arising often secundly from 12–20 of the basal segments, descending closely applied to the filament ; rhizoid-bearing basal segments 60–240μ diam., usually short, often being quadrate or a little shorter, or rarely a little longer, than the diameter ; the segment just above the basal rhizoid-bearing one 255–330μ diam. ; lower segments cylindrical, usually quadrate, constricted a little or not at joints ; upper segments 1–2.2 diameters long, up to 2.5 mm. in length, increasing in thickness to 1 mm. or even to 1.75 mm. in maximum diameter, being swollen to ventricose-ellipsoidal or almost spherical, consequently the mature filaments become moniliform except only at the base, then the plant quite resembles *Chaetomorpha moniligera* Kjellm. in external appearance ; filaments taper more or less abruptly towards the base and often also towards the apex rather gradually ; lateral wall of the segments fairly thick, 17.5–25μ in thickness, slightly lamellate ; chromatophore a thin parietal bands, single in each segment, clearly reticulate with many small openings in the lowermost segments, but in the upper segments nearly continuous with openings quite small and narrow ; pyrenoids small and numerous ; reproductive cells or swarmers, 7.5–15μ diam. and 30–37.5μ long, obovoid, extending posteriorly into a long "tail", provided anteriorly with four cilia ; substance soft and gelatinous, adhering tightly to paper on drying.

Remarks. The above description is drawn up from the typical form of our Saghalien plant. Besides this there are found some thinner forms differing in certain respects. In these thinner forms, the basal segments which produce rhizoids are often longer than the diameter, and less than 200μ in maximum diameter. In one of these forms, the segments are often elongated, up to 3.1 diameters long, 165–200μ diam. below, gradually increasing in thickness upwards to 600μ or to nearly 700μ in maximum diameter, and in the apical portions gradually tapering again to 500–82.5μ diam. The fertile segments are constricted at joints, but not swollen. In another one of the thinner forms, the lower segments are quadrate, 255–360μ diam., the upper fertile segments swollen to nearly spherical, 1–2 diameters long, 300–720μ diam., and the apical fertile segments gradually tapering again to 200–180μ diam.

In the writer's opinion, these thinner forms seem to prove merely the extent of the variation in the dimensions of the present species instead of showing that our specimens are specifically heterogeneous including two or three different species. The chromatophore and the swarmer of these forms do not show any difference to those of the typical.

The maximum diameter of the filament of our plant is determined to be 1.7 mm., although it measures ca. 2 mm. in a dried specimen pressed on paper. In the thickness of the filament it coccupies an intermediate position between *H. Wormskioldii* according to Setchell & Gardner (*loc. cit.*) and *H. vancouveriana* Setch. et Gardn.

H. Wormskioldii is said to have intramatrical rhizoids (cf. Setchell & Gardner, *loc. cit.*). But the writer has experienced some difficulties in proving their presence in our Saghalien plant. The rhizoidal outgrowths are descending quite closely applied to the filament and when separated from each other under a considerable pressure they do not appear to be running down within the outer wall of the filament for any considerable distance (cf. Pl. I). The basal part of our plant resembles that of the Greenland plant illustrated by Rosenvinge (1893, fig. 36), but it never shows such an unmistakable "intramatrical" structure as figured by Setchell & Gardner for *H. sphaerulifera* Setch. et Gardn. and *H. grandis* (Kylin) Setch. et Gardn. (1920*a*, pl. 9, figs. 2A and 3A). In connection with the nature of holdfast, it is to be noted that Setchell and Gardner illustrate a young plant of *H. penicilliformis* (Roth) Fries provided with intramatrical rhizoids, although the species itself is described to have extramatrical rhizoids, and that certain authors, such as Lakowitz (1929), Newton (1931), and Taylor (1937), do not touch on the character in question at all in their descriptions on *Hormiscia* species.

4. **Chaetomorpha** Kützing

Phyc. Germ., 1845, p. 203 ; Okamura, 1936, p. 63.

Key to the species

I. Filaments horizontal and entangled on other algae, up to 500μ (rarely to 600μ) in maximum diameter .... 1. *C. Linum*
II. Filaments erect.
  A. Upper segments moniliform, up to 2 mm. in maximum diameter .... 3. *C. moniligera*
  B. Upper segments barrel-shaped, not over 300μ in diameter .... 2. *C. aerea*

1. ***Chaetomorpha Linum*** (Müll.) Kützing

Phyc. Germ., 1845, p. 204 ; Sp. Alg., 1849, p. 378 ; Tab. Phyc., III, 1853, pl. 55, fig. 3 ; Farlow, 1881, p. 49 ; Hauck, 1885, p. 439 ; Yendo, 1916, p. 48 ; Collins, 1918, p. 79 ; Yamada, 1925, p. 88 ; 1934, p. 42 ; Taylor, 1931, p. 10; 1937, p. 80, pl. 1, figs. 1 & 2 ; Hamel, 1931/32, p. 30 ; Okamura, 1936, p. 65 ; Yamada & Tanaka, 1938, p. 58 ; Takamatsu, 1939, p. 27.

Conferva Linum Müller, *in* Fl. Dan., V, 1782, pl. 771, fig. 2.

Chaetomorpha aerea f. *Linum* Collins, Green Alg. N. Amer., 1909, p. 245.

Japanese name. Warakuzumo (n. n.).

Habitat. Entangled with *Ahnfeltia plicata.* Aniwa Bay: Tôbuchi-ko (T., '29).

Distribution. Formosa, Ryûkyû, Honshû, Saghalien ; Atlantic coasts of North and South America and of Europe ; North Sea ; Baltic Sea ; Mediterranean Sea ; Red Sea.

Remarks. Our specimens referable to the present species are entangled with *Ahnfeltia plicata* var. *tobuchiensis*, hauled up from the depth of about two meters in the lagoon Tôbuchi-ko. The diameter of the filaments is somewhat larger than that given by the authors above mentioned, being 240–500μ or rarely even to 570–600μ.

According to Collins (1918, p. 78) the filaments of this species are 200–250μ, rarely to 125μ or 400μ in diameter. The filaments are cylindrical throughout, not constricted at joints, with thick lamellate walls, and not much contorted. The segments are 0.7–2.4 times as long as diameter.

As it is understood from the distribution above mentioned, this species seems to prefer rather warmer waters. The lake Tôbuchi is a shallow lagoon, and in summer months the water temperature rises higher than in open sea. On this account, some widespread temperate species such as *Chorda Filum* and *Chaetomorpha Linum* are capable of growing here and make their appearance in the marine flora of Saghalien.

2. *Chaetomorpha aerea* (Dillwyn) Kützing

Sp. Alg., 1849, p. 379 ; Tab. Phyc., III, 1853, pl. 59 ; De Toni, 1889, p. 272 ; Collins, 1909, p. 324 ; Cotton, 1915, p. 109 ; Setchell & Gardner, 1920*a*, p. 260, pl.. 14, figs. 9-11 ; Okamura, 1927, p. 3 ; 1936, p. 66 ; Kawabata, 1936, p. 201 ; Takamatsu, 1936, p. 5 ; 1938*a*, p. 84 ; 1939, p. 27 ; Taylor, 1937, p. 81, pl. 1, figs. 10-12 ; Nagai, 1940, p. 29 ; Yamada & Tanaka, 1944, p. 50.

Conferva aerea Dillwyn, Brit. Conf., 1809, pl. 80.

Chaetomorpha Linum (Müll.) Kützing f. *aerea* (Dillw.) Collins, Green Alg. N. Amer., Second Suppl., 1918, p. 79.

Japanese name. Tarugata-juzumo (Okamura).

Habitat. Growing on rocks in the littoral belt. Aniwa Bay : Chishiya (T., '37). E. coast : Ondo-ko (Herb. Rakuma)[1].

Distribution. Honshû, Hokkaido, Kuriles and Saghalien ; China ; Pacific coasts of North and South America ; Australia ; Atlantic coasts of North and South America and of Europe ; North Sea ; Baltic Sea ; Mediterranean Sea.

Remarks. Our specimens, provisionally referred to the present species, are of dwarf and rather thinner frond. The filaments are 4-5 cm. high, 40–60μ diam., at the base and 200–285μ diam. in the upper segments. The lower segments are up to five times as long as broad. The basal segment is somewhat elongated, but not ranging over 500μ in length.

Excepting the above noted specimens, this widespread species is not represented at present in our Saghalien collections.

3. *Chaetomorpha moniligera* Kjellman

Mar. Chlor. fr. Jap., 1897, p. 24, pl. 4, figs. 17-23 ; Okamura, 1916, p. 244 ; 1927, p. 3 ; 1929, p. 15, pl. 260, 20, figs. 1-8 ; 1936, p. 66, fig. 34 ; Takamatsu, 1936, p. 5 ; 1938*a*, p. 84 ; Kawabata, 1936, p. 201 ; Nagai, 1940, p. 29 ; Yamada & Tanaka, 1944, p. 50.

Japanese name. Tama-juzumo (Okamura).

Habitat. Growing on rocks in the littoral belt and in tide pools. W. coast : Yenchishi (T., '27), Nishinotoro (T., '32. '35, '37), Kaiba-tô (Miyake, '06 ; Morimoto, '27, '33. '38 ; T., '30). Aniwa Bay ; Chishiya (T., '35), Nobori (T., '26), Nagahama

1) Herbarium of the Fisheries Dept. (at Rakuma) of the Saghalien Central Experimental Station.

(T., '35), Tôbuchi-ko (T., '35).

Distribution. Endemic in the waters along the coasts of northern Honshû, Hokkaido, southern Kuriles and Saghalien.

Remarks. The specimens from Kaiba-tô and Nagahama are quite typical of the present species. The upper portion of their filaments is beautifully moniliform, the segments being spherically swollen and nearly as long as broad. The specimens from Nishinotoro, however, are short-articulated, and at first glance, they are apt to be considered as some other species than the present.

5. **Cladophora** Kützing

in Linnaea, XVII, 1843, p. 91 ; Phyc. Gen., 1843*a*, p. 26 ; Sp. Alg., 1849, p. 387 ; Okamura, 1936, p. 49.

Key to the species

I. Filaments at base 50-70μ in diameter .... 1. *C. glaucescens*
II. Filaments at base 100-160μ in diameter .... 2. *C. Stimpsonii*

1. ***Cladophora glaucescens*** (Griff.) Harvey

Phyc. Brit., 1848, pl. 196 ; Ner. Bor.-Amer., III, 1858, p. 77 ; *in* Jour. Proc. Linn. Soc., Bot., VI, 1862, pp. 160, 161, 176 ; Kützing, 1854, pl. 24 ; De Toni, 1889, p. 320; Collins, 1909, p. 336 ; 1913, p. 103 ; Yendo, 1916*a*, p. 248 ; Setchell & Gardner, 1920*a*, p. 219 ; Yamada, 1928, p. 501, fig. 3 ; Okamura, 1936, p. 55 ; Taylor, 1937, p. 86 ; Takamatsu, 1938, p. 6 ; 1939, p. 26 ; Nagai, 1940, p. 30.

Conferva glaucescens Griffiths, *in* Wyatt, Alg. Danm., no. 195.

Japanese name. Haiiro-shiwogusa (n. n.).

Habitat. Growing on stones in the littoral belt. W. coast : Sôni (T., '27), Kaiba-tô (Miyake, '06 ; T., '30 ; Morimoto, '33). Aniwa Bay : Tôbuchi-ko (T., '26).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Pacific coast of North America (from Vancouver Isl. to California) ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. Our plants, especially those from Kaiba-tô, appear to be quite identical with Yamada's *Cladophora glaucescens* from Mutsu Bay. The segments are usually long, 4–9 times as long as diameter, in main filaments up to 65μ and in ramuli 22.5–37.5μ in diameter. The terminal segment is tapering toward the apex, which is obtuse instead of being acute. The fertile segments observed are often slightly swollen, taking somewhat ellipsoidal shape.

Concerning the branch tip of *C. glaucescens* several authors describe as follows : "straight branches.... taper strongly toward the tip" (Kjellman, 1883, p. 308) ; "plants ....ending in long, erect, acute....ramuli" (Collins, 1909, p. 336, Setchell & Gardner, 1920*a*, p. 219) ; "Endzellen der Äste ziemlich spitz endigend" (Lakowitz, 1929, p. 155 in the key to the species) ; "ultimate ramuli long, erect, acute" (Newton, 1931, p. 85) ;

"Die Ramuli sind langgestreckt, gegen die Spitze sich verengernd" (Sjöstedt, 1940, p. 18). On the other hand, as far as the writer is aware, acute branches have not been detected in the Japanese plant.

2. ***Cladophora Stimpsonii*** Harvey

Plate II, Figs. 1–4

Charact. New Alg., 1859, p. 333 ; Collins, 1909, 338 ; 1913, p. 104 ; Setchell & Gardner, 1920*a*, p. 219 ; Yamada, 1928, p. 501, fig. 4 ; Okamura, 1936, p. 54 ; Takamatsu, 1938, p. 6 ; Yamada & Tanaka, 1944, p. 50.

Japanese name. Kinu-shiwogusa (Okamura).

Habitat. Growing on rocks in the littoral belt. W. coast ; Rakuma (T., '27), Kaiba-tô (T., '30 ; Morimoto, '37).

Distribution. Northern Honshû, Hokkaido, Saghalien ; Pacific coast of North America (from Vancouver Island to southern California).

Remarks. This species of *Cladophora* is one of the beautiful green algae, and its delicate filamentous frond, when dried on paper, takes a silky lustre and produces a pleasing picture.

Our Saghalien plants coincide in every respect with those from Hakodate, Hokkaido, the type locality of the species. The terminal segment of sterile branches is 40–52.5μ in diameter, nearly always acute at apex, while that of fertile branches is 62.5–75μ in diameter, provided with a more or less distinct mucro at apex. The segments of fertile branches appear to mature and discharge swarmers successively from the terminal downward.

6. **Spongomorpha** Kützing

Phyc. Gen., 1843, p. 273 ; Okamura, 1936, p. 71.

Key to the species

I. Hooked branchlets present
- A. Main filaments up to 230μ, or over, in diameter .... 2. *S. Mertensii*
- B. Main filaments not over 90μ in diameter .... 2*a*. *S. Mertensii* var. *tenuis*

II. Hooked branchlets absent
- A. Main filaments up to 255μ in diameter .... 1. *S. duriuscula*
- B. Main filaments up to 400μ, or over, in diameter . . 1*a*. *S. duriuscula* var. *cartilaginea*

1. ***Spongomorpha duriuscula*** (Rupr.) Collins

Green Alg. N. Amer., 1909, p. 357 ; Setchell & Gardner, 1920*a*, p. 225 ; Tokida, 1932, p. 4. pl. 2, fig. a ; Okamura, 1936, p. 72 ; Kawabata, 1936, p. 201.

Conferva duriuscula Ruprecht, Tange Ochot. Meer., 1851, p. 401.

Acrosiphonia duriuscula Yendo, Notes Alg. New to Jap., V, 1916*a*, p. 246.

Cladophora diffusa Kjellman, Beringhafv. Algfl., 1889, p. 55 (*partim* ; *fide* Yendo, *loc. cit.*, p. 247).

Japanese name. Motsure-gusa (Yamada).

Habitat. Growing on stones in the upper sublittoral and lower littoral belts. W. coast : Tomariori (T., '30), Honto (Morimoto, '25), Muidomari (Ishii, '24), Sôni (T., '27), Hishitoma (T., '32), Shiranushi (T., '26, '37), Nishinotoro (Morimoto, '35 ; T., '35, '37). Aniwa Bay : Nobori (T., '35). E. coast : Sakaehama (T., '29), Higashi-shiraura (T., '31), Kashiho (T., '31), Kaihyô-tô (T., '30, '32, '35), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Kuriles; Saghalien ; Ochotsk Sea ; Bering Island ; Alaska.

Remarks. This alga is one of the commonest seaweeds in southern Saghalien. Most of our specimens appear to be of the typical form of the species. The main filaments are 70–120μ in diameter near the base, up to 255μ in diameter above. Ruprecht gives 1/8 Lin. (approximately 275μ) as the maximum diameter of his *Conferva duriuscula* from Unalaska. Fine transverse striations on the membrane of the lower segments, one of the striking characteristics of the species, are detectable usually under high magnification (cf. Tokida, *loc. cit.*, pl. 2, fig. a), but occasionally some of them are quite conspicuous and may be perceived under lower magnification. It should be also remarked here that the apical segment of the rhizoidal filaments, in the specimens from Nishinotoro, not rarely happens to be enlarged to take an obovate shape, often enclosing one to several spherical bodies with granular contents. These bodies, 105–125μ in diameter, are considered to be zoosporangia of a certain Chytridiaceous fungus, probably belonging to the genus *Olpidium*. The emptied bodies provided with one or two peaked ostioles are also observed. In the specimens from the Kaihyô-tô, some enlarged apical segments of the rhizoids contain much smaller spherical bodies, measuring 20–40μ in diameter. They may represent another species of *Olpidium*. There occur also a few apical segments filled up with minute globules, measuring 5–7.5μ in diameter. They may represent in their turn third parsaitic fungus infecting the present alga (cf. Tokida, 1948).

In describing *Spongomorpha Hystrix* from the Kuriles, Nagai has made an error in interpreting the differences between that species and *S. duriuscula*. He has no doubt misread the remark of Setchell & Gardner (1920*a*, p. 225) under *S. Hystrix*. For *S. duriuscula*, but not for *S. Hystrix*, is remarked the following : "filaments are so slightly bound together that the plant seems much less like a *Spongomorpha*" (Setchell & Gardner, *loc. cit.*, p. 226). *S. Hystrix* is known to have thinner cell-walls than *S. duriuscula*, and Nagai also adopts the character in his key to the species. Notwithstanding, he describes the thickness of the cell-wall of *S. duriuscula* var. *tenuis*, the only variety treated in his account, and of *S. Hystrix* as being 12–24μ and 40–48μ respectively. The writer cannot help entertaining a doubt on Nagai's identification of *S. Hystrix*.

A few words should be also added here concerning *Cladophora arcta* Tilden (Amer. Alg., no. 373). Setchell & Gardner (*loc. cit.*, p. 226) misinterpret that Yendo has referred it to *Acrosiphonia duriuscula*. Yendo (1916, p. 247) has never dared to do so, but he only stated as follows ; "*Conf. coalita* Rupr. has nothing to do with the present species (*Acr. duriuscula*). It is excellently represented by the specimens as Phyc. Bor.-Amer., No. 819 and 922 under *Cladophora scopaeformis*. Miss Tilden's Amer. Algae No. 373 under *Cladophora arcta*, in the copy I have seen, should be also referred to it." These passages are without question concerned with the identity between the latter two species and *Conferva coalita*.

1a. ***Spongomorpha duriuscula*** var. ***cartilaginea*** (Rupr.) Yamada

Mar. Alg. Urup, 1935, p. 10 ; Okamura, 1936, p. 72 ; Nagai, 1940, p. 31.

Conferva cartilaginea Ruprecht, Tange Ochot. Meer., 1851, p. 404.

Cladophora alaskana Collins, *in* Collins, Holden & Setchell, Phyc. Bor.-Amer., Exsicc., no. 917 (*nomen nudum*) ; Setchell & Gardner, 1903, p. 228.

Japanese name. Kata-motsuregusa (Yamada).

Habitat. Growing intermixed with the typical form of the species. E. coast : Kaihyô-tô (T., '35).

Distribution. Kuriles and Saghalien ; Unalaska.

Remarks. A few fragmental specimens referable to the present variety are found among the tufts of the typical form of the species. They are of cartilaginous and remarkably thick frond, having the main filaments 90–140μ in diameter near the base, up to 400μ or even to 435μ in diameter toward the submits. The maximum diameter of our specimens is markedly larger than that (300μ) of *S. duriuscula* (incl. *Conferva cartilaginea* Rupr., *fide* Yendo, 1916, p. 247) given by Collins (1909, p. 357) and also than that (325μ) of var. *cartilaginea* given by Yamada (*loc. cit.*). However, Ruprecht describes his *Conferva cartilaginea* from Unalaska as having main filaments 1/4 Lin. or nearly 1/3 Lin. (approximately 550μ and 700μ) in the maximum diameter, and therefore the thickness of our plant should by no means be thought as exceptional.

Besides the present variety, Yamada has reported var. *tenuis* Yamada from Urup Island. It is described to have thinner filaments, up to 200μ in diameter. The writer has failed to find out it among his Saghalien specimens.

2. ***Spongomorpha Mertensii*** (Rupr.) Setchell et Gardner

Phyc. Contr., I, 1920, p. 280 ; Mar. Alg. Pacific Coast N. Amer., II, 1920*a*, p. 227 ; Yamada, 1935, p. 10 ; Okamura, 1936, p. 74 ; Nagai, 1940, p. 33, pl. 2, fig. 3 ; Yamada & Tanaka, 1944, p. 50.

Conferva Mertensii Ruprecht, Tange Ochot. Meer., 1851, p. 403.

Cladophora Mertensii De Toni, Syll. Alg., I, 1889, p. 317.

Acrosiphonia Mertensii Yendo, Notes Alg. New to Jap., V, 1916*a*, p. 246 ; Okamura, 1936, p. 46.

Conferva viminea Ruprecht, *loc. cit.*, p. 403.

Cladophora viminea De Toni, *loc. cit.*, p. 318.

Spongomorpha ochotensis Tokida, Mar. Alg. Robben Isl., 1932, p. 5, pl. 1, fig. c, text-fig. 1 ; Okamura, 1936, p. 72, fig. 36.

Japanese name. Kagi-motsuregusa (Yamada).

Habitat. Growing on stones side by side with *Spongomorpha duriuscula*, and often washed ashore, entangled with other algae. E. coast : Kaihyô-tô (T., '30, '35), Kita-shiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Kamtschatka ; Pacific coast of North America (from Alaska to California).

Remarks. A thorough description of the Saghalien plant is given by Tokida (*loc. cit.*). *Spongomorpha ochotensis mihi* was founded upon a few specimens from Kaihyô-tô (Robben Island), collected in 1930, after being compared with the descriptions of *S. Mertensii* given by Ruprecht and by Setchell & Gardner, as well as with a Californian specimen of that species distributed by the last mentioned authors (Gardner, no. 4446) and kept in the herbarium of our University. In 1935, a considerable amount of well grown specimens of the algae in consideration was collected on the same island. Studying them carefully, the writer came to a conclusion that it is more appropriate to unite his species with *S. Mertensii*. It may be added that our specimens are identical with the Kurile specimens of *S. Mertensii* identified so by Yamada and by Nagai. However, our plant does not satisfactorily agree with the descriptions given by previous investigators. A description of the species drawn up entirely from our Saghalien specimens is given by the writer in his previous paper as mentioned above.

As pointed out by Yendo (*loc. cit.*, p. 246), *Spongomorpha Mertensii* resembles very much in certain characters to *S. duriuscula*. Yendo states that the filaments are much finer in *S. Mertensii*, measuring but 110μ or little more in diameter in the upper cells ; and the cells in the upper parts of frond are once to twice as long as the diameter, only occasionally being as half short. In *S. Mertensii* from Saghalien, the filaments are of course usually thinner but those measuring 200μ or over in diameter are not uncommon, and the upper segments, when fertile, are rather frequently shorter than the diameter. There also rarely occurs a remarkably thick frond measuring about 180μ in diameter near the base, up to 300μ in diameter in the middle portion. Even the transverse striations on the membranes of the lower segments are not lacking, sometimes being quite distinct. Striations in longer segments are densely set toward the both ends of the segment but scattered or almost disappearing in the middle. Such an arrangement of the striations may show the disposition of the elongating zone of the segment in the middle portion. So far as the writer has studied with the Saghalien specimens, the differences between the two species appear to consist in the following points : 1. the hooked branches absent (*S. duriuscula*) or present (*S. Mertensii*) ; 2. the branching mostly alternate (*S. duriuscula*) or alternate and frequently also opposite or occasionally with two branches on a segment (*S. Mertensii*) ; 3, the filaments rigid and becoming light browinsh in oclor when preserved in dilute formalin in sea-water (*S. duriuscula*) or less rigid and becoming almost colorless when preserved in the same solution (*S. Mertensii*).

2a. ***Spongomorpha Mertensii*** var. ***tenuis*** Tokida

Spongomorpha ochotensis f. *tenuis* Tokida, Mar. Alg. Robben Isl., 1932, p. 7, pl. 1, fig. d ; Okamura, 1936, p. 73.

Japanese name. Hoso-kagimotsuregusa (n. n.).

Habitat. Entangled on the thallus of *Odonthalia kamtschatica*, mixed with the typical form of the species. E. coast : Kaihyô-tô (T., '30).

Distribution. Endemic.

Remarks. This form is easily distinguished from the species by its markedly diminished dimensions.

7. **Aegagropila** Kützing

Sp. Alg., 1849, p. 413 ; Okamura, 1936, p. 47.

Aegagropila Kannoi Tokida, sp. nov.

Plate III, Figs. 1–4

Pila subglobosa ad 4 cm. diam. ; filamentis 42–65μ latis, ramosissimis, flexibilis ; ramis alternis, superioribus secundis, inferioribus saepe oppositis ; ramulis 30–42μ diam. apice leviter attenuatis ; articulis diametro 5–20–plo longioribus, subcylindricis, nonnullis terminalibus et intercalaribus raro inflatis ad 90–180μ crassis ; membrana articulorum inferiorum ad 5μ crassa, lamellata ; ramis rhizoideis paucissimis.

Aegagropila Lagerheimii Kanno (*non* Nordstedt), Stud. Aegagr., Jap., 1934, p. 225 ; Okamura, 1936, p. 49.

Japanese name. Karafuto-marimo (n. n.).

Habitat. Growing at about one meter depth, lying on the sandy bottom of a fresh-water marsh. E. coast : Tôba-ko (Herb. Rakuma).

Distribution. Endemic.

Ball subglobose, up to 4 cm. diam. ; filaments 42–65μ thick, repeatedly branched, rather flexible in substance ; branches alternate, secund above, or often opposite below ; ramuli 30–42μ diam., slightly attenuated at the apices ; segments 5–20 times as long as the diameter, subcylindrical, terminal and intercalary ones quite rarely inflated to fusiform or obovoid, 90–180μ broad ; walls of lower segments up to 5μ thick, lamellate ; rhizoidal branches rarely present.

Remarks. According to Kanno (*loc. cit.*, p. 225) the present interesting alga was discovered in July 1928, in a small fresh-water marsh named Tôba-ko, about 11 km. in circumference, 2–3 m. in depth, situating just south of Tonnai-ko, the largest lagoon in southern Saghalien. The ball-shaped fronds of this alga are heaped at about one meter depth on the sandy bottom off the western shore of the marsh. The just mentioned author has referred it to *Aegagropila Lagerheimii* (Brand) Nordstedt, without mentioning any sufficient reasons of his identification. The writer could examine some living materials of this plant through the kindness of the late Mr. S. Ishii. In the writer's opinion, it has nothing to do with *A. Lagerheimii* (*Cladophora Lagerheimii* Brand ; cf. Heering, 1921, p. 52), but is most closely allied with *Aegagropila kurilensis* Nagai (1940, p. 35, pl. 3, fig. 6). The writer describes here our plant provisionally as a new species.

The largest ball known to us is scarcely exceeding 4 cm. in diameter, composed of a single, rather loosely compacted hollow layer, ca. 1.5 cm. thick, of radiating and irregularly intertwined filaments. The filaments are not so rigid but flexible and usually decumbent at the surface of the ball. As a result of this fact, the ball does not appear so well-finished as that of the *Aegagropila Sauteri* Kütz. from Lake Akan in Hokkaido. Some terminal and intercalary segments are occasionally remarkably swollen, the maximum diameter attaining from 90 to 180μ. They have been supposed by Kanno (*loc. cit.*, p. 218) to be compared to the akinetes of *Pithophora*. They may also be supposed to be malformed segments attacked by some parasitic fungus as in the case of the rhizoidal filaments of *Spongomorpha duriuscula*. In the present case, however, the segments in question usually appear quite sound in their protoplasmic condition, and even when they have rarely become colorless nothing can be detected to suggest fungal bodies in them. It should be noted here that similar inflated segments are described in *Cladophora* (*Aegagropila*) *clavuligera* Grun. from Ceylon as follows : "articulis .... nonnullis terminalibus (fructiferis ?) cum ramulorum brevium inflatis ad 50μ crassis." (Cf. De Toni, Syll. Alg., I, p. 341).

Order 2. ULVALES Blackman et Tansley

Rev. Class. Green Algae, 1902, pp. 20. 136 ; West, 1916, p. 275 ; Setchell & Gardner, 1920*a*, p. 233 ; Smith, 1933, p. 451 ; Tilden, 1935, p. 427.

Thallus a flat plate, one or two cells in thickness, or a hollow tube with a wall one cell in thickness, or a filament composed of two or more vertical rows of cells, simple or branched, attached by a single basal cell, or by unicellular rhizoidal outgrowths from the basal part of the thallus ; cells uninucleate except in rhizoidal outgrowths, with a single, laminate, parietal chloroplast containing usually one, but occasionally two or more pyrenoids ; vegetative multiplication by abscission of proliferous shoots, by accidental breaking of the thallus, by plano- or aplanogonidia or by hypnogonidia ;

alternating generations, gametophyte and sporophyte, similar or dissimilar in appearance ; gametophyte usually dioecious, rarely monoecious, producing biciliate iso- or anisogametes ; sporophyte producing bi- or quadri-ciliate zoospores.

Key to the Families

I. Alternating generations similar in appearance; frond tubular or expanded, but not a broad monostromatic membrane .... **3. Ulvaceae**
II. Alternating generations dissimilar in appearance ; frond at first often tubular or saccate, at maturity expanded to a monostromatic membrane .... **4. Monostromaceae**

Family 3. Ulvaceae Greville

Alg. Brit., 1830, p. 168 (lim. mut.) ; Okamura, 1936, p. 7.

Key to the genera

I. Frond tubular, at least in part .... 8. *Enteromorpha*
II. Frond not tubular but expanded, of two united cell layers .... 9. *Ulva*

8. **Enteromorpha** Link

Epistola, 1820, p. 5 ; Okamura, 1936, p. 11.

Frond persistently tubular throughout, or in some species at least in part, capillary to ample, simple or alternately branched, its wall consisting of a single cell layer, branch tips and ultimate ramuli sometimes of a single series of cells ; attached by holdfasts formed by downgrowths from the basal cells, sometimes later free-floating ; cells commonly arranged parenchymatously, cell-walls moderately thin laterally, often thickened internally and externally ; all cells of the plant, except the very lowest, capable of producing reproductive bodies, which are discharged through an opening in the outer wall of the cell ; gametophyte usually dioecious, but rarely monoecious, producing biciliate iso- or anisogametes, which germinate after syngamy without meiosis to produce sporophytes, sometimes capable of germinating parthenogenetically to produce normal gametophytes or diploid plants multiplying by haploid quadriciliate zoospores and diploid quadriciliate planogonidia or merely by diploid quadriciliate planogonidia ; sporophyte producing after meiosis usually quadriciliate or rarely biciliate zoospores.

Key to the species

I. Frond flat, membranes united except at the margins, with tubular stipe .... 5. *E. Linza*
II. Frond in most parts tubular
  A. Cells more or less in longitudinal series in the greater part of the frond
    1. Branches of successive orders, tapering from base to apex ; ultimate ramuli and branch tips of a single series of cells .... 2. *E. plumosa*

2, Branches similar to main axes, not having uniseriate portions .... 3. *E. prolifera*

B. Cell not arranged in longitudinal series except in very youngest parts

1. Cells minute, up to 7–10μ diam. in surface view

a. Membrane equally thickened on both surfaces .... 1. *E. nana*

b. Membrane distinctly thickened on the inner surface

i. Frond nearly plane, simple or slightly proliferous at times .... 1a. *E. nana* var. *minima*

ii. Frond often much contorted, with numerous minute proliferations when old .... 1b. *E. nana* var. *subsalsa*

2. Cells not so minute as above, frond relatively large

a. Walls generally thick, especially on the inner side of the membrane .... 4. *E. intestinalis*

b. Walls not thickened .... (*E. compressa*)

1. *Enteromorpha nana* (Sommerf.) Sjöstedt

Plate IV, Figs. 17–19

Enteromorphastud., 1939 p. 35, figs. 3–6.

Ulva intestinalis ε. *nana* Sommerfelt, Suppl, Flor. Lapp. 1826 p. 186.

Enteromorpha minima Ahlner (*non* Nägeli). Enterom., 1877 p. 48 ; J. Agardh 1883, p. 135 ; Hauck 1885, p. 432 ; Collins, 1909, p, 201 ; 1913 p, 102; Setchell & Gardner, 1920*a*, p. 250 ; Taylor, 1937 p. 66.

E, intestinalis var. *minima* Rosenvinge, Grönl. Havalg., 1893 p. 959 ; Börgesen, 1902, p. 490 ; 1925, p. 13.

E. compressa var. *minima* Hamel, Chlor. d. cotes Franc., 1931/32, p. 65.

Japanese name. Kotsubu-awonori (n. n.).

Habitat. Growing on stones, shells, and on woodwork, near high water mark, or in the lower half of the littoral belt. E. coast : Sôya near Maguntan (Miyake, '06).

Distribution. Saghalien ; Pacific coast of North America (from Alaska to Mexico) : Bering Sea (St. Paul Island) ; North Atlantic coasts of America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea.

Frond several centimeters long, very narrow throughout, hardly exceeding 1 cm. in the broadest part, sometimes simple for a considerable length or more frequently slightly proliferous, branchlets short, usually simple, never narrowed at the base, in drying adhering not well to paper, rather soft in substance and yellowish-green in color ; cells angular, up to 7μ diam., arranged in no definite order, in section nearly cubical ; membrane 8–12μ thick, equally thickened on both surfaces.

Remarks. A confusedly entangled mass of dried specimens mounted on a sheet of paper is simply placed in our hand. Fruiting specimens have not been observed. As understood by the above description, our specimens are to be referred to the species that has passed among phycologists under the name of *Enteromorpha minima.* According to the interesting investigation lately published by Sjöstedt (1939) there has long prevailed among phycologists a misinterpretation on the characters of *Enteromorpha minima* Nägeli and *E. micrococca* Kützing, or a transposition of the characters between the two species, which was unfortunately introduced early by Ahlner (1877). Sjöstedt (*loc. cit.*, p, 23) states : "Die Struktur der Membran im Querschnitt ist bis jetzt als der sicherste Unterschied zwischen *minima* und *micrococca* angesehen. Von Kützing (Tab. phyc. VI, tab. 30 : II und 43 : III) ist die Membran bei *micrococca* dünn, bei *minima* dick gezeichnet. Die Innenwand der Zellen im Querschnitt des Thallus ist auch wie aus verliegender Untersuchung des Originalmateriales deutlich hervorgeht bei *minima* stark verdickt, bei *micrococca* dünn. Bei Ahlner und späteren Verfassern ist aber der Membranencharakter umgestellt worden, so dass *minima* die dünne und *micrococca* die dicke Membran erhalten hat. Die Umstellung der Wandcharaktere findet man in der Literatur zum erstenmal bei Le Jolis (1863) betreffend *micrococca* und dann bei Ahlner (1877) betreffend sowohl *minima* als *micrococca*. Die Verwechselung findet man dann bei allen folgenden Verfassern bis zu unseren Tagen (p. 23)...Das Originalmaterial von *Ulva intestinalis* var. *nana* Sommerfelt scheint also mit dem Typus zusammenzufallen, der nach Ahlner als *E. minima* gewöhnlich bezeichnet worden ist ...... Da aber Ahlners *micrococca* Nägelis *minima* entspricht und Ahlners *minima* mit Sommerfelts *nana* zusammenfällt muss, da der Name *nana* der ältere ist, dieser Name *nana* Somrf. für den dünnwandigen und der Name *minima* Näg. für den dickwandigen der betreffenden unverzweigten Enteromorpha-Typen mit den Zellen ohne Reihenordnung bestehend werden (p. 26–28)."

This is for the first time, so far as the writer knows, that the present species is added to the marine flora around Japan. Besides the typical form of the species, there occur also two varieties in Saghalien as follows.

1a. *Enteromorpha nana* var. *minima* (Nägeli) Sjöstedt

loc. cit., p. 38, fig. 7.

Enteromorpha minima Nägeli, *in* Kützing, Sp. Alg., 1849, p. 482 ; Tab. Phyc., VI, 1856, p. 16, pl. 43, III.

Ulva enteromorpha γ. intestinalis f. *micrococca* Le Jolis, Liste alg. Mar. Cherb., 1863, p. 47.

Enteromorpha micrococca Ahlner (*non* Kützing, 1856), Enterom., 1877, p. 46, fig. 7a–b ; J. Agardh, 1883, p. 123 ; Kjellman, 1883, p. 291 ; Hauck, 1885, p. 432 ; De Toni, 1889, p. 119 ; Saunders, 1901, p. 411 ; Collins, 1909, p. 204 ; Yendo, 1915, p. 99 ; Okamura, 1916, p. 225 ; 1936, p. 14 ; Setchell & Gardner, 1920*a*, p. 249 ; Sinova, 1933, p. 10 ; Kawabata, 1936, p. 200 (cum ?) ; Taylor, 1937, p. 67 ; Nagai, 1940, p. 10, pl. 1, figs. 7 & 8 ; Yamada & Tanaka, 1944, p. 48.

Enteromorpha intestinalis β micrococca Rosenvinge, Grônl, Havalg., 1893, p. 957 ; Börgesen, 1902, p. 490.

E. coarctata Kjellman, Mar. Chlor. fr. Jap., 1897, p. 15, pl. 3, figs. 19 21 (*fide* Yendo, *loc. cit.*).

E. compressa var. *minima* f. *micrococca* Hamel, Chlor. d. cotes Franc., 1931/32, p. 66, fig. 48 (7–8).

Japanese name. Hime-awonori (Yamada & Tanaka).

Habitat. Growing in the upper littoral belt, on rocks, other algae and on woodwork. Aniwa Bay : Tôbuchi-ko (T., '41). E. coast ; Higashi-shiraura (T., '31), Kashiho (T., '31), Kaihyô-tô (T., '35).

Distribution. Hokkaidô, Kuriles and Saghalien ; Kamtschatka ; Pacific coast of North America (from Alaska to Mexico) ; Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea.

Remarks. A few specimens found among other algae collected at the above localities are referable to the present variety. They have small cells, usually less than 10μ in diam., and their membrane, about 20μ thick, is distinctly thickened on the inner surface. The fertile cells, in our specimens, are filled with a few swarmers. In surface view one or two swarmers are seen in each cell, while in cross section about four to five nearly transversely divided ones are observed. The openings of the fertile cells, in surface view, are not distinctly visible.

1b. ***Enteromorpha nana*** var. ***subsalsa*** (Kjellm.) Sjöstedt

loc. cit., p. 53.

Enteromorpha micrococca f. *subsalsa* Kjellman, Alg. Arct. Sea, 1883, p. 292, pl. 31, figs. 1-3 ; Collins, 1909, p. 204 ; 1913. p. 102 ; Setchell & Gardner, 1903, p. 211 ; 1920*a*, p. 249, pl. 16, fig. 1 ; Taylor, 1937, p. 67 ; Nagai, 1940, p. 11, p. 1, fig. 9.

E. clathrata f. *uncinata* Kjellman, Spetsb. Thalloph., II, 1877, p. 44 ; Algenveg. Murm. Meer., 1877*a*, p. 50.

E. minima f. *rivularis* Collins, *in* Phyc. Bor.-Amer., no. 26 ; Green Alg. N. Amer., 1909, p. 201 (*fide* Sjöstedt, *loc. cit.*, p. 51).

E. arctica J. Agardh, Till Alg. Syst., III, 1883, p. 124, pl. 4, figs. 100-102 (*partim*) (*fide* Sjöstedt, *loc. cit.*, p. 58).

Japanese name. Kawa-awonori (Yamada & Hirose).

Habitat. Growing on stones in running fresh water near the sea shore. Aniwa Bay : Shiraiwa (T., '32).

Distribution. Kuriles and Saghalien ; Pacific coast of North America (from Alaska to California) ; North Atlantic Ocean (northern Massachusetts and Faeröes) ; Arctic Ocean.

Remarks. The specimens at hand are of from capillary to narrow cylindrical or band-shaped frond, up to 3 mm. broad and 10 cm. or over long, simple or sometimes rather sparingly branched. The frond is often irregularly much contorted, and beset with, when old, numerous longer or shorter, mostly microscopic, proliferations on the whole surfaces. The membrane is about 11-12.5μ thick, slightly thickened on the inside. The cells are polygonal, arranged in no definite order, except in the most thinner part of a branchlet, 5–8.5μ diam. in surface view, 5–7.5μ high in cross section. Judging from these characters, our plant is to be referred to the present variety, although such a richly branched form as shown by Kjellman (1883, pl. 31, fig. 1) and by Setchell & Gardner (1920*a*, pl. 16, fig. 1) is not met with in our specimens.

The fertile cell contains about eight swarmers. After emission of the latter, the cell wall remains unchanged, but the opening is hardly visible in surface view.

2. ***Enteromorpha plumosa*** Kützing

Plate IV, Figs. 1–10

Phyc. Gen., 1843, p. 300, pl. 20, fig. 1 ; Hauck, 1885, p. 430, fig. 189 ; De Toni, 1889, p. 132 ; Collins, 1909, p. 198 ; 1919, p. 205 ; Okamura, 1916, p. 228 ; 1936, pl. 18, fig. 9 (1–2) ; Setchell & Gardner, 1920*a*, p. 259 ; Taylor, 1928, p. 56, pl. 3, figs. 1, 18 ; 1937, p. 62 ; Kawabata, 1936, p. 200 ; Nagai, 1940, p. 15, pl. 1, figs. 14, 15.

Enteromorpha paradoxa Kützing, Sp. Alg., 1849, p. 479 ; Tab. Phyc., VI, 1856, pl. 35 ; Martens, 1866, p. 113, 126 (*β tenuissima* Kütz.).

E. clathrata var. *erecta* (Lyngb.) Le Jolis, Liste d. alg. mar. Cherbourg., 1863, p. 52 ; Hamel, 1931/32, p. 69, fig. 51 (I–II).

Scytosiphon erectus Lyngbye, Hydroph. Dan., 1819, p. 65.

Enteromorpha erecta J. Agardh, Till Alg. Syst., III, 1883, p. 152 ; Hauck, 1885, p. 431.

Japanese name. Watage-awonori (n. n.).

Habitat. Growing on pebbles and other algae, in quiet waters in the littoral belt. W. coast : Rakuma (T., '27), Nishinotoro (Morimoto, '25). Aniwa Bay : Tôbuchi-ko (T., '26, '35).

Distribution. Middle Honshû, Kuriles and Saghalien ; Pacific coast of North America (Washington and California) ; South Pacific Ocean (Samoa) ; Atlantic coasts of North America and Europe ; North Sea ; Baltic Sea ; Mediterranean Sea.

Remarks. The occurrence of the present species in the Japanese waters was reported at first many years ago from Kanagawa near Yokohama by Martens (*loc. cit.*) under the name *Enteromorpha paradoxa β tenuissima* Kg., and for the second time recently from Shikotan Island of the South Kuriles by Kawabata (*loc. cit.*). The writer refers here filiform and much branched specimens which have branches tapering towards the tips, ending in a single series of cells. The cells are arranged almost always in longitudinal series, 10–16μ wide in the monosiphonous parts, the apical cell of which is about 8μ diam. The chromatophore, as seen from surface, does not fill the cell. The membrane is 14–22μ thick, equally thickened on both surfaces. Cross sections of thinner branches often have an irregular outline on the outside. The fertile cells open with a roundish hole, which is usually situated not in the centre. The hole, as seen in surface view, is not distinct but very obscure. Among fertile specimens we can distinguish at least two kinds of frond, the one containing a small number of large swarmers in each cell, the other a considerable number of diminutive ones. The former may be, most probably, a zoosporophyte, while the latter a gametophyte.

3. ***Enteromorpha prolifera*** (Müll.) J. Agardh

Plate IV, Figs. 11–16

Till Alg. Syst., III, 1883, p. 129, pl. 4, figs. 103, 104 ; Howe, 1914, p. 23 ; 1924, p. 136 ; Collins, 1909. p. 202 ; Yendo, 1914, p. 263 ; Setchell & Gardner, 1920*a*, p. 254 ; Okamura, 1936, p. 14, figs. 5 (4), 6 (1) ; Taylor, 1937, p. 65, pl. 32, fig. 2 ; Takamatsu, 1939, p. 23 ; Nagai, 1940, p. 13, pl. 1, figs. 10–11 ; Yamada & Tanaka, 1944, p. 48.

Ulva prolifera Müller, *in* Fl. Dan., V, 13, 1778, pl. 763, fig. 1.

Enteromorpha compressa var. *prolifera* Hamel, Chlor. d. cotes Franc., 1931/32, p. 65.
E. intestinalis f. *prolifera* Hauck, Meeresalg., 1885, p. 427 ; Börgesen, 1902, p. 401 (*sub* var. *prolifera*).

Japanese name. Suji-awonori (Nagura), Toge-awonori (Nagai).

Habitat. Growing on rocks, woodwork, and on *Phyllospadix* in sheltered localities near low-water mark. W. coast : Rakuma (T., '27), Hirochi (T., '27), Honto (Morimoto, '25), Kaiba-tô (Morimoto, '33, '37). Aniwa Bay ; Tôbuchi-ko (T., '26). E. coast : Ondo-ko (Herb. Rakuma).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles and Saghalien ; China ; Pacific coast of North America (from Alaska to California), and of South America (Peru) ; South Pacific Ocean (Samoa) ; Atlantic coast of North America ; coasts of whole Europe.

Remarks. Among the specimens referable to the present species are found two different forms, which coincide with each other in habit and in the regular arrangement of cells, but distinctly differ from each other in the size of vegetative cells, in the thickness of membranes, and in the form of cells in cross section of the frond. The small-celled form, from Rakuma and Kaiba-tô, seems to be somewhat smaller, its frond being up to nearly 20 cm. high, the membrane 20–28μ thick, equally thickened on both sides, the cells 7–22μ in length as seen in surface view, 20μ high and 8–12μ diam. in a cross section. This form agrees fairly well with the description of var. *arctica* (J. Ag.) Collins given by Collins (*loc. cit.*, p. 203). In the large-celled form, from Tôbuchi-ko, the frond is up to nearly 40 cm. high, the membrane 12–15μ thick, the cells 16–30μ long as seen in surface view, usually broader than high in section. The openings of the fertile cells, in surface view, are equally well visible in both forms. It is to be noticed that their reproductive cells have no marked difference in size. Only one kind of the reproductive cells, probably gametes, was observed.

The specimens from Lake Taraika were collected by the late Mr. Fumio Fujita in the summer of 1935, when he was engaged in the biological and fishery survey of the lagoon. They are of a small narrow frond, about 7 cm. high and 0.3–3 mm. broad, which is often contorted, simple or sometimes slightly proliferous. The tip of branchlets terminates in a single series of one to several short cells. Such uniseriate branchlets have already been observed in the present species by Kützing (under the name of *E. pilifera* Kütz., Tab. Phyc., VI, pl. 30 III) and by Nagai (*loc. cit.*, pl. 1, fig. 11).

4. ***Enteromorpha intestinalis*** (L.) Link

Epistola, 1820, p. 5 ; J. Agardh, 1883, p. 131 ; Kjellman, 1883, p. 287 ; De Toni, 1889, p. 123 ; Collins, 1909, p. 204 ; 1919, p. 205 ; Howe, 1914, p. 24 (*cum* ?) ; Okamura, 1916, p. 226 ; 1933, p. 85 ; 1936, p. 15, fig. 5 (2), fig. 6 (9–10) ; Setchell & Gardner, 1920a, p. 252 ; Sinova, 1933, p. 9 ; Yamada, 1934, p. 35 ; Takamatsu, 1936, p. 4 ; 1938, p. 3 ; 1938*a*, p. 79 ; 1939, p. 23 ; Taylor, 1937, p. 65, pl. 3, fig. 7, pl. 4, figs. 4–5 ; Nagai, 1940, p. 12 ; Yamada & Tanaka, 1944, p. 48.
Ulva intestinalis Linnaeus, Fl. Suec., ed. 2, 1755, p. 418.

Enteromorpha compressa var. *intestinalis* Hamel, Chlor. d. cotes Franc., 1931/32, p. 62, fig. 47 (II), 48, (9-10).
Ulva Enteromorpha var. *intestinalis* Farlow, Mar. Alg. New Engl., 1881, p. 43.

Japanese name. Bô-awonori (Nagura), Yore-awonori (Nagai).

Habitat. Growing on shells, stones and woodwork in the lower littoral belt in protected places. Aniwa Bay : Tôbuchi-ko (T., '26).

Distribution. Ryûkyû, Honshû, Hokkaido, Kuriles and Saghalien ; China ; Kamtschatka ; Pacific coasts of North and South America (from Alaska to Mexico and Peru) ; South Pacific Ocean (Samoa) ; Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; Baltic Sea.

Remarks. The specimens referred to the present species have a membrane which is in section 20–40μ thick and generally with a wall distinctly thickened on the inner surface. In our specimens are found four different kinds of frond, the one has smaller vegetative cells than the other three and its fertile cells contain rather small reproductive cells, while the other three can be distinguished from each other in the size of reproductive cells, but hardly separable by the size of vegetative cells. The vegetative cells of the former are about 7–14μ diam. in surface view, and those of the latter three 10–18μ diam. *E. intestinalis* has been proved to be heterothallic anisogamous in sexuality, and to perform an antithetic alternation of generations (Kylin, 1930*a* ; Bliding, 1933 ; Moewus, 1938). The just mentioned three kinds of frond differing from each other in the size of the reproductive cells seem to represent the male gametophyte. the female gametophyte, and the zoosporophyte respectively.

5. *Enteromorpha Linza* (L.) J. Agardh

Till Alg. Syst., III, 1883, p. 134, pl. 4, figs. 110-112 ; De Toni, 1889, p. 124 ; Collins, 1909, p. 206 ; Yendo, 1909, p. 119 (var. *crispata* J. Ag.) ; Howe, 1914, p. 24 ; 1924, p. 135 ; Okamura, 1915, p. 163, pl. 138 ; 1916, p. 226 ; 1927, p. 2 ; 1936, p. 15 ; Sinova, 1933, p. 10 ; 1938, p. 38 ; Hamel, 1931/32, p. 60 ; Segawa, 1935, p. 60 ; Taylor, 1937, p. 68, pl. 3, fig. 8 ; Bliding, 1939, p. 139, figs. 4-7 ; Tokida, 1941, p. 49, Figs. 1 &2 ; Yamada, & Tanaka, 1944, p. 48.
Ulva Linza Linnaeus, Sp. Plant., II, 1753, p. 1163 ; Postels & Ruprecht, 1840, p. 21 ; Setchell & Gardner, 1920*a*, p. 262 pl. 12, figs. 1-4 ; Nagai, 1933, p. 13 ; 1940, p. 7 ; Kawabata, 1936, p. 200.

Japanese name. Usuba-awonori (Okamura).

Habitat. Growing on rocks, woodwork and on other algae, in the lower littoral belt. W. coast : Rakuma (T., '27), Hirochi (T., '27), Shiranushi (T., '26, '27), Kaibatô (Morimoto, '33, '37). Aniwa Bay: Chishiya (T., '35), Nobori (T., '35), Merei (Miyabe, '06). East coast : Sakaehama (T., '32).

Distribution. Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China ; Japan Sea coast of Siberia ; Kamtschatka ; Pacific coast of North America (from Alaska to Mexico) and of South America ; Tasmania ; Altantic coasts of North and South America, and of Europe ; North Sea ; Baltic Sea.

Remarks. Among our Saghalien specimens are found both gametophytes and zoosporophytes. In the gametophyte, the membrane of the tubular stipe is 40–44μ thick, with the cell-cavity 23–28μ high. In the lower part of the blade, the two layered united portion is 39–48μ thick, while the monostromatic membrane of the marginal tubular portion 28–30μ thick. In the zoosporophyte, the membrane of the tubular stipe is 54–56μ thick, with the cell-cavity 28–30μ high. The two layered united portion of the blade is 30–32μ thick above, up to 68μ thick near the base. The membrane of the marginal tubular portion is 28–36μ at the place where the two layered portion is 44–50μ thick.

As the above description of the zoosporophyte shows, the thickness of the blade is quite variable even in one and the same individual. The size of the cells, as seen in surface view, is also as much variable (cf. Okamura, 1915, pl. 138, figs. 8, 9). The cells are often arranged in longitudinal series, especially in the lower portion of frond. In this point our plant agrees with Bliding's *E. Linza* (1939, p. 139, figs. 4, 5 B). The membrane of tubular portions in the lower part of frond is distinctly thickened a little on the inner surface, which character appears to have not attracted any special attention of previous authors (cf. Setchell & Gardner, 1920*a*, pl. 12, figs. 1, 3 ; Bliding, 1939, fig. 5 A).

The hollow cavity of stipe and of lower marginal portion of blade is always found to be traversed by transverse and oblique "trabeculae". This kind of trabeculae, as far as the writer is aware, has never been described in any species of *Enteromorpha* except *E. prolifera* var. *trabeculata* of Rosenvinge (1893, p. 960, fig. 55). The trabeculae are proved to be present in *E. Linza* not only from Saghalien but also from Hokkaido, Kuriles, Kamtschatka (Petropaulovsk, *leg.* B. Umeno, in the herbarium of Dr. M. Nagai), and from Washington (Griffin Bay, *leg.* N. L. Gardner, no. 4086, distributed from the herbarium of the University of California), as well as in other species of *Enteromorpha*, viz., *E. prolifera* and *E. intestinalis*. They are considered to be a structure of not unusual occurrence in *Enteromorpha*, although their frequency is not always the same.

As to the life-history of *E. Linza*, Moewus (1938) has proved the presence of three different kinds of frond, namely the gametophyte (heterothallic and forming isogametes), the zoosporophyte and the diploid parthenogametophyte. The last mentioned, which produces without meiosis large 4-ciliate swarmers, seems to be most common in nature. With the materials collected at Hakodate in each month from March to November, the writer has failed to discover the formation of gametes. They always produce 4-ciliate swarmers, 8.5–14μ, rarely up to 18.5μ long. Judged by the size of the swarmer, the materials should have been parthenogametophytes. On the other hand, our Saghalien specimens which contain larger reproductive cells may be concluded to be zoosporophytes from the fact that there are other specimens containing gamete-like small reproductive cells. The opening of the fertile cells of both gametophyte and zoosporophyte is hardly visible in surface view.

9. **Ulva** Linnaeus

Gen. Plant., 1737, p. 326 ; Sp. Plant., II, 1753, p. 1163 (*partim*) ; Okamura, 1936, p. 8.

Frond membranaceous, flat, of two layers closely united throughout ; reproductive bodies formed from any cell except the lowermost ones, escaping through an opening in the outer wall of the cell ; gametophyte generally dioecious, producing usually eight biciliate iso- or anisogametes, the zygote germinating without meiosis to produce a sporophyte ; parthenogenesis present, sometimes producing a gametophyte, the cells of which later on become partially diploid and forming after meiosis quadriciliate zoospores while the haploid cells biciliate gametes.

Ulva pertusa Kjellman

Mar. Chlor. fr. Jap., 1897, p. 4, pl. 1, figs. 1–5, pl. 3, figs. 1–8 ; Tokida, 1932, p. 3 ; Kawabata, 1936, p. 200 ; Nagai, 1940, p. 8 ; Yamada & Tanaka, 1944, p. 49.

Japanese name. Ana-awosa or Awosa (Okamura).

Habitat. Growing on rocks and on other algae, in the littoral and sublittoral belts. W. coast : Sokorai (Miyabe, '06), Ushiro (Miyabe, '06 ; Nakamura, '06), Tomunai (Miyabe, '06), Tomarioru (T., '30), Rakuma (T., '27), Hirochi (T., '27), Yenchishi (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '26), Shiranushi (T., '26, '37), Kaiba-tô (Morimoto, '27. '33, '38 ; T., '30), Nishinotoro (T., '26). Aniwa Bay : Chishiya (Nakamura, '06 ; T., '37), Nobori (T., '26, '37), Ôdomari (Izumiyama, '06 ; T., '29), Merei (Miyabe, '06 ; T., '26), Nagahama (T., '35), Tôbuchi-ko (Miyabe, '06 ; T., '35), Yaman (Matsubara, '33). E. coast : Hota (T., '32), Sakaehama (Miyabe, '06 ; T., '29), Kashiho (T., '31), Higashi-shiraura (T., '31), Nairo (Miyabe, '06) Jimutaki (Miyabe, '06), Motodomari (T., '31), Kaihyô-tô (Kubo, '06 ; Tokida, '30, '32, '35), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Formosa, Ryûkyû, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China, Malay Archipelago.

Remarks. As stated by Okamura (1936, p. 10), it is not satisfactorily clear to us at present whether *Ulva pertusa* Kjellman is quite distinct from *U. Lactuca* L. or not. The specimens from Hakodate, Hokkaido, one of the type localities of *U. pertusa*, agree fairly well with the diagnosis of Kjellman. They have been experimentally proved by the writer to be heterothallic anisogamous. The zoosporophyte is also present, which produces 4–ciliate zoospores. The cells of the gametophyte, as seen in surface view, are distinctly smaller than those of the zoosporophyte. In the specimens from Kaihyô-tô is also observed a similar difference in size of the cells. According to Föyn (1934), who has first pointed out the difference of this kind in *Ulva Lactuca* L., the diploid cells in the sporophyte of that species measure 12–24μ long, 8–18μ wide, while the haploid ones in the gametophyte measure 7–14μ long, 5–11μ wide. Our specimens of *U. pertusa* from Hakodate have slightly larger cells, which measure 14–28μ long in the sporophyte, and 9–19μ long in the gametophyte. The fertile part of a sporophyte from Hakodate measures 42–44μ thick and that of a gametophyte 44–46μ while in the plant from Kaihyô-tô it is composed of more elongated cells and measures 84μ thick in the sporophyte, and 64μ in the gametophyte. Otherwise they coincide very well with each other.

Family 4. Monostromaceae Kunieda

in Proc. Imp. Acad., X, 2, 1934, p. 106 ; Okamura, 1936, p. 21.

Alternating generations dissimilar in appearance ; macroscopic plants belonging as a rule to the gametophytic generation, at first usually saccate, later splitting into a membrane of a single cell layer, or sometimes from the beginning never saccate, attached by rhizoidal outgrowths from the basal cells ; cell walls generally thin, but sometimes gelatinous ; cells uninucleate, with a single platelike, parietal chloroplast and one pyrenoid ; gametophyte vegetatively multiplying by fragmentation, at maturity generally producing heterothallic biciliate iso- or anisogametes, which fuse in pairs to form unicellular spherical diploid hypnocysts (so-called aplanospores) of limited growth, or in some cases mature plants producing bi- or quadriciliate planogonidia directly growing into hypnocysts ; hypnocysts belonging to the sporophytic generation, producing at maturity 32 quadriciliate zoospores, which by germination form multicellular thalli of the gametophytic generation ; gametes sometimes capable of parthenogenetic development, growing directly into gametophytes ; macroscopic plants rarely being diploid (?), multiplying merely by quadriflagellate planogonidia.

Remarks. The family *Monostromaceae* was proposed by Kunieda in 1934 separating from the *Ulvaceae* to contain a single genus *Monostroma*. The genus *Monostroma* differs fundamentally from all others of the family just mentioned in the possession of a sporophyte quite dissimilar in appearance to gametophyte, being thoroughly unicellular and converting finally into a zoosporangium. This peculiar type of life history of *Monostroma*, which was brought into light for the first time by the investigation of Kunieda (*loc. cit.*), has been ascertained to be of a normal and universal occurrence by the researches of Yamada & Satio (1938) as well as of Moewus (1938). The whole cycle of the life history has been completely traced in laboratory by the last mentioned author. Yamada and Kanda (1941, pp. 217–221, figs. 1–4) has reported the production of quadriciliate asexual "zoospores" in the normal macroscopic individuals of *M. zostericola* Tilden, and their direct development to multicellular thalli. In classifying the present family in the order Ulvales, the writer follows Okamura (*loc. cit.*).

10. **Monostroma** Thuret

in Mem. Soc. Sci. Nat. de Cherbourg, II, 1854, p. 13 ; Okamura, 1936, p. 21.
Ulvaria Ruprecht, Tange Ochot. Meer., 1848, p. 218.

Key to the species

I. Frond saccate until well developed, then splitting nearly or completely to the base.
  A. Membrane 28–32μ (up to 44μ) thick, rather soft in texture, cell walls thin .... 3. *M. arcticum*
  B. Membrane 32–54μ thick, tougher, cell walls thick .... 4. *M. angicava*
II. Frond saccate in the early stages only, or not at all.
  A. Frond darkening on drying, not adhering well to paper.
    a. Frond 16–48μ thick, cells quadrate in section .... 6. *M. fuscum*
    b. Frond 28–78μ thick, cells palisade-form in section...... 6*a*. *M. fuscum* f. *splendens*
  B. Frond light to bright green on drying, generally adhering well to paper.
    a. Membrane less than 15μ thick .... 1. *M. zostericola*
    b. Membrane more than 15μ thick ....
      1. Frond very soft, strongly undulate on the margins ; membrane 15–40μ thick .... 2. *M. undulatum* var. *Farlowii*
      2. Frond not as above ; membrane 27–88μ thick, with enormously thickened gelatinous walls (cuticular layers) under each surface .... 5. *M. crassidermum*

1. *Monostroma zostericola* Tilden

Plate VI, Figs. 1–3

Amer. Alg. (Exsicc.), 1900, no. 388 ; Yendo, 1917, p. 184 ; Setchell & Gardner, 1920*a*, p. 238, pl. 14, figs. 12, 13 ; Yamada, 1935, p. 9 ; Kawabata, 1936, p. 199 ; Okamura, 1936, p. 26 ; Takamatsu, 1938, p. 3 ; 1938*a*, p. 81, pl. 10, fig. 2 ; 1939, p. 25 ; Nagai, 1940, p. 20, pl. 1, figs. 27, 28 ; Yamada & Tanaka, 1944, p. 49.

Monostroma leptodermum Collins (*non* Kjellman), Green Alg. N. Amer., 1909, p. 213 ; Setchell & Gardner, 1903, p. 209.

Japanese name. Motsuki-hitoe (Yamada).

Habitat. Growing on the leaves of *Phyllospadix*, in the sublittoral belt. W. coast : Pilevo (Miyabe, '06), Hirochi (T., '27), Hishitoma (T., '26). Aniwa Bay : Tôbuchi-ko (T., '35). E. coast : Sakaehama (Miyabe, '06). Motodomari (T., '30), Chiriye (T., '30, '35), Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Pacific coast of North America (Vancouver Island and Puget Sound) ; Atlantic coast of North America (Massachusetts).

Remarks. Yendo (*loc. cit.*) was the first to recognize this species of Tilden as a valid one instead of following Collins to synonymize it under *M. leptodermum* Kjellm. (erroneously spelled as *M. lepidodermum* Kjellm. by Yendo). According to his measurement the plant seldom reaches 6 cm. in height. Our specimens are also usually very short, but those from Tôbuchi-ko measure up to 7 cm. high.

This species is readily distinguished from the other species on our coast by its diminutive cells and more or less regular arrangement of them as seen in surface view. The fertile part of our specimens measures 10–13μ thick, with the cells 7–8μ high. The fertile cell contains only about four reproductive cells. After emission of the latter, the cell wall does neither dissolve nor shrink but remains unchanged, and the opening is hardly visible in surface view. According to Yamada & Kanda (1941), the sporangia contain about 8–16 "zoospores", which are quadriflagellate and destitute of an eye-spot ; on germination they develop directly to multicellular new thalli.

2. ***Monostroma undulatum*** Wittrock var. ***Farlowii*** Foslie

Plate VII, Figs. 8 14 ; XII, Figs. A–C

Mar. Alg. Norway, Contrib., I, 1890, p. 114 ; Collins, 1909, p. 211 ; Collins, Holden & Setchell, Phyc. Bor.-Amer., no. 406 ; Taylor, 1937, p. 71.

Monostroma pulchrum Yendo (*non* Farlow), Notes Alg. New to Jap., VII, 1917, p. 186 ; Okamura, 1936, p. 24 ; Takamatsu, 1939, p. 25.

Japanese name. Hida-hitoe (Yamada).

Habitat. Growing on other algae in the upper sublittoral belt. W. coast : Nishinotoro (T., '37). Aniwa Bay : Nobori (T., '37), Chishiya (T., '37).

Distribution. Northern Honshū, Hokkaido and Saghalien ; North Atlantic coast of North America ; Arctic Ocean ; Norway.

Frond epiphytic, membranaceous, flaccid, up to nearly 15 cm. high, divided into several lobes, margin strongly undulate ; membrane 15–40μ thick ; cells in surface view angular, closely set, in section 12–21μ high ; chromatophore not occupying the full height of the cell.

Remarks. This variety is known to have a close resemblance to *Monostroma pulchrum* Farl. in the external appearance. The latter species was reported from Hokkaido by Yendo (*loc. cit.*). His identification is, however, rather questionable, because he seems to have misunderstood the relation between *M. pulchrum* Farl. and *M. undulatum* var. *Farlowii* Foslie. He relegates the last mentioned variety (as f. *Farlowii* Foslie) to synonymy including it under *M. pulchrum.* and writers ; "It seems curious to me to find that Collins in the Green Algae of North America, p. 221, treated *M. pulchrum* Farl. as a valid species in spite of *M. undulatum* var. *Farlowii* Foslie separately mentioned on the same page." It is by no means curious when we read the following in Collins' article (1903, p. 14) : "Foslie and Rosenvinge include *M. pulchrum* under *M. undulatum* as var. *Farlowii* Foslie, but this is probably incorrect. It may be that specimens of the latter variety have been distributed under the name of *M. pulchrum,* as there is some external resemblance between them. . . Both, however, vary considerably, and forms can be found which it would be hard to distinguish by external characters."

The full diagnosis of the present variety was lately given by Taylor (*loc. cit.*). It is described to have the thickness of frond 18–30μ, the height of cells 12–15μ, and the cells angular, closely set, somewhat in groups of 2–4 cells as seen in surface view, while in *M. pulchrum* the thickness of frond 6–15μ and the cells rounded, irregularly placed. The writer has examined many specimens apparently of *M. pulchrum*-type in his possession from various localities in Hokkaido, viz., Oshoro nerar Otaru Bay, Muroran and Hakodate, as well as from Saghalien, but he failed to find a true *M. pulchrum* among them.

In our specimens, the thickness of frond measures 13μ near the margin, 15μ in the upper part, 40μ in the lower, and up to 45μ in the basal rhizoid-bearing portion. The cells in surface view are angulate and closely set, and in cross section, roundish, often broader than height in the lower portion of fornd, 10.5μ high near the margin, usually 12–21μ high, and when fertile 18–22,5μ × 8–10μ.

The swarmers of this plant are of very peculiar character, as described by Yamada & Saito (1937, under the name of *M. pulchrum*). The writer also made public his observation on the plant of Hakodate before the 4th Local Congress of the Japanese Society of Scientific Fisheries at Hiroshima (Bull. Jap. Soc. Sci. Fish., VI (4) : p. 216–217, 1937, an abstruct in Japanese, under the name of *M. pulchrum* var. *asiaticum* MS.). If we place a matured frond in a vat, the marginal fertile parts fall to small square pieces which float for a while on the surface of water. If one of these pieces is taken in a drop of water on a slide-glass, the swarmers ooze out from almost all the fertile cells spontaneously into the intercellular spaces and as a whole assume a net-work appearance. The swarmers slip out one after another through the lateral wall of fertile cells into the intercellular space, move passively in the space turning their posterior ends containing plastids usually forward, and finally become free in water from the margin of frond. The free swarmers do not swim away but immediately attach with their posterior ends to each other, and often several dozens of them form a mass, which oscillates by the cilial movement of each cell. The attached swarmers can move sliding along each other. Sometimes a swarmer separates from the mass and again attaches to other swarmer. At last, free swarmers attach to the substratum at the anterior ends and become spherical cysts.

The swarmers are characterised by the absence of both eyespot and phototaxis ; they measure 5-12μ × 3–6μ, and are provided with mostly four cilia at the anterior end and sometimes also a single filiform appendage at the posterior. Besides the quadriciliate swarmers, biciliate smaller ones are also formed on the same individual ; they are often found to be fused each other as if they were a couple of conjugating gametes. In the writer's opinion, they do not represent conjugating gametes but incompletly divided swarmers, because they are fused always laterally at the posterior parts, and the true conjugation movement between any couple of swarmers could never been observed. It is to be noted here that "imperfectly separated microzoospores" are reported in *Hormiscia tetraciliata* Frye et Zeller (cf. Collins, 1918, p. 86 ; Setchell & Gardner, 1920*a*, p. 194–195).

3. *Monostroma arcticum* Wittrock

Plate V, Figs. 14–17 ; VII. Figs. 1 7

Monostr., 1866, p. 44, pl. 2, fig. 8 ; Kjellman, 1883, p. 299 ; Collins, 1903, p. 13, figs. 6, 7 ; 1909. p. 210 ; Setchell & Gardner, 1903, p. 208 ; 1920*a*, p. 238 ; Yendo, 1909, p. 118 ; Sinova1933,

p. 12 ; Okamura, 1936, p. 24 ; Takamatsu, 1938*a*, p. 80 ; Nagai, 1940, p. 18, pl. 1, figs. 31, 32 (*pro parte*).

Monostroma Grevillei γ. arctica Rosenvinge, Grönl. Havalg., 1893, p. 949, fig. 51 (*pro parte*) ; Börgesen, 1902, p. 495.

Japanese name. Kita-hitoegusa (n. n.).

Habitat. Growing on other algae in the littoral belt. W. coast : Shiranushi (T., '37). Aniwa Bay : Chishiya (T., '37).

Distribution. Northern Honshû, North Kuriles and Saghalien ; Pacific coast of North America (Alaska) ; Arctic Ocean ; Atlantic coast of northern Europe.

Remarks. Our specimens referred to the present species have fronds which measure, in cross section, 28–32μ thick in the middle and basal parts, and up to 44μ at the marginal fertile part. The fertile cells, after emission of swarmers, are somewhat separated from each other with no distinct intercellular substance, and their walls are rather thin, more or less shrinked but without such an irregullar margin as in the case of *M. angicava*, and in surface view, with no distinct pore.

In external appearances, our specimens bear a close resemblance to *M. angicava* Kjellm. of Hokkaidō. They may be distinguished from the latter by having a thinner and somewhat softer frond, and by their fertile cells with thinner walls, more loosely placed. The margin of the frond is not so distinctly crisped as is described for *M. arcticum* of North America (cf. Collins, 1909, p. 210 and Setchell & Gardner, 1920*a*, p. 238).

4. ***Monostroma angicava*** Kjellman

Plate V, Figs. 3-6 ; XI, Fig. C

Alg. Arct. Sea, 1883, p. 279, pl. 29 ; Yamada 1932, p. 109, pls. 21, 22 ; Okamura, 1936, p. 23, fig. 10 ; Takamatsu, 1936, p. 3, 1938*a*, p. 80, pl. 10, fig. 1 ; 1939, p. 24.

Japanese name. Yezo-hitoegusa (Yamada).

Habitat. Growing on rocks, on other algae, e. g., *Tichocarpus* and *Rhodomela*, and on the leaves of *Phyllospadix*, in the lower littoral and upper sublittoral belts. E. coast : Kita-shiretoko (T., '35), Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido and Saghalien ; Norwegian Polar Sea.

Frond up to 10 cm. high, narrowly saccate and compressed below, divided into usually two lobes above, or rarely splitted entirely to the base ; membrane 32–54μ thick ; cells seen superficially rounded angular, placed often in twoes, and in the lower part in longitudinal series, in cross section quadrate with rounded corners or vertically oval, 24–30μ high and 12–18μ diam., with thick wall ; fertile cell-cavity in cross section vertically oval while containing swarmers, but after discharge of them always surrounded by a wrinkled wall which has a single opening, opening hardly visible in surface view ; intercellular substance seems to be fairly firm, and consequently the cell walls remaining more or less persistently after the emission of swarmers.

Remarks. The above description is drawn up from our Saghalien specimens which are, in general characters, identical to the specimens of *M. angicava* from Oshoro and Muroran in Hokkaidō. As shown in the above description, the basal part of frond of ours is nearly always narrowly saccate and distinctly compressed. The splitting of the frond seems to occur primarily always on the margins of the compressed frond, resulting in two main lobes at the top of the saccate basal part. *M. angicava* is not very soft in substance, and its specimen keeps fairly well in formalin-seawater.

5. ***Monostroma crassidermum*** Tokida, sp. nov.

Plate V, Figs. 7–13 ; XI, Fig. D

Monostroma angicava Tokida (*non* Kjellm.), Mar. Alg. Robben Isl., Suppl. Rep., 1934, p. 17.

Fronde aliquantum molli, usque ad 20 cm. altis, suborbiculato-expansa, plus minusve lobata, sessili, basi umbilicato-plicata, marginibus integerrimis undulatis aut laceratis, laete viridi ; membrana ad basin 60–88μ, ad marginem superiorem 27–32μ, in partem fertilem 40–60μ, crassa, strato hyalino, lamellato, crassissimo, sub superficibus omnibus occupato ; cellulis e superficie rotundato-angulatis, irregulariter dispositis, in sectione transversali verticaliter ovalis, 12–16μ altis.

Japanese name. Atsukawa-hitoe (n. n.).

Habitat. Growing on rocks in the upper sublittoral belt, and often cast ashore. W. coast : Hishitoma (T., '32), Shiranushi (T., '32). Aniwa Bay : Chishiya (T., '35), Nobori (T., '35). E. coast : Kaihyô-tô (T., '35).

Distribution. Endemic.

Frond rather soft, up to 20 cm. high, sub-orbicular in outline, sessile, more or less lobed and folded, with umbilicate base, with entire, undulate or lacerate margins, and bluish bright green in color ; membrane 60–88μ thick near the base, 27–32μ in the marginal, 40–60μ in the fertile portion, with a very much thickened hyaline, stratified, layer under each surface ; cells rounded angular in surface view, irregularly placed ; cells in cross section vertically oval, 12–16μ high ; on drying firmly adhering to paper except the base and sometimes becoming yellowish.

Remarks. In the external appearance the present new species has some apparent resemblance to *Monostroma angicava* Kjellm. After close examination, however, the writer has come to a conclusion that they are sufficiently different from each other. In the thickness of frond *M. crassidermum* is most prominent among other known species of the genus. It attains 88μ thick in the basal part of the frond, even before the formation of rhizoids. Such remarkable thickness is wholly due to enormously thickened hyaline layers on both surfaces ; the cells themselves remaining unchanged in size throughout. The hyaline layer is obscurely stratified, and is stained by an alcoholic aqueous solution of methylene blue not uniformly but deeply at the stratification. In the cross section of the frond, our plant bears some resemblance to *Monostroma Grevillei* var. *arctica* (Wittr.) Rosenv. and var. *intestiniformis* Rosenv. but it differs from these varieties in having much more thickened frond (cf. Rosenvinge, 1893, fig. 51 C and 52 C). The cells are not elongated in surface view even near the base of frond, while in *M. angicava* they are elongated and arranged in longitudinal rows.

The fertile part of a dried specimen can be recongized by its yellowish color. The walls of fertile cells seem to dissolve soon or later after the discharge of swarmers, and in fact, none of our specimens has small pieces of colorless membrane attached to the marginal fertile parts, as we usually see in *M. angicava*. The fertile cells, in surface view, are roundish and overlapping one another, and in a cross section often horizontally oval and arranged not in one layer but irregularly place in consequence of the dissolution of intercellular substance.

The substance of our plant is rather soft in spite of the great thickness of the hyaline layer. The specimens preserved in formalin are so soft that they are all broken down to fragments especially when they are mixed with other algae.

All of our specimens are not saccate but expanded. The earlier stages of the growth of this species are unknown to us at present, but it is most probable that they are of a saccate form.

6. ***Monostroma fuscum*** (Post. et Rupr.) Wittrock

Monostr., 1866, p. 53, emend. Rosenvinge, 1893, p. 940.
Ulva fusca Postels et Ruprecht, Illustr. Alg., 1840, p. 21, (= var. *typicum*).

This species contains three varieties, viz., var. *typicum*. *splendens* and *Blyttii* (cf. Setchell & Gardner, 1920a, p. 243), of which the former two are found in Saghalien.

6a. ***Monostroma fuscum*** var. ***typicum*** Rosenvinge

Plate VI, Figs. 4, 10–11 ; XI, Fig. A

loc. cit., 1893, p. 942.

Monostroma fuscum Wittrock, *loc. cit.*, 1866, p. 53, pl. 4, fig. 13 ; Kjellman, 1883, p. 299 ; De Toni, 1889, p. 109 ; Collins, 1909, p. 213 ; Yendo, 1917, p. 187 ; Setchell & Gardner, 1920*a*, p. 242 ; Okamura, 1936, p. 27 ; Nagai, 1933, p. 12.

Ulva fusca Postels et Ruprecht, *loc. cit.*, 1840, p. 21.

Japanese name. Kuro-hitoegusa (Okamura).

Habitat. Cast ashore, growing on the stem of *Cystophyllum*. E. coast : Sakaehama (T., '29).

Distribution. Hokkaidō, Saghalien and Korea ; Kamtschatka ; Pacific coast of N. America from Alasksa to Puget Sound ; Atlantic coasts of N. America and northern Europe ; Arctic ocean ; Baltic Sea.

Remarks. Sterile specimens are only before us. In external appearance, they bear some resemblance to *Enteromorpha Linza*. The stipe is very short and generally remains tubular. The membrane is monostromatic, measuring 16–40μ thick, up to 48μ thick close to the basal rhizoid-bearing part. The cells, in cross section, are quadrate, with slightly rounded corners, usually vertically elongated but sometimes horizontally elongated in the upper part of the frond, 12–32μ (40μ) in height ; in the basal rhizoid-bearing portion the cell cavity is 36–48μ in height.

6b. ***Monostroma fuscum*** var. ***splendens*** (Rupr.) Rosenvinge

Plate III, Figs. 5–6 ; VI, Figs. 5 9, 12–13 ; XI, Fig. B

loc. cit., 1893, p. 942 ; Yendo, 1909, p. 117 (*sub* forma) ; Setchell & Gardner, 1920*a*, p. 242 ; Nagai, 1940, p. 21, pl. 1, figs. 25, 26.

Ulva splendens Ruprecht, Tange Ochot. Meer., 1851, p. 410,.

Monostroma fuscum f. *splendens* (Wittr.) Collins, Ulvac. N. Amer., 1903, p. 12 ; Green Alg. N. Amer., 1909, p. 213 ; Yamada, 1935, p. 10 : Okamura, 1936, p. 27.

M. splendens Wittrock, Monostr., 1866, p. 50, pl. 3, fig. 12 ; J. Agardh, 1883, p. 112, pl. 3, figs. 91, 92 ; De Toni, 1889, p. 107 ; Kjellman, 1889, p. 54 ; Setchell, 1899, p. 591 ; Sinova, 1933, p. 11.

Japanese name. Ō-hitoegusa (Yamada).

Habitat. Growing on stones and on other algae in the littoral belt, and floating or cast ashore. W. coast : Hirochi (T., '26), Kaiba-tô (T., '30). Aniwa Bay : Tôbuchi-ko (T., '35). E. coast : Mototomari (T., '31).

Distribution. Kuriles, Saghalien ; Kamtschatka ; Bering Isl. ; Pacific coast of N. America from Alaska to Vancouver Isl.

Remarks. This variety has a thicker frond than any other species of *Monostroma* except *M. crassidermum* mihi, found on our coast. The measurement of a specimen from Kaiba-tô is as follows : the frond is 28–34μ thick in the marginal fertile part, 38–46μ in the middle, up to 57–76μ near the base ; the cells are palisade-form in cross section, 22–48μ, up to 60μ high, 10–22μ broad ; the basal rhizoid-bearing portion is 64–192μ thick, with the cells 48–52μ high. In a cross section of the tubular stipe of a specimen from Tôbuchi-ko, which measures 768μ diam. in the direction of the short axis, the membrane, containing a thick layer of rhizoids, is 336–400μ thick.

The short tubular stipe of the young specimens of this species has already been observed by several authors (Postels & Ruprecht, 1840, p. 21 ; Rosenvinge, 1893, p. 942, fig. 48 ; 1894, p. 148, fig. 48 ; Setchell & Gardner, 1920*a*, p. 244). It is, in our specimens, very short and of a peculiar structure as shown in Pl. VI, Figs, 10–13.

The fertile cell of our plant, when emptied, is provided with a very distinct pore in the center of the superficial wall. So far as the writer has examined, the pore is usually invisible in other species of Monostroma, or quite obscure if any, even in such a thick-walled species as *M. angicava*.

According to Collins (1909, p. 213) and Setchell & Gardner (1920*a*, p. 242–243) three varieties or forms of *M. fuscum* differ from each other chiefly in the thickness of frond. In the typical form or var. *typicum* it measures 20–35μ, in var. *splendens*

50–55μ, and in var. *Blyttii* 60–70μ. On the other hand, the thickness of frond of our plant is of very wide range; it ranges from 28 to 76μ, as shown in the above measurement. So far as the limit of the thickness is concerned, our plant comes near by var. *Blyttii*. However, the writer inclines to follow Rosenvinge (1893, p. 940; 1894, p. 146) to include the last mentioned form under var. *splendens*.

One of the well-known distinctive features of this species and its varieties is that the frond becomes blackish when dried and stains the paper on which it is mounted. This character is well represented in our specimens of var. *typicum* as well as of var. *splendens*.

Order 3. PRASIOLALES Fritsch

in West & Fritsch, Freshw. Algae, 1927, pp. 150, 164 (as a Series under the Group Ulotrichales); Knebel, 1935, p. 6; Taylor, 1937, p. 76.

Schizogoniales West, Brit. Freshw. Alg., 1904, p. 98; Algae, 1916, p. 279; Setchell & Gardner, 1920*a*, p. 275; Smith, 1933, p. 458.

Thallus filamentous to foliaceous; cells often showing regular arrangements in groups in the broader forms; cells uninucleate, with a single stellate axile chloroplast and one central pyrenoid; multiplication by fragmentation; asexual reproduction by aplanogonidia and hypnogonidia; the former produced by division of vegetative cells while the latter either by direct conversion of vegetative cells or after one division across the plane of the blade, the hypnogonidia either germinating directly or producing several aplanogonidia; sexual reproduction known in some species, by the production of biciliate homoeothallic anisogametes.

Family Prasiolaceae West

Brit. Freshw. Alg., 1904, p. 98; Algae, 1916, p. 279; Oltmanns, 1904, p. 208; Collins, 1909, p. 217; Fritsch, *in* West & Fritsch, 1927, p. 164; Knebel, 1935, p. 9–10; Taylor, 1937, p. 76.

Schizogoniaceae Chodat. Alg. vertes de la Suisse, 1902, p. 341; Setchell & Gardner, 1920*a*, p. 275; Tilden, 1935, p. 432.

Blastosporeae Jessen, Prasiolae Gen. Alg. Monogr., 1848, p. 13,

Blastosporaceae Wille, *in* Engler & Prantl, Natürl. Pflanzenfam., Nachtr., 1 Th., 2 Abt., 1909, p. 73; Heering, 1914, p. 56; Printz, *in* Engler & Prantl, *loc. cit.*, ed. 2, III, 1927, p. 178; Okamura, 1936, p. 28.

10. **Prasiola** (Agardh) Meneghini

Cenni Organorg. Fisiol. Alg., 1838, p. 36.

Prasiola Agardh, Sp. Alg., 1822, p. 416 (as a tribe of the genus *Ulva*); De Toni, 1889, p. 140; Okamura, 1936, p. 28.

Prasiola crispa (Lightf.) Meneghini

loc. cit., 1838, p. 36; Tokida, 1932, p. 4, pl. 1, figs. a–b; Okamura, 1936, p. 29; Knebel, 1935,

p. 13–22, figs. 2–10.

Ulva crispa Lightfoot, Flor. Scot., II, 1777, p. 972.

Prasiola crispa Agardh, Sp. Alg., I, 2, 1822, p. 416.

(For further synonyms see : Knebel, *loc. cit.*).

a. ***Prasiola crispa*** subsp. ***eu-crispa*** Knebel

loc. cit., 1935, p. 15–20, figs. 2–8.

Japanese name. Oka-nori (n. n.).

Habitat. Terrestrial, growing on the surface of rocky cliffs. Aniwa Bay : Chishiya (T., '35), Akaiwa (Kanno, '31). E. coast : Kaihyô-tô (T., '30).

Distribution. Saghalien ; North Amercia ; Greenland ; Faeroe Islands ; Europe.

Thallus in *Hormidium*-stage filamentous, of a single series of cells, with a smooth wall ; *Schizogonium*-stage present ; in *Prasiola*-stage cells 1–6μ diam., grouped into areolae of 1.2–1.6μ broad.

Remarks. Knebel has divided the present species into two subspecies, viz., *eu-crispa* Knebel and *antarctica* (Kütz.) Knebel. The former is restricted in the northern hemisphere while the latter occurs in the southern hemisphere (South America). They differ from each other in some minor characters. Our Saghalien specimens agree quite well with the diagnosis of the subsp. *eu-crispa*, a translation of which is given above.

By a thorough cultural experiment of *Prasiola crispa*, Knebel has proved the following three methods of multiplication : 1. by the fragmentation of thallus, 2. by thick-walled akinetes (hypnogonidia), and 3. by aplanospores (aplanogonidia). The hypnogonidia are 3–6μ diam., in germination usually growing directly to new filaments but sometimes dividing at first into several aplanogonidia. The aplanogonidia are 1–3μ diam., produced by the division of certain vegetative cells (aplanogonidangia) or of some hypnogonidia, in germination increasing in size to become as large as hypnogonidia and then growing to new filaments. Neither a flagellate motile cell nor a sexual mode of reproduction has ever been observed in the present and any other species of the genus except *Prasiola japonica* Yatabe. For the last mentioned species was reported by Yabe (1932) the homoeothallic heterogamy by means of biflagellate gametes. As the discovery of the sexual reproduction by means of motile gametes was quite unexpected for *Prasiola*, some phycologists such as Smith (1933, p. 460) and Fritsch (1935, p. 218) seem to have been hesitating to accept it at once. However, recent studies on the life-history of *P. japonica* reported by Uda (1948, p. 33, figs. 1–2 ; 1948a, p. 90, figs. 3–5) and Fujiyama (1949, p. 25, figs. 1–2) have reassured the validity of Yabe's discovery leaving no more room for doubt. The writer himself also could observe the motile gametes in *Prasiola japonica* collected in the Kinugawa River, Prov. Musashi, in December 1938.

As to the relation between *Prasiola crispa* and the genus *Gayella* of Rosenvinge (1893, p. 936), Knebel is of an opinion that *Gayella* is an independent, valid genus instead of representing an undeveloped phase of the marine form of *Prasiola crispa* as discussed by Börgesen (*loc. cit.*, p. 484–485).

Order 4. CHLOROCOCCALES Fritsch

in West & Fritsch, Brit. Freshw. Alg., 1927, p. 95.
Protococcales Oltmanns, Morph. Biol. Alg., I, 1904, p. 169.

Thallus unicellular, solitary or coenobic, nonmotile in vegetative phase ; vegetative cell division wanting ; cells mostly uninucleate, but sometimes coenocytic with a limited or a large number of nuclei ; chloroplast of various types, differing in number and shape, with one to many pyrenoids ; reproduction by biciliate planogonidia, aplanogonidia (so-called "autospores"), and by biciliate iso- or anisogametes ; zygote mostly growing directly into a vegetative cell, but sometimes germinating to form four biciliate zoospores which developing into "polyhedra" (or "tetraedron"-stage) and finally producing many planogonidia liberated and swarming within a vesicle to form a new coenobic thallus.

Family 6. Chlorochytriaceae Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer., II, 1920*a*, p. 146.
Planosporaceae West, Algae, I, 1916, p. 209.
Endosphaeraceae Klebs, Organ. einig. Flagellaten-Gruppe, 1883, p. 344 ; Smith, 1933, p. 473 ; Taylor, 1937, p. 41.

Thallus unicellular, not united into colonies, or single unseptate coenocytes, reproducing solely by aplanogonidia, planogonidia, and by isogametes.

11. **Chlorochytrium** Cohn

Über parasitische Algen, 1872, p. 102.

Thallus endophytic, unicellular, irregularly globose or ellipsoidal ; cell wall thin and homogeneous or thick and stratified, with localized lamellated thickenings ; chloroplast at first parietal and cup-shaped, later radially vacuolate and filling the cell, in mature cells with radial projections with a single or many pyrenoids ; vegetative cells uninucleate, frequently persisting in a densely starch-packed akinete-like condition ; nuclear divisions first meiotic, then mitotic to produce many (256) uninucleate protoplasts, which become transformed into biciliate isogametes (*C. Lemnae* Cohn), or in other cases (*C. Moorei* Gardn.) the cells producing quadriciliate planogonidia that may form new vegetative cells without fusion ; zygote quadriciliate and motile for a short time, then becoming to rest and penetrating the host plant, growing directly into a vegetative cell ; aplanogonidia, 32-64 in a gonidangium, present in some species (*C. gloeophilum* Bohlin).

Chlorochytrium inclusum Kjellman

Plate VII, Figs. 15–16

Alg. Arctic Sea, 1883, p. 320, pl. 31, figs. 8–17; Collins, 1909, p. 147 (*in part*); Setchell & Gardner, 1920*a*, p. 147, pl. 13, fig. 1; Sinova, 1930, p. 92; 1938, p. 39; Taylor, 1937, p. 43; Nagai, 1940, p. 4.

Japanese name. Midori-uzumimo (n. n.).

Habitat. Endophytic in the cortical tissues of *Neodilsea Yendoana, Farlowia irregularis, Iridophycus cornucopiae* and *Rhodoglossum pulchrum.* W. coast: Chishiya (T., '35). E. coast: Sakaehama (T., '29).

Distribution. Kuriles and Saghalien; Ochotsk Sea; Pacific coast of North America from Alaska to Puget Sound; Atlantic coasts of N. America and Europe; Arctic Ocean.

"Cells in the vegetative condition, spherical or subspherical, entirely included within the host plant, at the time of the formation of the zoospores, slightly elongated, depressed conical, ampullaeform, ovoid or ellipsoid, at length exposed through the penetration of the cortical layer of the host by the apiculate tip, emitting the zoospores through an ostiole."

Remarks. The description of the species given here is a literal translation of the Latin diagnosis of Kjellman, translated by Setchell & Gardner (*loc. cit.*). According to the measurement given by Taylor (*loc. cit.*), the cells are 80–100μ (–270μ) in diameter. Our specimens are decidely smaller, measuring 30–72μ diam., and 54–88μ (–104μ) long, usually plane or sometimes slightly lobed but never pointed at the base, with thick walls which are apiculate at the outer end of the cell. The chloroplast spreads over the whole wall, and contains several pyrenoids. The reproductive bodies are not observed in our plant.

Besides the present species, two kinds of *Chlorochytrium*-like endophytes, as far as the writer is aware of, have been hitherto touched quite briefly by Yendo and Yamada. The one is an unicellular green alga which is mentioned by Yendo (1911, p. 519) to infect *Porphyra tenera* Kjellm. in Tokyo Bay. The other is found by Yamada (1934, p. 37) in the thallus of *Callymenia ornata* (Post. et Rupr.) J. Ag. (?) from Urup Isl., Kuriles, and is said to be yellowish gland-cell like bodies, probably belonging to the genus *Chlorochytrium.* Yendo illustrates also a *Chlorochytrium* embedded within the cortex of an *Iridaea* (*loc. cit.*, p. 118, fig. 38). The last mentioned resembles closely our specimens and may belong to the same species.

Order 5. SIPHONALES (Grev.) Oltmanns

Morph. Biol. Alg., I, 1904, pp. 134, 291 (*s. str.*) ; Fritsch, 1935, pp. 74, 368 (*s. lat.*) ; Okamura, 1936, p. 88 (*s. str.*).

Siphoneae Greville, Alg. Brit., 1930, p. 183 (excl. gen. Nemalion) ; De Toni, 1889, p. 391.

Siphonaceae Harvey, Ner. Bor. Amer., III, 1858, p. 9.

Fronds filamentous, the threads without septa, or vesicular, or elaborately differentiated, sometimes, with a peculiar type of division (segregative division in the Valoniaceae), all parts coenocytic, calcification frequent ; chloroplasts numerous and discoid ; reproduction inadequately known in many cases, but probably in the main sexual and iso- or anisogamous, the Vaucheriaceae oogamous ; asexual reproduction by aplanospores, by cysts, or by 2–, 4–, or multi-flagellate zoospores ; vegetative multiplication by fragmentation ; mainly marine.

The diagnostic remark of the order is a slight modification of what given by Fritsch (*loc. cit.*, p. 74), who unites the Siphonocladiales with the Siphonales as West & Fritsch (1927) have done. Setchell (1929, p. 584) has also suggested that the Siphonocladiales might be inacceptable from the phylogenetical point of view. That the "Siphonales" is an incorrect ordinal name was pointed out by Setchell (1929, p. 584). He has suggested at the same time that the Siphonales is to be better separated into Codiales and Caulerpales.

In this order are placed nine families (cf. Fritsch, *loc. cit.*, p. 439), of which only two, the Caulerpaceae and the Codiaceae, have their representatives in our region.

Key to the Families

I. Thallus coenocytic, with high morphological differentiation, but without a pseudoparenchymatous construction .... 7. **Caulerpaceae**

II. Thallus composed of coenocytic filaments interwoven densely to form a pseudoparenchymatous tissue .... 8. **Codiaceae**

Family 7. Caulerpaceae Wille

in Engler & Prantl, Ntürl. Pflanzenfam., I, 2, 1870, p. 134 ; Fritsch, 1935, p. 374 (incl. *Bryopsidaceae* (Bory) De Toni, 1889, p. 427) ; Okamura, 1936, p. 93.

Fritsch says (*loc. cit.*) : "There appear to be no good reasons for referring Bryopsis and Caulerpa to distinct families as is usually done, since the simpler forms of the latter do not differ in any essential respects from the former. Both exhibit a pronounced morphological elaboration of the coenocyte, without any tendency towards the pseudoparenchymatous construction that characterises Codiaceae and Dasycladaceae." And he has abandoned the Bryopsidaceae, amalgamating it under the Caulerpaceae. Even the skeletal strands or trabeculae are stated to be sometimes present in older stems of Bryopsis (and also of Pseudobryopsis ?) (cf. Printz. 1927, p. 300 ; Fritsch, *loc. cit.*, p. 375).

12. **Bryopsis** Lamouroux

Observ. sur la physiol. des alg. mar., 1809, p. 333 ; Mem. sur trois nour. gen. de la famille des alg. mar., 1809*a*, p. 133 ; Okamura, 1936, p. 89.

Bryopsis hypnoides Lamouroux

Mem. sur trois nouv. gen., 1809a, p. 135, pl. 1, fig. 2 ab ; Harvey, 1847, pl. 119; Vickers, 1908, p. 30, pl. 53, figs. 1, 2 ; Collins, 1909, p. 403 ; Setchell & Gardner, 1920*a*, p. 159 ; Yendo, 1915, p. 103 ; Yamada, 1928, p. 503, fig. 6 ; Okamura, 1936, p. 90.

Japanese name. Obana-hanemo (Okamura).

Habitat. Washed ashore. W. coast : Chinehira (T., '26), Nishinotoro (Morimoto, '25). Aniwa Bay : Tôbuchi-ko (T., '35).

Distribution : Northern Honshû, Hokkaido and Saghalien ; Pacific coast of North America from Victoria, B. C., to San Pedro, Calif. ; Atlantic coasts of North America and Europe ; Adriatic Sea (f. *adriatica* J. Ag.).

Remarks. The present species is distributed near Japan along the northern coasts washed by the Tsushima Current, namely from Mutsu Bay, Northern Honshu, northward along the Japan Sea side of Hokkaido, from Hakodate to Rishiri and Rebun Island, and as far north as Chinehira, just south of Maoka, in Saghalien. In the collection of Morimoto, which has been laid in the writer's hand, there is a single specimen of *B. hypnoides* collected at Cape Nishinotoro, situated in the cold water region of Nishinotoro Peninsula. In spite of his frequent visits to the cape, however, the writer has not met with the present species either growing of drifted ashore there.

Family 8. Codiaceae (Trevis.) Zanardini

Sagg. di Class. nat. d. Ficee., 1843, (table opposite p. 17); Okamura, 1936, p. 106.
Codieae Trevisan, Prosp. Fl. Eugan., 1842, p. 50 ; *in* Flora, XXVI, 1843, p. 465 (*in part*).

13. **Codium** Stackhouse

Nereis Brit., Fasc. 2, 1797, p. xvi ; Okamura, 1936, p. 118.

Codium dichotomum (Huds.) S. F. Gray

Nat. Arr. Br. Pl. I, 1821, p. 293 ; Papenfuss, 1944, p. 338.
Spongia dichotoma Hudson, Fl. Angl., ed. 1, 1762, p. 489.
Codium dichotomum (Huds.) Setchell, Some early algal confusions, 1931, pp. 357, 361.
Fucus tomentosus Hudson, *loc. cit.*, ed. 2, 1778, p. 584.
Codium tomentosum (Huds.) Stackhouse, Ner. Brit., ed. 1, 1797, p. XXIV ; 1801, p. xxiv, pl. 7 ; Cotton, 1912, p. 114 ; Setchell & Gardner, 1920*a*, p. 174 ; 1924, pl. 16, figs. 38, 39 ; Schmidt, 1923, p. 39 ; Okamura, 1930, p. 104 ; 1936, p. 122 ; Sinova, 1938, p. 39 ; Yamada & Tanaka, 1944, p. 51.

Japanese name. Imose-miru (Okamura).

Codium dichotomum var. ***typicum***
subvar. ***yezoense*** Tokida, var. et subvar. nov.

Plate II, Figs. 6–8

Codium tomentosum var. *α typicum* Schmidt, *loc. cit.*, 1923, p. 42.

Utriculis 75–400μ latis et 585–975μ longis, apice obtuso incrassatis, lamellatis, usque ad 75μ (raro ad 90μ) crassis.

Japanese name. Yezo-miru (Miyabe).

Habitat. Growing on rocks in the sublittoral belt, often found drifted ashore. W. coast : Kaiba-tô (Morimoto, '33 ; T., '43). Aniwa Bay : Merei (Miyabe, '06). E. coast : Airô (Miyabe & Miyagi, '06 ; T., '27).

Distribution. Sp.–Formosa, Ryûkyû, Honshû, Idzu Islands, Hokkaido, Saghalien and Korea ; Japan Sea coast of Siberia ; Philippine Islands ; Oceania ; Indian Ocean ; Atlantic coasts of North and South America and of Europe ; West Indies ; Caribbean Sea ; Mediterranean Sea ; Adriatic Sea ; Red Sea. Var. *typicum* subvar. *yezoense* – Hokkaido and Saghalien.

Remarks. According to O. C. Schmidt (*loc. cit.*), *Codium tomentosum* (Huds.) Stackh, (*Codium dichotomum* (Huds.) Setch.) is a quite variable and wide spread species, occurring nearly in all oceans, with the only exception of the Arctic. In the North Pacific it has been reported on the Asiatic side from the Malay Archipelago, China, Formosa, Ryûkyû, Korea, Japan (Hachijô Island, Honshû and Hokkaido), and the Japan Sea coast of Siberia (Petrov Island), while on the American side only from one locality in Lower California (La Paz, Mexico, cf. Howe, 1911, p. 493). Setchell and Gardner (1924, p. 705) doubt the occurrence of the typical material of this species on the North American Pacific coast, and state that (p. 706) Howe's specimens of *C. tomentosum* (from La Paz) seem to belong to *C. simulans* Setch. et Gardn.

The nature of the typical *Codium dichotomum* has been made clear to some extent by Cotton's description of the Clare Island plant (Cotton, 1912, p. 114), which was adopted by Setchell and Gardner (1920a, p. 174)as the diagnosis of true *C. dichotomum*, and by the last mentioned authors' figures (1924, pl. 16, figs. 38, 39) of the utricles of the material from Cherbourg (Le Jolis, Algues Marines de Cherbourg, No. 204–W. A. Setchell's copy). In external appearance, our Saghalien specimens of *Codium* are to be ranked in var. *typicum* Schmidt of *C. tomentosum*, but in internal structure they were proved, after a close comparison, to differ in some respects not only from the typical *C. dichotomum* but also from *C. tomentosum* in the limitation by O. C. Schmidt.

The utricles at the branch apices are uniformly large and with thin apical walls, while those of other parts of the frond show a sort of dimorphism regarding their size, the larger type of them being 225–400μ in diameter and the smaller 75–180μ in diameter, and provided with apical walls usually distinctly thickened. The likewise variation of the utricles in different parts of the frond has been observed by Hurd (1916) in *C. fragile* (Huds.) Hariot. The thickening of the terminal wall of the utricles is often remarkable in our plant. The terminal wall is up to 75μ, or rarely even to 90μ, thick, finely laminated, frequently blunt conical in shape, and sometimes umbonate but never mucronate. Among the cylindrical and dichotomous *Codium*, *C. simulans* Setch. et Gardn. (1924, p. 706, pl. 14, figs. 21, 22, pl. 31) and *C. Brandegeei* Setch. et Gardn. (1924, p. 712, pl. 14, figs. 25, 26, pl. 30) are somewhat comparable with our plant in the thickness as well as in the shape of the terminal wall of the utricles, but they seem to differ from the latter in their fronds rather definitely cuneate below the forkings. The gametangia are fusiform, 80–170μ diam., and 180–350μ long as measured in herbarium specimens, usually two to each utricle, and borne below the middle of the utricles.

So far as the writer has examined, the above remarked plant is the only *Codium* collected in Saghalien. It is, at present, referred provisionally to a new subvariety, subvar. *yezoense* under var. *typicum* of *Codium dichotomum*. In the herbarium of our University, there are kept several specimens referable to the present subvariety, which were collected in the following localities : Muroran (Yoshikawa), Akkeshi (Tokida), Nemuro (Miyabe), and Abashiri (Miyabe). On the other hand, a single formalin specimen of *C. dichotomum* collected at Oshoro, near Otaru Harbour, is somewhat different from the subvariety in its utricles bearing the terminal walls not so remarkably thickened. It may presumably represent another subvariety (?), which is distributed in the warmer waters.

Division II. PHAEOPHYTA Pascher

in Ber. d. det. bot. Ges., XXXII, 1914, p. 153 ; Smith, 1933, pp. 9, 10.

Class 2. PHAEOPHYCEAE Hauck

Meeresalg., 1885, p. 282 ; Kjellman, *in* Engler & Prantl, 1897, p. 176 ; Okamura, 1936, p. 130.
Fucoideae Agardh, Syn. Alg. Scand., 1817, p. IX.
Melanospermeae Harvey, *in* Mackay, Flora Hibern., 3, 1836, p. 157.
Melanophyceae Stizenberger, *in* Dr. Ludwig Rabenhorst's Algen Sachsens, 1860, p. 36; Ruprecht, 1851, p. 200 ; Setchell & Gardner, 1925, p. 387.

Key to the Orders

I. Alternation of morphologically similar or dissimilar generations present ; sporophyte producing zoospores (Subclass **Phaeosporeae**)
  A. Alternation of similar generations known or inferred to be present (Series **Isogeneratae**)
    1. Growth in length of thallus taking place from a conspicuous apical cell .... 1. **Sphacelariales**
    2. Growth in length of thallus strictly subapical .... 2. **Ectocarpales**
  B. Alternation of dissimilar generations known or inferred to be present (Series **Heterogeneratae**).
    1. Thallus composed of branching cell filaments, without intercalary longitudinal division (Subseries **Haplostichineae**).

a. Growth in length of sporophyte from subapical cells, but not trichothallic; gametophyte isogamous .... 3. **Chordariales**
b. Growth in length of sporophyte trichothallic; gametophyte oogamous .... 4. **Desmarestiales**

2. Thallus composed of true parenchymatous tissues formed by intercalary longitudinal division (Subseries **Polystichineae**).
a. Growth in length of sporophyte by a single apical cell or subapical, or diffuse; gametophyte monoecious, producing planogametes .... 5. **Dictyosiphonales**
b. Growth in length of sporophyte intermediate or near the base, from a meristematic tissue; gametophyte dioecious, producing sperms or eggs .... 6. **Laminariales**

II. Alternation of morphologically similar generations present; plant being a sporophyte, producing aplanospores (Subclass **Aplanosporeae** .... 7. **Dictyotales**
III. Alternation of generations only cytologically present, plant being a sporophyte, producing sperms or eggs (Subclass **Cyclosporeae**) .... 8. **Fucales**

Subclass 1. Phaeosporeae Thuret

Rech. sur les zoosp. des alg. etc., 1850, p. 233.

Series 1. Isogeneratae Kylin

Ueber d. Entwickl. d. Phaeophyc., 1933, p. 91 (*sub* Class).

Order. 1. SPHACELARIALES Oltmanns

Morph. u. Biol. Alg., II, 1922, p. 83; Okamura, 1936, p. 149.

Family 1. Sphacelariaceae (Decaisne) Kützing

Phyc. Gen., 1843, p. 291; *in* Linnaea, XVII, 1843a, p. 93; Okamura, 1936, p. 149.
Sphacelarieae Decaisne, *in* Ann. Sci. Nat., Ser. 2, Bot., XVII, 1842, p. 32.

Key to the genera

I. Branches formed by division of the subapical cells; the base of branches covering about one half of the segment of the axis .... 1. *Sphacelaria*
II. Branches formed by division of the subapical cells; the base of branches covering the joint of two segments of the axis .... 2. *Halopteris*

1. **Sphacelaria** Lyngbye

Hydrophyt. Dan., 1819, p. 103; Okamura, 1936, p. 150.

Key to the species

I. Branching pinnate .... 1. *S. plumigera*
II. Branching not pinnate

A. Rays of propagula occasionally bifurcate ; hairs absent .... 2. *S. variabilis*
B. Rays of propagula simple ; hairs present .... 3. *S. subfusca*

1. *Sphacelaria plumigera* Holmes

New British Mar. Alg., *in* Grevillea, XI, 1882/3, p. 145 ; Tokida, 1931, p. 215, figs. 1–4 ; Okamura, 1936, p. 153 ; Taylor, 1937, p. 132.

Japanese name. Hane-kurogashira (Tokida).

Habitat. Growing on stones in the sublittoral belt and drifted ashore being admixed with other filamentous algae such as *Rhizoclonium tortuosum* and *Spongomorpha duriuscula*. Aniwa Bay : Tôbuchi-ko (T., '29). E. coast : Sakaehama (T., '29).

Distribution. Saghalien ; Atlantic coast of North America ; North Sea.

Remarks. This beautiful species had long been known only from the North Sea until it was reported from Saghalien in 1931 by the writer, and from southern Massachusetts in 1933 by Taylor (*in* Lewis & Taylor, 1933, p. 151). A thorough description of the Saghalien plant is given in the writer's paper cited above.

2. *Sphacelaria variabilis* Sauvageau

Remar. sur. le Sphac., 1901, p. 160, fig. 37 ; Okamura, 1916, p. 148 ; 1936, p. 152, fig. 78 ; Yamada, 1928, p. 504, fig. 7 ; Takamatsu, 1938, p. 9 ; 1939, p. 31.

Japanese name. Matazaki-kurogashira (Okamura).

Habitat. Epiphytic on *Ahnfeltia plicata* var. *tobuchiensis* and *Hypophyllum Middendorffii*. Aniwa Bay : Tôbuchi-ko (T., '26).

Distribution. Kyûshû, Honshû, and Saghalien ; Pacific coast of N. America (California).

Remarks. Our specimens referable to the present species are provided with long rhizoidal filaments at the base of frond and rarely also at the branch apex. The hair is lacking in accordance with the original descripition of the species, while it is said to be present in Yamada's plant from Mutsu Bay. The propagula are met with but rarely on the thallus. However, we can find them attaching and germinating on the leaf of *Hypophyllum Middendorffii*. They are usually bifurcate, but rarely tri-furcate. One of the two rays of the bifurcate propagulum is sometimes again bifurcate. The secondary transverse partitions of the primary segment cells are occasionally met with.

3. *Sphacelaria subfusca* Setchell et Gardner

Phyc. Cont., VII, 1924*a*, p. 1 ; 1925, p. 395, pl. 37, fig. 28 ; Tseng & Li, 1935, p. 205, fig. 6 ; Tseng, 1936, p. 21, pl. 2, fig. 7 ; Nagai, 1940, p. 41, pl. 2, figs. 9–11.

Japanese name. Mitsumata-kurogashira (Nagai).

Habitat. Epiphytic on *Sargassum Miyabei*, *Tichocarpus crinitus* and *Rhodomela*

Larix. E. coast : Airô (T., '27), Sakaehama (T., '29).

Distribution. Kuriles and Saghalien ; China ; Pacific coast of N. America from Alaska to southern California.

Remarks. Our specimens agree in general characters quite well with the description of the present species given by Setchell & Gardner and by Nagai. The hairs are fairly abundant. The tip of the main filament may rarely be transformed into a hair. The propagula are most frequently trifuracte, but bi- or tetrafurcate ones are also not uncommonly met with. The secondary transverse partitions of the primary segment cells take place occasionally. Some of the specimens from Sakaehama are occasionally found to be infected by *Olpidiopsis* (?) *Sphacellarum* (Kny) Sparrow (1943, p. 629) (syn. *Olpidium Sphacellarum* Kny, 1871 ; *O. Sphacelariarum* (Kny) Fischer, 1892, p. 26) as already reported by the writer in 1948 (p. 113, figs. 8–17).

2. **Halopteris** Kützing, (*emend.* Sauvageau)

Phyc. Gen., 1843, p. 292 (*s. str.*) ; Sauvageau, 1914, p. 437 (*s. lat.*) ; Okamura, 1936, p. 151.
Stypocaulon Kützing, *loc. cit.*, 1843, p. 293.
Anisocladus Reinke, *in* Ber. d. deut. bot. Ges., VIII, 1890, p. 213.

Halopteris scoparia (L.) Sauvageau

Remar. sur les Sphac., 1904, p. 349, figs. 69–73 ; Tokida, 1931, p. 217, figs. 5, 6 ; Okamura, 1936, p. 155, fig. 80 ; Taylor, 1937, p. 134.
Conferva scoparia Linnaeus, Syst. Nat., II, 1759, p. 720.
Sphacelaria scoparia Lyngbye, Hydr. Dan., 1819, p. 104, pl. 31, fig. 4.
Stypocaulon scoparium Kützing, Phyc. Gen., 1843, p. 293, pl. 18, fig. II ; Sinova, 1930, p. 95.

Japanese name. Hake-kashirazaki (Tokida), Yezo-kashirazaki (Okamura).

Habitat. Growing on stones and shells in the sublittoral belt and drifted ashore. Aniwa Bay : Tôbuchi-ko (T., '26, '29, '30). E. coast : Airô (T., '27).

Distribution. Ochotsk Sea coasts of Hokkaido and Saghalien ; Ochotsk Sea (Grand Schantar Isl.) ; Australian Sea ; Atlantic coasts of N. America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea ; Adriatic Sea.

Remarks. The occurrence of the present widely distributed alga in the Ochotsk Sea was first reported in 1930 by Sinova from Grand Schantar Island, and in the next year by the writer himself from the above mentioned localities in southern Saghalien and from Nemuro in Hokkaido. The Saghalien plant has been described in detail in the writer's paper above cited.

Order 2. ECTOCARPALES Setchell et Gardner

Phyc. Cont., VI, 1922, p. 403 ; 1925, p. 398 ; Oltmanns, 1922, p. 2 ; Okamura, 1936, p. 134.

Key to the Families

I. Fronds erect, monosiphonous filaments .... 2. **Ectocarpaceae**
II. Fronds prostrate, crustaceous .... 3. **Lithodermataceae**

Family 2. Ectocarpaceae Harvey

Ner. Bor.-Amer., I, 1852, p. 132 (*in part*) ; Setchell & Gardner, 1925, p. 400 ; Okamura, 1936, p. 134.

Key to the genera

I. Uni- and plurilocular sporangia seriate, intercalary .... 3. *Pylaiella*
II. Uni- and plurilocular sporangia lateral or terminal ....
  A. Vegetative filaments mostly external and free .... 4. *Ectocarpus*
  B. Vegetative filaments mostly endophytic .... 5. *Streblonema*

3. **Pylaiella** Bory

in Dict. Class., IV, 1823, p. 393 ; *id.*, XIII, 1828, p. 565, (*Pilayella*) ; Leman, *in* Levrault, 1826, p. 127 ; Okamura, 1936, p. 134,

Pylaiella littoralis (L.) Kjellman

Skan. Ect. och Tilopt., 1872, p. 99 ; Alg. Arct. Sea. 1883, p. 281 ; Om Beringhafv. Algfl., 1889, p. 51 ; Hauck, 1885, p. 339, fig. 42 ; De Toni, 1895*a*, p. 531 ; Yendo, 1909, p. 120 ; Setchell & Gardner, 1925, p. 402, pl. 37, fig. 32 ; Sinova, 1930, p. 93 ; 1933, p. 14 ; Yamada, 1935, p. 11 ; Kawabata, 1936, p. 201 ; Okamura, 1936, p. 135, fig. 65 ; Taylor, 1931, p. 16 ; 1937, p. 103, pl. 9, figs 1–3 ; 1939, p. 136 ; Takamatsu, 1939, p. 29 ; Nagai, 1940, p. 38 ; Yamada & Tanaka, 1944, p. 51.

Conferva littoralis Linnaeus, Sp. Pl., ed. 1, 1753, p. 1165 (*in part*).

Pylaiella ochotensis Ruprecht, Tange Ochot. Meer., 1851, p. 378.

P. olivacea Ruprecht, *loc. cit.*, 1851, p. 381.

Japanese name. Piraera (Okamura).

Habitat. Growing on stones and on other algae, most frequently on *Fucus evanescens*. W. coast : Nishinotoro (T., '32, '37). Aniwa Bay : Chishiya (T., '35), Nobori (T., '26, '35, '37), Nagahama (T., '35). E. coast : Hota (T., '32), Sakaehama (T., '29), Higashishiraura (T., '31), Maguntan (Miyake, '06 ; T., '29), Kashiho (T., '31), Noto (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Pacific coasts of North and South America ; Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea ; Adriatic Sea.

Remarks. The occurrence of this widely spread species in the Ochotsk Sea was first recorded by De Toni (1895), following the authority of Ruprecht. According to Ruprecht himself, of 12 (or 13) species of *Pylaiella* listed in his Tange des

Ochotskischen Meeres, only two, i.e., *P. Ochotensis* (*siliquosa* = plurilocular-sporangial form and *lomentacea* = unilocular-sporangial form) and *P. olivacea*, are found in the Ochotsk Sea. In the list of the synonyms given by De Toni under *P. littoralis* he did not mention these two binomials but other four binomials of Ruprecht, i. e., *P. flexilis*, *P. Norlandica*, *P. pyrrhogon*, and *P. saxatilis*, only following Kjellman (1883, p. 281) who had already amalgamated the last mentioned four species, all known from the Murmann Sea, with *P. littoralis* in his account of the Arctic Sea algae. Excepting that Kjellman (1890, *in* Bot. Centralbl., I, p. 168) has suggested the identity between *P. olivacea* and *P. littoralis*, no one has touched on *P. ochotensis* and *P. olivacea* since Ruprecht, as far as the writer knows, and even Sinova (*loc. cit.*), who has recently reported *P. littoralis* from the Ochotsk Sea and Kamtschatka, is following the custom to enlist the above mentioned four binomials of Ruprecht as synonyms. Ruprecht says that *P. Ochotensis* and *P. olivacea* are the first species among "*Ectocarpi*" in which the presence of both uni- and plurilocular sporangia has certainly been proved (p. 382), and that *P. Ochotensis β Kamtschatica* was once referred by him to "*Ectocarpus littoralis*" (p. 380). Then it can be said that *P. Ochotensis* and *P. olivacea* are true Pylaiellae, and most probably identical with *P. littoralis* in the current broader sense. Now, we can say that Ruprecht was the first to report the present alga from the Ochotsk Sea. In Japan, it was first reported by Yendo (*loc. cit.*) from the North Kuriles, who collected it in Shumushu Island in July 1903. In the specimens of *P. littoralis* laid in the writer's hand, there are two specimens from Hokkaido, both collected at Nemuro, one by Miyabe (Aug. 1884) and the other by Tanaka (June 1892). Recently it has been reported from the Kuriles by Yamada and by Nagai, and also rather unexpectedly from the Japan Sea side of Awomori Prefecture, Nothern Honshû, by Takamatsu (*loc. cit.*). In southern Saghalien it is one of the commonest algae, being found frequently associated with *Fucus evanescens*, while the specimen from Maguntan (*leg.* T. Miyake, Sept. 1906) is labelled as found growing on stones in brackish water at a river mouth.

4. **Ectocarpus** Lyngbye

Hydr. Dan., 1819, p. 130, (*in part*) ; Bory, 1824, p. 63 ; Okamura, 1936, p. 36.

Ectocarpus confervoides (Roth) Le Jolis

Liste Alg. Mar. Cherb., 1863, p. 75, (*in part*) ; Kjellman, 1890, p. 77 ; Kuckuck, 1891, p. 69; Saunders, 1901, p. 418 ; Setchell & Gardner, 1925, p. 412 ; Lakowitz, 1929, p. 218, figs. 305, 306; Takamatsu, 1936, p. 7 ; 1939, p. 29 ; Taylor, 1931, p. 15 ; 1937, p. 109, pl. 8, figs. 1–3 ; 1939, p. 136.

Ceramium confervoides Roth. Cat. Bot., Fasc. 1, 1797, p. 151.

Japanese name. Kenashi-shiwomidoro (n. n.).

The present variable species is represented in our collection only by the following typical form.

a. ***Ectocarpus confervoides*** f. ***typicus*** Kjellman

Plate VIII, Figs. 5-7

Handb. Skan. Hafsalg., I, 1890, p. 77; Kuckuck, 1891, p. 69, fig. 3; Setchell & Gardner, 1925, p. 414.

Habitat. Growing on *Rhodomela Larix.*

E. coast - Airô (T., '27).

Distribution. *Sp.* -Northern Honshû, Hokkaido, Saghalien; Pacific coast of North America, from Alaska to California, and of South America; Arctic Ocean; Atlantic coasts of North and South America and of Europe; North Sea; Baltic Sea; Mediterranean Sea; Adriatic Sea.

"Fronds 1-10 cm. high, feathery, profusely branched; primary filament 25-32μ diam., not constricted at the partitions; zoosporangia unknown; gametangia abundant, alternate or secund on the branches, sessile or upon a one to several celled pedicel, 40-80μ (up to 200μ) long, 20-35μ diam."

Remarks. The above description of f. *typicus* is after Setchell & Gardner (*loc. cit.*). This does not fully coincide with that given by Kuckuck (*loc. cit.*) but differs from the latter in some details. The specific character of *Ectocarpus confervoides* given by Taylor, who is not segregating f. *typicus*, shows also some differences as compared with the above two. The characters of our Saghalien plant agree partly with either of these descriptions and as a whole justify the present identification. Its leading characters are described as follows. The main branches are up to 50-54μ diam., more or less corticated with rhizoids below. The branches are gradually attenuated, sometimes ending in a hair. The hairy part of the branches consists of almost hyaline long cells, up to 4 diameters long. The cells are as usual slightly constricted at the partitions. The chromatophores are ribbon-shaped, often forked, and provided with pyrenoids. The plurilocular sporangia are abundant, uniformly short, 37.5-76.5μ long and 17.5-30μ diam., short-obovoid or short fusiform, often asymmetrical in shape, rather suddenly attenuated toward the blunt apex, never ending in a hair, lateral or terminal on short branchlets, usually with short stalks or rather rarely sessile. Unilocular sporangia are unknown.

Ectocarpus convervoides has recently been reported to occur in northern Honshû by Takamatsu and f. *typicus* in eastern Hokkaido by Yamada & Tanaka. In the Ochotsk Sea, excepting *E. fusiforme* Nagai of the Kuriles, *E. siliculosus* (Dillw.) Lyngb. has been the only known *Ectocarpus*, which was reported by Sinova (1930, p. 94) from Grand Schantar Island.

5. **Streblonema** Derbes et Solier

in Castagne, Supplem. Catal. Marseille, 1851, p. 100.

"Fronds composed of more or less branched, monosiphonous or in part polysiphonous filaments, wholly or largely endophytic; prostrate primary filaments wholly endophytic, creeping among the cells of the host, erect secondary filaments wholly or in large part endophytic, simple or branched, hairs present or absent; zoosporangia and gametangia both present, terminal or lateral on the erect or on the prostrate filaments, sessile or, more rarely, short-stalked." (Setchell & Gardner 1925, p. 440).

Streblonema Eudesmide Tokida, sp. nov.

Plate VIII, Figs. 8-9

Fronde microscopica; filamentis repentibus inter filamentas periphericas hospities penetrantibus, moderate et irregulatriter ramosis; filamentis erectis simplicibus aut leviter ramosis, saepe a sporangiis plurilocularibus terminata; cellulis cylindricis usque ad leviter doliiformibus, 8–16μ diam., diametro 0.7–3–plo longioribus, ad dissepimenta constrictis; chromatophoris tenuibus, taeniatis, in cellula quaque paucis; pilis sparsis, sessilibus aut in pedicellis, 8–11μ diam., vaginia basalibus ornatis; sporangiis unilocularibus ignotis; sporangiis plurilocularibus cylindrico-conicis, 40–88μ longis, 14–40μ latis, loculis pluriseriatis.

Japanese name. Yadori-midoro (n. n.).
Habitat. Growing on *Eudesme virescens.* Aniwa Bay; Tôbuchi-ko (T., '35).
Distribution. Endemic.

Frond microscopic; creeping filaments penetrating among the peripheral filaments of the host, moderately and irregularly branched; erect filaments simple or slightly branched, often terminated by plurilocular sporangia; cells cylindrical to slightly doliiform, 8–16μ diam., 0.7–3 times as long as broad, constricted at the cross-walls: chromatophores thin, band-shaped, few in each cell; hairs scattered, sessile or pedicellate, 8–11μ diam., with basal sheaths; unilocular sporangia unknown; plurilocular sporangia cylindrico-conical, 40–88μ long, 14–20μ broad, with pluriseriate loculi.

Remarks. In having cone-shaped plurilocular sporangia with pluriseriate loculi, *Streblonema Eudesmide* resembles *S. anomalum* Setch. et Gardn., *S. irregulare* Saunders, and *S. Johnstonae* Setch. et Gardn., but it is identical with none of them nor with any other known species of the genus, so far as the writer has examined. In our species, the cells are sometimes divided lengthwise, but not so frequently as in *S. anomalum.* The hairs are fairly abundant, very long, and provided with a sheath at their bases. As far as the writer is aware, the basal sheath of this kind has never been described in *Streblonema*.

Family 3. Lithodermataceae Kjellman

Alg. Arct. Sea, 1883, p. 255, (Fam. *Lithodermateae*) ; Hanbd. Skand. Hafsalg., I, 1890, p. 17, (*lim. mut.*) ; O. C. Schmidt, 1938, p. 213,.

Ralfsiaceae Hauck. Meeresalg., 1885, p. 399 ; Okamura, 1936, p. 142.

Stragulariaceae Stroemfelt, Om Algenveg. vid Islands Kuster, 1886, p. 49.

6. **Ralfsia** Berkeley

in Engl. Bot., Suppl., III. 1843. pl. 2866 ; Okamura, 1936. p. 142.

Key to the species

I. Frond loosely attached in the center by rhizoids, free at the margin ; hairs absent .... 1. *R. fungiformis*

II. Frond firmly attached by the whole lower surface ; hairs present ...... 2. *R. verrucosa*

1. ***Ralfsia fungiformis*** (Gunn.) Setchell et Gardner

Plate VIII, Figs. 10–12 ; XIII, Figs. A–C

Phyc. Cont., VII, 1924, p. 11 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 499 ; Kawabata, 1936, p. 203 ; Okamura, 1936, p. 143 ; Taylor, 1937, p. 122 ; Nagai, 1940, p. 40.

Fucus fungiformis Gunnerus, Fl. Norv., 1772, p. 107.

Zonaria deusta Agardh, Syn. Alg., 1817, p. 40.

Padina deusta Postels et Ruprecht, Illustr. Alg., 1840, p. 20.

Ralfsia deusta J. Agardh, Sp. Alg., 1848, p. 63 ; Kjellman, 1883, p. 248 ; De Toni, 1895, p. 312 ; Yendo, 1909, p. 123,.

Japanese name. Isogawara (Nagai).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts, or in tide pools. W. coast : Shiranushi (T., '37), Nishinotoro (T., '37). E. coast : Airô (T., '27). Kashiho (T., '31), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Pacific coast of North America (Alaska) ; Atlanitc coast of North America ; Arctic Ocean.

Remarks. The reproductive organs have long been unknown to this species. Setchell & Gardner (1925, p. 496, 499) once suggested that the study of the winter material might reveal the presence of the organs. In the latter part of April 1937, the writer was fortunate enouth to collect fructifying specimens with unilocular sporangia and those with plurilocular sporangia at Nishinotoro and Shiranushi respectively. In the external appearance and in the internal structure, these fertile specimens agree well with the descriptions of the species in the works above cited. The thallus is, however, a little thicker than that described, being 210–570μ, rarely up to 855μ in thickness. Both kinds of sporangia are collected in sori, occurring on different plants. The unilocular sporangia are lateral at the base of the free erect filaments, broadly clavate, up to 180μ long and 36μ broad. The erect filaments or paraphyses are very slightly clavate, composed of 5–7 cells, 165–200μ long, 6–9μ broad at the apices. In the sorus of the unilocular sporangia, especially near the periphery, are often found plurilocular sporangia at near the base of the ercet filaments. Sometimes the latter resembles apparently so-called "monstroses plurilokulares Sporangium" of *Ralfsia Borneti* Kuckuck, which is said to be found accompanied with the unilocular sporangia in one and the same sorus (cf. Kuckuck, 1894, fig. 15 E). The sori of plurilocular sporangia are 90–180μ high. The plurilocular sporangia are 5–6μ broad, formed by the transformation of all the cells, except the apical cells of the erect filaments. In the cross section of the sorus, the light green colored sporangial layer is bounded at the periphery by 1–3 layers of the sterile brown colored cells. The erect filaments are closely packed and covered by a common cuticula, never becoming free as in the unilocular sporangial sori. In the periphery of the sori they are either remaining sterile or in the course of the formation of the sporangia in the lower cells. Hairs are entirely wanting.

2. ***Ralfsia verrucosa*** (Aresch.) J. Agardh

Sp. Alg., I, 1848, p. 62; Kützing, 1859, pl. 77, fig. 2; Farlow, 1881, p. 87, pl. 5, fig. 5; Kjellman, 1883, p. 249; Hauck, 1885, p. 401, fig. 176; Reinke, 1889, pls. 5, 6; 1889*a*, p. 48; Kuckuck, 1894, p. 242, fig. 13 (with a query); De Toni, 1895*a*, p. 311; Setchell & Gardner, 1903, p. 253; 1925, p. 497; Yendo, 1918, p. 65; Newton, 1931, p. 153; Sinova, 1933, p. 27; Okamura, 1936, p. 143, fig. 70; Taylor 1937, p. 123, pl. 11, figs. 1, 2.

Cruoria verrucosa Areschoug, *in* Linnaea, XVIII, 1843, p. 264, pl. 9, figs. 5, 6.

Japanese name. Iso-iwatake (n. n.).

Habitat. Growing on the shells of *Mytilus*, in the littoral belt. W. coast: Kaiba-tô (T., '43).

Distribution. Hokkaido & Saghalien; Kamtschatka; Pacific coast of North America (Alaska to California); Atlantic coasts of North America and Europe; Arctic Ocean; North Sea; Baltic Sea; Mediterranean Sea; Adriatic Sea.

Remarks. The Saghalien plant, which was collected at the end of September, is provided with the sori of the unilocular sporangia. The crustaceous frond closely adherent on the substratum, is 0.5–1.5 mm. thick. The hairs are present, as Kuckuck assigned them for his Helgoland specimens referred with question to the present species. The paraphyses are up to 140μ long; their subapical segments are rarely beset with sheath-like appendages as in the case of the paraphyses of *Chordaria Nagaii* mihi. Plurilocular sporangia are not observed in the Saghalien plant.

Ralfsia verrucosa is supposed to be widely distributed in Japan, as suggested by Okamura (1936, p. 144), although it is at present actually known only from two localities, i.e., Hakodate and Kaiba-tô.

Series 2. **Heterogeneratae** Kylin

Ueber Entwickl. Phaeoph., 1933, p. 91.

Subseries 1. **Haplostichineae** (Kuckuck) Kylin

loc. cit., 1933, p. 91.
Haplostichales Kuckuck, Fragm. Monogr. Phaeosp., 1929, p. 6.

Order 3. CHORDARIALES Setchell et Gardner (*emend.* Kylin)

Mar. Alg. Pacific Cosat N. Amer., III, 1925, p. 570 ; Kylin, 1933, p. 92 ; 1940, p. 1 ; Okamura, 1936, p. 185.

Key to the Families

I. Fronds small, pulvinate or penicillate .... 4. **Elachistaceae**
II. Fronds larger, globular or expanded, carnose .... 5. **Leathesiaceae**
III. Fronds large, erect, cylindrical, simple or branched
  A. Central axis composed of a single central filaments ending in an apical hyaline hair .... 7. **Acrothricaceae**
  B. Central axis composed of a single or many central filaments, not ending in a hair .... 6. **Chordariaceae**

Family 4. Elachistaceae Kjellman

Handb. Skand. Hafsalgfl., 1890, p. 41 ; Okamura 1936, p. 144.

Key to the genera

I. Plurilocular sporangia intercalary or apical on the assimilating filaments, with pluriseriate loculi
  A. Paraphyses absent .... 7. *Leptonema*
  B. Paraphyses present .... 8. *Halothrix*
II. Plurilocular sporangia lateral at the base of assimilating filaments, with uniseriate loculi .... 9. *Gonodia*

7. **Leptonema** Reinke

in Ber. d. deut. bot. Ges., VI, 1888, p. 16 ; Atlas deut. Meeresalg., 1, 1889, p. 13 ; Algenfl. westl. Ostsee, 1889*a*, p. 50.

Leptonema fasciculatum Reinke

in Ber. d. deut. Bot. Ges., VI, 1888, pp. 16, 19 ; Atlas deut. Meeresalg., I, 1889, p. 13, pls. 9, 10 ; Algenfl. westl. Ostsee, 1889*a*, p. 50 ; Tokida & Ohmi, 1941, p. 428.

a. ***Leptonema fasciculatum*** var. ***subcylindricum*** Rosenvinge

Grönl. Havalg., 1893, p. 879 ; On Some Danish Phaeoph., 1935, p. 39, figs. 38, 39, (*sub* forma) ; Tokida & Ohmi, *loc. cit.*, 1941, p. 428, figs. 1 & 2.

Japanese name. Namimakura-modoki (Tokida & Ohmi).

Habitat. Growing on *Chaetomorpha Linum.* Aniwa Bay : Tôbuchi-ko (Ohmi, '40).

Distribution. Saghalien ; Arctic Ocean (Greenland) ; Europe (England and Denmark).

Thallus up to 3 mm. (ours 2 mm.) high, forming small tufts on other algae, arising from a basal creeping layer ; assimilating filaments cylindrical without constrictions at the joints, 7–16μ broad ; chromatophores a number of small discs in each cell ; plurilocular sporangia intercalary in the upper portion of the assimilating filaments, in long series, nearly cylindrical, often only slightly protruding ; unilocular sporangia unknown in the Saghalien plant.

Remarks. This minute interesting alga was discovered together with *Stictyosiphon tortilis* on the thallus of *Chaetomorpha Linum* collected by H. Ohmi in August 1940. Our specimens agree very well with the descriptions and figures of the present variety given by Rosenvinge (1893, p. 879 and 1835, p. 39, fig. 38). In the original diagnosis of his Greenland plant, Rosenvinge has given 8–15μ for the thickness of the vegetative and 14–19μ for that of the fructiferous filaments. Describing the Danish plant he gives 7–16μ for the breadth of the assimilating filaments without mentioning the differences between vegetative and fertile filaments. The fertile filaments of our Saghalien plant appear at a glance to be rather thinner than the sterile ones in the same tuft, measuring 10–12.5μ broad, although a careful search soon reveals the presence of thicker fertile filaments attaining to 16μ or over in breadth. Unilocular sporangia are not observed in our specimens. According to Resenvinge, they are rarely found in the Danish plant from April to July, most frequently in April and May ; they are 56–112μ long, 25–32μ broad, arising laterally near the base of the assimilating filaments.

This is the first record of the genus *Leptonema* from the Asiatic coast.

8. **Halothrix** Reinke

in Ber. d. deut. bot. Ges., VI, 1888, p. 16 ; Atlas deut, Meeresalg., I, 1889, p. 1 ; Algenfl. westl. Ostsee, 1889*a*, p. 49 ; Okamura 1936, p. 147.

Halothrix ambigua Yamada

Mar. Alg. Mutsu Bay, II, 1928, p. 513, fig. 12 ; Okamura, 1936, p. 148, fig. 75 ; Yamada & Tanaka, 1944, p. 56.

Japanese name. Somewake-gusa (Okamura).

Habitat. Growing on the leaves of *Zostera caespitosa.* Aniwa Bay : Tôbuchi-ko

(T., '41).

Distribution. Northern Honshû, Hokkaido and Saghalien.

Remarks. In northern Honshû (Mutsu Bay) and in Hokkaido (Oshoro, *leg.* Tokida, March 1931 ; Muroran, *leg.* T. Inaba, April 1936), *Halothrix ambigua* is growing on the leaves of *Phyllospadix iwatensis* Makino. In Saghalien (Lake Tôbuchiko, *leg.* Tokida, July 1941), it was found on the leaves of *Zostera caespitosa* Miki. In our Saghalien plant, the erect free filaments are 36–80μ thick at the broadest portion, the plurilocular sporangial sori up to 88μ thick, and the apical cells of the erect filaments 11–16μ thick. The cells are mostly short, but in the upper portion often elongate, attaining to five times as long as the diameter. In the thickness of the erect filaments, *Halothrix ambigua* (Yamada gives 70–100μ for their thickness at the broadest portion) excels *H. lumbricalis* (Kütz.) Reinke (Taylor, 1937, p. 151, gives 20–56μ for their thickness and 47–75μ for the thickness of the plurilocular sporangial sori). Unilocular sporangia, which were discovered by Yamada in his *H. ambigua*, are not observed in the Saghalien plant.

9. **Gonodia** Nieuwland

Critical Notes IX, 1917, p. 30.

Myriactis Kützing, Phyc. Gen., 1843, p. 330 (non *Myriactis* Lessing, 1831, which belongs to Compositae) ; Okamura, 1936, p. 189.

Gonodia Sargassi (Yendo) Setchell et Gardner

Plate IX, Fig. 3.

Mar. Alg. Gulf. Calif., 1924, p. 722.

Myriactis Sargassi Yendo, Nov. Alg. Jap., *in* Bot. Mag. Tokyo, 1920, p. 3 ; Okamura, 1936, p. 189.

Japanese name. Gonokenori (n. n.).

Habitat. Growing on the vesicles of *Sargassum Miyabei*, associated side by side with *Leathesia umbellata*. E. coast : Airô (T., '27).

Distribution. Hokkaido (Oshoro) and Saghalien.

Remarks. The present minute alga described by Yendo in 1920 is no doubt the same as that which was briefly noted by the same author in 1916 (p. 251) under the remarks on *Leathesia umbellata* Menegh. as follows : "Our plant (*L. umbellata*) is found copiously on the vesicles of *Sargassum Kjellmanianum* and is hitherto known with unilocular sporangia only. Apparently similar plant, with assimilators nearly homogeneous in diameter for the whole length, and closely resembling to *Myriactis pulvinata* but not identical to it, is always found associated with the present species." It is interesting to find this alga on the Saghalien plant of *Sargassum Miyabei* also being associated with *Leathesia umbellata*. The tuft of *Gonodia Sargassi* consists of much smaller number of filaments occupying much smaller area than that of *L. umbellata*, and penetrates rather deeply into the host tissue at the base while *L. umbellata* has no penetrating base at all. The assimilating filaments are, as stated by

Yendo, nearly homogeneous in diameter for the whole length, attenuating slightly toward both ends, composed of short articulations which are 10–14μ diam. and 8–24μ long, slightly constricted at the joints. The unilocular sporangia are clavate, 10-14μ in the maximum diameter and up to about 40μ in length. The plurilocular sporangia are cylindrical, 6μ diam. and nearly as long as the unilocular sporangia, with uniseriate loculi. The hairs, 7–8μ diam., are composed of longer segments upward.

Family 5. Leathesiaceae Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 507 ; Okamura, 1936, p. 185.
Corynophloeaceae Oltmanns, Morph. Biol. Alg., ed. 2, II, 1922, p. 23.

10. **Leathesia** Gray

Nat. Ar. Brit. Pl., I, 1821, p. 301 ; Okamura, 1936, p. 187.
Corynophlaea Kützing, Phyc. Gen., 1843, p. 331.

Key to the species

I. Fronds small, 1–3 mm. diam.
  A. Assimilators gradually enlarged upward ending in a cell 10–14μ diam .. 1. *L. umbellata*
  B. Assimilators abruptly enlarged at the apex ending in a spherical or obovoidal cell 18–27μ diam .... 2. *L. sphaerocephala*
II. Fronds variable in size, up to several centimeters in diameter .... 3. *L. difformis*

1. ***Leathesia umbellata*** (Agardh) Meneghini

Plate IX, Figs. 1–2

Alg. Ital., 1843, p. 307 ; J. Agradh, Sp. Alg., I, 1848, p. 51 ; Hauck, 1885, p. 345, fig. 149 ; Yendo, 1916, p. 250 ; Okamura, 1936, p. 189 ; Takamatsu, 1939, p. 8, pl. 1, fig. 4, text-fig. 5 ; 1939*a*, p. 34.
Corynephora umbellata Agardh, Aufzähl., no. 25, 1827.
Corynophlaea umbellata Kützing, Sp. Alg., 1849, p. 543 ; Tab. Phyc., VIII, 1858, pl. 2.

Japanese name. Kotsubu-nebarimo (Okamura).

Habitat. Growing on the vesicles of *Sargassum Miyabei*. E. coast : Airô (T., '27).

Distribution. Japan Sea side of northern Honshû and Hokkaido, Ochotsk Sea side of Saghalien ; Adriatic Sea ; Australian Sea.

Remarks. The occurrence of *Leathesia umbellata* in Japan was first reported by Yendo (*loc. cit.*) in 1916, as growing on the vesicles of *Sargassum Kjellmanianum* from Oshoro in Hokkaido, together with *Gonodia Sargassi*. Lately it has been reported again by Takamatsu from northern Honshû to be epiphytic on *Sargassum confusum*.

The fronds of our Saghalien plant are hemispherical, up to 700μ diam. The assimilating filaments are 90–140μ in length, clavate, gradually increasing in diameter upward, composed of 5–9 segments, which are cylindrical below, 4–6μ diam. and 16–22μ long, somewhat moniliform above, 9–14μ diam. and 8–20μ long. The unilocular sporangia are clavate to ellipsoidal or obovate in shape, usually sessile on the basal segment of assimilating filaments, 20–24μ diam. and 34–48μ long. The plurilocular sporangia are cylindrical, with uniseriate loculi, single or in twoes, sessile or pedicellate, on the basal segment of assimilating filaments, 6–8μ diam. and 52–82μ long. The hairs are cylindrical, 9–12μ (up to 16μ) diam., composed of longer cells above, up to 8 diameters long.

2. *Leathesia sphaerocephala* Yamada

Notes Some Jap. Alg., IV, 1932, p. 269, text-fig. 2 ; Okamura, 1936, p. 188 ; Nagai, 1940, p. 44 ; Yamada & Tanaka, 1944, p. 57.

Japanese name. Hime-nebarimo (Yamada).

Habitat. Growing on *Cystophyllum hakodatense.* Aniwa Bay : Nagahama (T., '35). E. coast : Rorei (T., '32), Noto (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien.

Remarks. *Leathesia sphaerocephala* is characterized by its assimilating filaments ending in a remarkably enlarged spherical to obovoidal cell measuring 18–20μ or over in diameter. In this respect the present species seems to be closely related to *Leathesia globulifera* Rupr., an epiphyte on the male receptacles of *Cystoseira Lepidium* (*Cystophyllum geminatum*) from Cape Nichta in the northern Ochotsk Sea. *L. globulifera* is said to be nearly allied to *L. umbellata,* from which it differs in having assimilating filaments ending in a large spherical, rarely oval, cell (Ruprecht, 1851, p. 391). However, *L. globulifera* has not been cited by any one since Ruprecht, so far as the writer is aware, and Ruprecht's rather incomplete description of the species scarcely enables us a critical comparison with any other species. *L. sphaerocephala,* originally known from Saruru, Prov. Kitami, on the Ochotsk coast of Hokkaido, has been described by Yamada to have sessile unilocular sporangia and no hairs. In reporting the present species from Kunashiri Island, Kuriles, Nagai has remarked the presence of hairs in his specimens. The writer has also observed fairly abundant hairs in his Saghalien plant, as well as in the specimens from Muroran, Prov. Iburi, Hokkaido, collected by T. Inaba in June 1936. The unilocular sporangia are usually sessile, but sometimes pedicellate in the Inaba's plant, while they are more frequently pedicellate than sessile in the Saghalien plant. They measure 30–60μ in length and 15–37.5μ in width. The assimilating filaments are 5–9–celled, ending in a large spherical to obovoidal cell measuring 18–27μ in diameter. Plurilocular sporangium is not observed yet.

3. ***Leathesia difformis*** (L.) Areschoug

Phyc. Scand., I, 1846, p. 376 ; Kjellman, 1883, p. 252 ; Hauck, 1885, p. 355 ; De Toni, 1895a, p. 422 ; Okamura, 1907, p. 80, pl. 18 ; 1927, p. 5 ; 1936, p. 187, fig. 97 ; Collins, 1919, p. 205 ; Howe, 1924, p. 136 ; Setchell & Gardner 1925, p. 511, pl. 40, fig. 52, pl. 43, figs. 65, 66 ; Takamatsu, 1936*a*, p. 50 ; 1938*a*, p. 87 ; 1939, p. 15, pl. 3, fig. 3, text-fig. 10 ; 1939a, p. 34 ; Taylor, 1937, p. 145, pl. 12, fig. 5, pl. 14, fig. 8 ; Sinova, 1938, p. 43 ; Nagai, 1940, p. 43 ; Yamada & Tanaka, 1944, p. 57.

Tremella difformis Linnaeus, Fl. Suec., ed, 2, 1755, p. 429

Japanese name. Nebarimo (Okamura).

Habitat. Growing on other algae, e.g., *Cladophora, Chordaria, Corallina,* etc. W. coast : Kaiba-tô (T., '30). Aniwa Bay : Tôbuchi-ko (T., '41). E. coast : Airô (T., '27).

Distribution. Kyûshû, Honshû, Hokkaidō, Kuriles and Saghalien ; Japan Sea coast of Siberia ; China ; Bering Sea ; Pacific coast of North America from Alaska to southern California ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. Most of our Saghalien specimens are bearing plurilocular sporangia. A few individuals with unilocular sporangia at hand are usually found to bear plurilocular sporangia on the same frond as in the case of Okamura's plant (1907, p. 81, pl. 18, fig. 6).

Family 6. Chordariaceae Reichenbach

Consp. Regn. Veg., 1828. p. 25 (*in part*) ; Okamura, 1936, p. 190 ; Kylin 1940, p. 5.

Key to the genera

I. Central axis composed of many sympodially built central filaments .... 11. *Eudesme*
II. Central axis with a single monopodially built central filament .... 12. *Sphaerotrichia*
III. Central axis composed of many, monopodially built central filaments ; subterminal meristem present at the frond apex
  A. Central axis composed of loosely anastomosing filaments
    1. Unilocular sporangia only present .... 15. *Saundersella*
    2. Unilocular and plurilocular sporangia present .... 16. *Heterosaundersella*
  B. Central axis composed of firmly agglutinated filaments
    1. Unilocular sporangia only present .... 13 *Chordaria*
    2. Unilocular and plurilocular sporangia present on different individuals .... 14. *Heterochordaria*

11. **Eudesme** J. Agardh

Till Alg. Syst., II, 1880, p. 29 ; Okamura, 1936, p. 191; Kylin, 1940, p. 31.

Eudesme virescens (Carm.) J. Agardh

Plate IX, Figs. 4-7 ; XIII, Fig. E

Till Alg. Syst., IV, 1885, p. 31 ; Kjellman, 1883, p. 251; De Toni, 1895*a*, p. 404; Kylin, 1940, p. 31, fig. 16 A.

Mesogloia virescens Carmichael, *in* Hooker, Br. Fl., II, 1833, p. 387 ; Harvey, 1846, pl. 82 ; 1852, pl. 10 ; Kützing, 1858, pl. 9.

Aegira virescens Setchell et Gardner, Phyc. Cont., VII, 1924, p. 11 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 547, pl. 42, figs. 59, 60 ; Kawabata, 1936, p. 203 ; Taylor, 1937, p. 140, pl. 12, fig. 3 ; 1939, p. 137 ; Nagai, 1940, p. 48; Yamada & Tanaka, 1944, p. 58.

Rivularia zosterae Mohr, Bemerk. Roth. Rivul., 1810, p. 367 (*fide* Reinke, 1889, p. 76 and Kylin, *loc. cit.*, p. 28).

Linkia zosterae Lyngbye, Hydr. Dan., 1819, p. 194, pl. 66 (*in part*) (*fide* Parke, 1933, pl. 21 and Kylin, *loc. cit.*, p. 28).

Mesogloia zosterae Kützing, Tab. Phyc., VIII, 1858, pl. 5.

Castagnea virescens Thuret, *in* Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 85; Newton, Handb. Brit. Seaw., 1931, p. 146, fig. 91.

Japanese name. Yezo-mozuku (n. n.), Nise-futomozuku (Yamada & Tanaka).

Habitat. Growing on rocks and on *Zostera* in the littoral and sublittoral belts. Aniwa Bay : Tôbuchi-ko (T., '35, '41). E. coast : Rorei (T., '32), Noto (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Alaska ; Chile ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. The character of our plant agrees quite well with the descriptions and illustrations of the anatomical structure of *Eudesme virescens* which have been given by Kylin (1933, p. 56, fig. 23) and by Parke (1933, p. 15). Unilocular sporangia often become nearly spherical in shape, measuring 50–108μ long and 30–63μ diam.

The peripheral assimilating filaments are mostly simple at the apical portions, but occasionally with short lateral branchlets which remind us of the initials of plurilocular sporangia. According to Kylin (1940, p. 31), however, it is quite uncertain at present whether the plurilocular sporangia are really present in *Eudesme virescens* or not. It should be noted here that as a matter of fact the writer has never met with true plurilocular sporangia in his material. The specimens from Lake Tôbuchi have an appearance somewhat different from the others, being less flaccid and smaller in external dimensions. When dried and pressed on paper, they are slightly over one mm. in breadth at most, while those from the other two localities reach four mm. in breadth in the broadest portion. Anatomical structures do not show any essential differences among them.

12. **Sphaerotrichia** Kylin

Phaeophyceenordnung Chordariales, 1940, p. 38.

Central axis with a single, monopodial central filament ; intercalary transverse division of the central filaments taking place only in the segments above the first branch of the filament ; only 2–4 cells present above the meristem, of which the uppermost one to two cells being spherical and particularly large ; central axis hollow, composed ot parenchymatically closely fitted cells ; thin rhizoids present only near the frond base ;

assimilating filaments moderately short, with a large spherical apical cell, consisting of 4–6 cells, enclosed entirely in mucilage ; typical phaeophycean hair present ; plurilocular sporangia unknown.

Sphaerotrichia japonica Kylin

Plate IX, Fig. 8

loc. cit., 1940, p. 38.

Chordaria Cladosiphon Okamura (*non* Kützing), Icon. Jap. Alg., III, 1915, p. 188, pl. 144, & 145, figs. 10–14 ; Nippon Kaisôshi, 1936, p. 198 ; Takamatsu, 1938, p. 14 ; 1939*a*, p. 35, pl. 5, fig. 2 ; Nagai, 1940, p. 47.

Chordaria Chordaria Okamura (*non* Howe), Mar. Alg. Mutsu Bay, I. 1927, p. 5.

Sphaerotichia divaricata (Ag.) Kylin, f. *typica* Inagaki, 1954, p. 11, figs. 8 a–e, 9.

Japanese name. Kusa-mozuku (Okamura).

Habitat. Growing on *Zostera* and on floating or sunken wood. Aniwa Bay : Tôbuchi-ko (Miyabe, '06 ; T., '29, '35, '41).

Distribution. Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China (?).

Remarks. The description of the present genus given above is a translation of the original diagnosis by Kylin (*loc. cit.*). In classifying the Japanese alga under consideration to his genus *Sphaerotrichia*, the Swedish author states : "Es sheint mir, als ob sie ziemlich nahe mit *Sphaerotrichia* (*Chordaria*) *divaricata* verwandt sei. Indessen ist es nur durch eine Untersuchung der Sprossspitze möglich, die Stellung der fraglichen Art sicher zu entscheiden". It is often rather difficult to detect the single central filament at the frond apex of this alga, and Okamura's figure (1915, pl. 144, fig. 4) has failed also to show it. With the intention of studying the structure of the frond apex, the writer brought home a considerable amount of this plant from Lake Tôbuchi in the summer of 1941. The result of his observation is as follows. The growing apex of the younger specimens is often provided with a single, projecting central filament ending in a large spherical cell or a moniliform series of 2 to 7 spherical cells. The lower part of the projecting portion of the central filament composed of narrow cylindrical cells is barely detectable for a few cells long, and we can recognize there the presence of a meristem composed of short cells. As far as the presence of the single central filament at the frond apex is concerned, the classification of our plant under *Sphaerotrichia* seems to be justified. In the shape of the apical portion of the central filaments, it seems to differ from the sister species, *Sphaerotrichia divaricata* (Ag.) Kylin (cf. Kylin, *loc. cit.*, fig. 20 C). The Chinese marine alga, which has been reported by Howe (1924, p. 136) under the name of *Chordaria Chordaria* (Harv.) Howe, is supposed to be identical with the species in question.

13. **Chordaria** Agardh (*emend.* Greville)

Syn. Alg. Scan. 1817. p. XII and p. 12 ; Greville, 1830, p. 44 ; Okamura, 1936, p. 195 ;

Kylin 1940, p. 39.

Key to the species

I. Fronds solid	1. *C. flagelliformis*
II. Fronds more or less hollow	
A. Fronds much branched	2. *C. firma*
B. Fronds simple	3. *C. Nagaii*

1. *Chordaria flagelliformis* (Müller) Agardh

Syn. Alg. Scan., 1817, pp. 12, xii ; Sp. Alg., I, 1, 1820, p. 166 ; Tokida, 1932, p. 8 ; Yamada, 1935, p. 13 ; Kawabata, 1936, p. 202 ; Taylor 1937, p. 143, pl. 12, fig. 6, pl. 14, fig. 4 ; 1939, p. 138 ; Kylin, 1940, p. 40, fig. 21 A, B.

Fucus flagelliformis Müller, Flor. Dan., 1771, pl. 650.

Key to the forms

I. Fronds much branched	a. f. *typica*
II. Fronds simple or only sparsely branched	b. f. *chordaeformis*

1a. *Chordaria flagelliformis* f. *typica* Kjellman

Om Spetsb. Mar. Thall., II, 1877. p. 28 ; Alg. Arct. Sea, 1883, p. 249 ; Setchell & Gardner, 1925, p. 573 ; Sinova, 1933, p. 16 ; 1938, p. 44 ; Nagai, 1940, p. 45 ; Yamada & Tanaka, 1944, p. 58.

Japanese name. Naga-matsumo (Okamura).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Pilevo (Miyabe, '06), Ushiro (Miyabe, '06), Tomarioru (T., '39), Rakuma (T., '30), Hirochi (T., '27), Yenchishi (Miyabe, '06), Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '26, '27), Nishinotoro (Morimoto, '25 ; T., '26, '35), Kaiba-tô (Morimoto, '30). Aniwa Bay : Chishiya (T., '35), Nobori (T., '26, '35), Ôtomari (Izumiyama, '06), Merei (Miyabe, '06), Nagahama (Miyabe, '06), Tôbuchi-ko (Miyabe, '06 ; T., '26, '35), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (T., '27), Sakaehama (T., '29), Higashi-sôya (T., '29), Kaihyô-tô (Kubo, '06 ; T., '30, '32), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Sp. – Middle Honshû, Hokkaido, Kuriles and Saghalien ; Japan Sea coast of Siberia ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Chile (Magellan Strait) ; North Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. Along the coasts of Japan, it seems to extend as far south as Rishiri Island and Muroran in Hokkaido, so far as the specimens at hand show. The southernmost locality ever reported for this species in Japan is Nou, Prov. Echigo, on the Japan Sea shore of Middle Honshû (cf. Okamura, 1936, p. 196). However, it is to be noted that the occurrence of *Chordaria flagelliformis* in northern Honshû has not been reported by Takamatsu, who lately performed a thorough algological survey of that region (1936, 1936*a*, 1938, 1938*a*, 1939*a*). In southern Saghalien, this alga is one of the most common and abundant seaweeds, and is not rarely gathered by fishermen to use as a substitute for "mozuku" (*Nemacystus decipiens* (Sur.) Kuck.), a common edible seaweed in Japan. As to the use of this alga as food in Kamtschatka, Ruprecht (1851, p. 374) states as follows: "An der SW Küste Kamtschatkas bei Javina ist die dicke Form häufig auf *Mytillus* is Gesellschaft mit *Halosaccion glandiforme*; sie heisst bei den dortigen Kamtschadales "Nebbpett" und wird, mit verschiedenen Beeren vermischt, gegessen".

1b. *Chordaria flagelliformis* f. *chordaeformis* Kjellman

Om Spetsb. Mar. Thall., II, 1877, p. 28, pl. 1, figs. 13–15; Alg. Arct. Sea, 1883, p. 249; Tokida, 1934, p. 17; pl. 1; Kawabata, 1936, p. 202; Okamura, 1936, p. 196; Nagai, 1940, p. 46; Yamada & Tanaka, 1944, p. 58.

Japanese name. Himo-nagamatsumo (Yamada).

Habitat. Growing on rocks in the upper sublittoral belt. Aniwa Bay: Nobori (T., '35). E. coast: Sakaehama (T., '29), Kaihyô-tô (T., '30, '32), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien; Arctic Ocean.

Remarks. The occurrence of the present form outside its type locality, the Arctic Ocean, was first reported by Yamada (1932, p. 269, pl. 4) from Akkeshi in Hokkaido and Chinomichi in Kunashiri Island, Kuriles. It is occasionally found intermingling with the typical form of this alga.

2. *Chordaria firma* Gepp

Chin. Mar. Alg., 1904, p. 162, pl. 460, figs 7, 8; Okamura, 1915, p. 183, pl. 143, 145, figs. 1–9; 1927, p. 5; 1936, p. 196; Takamatsu, 1938, p. 15; 1938*a*, p. 89; 1939*a*, p. 35, pl. 6, fig. 3; Kylin, 1940, p. 40.

Japanese name. Ishi-mozuku (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Kaiba-tô (T., '30; Morimoto, '37).

Distribution. Kyushû, Shikoku, Honshû, Hokkaido, Saghalien and Korea; China.

Remarks. The present species, which is commonly spread in the warmer parts of Japan, comes northwardly along the Japan Sea shore of Hokkaido as far as Kaiba-tô Island, but does not reach the coastal waters of Saghalien proper.

3. *Chordaria Nagaii* Tokida

Phyc. Observ., IV, 1938, p. 213, figs, 1–4; Nagai, 1940, p. 47; Yamada & Tanaka, 1944, p. 58. *Chordaria* sp. Kawabata, List Mar. Alg. Isl. Shikotan, 1936, p. 203.

Chordaria sp. Tokida, Taxon, & Phytogeogr. Stud. Mar. Alg. Saghalien, (Prelim. Rept.), 1936, p. 250, no. 18.

Japanese name. Nise-tsurumo (Tokida).

Habitat. Growing on stones and pebbles in the sublittoral belt. W. coast : Sôni (T., '27), Shiranushi (T., '35), Nishi-notoro (T., '32). Aniwa Bay : Chikatomari (Herb. Fish. Exper. St., Saghal.). E. coast : Chiriye (T., '30), Kaihyô-tô (T., '32, '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien.

Remarks. Yamada has kindly called the attention of the writer to the fact that the peripheral assimilating filaments or paraphyses illustrated by the writer in Fig. 4 a–c of the paper above cited bears some resemblance to the erect filaments of *Microsporangium Kuckuckianum* Schiffner illustrated by Schiffner (1916, figs. 79, 80). However, after a careful examination of properly fixed specimens collected at Akkeshi in Hokkaido, he also informed the writer that "the peripheral filament" is not to be considered as an epiphyte but as a tissue of the alga itself. As has already been noted by the writer himself in his paper above cited, this species is placed in the genus *Chordaria* but provisionally. The writer has been strongly inclined to consider it as representing a new genus, and is going to establish a new genus collaborating with Prof. Y. Yamada in a work of Mr. K. Inagaki on the Chordariales of Japan to be published in near future.

14. **Heterochordaria** Setchell et Gardner

Phyc. Cont., VII, 1924, p. 6 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 550 ; Okamura, 1936, p. 199 ; Kylin, 1940 p. 42.

Heterochordaria abietina (Rupr.) Setchell et Gardner

Phyc. Cont., VII, 1924, p. 6 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 555, pl. 36, figs. 18, 19, pl. 91 ; Okamura, 1927 p. 6 ; 1933, p. 87 ; 1936, p. 199, fig. 104 ; Yamada, 1934 p. 344 ; Kawabata, 1936, p. 203 ; Takamatsu, 1936, p. 10 ; 1936*a*, p. 51 ; 1938, p. 15 ; 1938*a*, p. 89 ; Nagai, 1940 p. 51 ; Kylin 1940, p. 42.

Chordaria abietina Ruprecht, *in* Farlow, List Mar. Alg. U. S., 1875, p. 357 ; De Toni, 1895, p. 53 ; 1895*a*, p. 434 ; Okamura, 1910, p. 122, pl. 85, figs. 8–15 ; Sinova, 1933, p. 16 ; 1938, p. 44.

Japanese name. Matsumo (Okamura).

Habitat. Growing on rocks in the littoral belt. W. coast : Pilevo (Miyabe, '06), Sokorai (Miyabe, '06), Muitomari (Ishii), Yenchishi (T., '26), Hishitoma (T., '26), Shiranushi (T., '26), Nishinotoro (T., '35), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Chishiya (T., '35), Nobori (T., '35), Merei (T., '26), Kochôbetsu (Matsubara, '33). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Airô (T., '27), Sakaehama (T., '29), Yôman (T., '35).

Distribution. Honshû, Hokkaido, Kuriles and Saghalien ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Aleutian Islands ; Pacific coast of North America

(Alaska to California).

Remarks. This is one of the most common and ubiquitous seaweeds in Saghalien. It flourishes from early spring to late summer. In April, luxuriant associations of the typical and the simple form (f. *simplex*) of the present species are observed on the shallow reefs at Shiranushi.

Setchell & Gardner state: "In the sporophyte, the zoosporangia seem to be confined to the ramuli, and this seems to be the case also with the gametangia of the gametophyte which have not been seen to occur on the main axis." This is not so, however, with the specimens examined by the writer, in which both unilocular and plurilocular sporangia are by no means confined to the ramuli but occur also on the main axis. The main axes and the ramuli are quite rarely branched, either subdichotomously or monopodially respectively.

In classifying *Heterochordaria* in the Chordariaceae, the writer follows Kylin (1940) at present, without entering into a discussion upon the problem concerning the life-history of *H. abietina.*

a. ***Heterochordaria abietina*** f. ***simplex*** Tokida, f. nov.

Axe principale nudo, ramulis nullis.

Japanese name. Himo-matsumo (n. n.).

Habitat. Growing on rocks in the littoral belt. W. coast: Shiranushi (T., '37), Nishinotoro (T., '37). E. coast: Yôman (T., '35).

Distribution. Endemic.

Main axis naked, with no ramuli.

Remarks. This form reminds us at a glance *Heterochordaria Gunjii* (Yendo) Tokida, but it can easily be distinguished from the latter in having the prostrate frond characteristic of *H. abietina.* From the typical form of *H. abietina,* it differs not only in being entirely naked but also in its clavate, somewhat thicker, erect frond. Unilocular and plurilocular sporangia are formed on the erect frond of different individuals. Although there may exist some intermediate forms between the present and the typical, the writer holds that it would be convenient to treat the naked form as a forma which sometimes playes the predominant part of an association in the localities mentioned above.

15. **Saundersella** Kylin

Phaeophyceenordnung Chordariales, 1940, p. 41.

Frond attached by a small scutate disc, filiform, simple, hollow, composed of an inner tissue of quite loosely anastomosing colorless filaments giving rise to short, compact, vertical, assimilating filaments. Hairs scattered. Rhizoidal filaments arising from the inner cortical cells. Unilocular sporangia arising at the base of the assimilating filaments. Plurilocular sporangia unknown.

Saundersella simplex (Saunders) Kylin

loc. cit., 1940. p. 42 ; Yamada & Tanaka, 1944, p. 57.

Mesogloia simplex Saunders, Harrim. Alaska Exped., Alg., 1901, p. 423, pl. 50, figs. 2-4.

Gobia simplex Setchell et Gardner, Phyc. Cont., VII, 1924, p. 12 : Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 576, pl. 42, fig. 58, pl. 78 B ; Okamura, 1929, p. 2, text-figs. 1, 2, pl. 251, figs. 8, 9 ; 1936, p. 202, fig. 107 ; Kawabata, 1936, p. 203 ; Nagai, 1940, p. 44.

Japanese name. Motsuki-chasômen (n. n.), Gobia (Okamura).

Habitat. Growing on *Chordaria flagelliformis*. W. coast : Pilevo (Miyabe, '06), Sokorai (Miyabe, '06), Sôni (T., '26), Shiranushi (T., 26', '27). Aniwa Bay : Nobori (T., '26, '35), Merei (Miyabe, '06). E. coast : Sakaehama (T., '29).

Distribution. Hokkaido, Kuriles and Saghalien ; Pacific coast of North America from Alaska to Vancouver Island.

Remarks The present alga, in the Japanese waters, is usually epiphytic on *Chordaria flagelliformis*, but rarely on *Heterochordaria abietina*, while in the American side of the Pacific the last mentioned species is the only one that has been known to be its host. Among our Saghalien specimens from the above localities, there is none that is epiphytic on that alga. Okamura once gave this plant a Japanese name "*Gobia*" after its former generic name *Gobia* Reinke (1889, p. 65). *Gobia baltica* Reinke, the type of the genus, has recently been revealed to be nothing but the Baltic Sea form of *Dictyosiphon Chordaria* Areschough (cf. Du Rietz, 1940, p. 35 ; Levring, 1940, p. 56 ; also cf. Kylin, 1940, p. 42). Consequently the second species of the genus, *Gobia simplex* (Saunders) Setchell et Gardner, which has correctly been assigned to the Chordariaceae by Setchell & Gardner, requires a new generic name. Kylin has established *Saundersella* upon that species. As it is not appropriate now to call the present alga "*Gobia*" in Japanese, the writer proposes here a new name as mentioned above. The third species of the genus *Gobia*, *G. saxicola* Okamura et Yamada, is so closely allied with *S. simpex* that it should be placed in the same genus.

16. **Heterosaundersella** Tokida

Phyc. Obs., V. 1942, p. 83.

Heterosaundersella Hattoriana Tokida

Plate XIII Fig. D

loc. cit., 1942, p. 84, figs. 2, 3.

Japanese name. Karafuto-mozuku (Tokida).

Habitat. Epiphytic on *Heterochordaria abietina*. E. coast : Yôman (T., '35).

Distribution. Endemic.

Remarks. In general constructions of the erect frond, the present species is closely related to *Saundersella simplex*, from which it differs in several remarkable characters as discussed by the writer in his paper cited above.

Family 7. Acrothricaceae Kuckuck

Fragm. Monogr. Phaeosp., 1929, p. 10 ; Okamura, 1936, p. 205 ; Kylin, 1940, p. 43.

17. **Acrothrix** Kylin

Algenfl. Schwed. Westk., 1907, p. 93 ; Okamura, 1936, p. 206.

Acrothrix pacifica Okamura et Yamada

Plates XXIV, XXV

in Yamada, Notes Some Jap. Alg., III, 1932, p. 113, text-fig. 2, pl. 24 ; Okamura, *loc cit.*, 1936, p. 206, fig. 110 ; Takamatsu, 1938*a*, p. 89, pl. 11. fig. 2 ; Kylin, 1940, p. 45 ; Inagaki, 1954, p. 6, fig. 6.

Nemacystus decipiens Ohmi (*non* Kuckuck), Mar. Alg. Lake Tôbuchi, 1940, p. 5.

Japanese name. Nise-mozuku (Okamura).

Habitat. Growing on *Chorda Filum* in the sublittoral belt. Aniwa Bay : Tôbuchi-ko (T., '29, '41 ; Ohmi, '40). E. coast : Airô (T., '27).

Distribution. Shikoku, Honshû, Hokkaido and Saghalien.

Frond epiphytic on *Chorda Filum* Lamx., over 30 cm. in height, cylindrical, fistulose and scarcely attaining 1 mm. in diameter below, gradually tapering above, repeatedly branched, more or less regularly alternate, branches gradually shortening from the base upwards ; assimilating filaments 4–11 cells long, 80–165μ in height, slightly constricted at the cross-walls, often slightly arcuate, the terminal cells cylindrical or ellipsoid, 13–38μ × 8–17μ ; terminal hair 13–15μ thick ; hairs arising from the basal cell of the assimilating filaments, scattered, 7–14μ thick ; unilocular sporangia ovate or subspherical, 38–58μ×20–54μ, sessile on the basal cell of the assimilating filaments.

Remarks. The description of the species given above is drawn from the Saghalien plant. In comparing our specimens with the type, through the kind permission of Prof. Yamada, the writer was at first inclined to hold that they are different specifically from the present species. The type specimen of *A. pacifica*, which is collected at Wagu, Prov. Kii, seems to be characterized to have very short and sparse assimilating filaments which scarcely reach 100μ in height, being frequently only 2–4 cells long and very sparsely scattered (cf. Yamada, 1932, fig. 2) or nearly lacking for a considerable area in the lower part of the frond. The assimilating filaments of the Saghalien specimens, on the other hand, are 4–11, mostly 7–9, cells long, usually over 100μ in height, consisting of longer cells than in the type, and uniformly scattered over the whole surface of the frond ; their subapical cells rarely produce a lateral protuberance which becomes later on 1–2–celled branchlets ; and abnormally enlarged apical cells are also rarely met with. However, on examining the specimens from Watanoha, Prov. Rikuzen, which the writer owes to Mr. I. Ôno, the writer found them to be an intermediate form linking those two extreme forms described above.

A. pacifica so far reported is always epiphytic on *Chorda Filum*. It is distributed from Shikoku (Prov. Iyo) and southern part of Honshû (Prov. Shima) northward along the Pacific side of northern Honshû (Prov. Rikuzen & Rikuchû) and also along both the Japan Sea side (Oshoro, *leg.* Tokida, July 1941) and the Pacific side (Akkeshi, *leg.* Tanaka, July 1941) of Hokkaido reaching as far north as the above mentioned localities in southern Saghalien. In Oshoro Bay, this alga flourishes at the innermost parts of the bay, during only two summer months. In the year 1941, it attained the full growth toward the end of June there, while in Lake Tôbuchi it was found at the end of July when it was still quite small, hardly reaching 2 cm. high. Unusual cold weather prevailed in early summer of that year was no doubt the cause of such a delay in growth of the alga. The specimens from Airô, collected on August 18, 1927, are fully grown, measuring about 15 cm. in height.

Order 4. DESMARESTIALES Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 554 ; Okamura, 1936, p. 214.

Family 8. Desmarestiaceae Kjellman

Enum. Pl. Scand., 1880, p. 10 ; Alg. Arct. Sea, 1883, p. 261 ; Okamura, *loc. cit.*, 1936, p. 214.

18. **Desmarestia** Lamouroux

Essai, 1813, p. 23 ; Okamura, *loc. cit.*, 1936, p. 214.

Key to the species

I. Fronds cylindrical or only very slightly compressed ; branching mainly opposite (Sect. Viridis)
   A. Fronds flaccid, with capillary branchlets .... 1. *D. viridis*
   B. Fronds more rigid, with coarser branchlets .... 2. *D. media*

II. Fronds compressed to slightly flattened, never strictly flattened-foliaceous, foliaceous, or cylindrical ; branching alternate, occasionally opposite below (Sect. Aculeatae). .... 3. *D. aculeata*

III. Fronds ligulate to broadly membranaceous or foliaceous ; branching abundant to very sparse or none, opposite or subopposite (Sect. Herbaceae) .... 4. *D. ligulata*

Section 1. **Viridis**

1. ***Desmarestia viridis*** (Müller) Lamouroux

Essai, 1813, p. 43 ; Postels & Ruprecht, 1840, p. 13 ; Hauck, 1885, p. 378 ; De Toni, 1895*a* p. 456 ; Saunders, 1901, p. 422 ; Okamura, 1910, p. 84, pl. 73, pl. 75, figs., 5, 6 ; 1927, p. 5 ; 1936, p. 215, fig. 115 (3, 4) ; Yamada, 1928, p. 506 : Newton, 1931, p. 164 ; Kawabata, 1936, p. 204 ; Takamatsu, 1936, p. 11, 1936*a*, p. 52 ; 1938, p. 17 ; 1938*a*, p. 92 ; 1939*a*, p. 36; Taylor, 1937, p. 160, pl. 13, fig. 3 ; Sinova, 1938, p. 42 ; Yamada & Tanaka, 1944, p. 59.

Fucus viridis Müller, Fl. Dan., 1771, pl. 886 ; Turner, 1809, p. 72, pl. 97.

Dichloria viridis Greville, Alg. Brit., 1830, p. 39, pl. 6 ; J. Agardh, 1848, p. 164 ; Kjellman, 1883, p. 263.

Japanese name. Ke-urushigusa (Okamura).

Habitat. Growing on rocks in the sublittoral belt ; frequently washed ashore. W. coast : Ushiro (Miyabe, '06), Tomarioru (Miyabe, '06 ; T., '30), Honto (Morimoto, '25), Nishinotoro (Morimoto, '25), Kaiba-tô (Morimoto, '33). Aniwa Bay : Nobori (T., '26), Nagahama (T., '35). Nakashiretoko (Miyabe, '06). E. coast : Airô (T., '27), Tonnai (T., '27), Noto (T., '35).

Distribution. Shikoku, Honshû, Hokkaido, Kuriles (?), Saghalien, Korea and Kwantôshû (Dalny) ; Gulf of Pechili ; Japan Sea coast of Siberia ; Alaska (?) ; Arctic coasts of North America and Europe ; North Sea : Baltic Sea.

Remarks. The specimens which the writer refers to *Desmarestia viridis* bear a close resemblance to the Massachusetts specimen which was identified by Farlow and has been distributed after his death, from Farlow's Herbarium to Emer. Prof. Miyabe. They are characterized by having capillary branchlets. On the other hand, they seem to be also closely related to *D. media* var. *tenuis* Setch. et Gardn., an authentic specimen of which is not available to the writer at present. According to Kylin (1933, p. 87), *D. viridis* belongs to the brown algae whose sporophytes attain their fertile stages in summer, late-summer, and in autumn. In Japanese plant, however, the sporangial sori are observed in March and April at Asamushi, Northern Honshû (cf. Abe, 1938, p. 475) and in May at Hakodate and Muroran in Hokkaido (Herb. J. Tokida). Our Saghalien specimens, which were collected in summer, are all sterile. They may possibly become fertile in autumn.

2. ***Desmarestia media*** (Ag.) Greville

Alg. Brit., 1830, p. xl ; Kützing, 1849, p. 571 ; 1859, pl. 95, fig. II ; Pease, 1917, p. 386 ; Setchell & Gardner, 1925, p. 561 ; Nagai, 1940, p. 52.

Sporochnus medius Agardh, Sp. Alg., I, 1, 1820, p. 153 ; Icon, Alg. Ined., Fasc. 2, 1821, pl. 16.

Desmarestia aculeata forma J. Agardh, Sp. Alg., I, 1848, p. 168.

D. aculeata var, *media* Rosenvinge, Grönl. Havalg., 1893, p. 858 ; De Toni, 1895, p. 459 ; Setchell & Gardner, 1903, p. 246 (*sub* forma).

Japanese name. Nagabo-urushigusa (Nagai).

Habitat. Washed ashore. W. coast : Ushiro (Miyabe, '06), Rakuma (T., 30), Kaiba-tô (Miyake, '06; T., '30). Aniwa Bay: Chishiya (T., '35).

Distribution. Kuriles and Saghalien; Alaska.

Remarks. The writer's specimens, especially those from Rakuma, agree quite well with the Alaskan specimen collected at Delarof Harbor, Unga, by Captain J. B. Downing in 1899, which has been distributed by Setchell & Gardner to the Herbarium of our University.

Section 2. **Aculeatae**

3. ***Desmarestia aculeata*** (L.) Lamouroux

Essai, 1813, p. 25; J. Agardh, 1848, p. 167 (forma *a*); Kjellman, 1883, p. 261; 1889, p. 50; 1890, p. 48; Hauck, 1885, p. 378, fig. 163; De Toni, 1895*a*, p. 458; Okamura, 1923, p. 193, pl. 199, figs. 5–9; 1936, pp. 215, 216 (*sub* forma ?); Sinova, 1933, p. 17; Yamada, 1934, p. 344; 1935, p. 15; Taylor 1937, p. 161, pl. 13, figs, 4, 5, pl. 14, fig. 7; Nagai, 1940, p. 53.

Fucus aculeatus Linnaeus, Sp. Pl,. ed. 2, 1763, p. 1632.

Desmarestia latifrons Okamura (*non* Ruprecht), Icon, Jap. Alg., II, 1910, p. 86, pl. 74, pl. 75, fig. 7 (*sec.* Okamura 1936, p. 216).

Japanese name. Toge-urushigusa (Okamura).

Habitat. Washed ashore. E. coast: Airô (T., '27), Rorei (T., '32), Sakaehama (T., '29), Naibuchi (Miyabe, '06), Higashishiraura (T., '31).

Distribution. Hokkaido, Kuriles and Saghalien; Kamtschatka; Bering Sea; Atlantic coasts of North America and Europe; Arctic Ocean; North Sea; Black Sea.

Remarks. The present species has been known to occur in Japan on the Ochotsk Sea side of Saghalien and throughout the entire range of the Kuriles. In Hokkaido proper it was once collected by the writer at Nishiwada, Prov. Nemuro, in September 1925.

Section 3. **Herbaceae**

4. ***Desmarestia ligulata*** (Lightf.) Lamouroux

Essai, 1813, p. 25; De Toni, 1895a, p. 460 (excl. var.); Okamura, 1910, p. 82, pl. 72, pl. 75, figs. 1–4; 1927, p. 5; 1936, p. 216, fig. 115, (1, 2); Pease, 1917, p. 388; 1920, pp. 314, 332, pl. 54, figs. 1, 2, pl. 62, figs. 1–7, pl. 63; Setchell & Gardner, 1925, p. 566, pl. 87; Kawabata, 1936, p. 204; Takamatsu, 1936, p. 11; 1936*a*, p. 52; 1938, p. 17; 1938*a*, p. 91; 1939*a*, p. 36; Newton, 1931, p. 164; Taylor, 1939, p. 138; Nagai, 1940, p. 54; Yamada & Tanaka, 1944, p. 59.

Fucus ligulatus Lightfoot, Flora Scotia, II, 1777, p. 946, pl. 29.

Japanese name. Urushi-gusa.

Habitat. Washed ashore. W. coast: Kaiba-tô (Miyake, '06; Morimoto, '33). Aniwa Bay: Chishiya (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien; Pacific coasts of North America (Washington) and of South America (Chile); Atlantic coasts of Europe and North Africa; South America (Falkland Islands and Magellan Strait).

Remarks. Only a few sterile specimens are before us. The writer has lately succeeded to collect fertile individuals of this alga at Oshoro near Otaru Harbour, Hokkaido, in the earlier part of May, 1942. The zoosporangial sori are very small, hemispherical in shape, measuring from 0.27 × 0.37 mm. to 0.37 × 0.45 mm., and dark brown in color. They are borne laterally on the margins of the upper branchlets or intercalary on the ultimate ramuli.

Subseries 2. **Polystichineae** (Kuckuck) Kylin

Ueber d. Entwickl. d. Phaeoph., 1933, p. 91.
Polystichales Kuckuck, Fragm. Monogr. Phaeosp., 1929, p. 6.

Order 6. DICTYOSIPHONALES Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 586 ; *emend*. Papenfuss, *in* Bull. Torry Bot. Club, 74 (5), 1947, pp. 398-401 ; Okamura, 1936, p. 239.
incl. Punctariales Kylin. Entwicklungsgesh. Phaeoph., 1933, p. 93 ; Okamura, 1936, p. 218.

Key to the Families

I. Unilocular and plurilocular sporangia present
  A. Sori definite, superficial or partially projecting
    1. Fronds membranous .... 9. **Punctariaceae**
    2. Fronds cylindrical .... 11. **Striariaceae**
  B. Sori definite or indefinite, entirely projecting ; fronds cylindrical or saccate .... 10. **Asperococcaceae**
II. Plurilocular sporangia only present ; sori indefinite, superficial .. 12. **Scytosiphonaceae**
III. Unilocular sporangia only present, immersed in the cortical tissue
  A. Growth in length of sporophyte by intercalary cell division .... 13. **Coilodesmaceae**
  B. Growth in length of sporophyte by a single apical cell ...... 14. **Dictyosiphonaceae**

Family 9. Punctariaceae Kjellman

in Gleerup, Enum. Pl. Scand., 1880. p. 9 ; Okamura, 1936, p. 218.

19. **Punctaria** Greville

Alg. Brit., 1830. p. 52 ; Syn., 1830, p. xlii ; Okamura, 1936. p. 218.

Punctaria plantaginea (Roth) Greville

Plate X, Figs. 1-2 ; XII, Fig. E

Alg. Brit., 1830, p. 53, pl. 9 ; J. Agardh. 1848, p. 73 ; Farlow, 1881, p. 64, pl. 4, fig. 5 ; De Toni, 1895*a*. p. 475 ; Okamura, 1927, p. 4 ; 1936, p. 220 ; Lakowitz, 1929, p. 240 ; Takamatsu, 1936, p. 9 ; 1938, p. 12 ; 1938*a*, p. 88 ; Taylor, 1937, p. 171, pl. 15, fig. 4, pl. 16, fig. 4 ; Yamada & Tanaka. 1944, p. 59.

Ulva plantaginea Roth, Catal, Bot., II, 1800, p. 243, III, 1806, p. 326.

Homoeostroma plantagineum J. Agardh, Anal. Alg., Cont. III, 1896, p. 11 ; Yendo, 1909, p. 121.

Japanese name. Haba-damashi (Okamura).

Habitat. On stones or on other algae, e.g., *Rhodomela* and *Odonthalia*. Aniwa Bay : Chishiya (T., '37), Merei (Miyabe, '06). E. coast : Airô (T., '27), Rorei (T., '32), Sakaehama (T., '29), Noto (T., '35).

Distribution. Northern Honshû, Hokkaido and Saghalien ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

"Plant in the form of broadly lanceolate blades arising from small basal disks, the stalks short, the blades with tapered bases, obovate-lanceolate, often mechanically split or truncate toward the tip, in length usually less than 2 dm., but to 6.5 dm., flat or very little undulate at the margin ; texture somewhat firm., even coriaceous, 4–7 cells and 110–225μ thick, cell membranes rather heavy, surface cells 15–40μ diam. ; plurilocular gametangia somewhat increasing the thickness of the thallus, to as much as 50 per cent, their lower parts sunken in the surface layer, oblong or obovoid, 30–48μ long, 20–34μ diam. ; unilocular sporangia (?) nearly globose, 32–48μ diam."

Remarks. The description of the species given here is cited from Taylor's work (*loc. cit.*). Our plant agrees very well with this description as well as with the illustrations of the present species given by the same author. This is probably the thickest species of *Punctaria*. Our specimens are sometimes reaching to 7–9 cells and 240–250μ (–300μ) thick. The plant is often irregularly perforated, and split or truncate toward the tip. Dried specimens are dark brown in color, and adhere well to paper. The largest specimen at hand, which was collected at Chishiya in spring, measures about 40 cm. in length and 6 cm. in breadth.

The occurrence of the present species in Japan was reported for the first time by Yendo from Nemuro Bay, Hokkaido, and again by Okamura from Mutsu Bay, northern Honshû. In his Nippon Kaisôshi, the latter author refers only to Yendo's work and stated that the identification of the Japanese plant is not certain. Recently Takamatsu reported this species from various localities in northern Honshû. The Alaskan plant reported by Saunders (1901, p. 420) under *P. plantaginea* is suggested by Setchell & Gardner (1925, p. 518) to belong to *P. fissilis* Setch. et Gardn. The last mentioned authors state : "We have not seen any typical *P. plantaginea* from our territory."

In the writer's collection, there are also found several other species of *Punctaria*. They are left undetermined at present, because monographical investigations of the genus seem to be necessary for their identification.

Family 10. Asperococcaceae Foslie

Mar. Alg. Norway., Cont. I, 1890, p. 88 ; Okamura, 1936, p. 221.

20. **Myelophycus** Kjellman

in Engler & Prantl. Natürl. Pflanzenfam., 86 Lief., 1893, p. 202 ; Om Fuc. Myelophycus, 1893, pp. 1–11 ; Okamura, 1936, p. 223.

Myelophycus intestinale Saunders

Alg. Harriman Alaska Exped., 1901, p. 420, pl. 47 (*sub Myelophycus intestinalis*) ; Setchell & Gardner, 1903, p. 241 ; 1925, p. 527 ; Sinova, 1930, p. 96 ; 1933. p. 14 ; Okamura, 1933, p. 86 ; 1936, p. 225.

Japanese name. Yezo-iwahige (n. n.).

Habitat. Growing on rocks in the littoral belt. W. coast : Shiranushi (T., '37), Nishinotoro (T., '26, '32). Aniwa Bay : Chishiya (T., '37), Nobori (T., '37). E. coast : Airô (T., '27), Rorei (T., '32).

Distribution. Hokkaido and Saghalien ; Ochotsk Sea ; Kamtschatka ; Pacific coast of North America.

Remarks. The occurrence of the present species in the Ochotsk Sea was first reported by Sinova from Grand Schantar Island (1930, p. 96). The species is distributed southwards along the coasts of Saghalien Island as far south as Atsubetsu, Prov. Hidaka (T., June 1925) and Muroran (T., May 1934) in Hokkaido. Some specimens collected at Muroran in late spring are the largest among the specimens in the writer's possession. They measure up to 30 cm. in height and 4 mm. in breadth. In Saghalien, the plant collected in April, in spite of being still sterile, was larger than that gathered in summer. Summer fertile plants are sometimes much reduced in size and apparently resemble f. *tenue* Setch. et Gardn. The dimensions of the internal structures seem to be fairly variable in this species. The following table shows the results of the writer's own observation on his specimens from Rorei and Muroran, accompanied with the original measurement given by Saunders for his Alaskan plant.

	Rorei	Muroran	Alaska
Paraphyses :			
length	57–150 μ	105–180 μ	—
number of cells	6–12	11–15	4–8
diam. of the apical cell	18–24 μ	18–24 μ	45–60 μ
Unilocular sporangia :			
height	33–60 μ	48–84 μ	20–30 μ
breadth	30–42 μ	27–39 μ	20–30 μ
Hairs :			
diam. at the base	7.5 μ	7.5 μ	—
diam. in the upper portion	0.5–15 μ	12–13.5 μ	—

Family 11. Striariaceae Kjellman

Handbok I. 1890, p. 53 ; Okamura, 1936, p. 225.

21. **Stictyosiphon** Kützing

Phyc. Gen., 1843, p. 301.

Stictyosiphon tortilis (Rupr.) Reinke

Algenfl. Westl. Ostsee, 1889, p. 55 ; Atlas deut. Meeresalg., 1889*a*, p. 47, pl. 31-32 ; Rosenvinge, 1893, p. 868 ; 1935, p. 3 ; De Toni 1895*a*, p. 468 ; Setchell & Gardner, 1925, p. 529 ; Sinova, 1930, p. 97 ; 1933, p. 16 ; Taylor, 1937, p. 179 ; Tokida & Ohmi, 1941, p. 429, fig. 3.

Scytosiphon tortilis Ruprecht, Tange Ochot. Meer., 1851, p. 373.

Phloeospora tortilis Areschoug, *in* Bot. Not., 1876, p. 34 ; *in* Hedwigia, 1876, p. 139 ; Kjellman, 1877*a*. pl. 1, fig. 1 ; 1889. p. 50.

P. pumila Kjellman, Algveget. Murm. Meer., 1877, p. 45, pl. 1, figs. 16-22 ; 1883, p. 265.

Japanese name. Habano-himo (Tokida & Ohmi).

Habitat. Growing on *Chaetomorpha Linum.* Aniwa Bay : Tôbuchi-ko (Ohmi, '40).

Distribution. Saghalien ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Alaska : Arctic Sea ; North Atlantic coasts of North America and Europe ; North Sea ; Baltic Sea.

Remarks. The type locality of the present widely spread species is Ajan on the north-western coast of the Ochotsk Sea. In our boundary this species is represented at present by only a few small fertile specimens of unbranched frond wanting growing apex. They agree very well with the unbranched Danish plant described by Rosenvinge (1935, pp. 5–6, figs. 2–5), except the presence of hairs. The chromatophore is disc-shaped, several in each cell, as illustrated by Rosenvinge, instead of band-shaped as generally described by other authors. Setchell & Gardner (1925, p. 530) describe the presence of both kinds of sporangia in *S. tortilis.* However, other authors do not mention about the unilocular sporangium in their descriptions of this species, and Rosenvinge (1935, p. 4) states : "it must provisionally be supposed that only plurilocular sporangia are known in this species." Our plant also bears plurilocular sporangia only.

Family 12. Scytosiphonaceae Foslie

List Mar. Alg. Isle of Wight, 1892, p. 13 ; Okamura, 1936, p. 226.

Key to the genera

I. Fronds hollow, cylindrical or globose
  A. Fronds narrowly cylindrical, usually constricted at intervals ...... 22. *Scytosiphon*
  B. Fronds globose with or without erect, irregularly cylindrical projections, not constricted .... 23. *Colpomenia*
II. Fronds solid, leaflike .... 24. *Ilea*

22. **Scytosiphon** Agardh (*emend.* Thuret)

Dispos. Alg. Suec., 1811, p. 24 (*in part*) ; Thuret, 1850, p. 239 ; Okamura, 1936, p. 227

Scytosiphon Lomentaria (Lyngb.) J. Agardh

Sp. Alg., I. 1848, p. 126 ("*S. lomentarium*") ; Kjellman, 1883, p. 258 ; 1889, p. 49 ; De Toni, 1895, p. 56 ; 1895*a*, p. 485 ; Saunders, 1901 p. 421 ; Okamura, 1908, p. 144, pl. 30 ; 1936, p. 227, fig. 121 ; Cotton, 1915. p. 111 ; Howe, 1924, p. 136 ; Sinova, 1930. p. 96 ; 1933, p. 15 ; 1938, p. 42 ; Setchell & Gardner, 1925, p. 531, pl. 44, figs. 72, 74, 75 ; Yamada, 1925, p. 242 ; 1928, p. 506 ; 1934, p. 344 ; Tokida, 1932, p. 7 ; Kawabata, 1936, p. 202 ; Takamatsu, 1936, p. 10 ; 1936*a*. p. 51 ; 1939*a*, p. 37 ; Taylor, 1937, p. 174, pl. 15, fig. 2, pl. 16, fig. 3 ; 1939, p. 139 ; Nagai 1940, p. 58 ; Yamada & Tanaka, 1944, p. 60.

Chorda Lomentaria Lyngbye, Hydrophyt. Dan., 1819, p. 74. pl. 18, fig. E.

Key to the forms

I. Plants constricted at intervals .... a. f. *typicus*
II. Plants not constricted
  A. Plants usually twisted .... b. f. *tortilis*
  B. Plants not twisted
    1. Plants 5–18 cm. high, 0.5–2 mm. diam .... c. f. *cylindricus major*
    2. Plants 2–6.5 cm. high, 0.3–0.55 mm. diam .... d. f. *cylindricus nanus*

a. *Scytosiphon Lomentaria* f. *typicus* Setchell et Gardner

in Phyc. Bot. Amer., (Exsicc.), no. 323 b ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 533, pl. 39, fig. 45, pl. 44, fig. 75 ; Nagai 1940, p. 58.

Scytosiphon Lomentaria var. *typicus* Rosenvinge, Grönl. Havalg., 1893, p. 863 (*sub α. typica*) ; Sinova, 1930, p. 97.

Japanese name. Kayamo-nori.

Habitat. Growing on rocks in the littoral belt and in tide pools. W. coast : Pilevo (Miyabe, '06), Sôni (T., '27), Shiranushi (T., '26, '32), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Ishihama (T., '26), Nobori (T., '35), Merei (Miyabe, '06), Nakasôya (Ishii, '25), Tôbuchi-ko (Miyabe, '06 ; T., '35), Yaman (Ishii, '25). E. coast : Higashishiraura (T., '31), Noto (T., '35), Yôman (T., '35).

Distribution. Sp. – Formosa, Kyushû, Shikoku, Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; China ; Kamtschatka ; Bering Sea ; Pacific coast of North America ; Arctic Ocean ; Atlantic coasts of North and South America and of Europe ; Baltic Sea ; Mediterranean Sea.

Remarks. As has been stated by Setchell & Gardner (1925, p. 532), *Scytosiphon Lomentaria* is a widespread and variable species. Besides the typical form bearing constrictions, there occur at least three unconstricted forms on the coast of Saghalien Island, one of which seems to be undescribed as yet.

b. ***Scytosiphon Lomentaria*** f. ***tortilis*** Yamada

Mar. Alg. Urup, 1935, p. 12, pl. 1 ; Kawabata, 1936, p. 202 ; Okamura, 1936, p. 228 ; Nagai, 1940, p. 59 ;

Japanese name. Yore-kayamo (Yamada).

Habitat. Growing on rocks exposed to wave action along hightide level. W. coast : Sôni (T., '27), Kaiba-tô (T., '30 ; Morimoto, '33). E. coast : Sakaehama (T., '29).

Distribution. Kuriles and Saghalien.

Remarks. Our specimens referred to the present form are 5–17 cm. high, 0.5–2 mm. diam., dark brown in color, cylindrical, not constricted, and more or less contorted and twisted.

c. ***Scytosiphon Lomentaria*** f. ***cylindricus major*** Setch. et Gardn.

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 533.

Japanese name. Ito-kayamo (n. n.).

Habitat. Growing on *Phyllospadix* in tide pools. W. coast : Kaiba-tô (T., '30).

Distribution. Saghalien ; Central California.

Remarks. The specimens which the writer refers to this form are gregarious on the leaves of *Phyllospadix.* They are 5–18 cm. high, 0.5–2 mm. diam., cylindrical, light brown in color, and not constricted nor twisted. The habitat of our plant differs from that of the Californian plant which is stated to grow on rocks in the lower littoral or in tide pools in the upper littoral belts. According to Nagai (1940, p. 59), "f. *cylindricus* is found more widely throughout the Kuriles than is either of the others (f. *typicus* & f. *tortilis*)". He does not mention, however, if his plant belongs to which of the two categories, *major* and *minor*, distinguished by Setchell & Gardnei.

d. ***Scytosiphon Lomentaria*** f. ***cylindricus nanus*** Tokida, subf. nov.

Fronds filiform, 2–6.5 cm. long, 0.3–0.55 mm. diam., tapering toward both ends, unconstricted, usually not twisted, light brown in color.

Japanese name. Hime-kayamo (n. n.).

Habitat. Growing on rocks in the upper littoral belt. W. coast : Sôni (T., '26). Aniwa Bay : Nobori (T., '26).

Distribution. Endemic.

Remarks. This form differs from f. *cylindricus major* and *minor* in having a thinner frond.

23. **Colpomenia** Derbes et Solier

Mem. Phys. Alg., 1856, p. 11 ; Okamura 1936, p. 230.

Colpomenia sinuosa (Roth) Derbes et Solier

loc. cit., 1856, p. 11, pl. 22, figs. 18–20 ; De Toni, 1895, p. 55 ; 1895a. p. 489 ; Saunders, 1898, p. 164, pl. 32, figs. 7, 8 ; 1901, p. 421 ; Okamura, 1898 p. 9 ; 1907, p. 86, pl. 19, figs. 11–12, pl. 20, figs. 10–12 ; 1936, p. 230, fig. 123 ; Howe, 1914, p. 50 ; 1924, p. 136 ; Collins, 1919, p. 205 ; Setchell & Gardner, 1925, p. 539, pl. 45, figs, 82–86 ; Yamada, 1925, p. 241 ; 1928, p. 506 ; Taylor, 1928, p. 110 ; 1931, p. 294 ; 1939, p. 139 ; Sinova, 1933, p. 15 ; Kawabata, 1936, p. 202 ; Takamatsu, 1936, p. 8 ; 1936*a*, p. 49 ; Nagai, 1940, p. 59 ; Yamada & Tanaka, 1944, p. 60.

Ulva sinuosa Roth, Catal. Bot., III, 1806, p. 327, pl. 12, fig. a.

Encoelium sinuosum Agardh, Sp. Alg., 1820, p. 146 ; Syst. Alg., 1824, p. 262 ; Martens, 1866, p. 26 & p. 113.

Asperococcus sinuosus Bory, Moree, III, 1832, p. 326 ; J. Agardh, 1848, p. 75.

Hydroclathrus sinuosus Zanardini, Icon. Phyc. Adriat., I, 1860, p. 109 ; Hauck, 1885, p. 393, fig. 171.

Japanese name. Fukuronori (Okamura).

Key to the forms

I. Fronds approximately globose, very thin and smooth .... a. f. *typica*
II. Fronds thick, extending into one to several long, finger-like lobes ...... b. f. *deformans*

a. ***Colpomenia sinuosa*** f. ***typica*** Setch. et Gardn.

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 540 ; Okamura, 1936, p. 231 ; Takamatsu, 1938, p. 10 ; 1938*a*, p. 86 ; Nagai, 1940, p. 60.

Habitat. Growing on *Cystophyllum crassipes* and *Rhodomela Larix* in quiet waters. W. coast : Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Nagahama (T., '35). E. coast : Rorei (T., '32), Noto (T., '35).

Distribution. Sp. – Formosa, Caroline Islands, Bonin Islands, Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles and Saghalien ; Kamtschatka ; China ; Pacific coasts of North and South America ; South Pacific Ocean (Australia and Tasmania) ; Atlantic coasts of North and South America and of Europe ; Mediterranean Sea ; Red Sea ; Indian Ocean.

Remarks. Among the five forms described by Setchell & Gardner (1925, p. 540–542) under *Colpomenia sinuosa*, only two, i.e., f. *typica* and *deformans*, are represented in our region, just as in the Kurile Islands (Nagai, 1940, p. 60).

Kunieda & Suto (1938, p. 539, figs. 1–2) has published an interesting study of the present species growing on branches of *Sargassum* in the sea around Misaki, Prov. Sagami, Middle Honshû. According to them, the plant collected in autumn is the sporophyte and bears plurilocular sporangia which produce asexual zoospores, while the plant collected in spring is supposed to represent the sexual generation of the same species and bears macro- and microplurilocular gametangia on different individuals which produce female and male gametes respectively. This investigation is quite noteworthy in proving or suggesting the presence of the heterothallic anisogamy and of the alternation of similar generations among the members of the order Dictyosiphonales.

b. ***Colpomenia sinuosa*** f. ***deformans*** Setch et. Gardn.

Alg. N.-W. Amer., 1903, p. 242, pl. 18, figs. 13–15 ; New Mar. Alg. Gulf of Calif., 1924, 726, pl. 16, figs. 61, 62 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 542 ; Okamura, 1916, p. 152 ; 1927, p. 4 ; 1936, p. 231, fig. 124 ; Yamada, 1935, p. 12 ; Takamatsu, 1936*a*, p. 49 ; 1938, p. 10 ; 1938*a*, p. 86; Nagai, 1940, p. 60 ; Yamada & Tanaka, 1944, p. 60.

Scytosiphon bullosus Saunders, Phyc. Mem., 1898, p. 163, pl. 31, figs. 1–7 ; 1901, p. 421.

Macrosiphon asperococcoidea Okamura, Nippon Sôrui Mei-i, ed. 1, 1902, p. 118 (*nomen nudum*).

Japanese name. Watamo (Okamura).

Habitat. Growing on rocks and on other algae, such as the prostrate frond of *Heterochordaria abietina* and *Corallina*, in the lower littoral belt. W. coast: Shiranushi (T., '37), Nishinotoro (T., '35), Kaiba-tô (Morimoto, '38). Aniwa Bay: Chishiya (T., '35), Nobori (T., '35).

Distribution. Kyûshû, Honshû, Shikoku, Hokkaido, Kuriles and Saghalien; Pacific coast of North America.

Remarks. The view of Setchell & Gardner to treat the present characteristic plant as a forma of *Colpomenia sinuosa*, has generally been followed by our algologists. A study on the life-history of the plant is desirable to throw the light upon the problem of its ture situation.

24. **Ilea** Fries

Flor. Scan., 1835, p. 321 (*in part*) ; Okamura, 1936, p. 233.

Ilea Fascia (Müller) Fries

loc. cit., 1835, p. 321 ; Kjellman, 1883, p. 257 ; Nordstedt, 1911, p. 265 ; Setchell & Gardner, 1925, p. 535, pl. 44, figs. 68–71, 73 ; Yamada, 1925, p. 242 ; Okamura, 1936, p. 234, fig. 127 ; Takamatsu, 1936, p. 9 ; 1936*a*, p. 50 ; 1938*a*, p. 87 ; 1939*a*, p. 39 ; Yamada & Tanaka, 1944, p. 59.

Fucus Fascia Müller, *in* Flor. Dan., 1778, pl. 768.

Phyllitis Fascia Kützing, Phyc. Gen., 1843, p. 342, pl. 24, III, figs, 1–6 ; *in* Linnaea, XVII, 1843, p. 97 ; Hauck, 1885, p. 391, fig. 170 ; Reinke, 1889*a*, p. 61 ; De Toni, 1895, p. 55 ; 1895*a*, p. 487 ; Saunders, 1901, p. 421 ; Setchell & Gardner, 1903, p. 243 ; Yendo, 1909, p. 122 ; Sinova, 1930, p. 96 ; 1933, p. 15; Newton, 1931, p. 176, fig. 110.

Petalonia Fascia Kuntze, Rev. Gen Plant., III, 1898, p. 419 ; Howe, 1914, p. 50; Taylor, 1937, p. 172, pl. 14, fig. 5, pl. 15, fig. 3.

Japanese name. Seiyô-habanori (Yendo).

Key to the forms

I. Fronds narrow, almost stipeless .... a. f. *typica*
II. Fronds broad, with a distinct stipe .... b. f. *caespitosa*

a. *Ilea Fascia* f. *typica* Kjellman

Alg. Arct. Sea, 1883, p. 257.
Fucus Fascia Müller, in Fl. Dan., 1778, pl. 768.
Laminaria Fascia J. Agardh, Sp. Alg., I., 1848. p. 129.
Phyllitis Fascia α *fascia* Hauck, Meeresalg., 1885, p. 391.
Ilea Fascia f. *typica* Setchell et Gardner, Phyc. Cont., VII, 1924*a*, p. 12; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 537.

Habitat. Growing on rocks in the lower littoral belt. W. coast: Kaiba-tô (Morimoto, '37).

Distribution. *Sp.* - Formosa, Kyûshû, Honshû, Hokkaido and Saghalien; Ochotsk Sea; Kamtschatka; China; Malay Archipelago; Pacific coast of North America; Atlantic coasts of North America and Europe; Arctic Ocean; Southern Ocean: Baltic Sea; Mediterranean Sea; Adriatic Sea. F. *typica*-Saghalien; Pacific coast of North America; Arctic Ocean; Southern Ocean; North Sea.

Remarks. Of the five forms distinguished by Setchell & Gardner (1924, pp. 12–13; 1925, p. 537) in *Ilea Fascia*, f. *typica* and f. *caespitosa* are represented in our region. The specimens referred to the former are collected by Morimoto in November 1937 on the Island of Kaiba-tô. Their flat fronds are very narrow, mostly less than 1 mm. broad in dried and pressed state, but they are already matured being provided with scattered sori of the plurilocular sporangia.

b. *Ilea Fascia* f. *caespitosa* (J. Ag.) Setch. et Gardn.

Phyc. Cont., VII. 1924*a*, p. 13; Mar. Alg. Pacific Coast N. Amer., III. 1925, p. 537.
Laminaria caespitosa J. Agardh. Nor., 1836, p. 14; Sp. Alg., I, 1848, p. 130.
Phyllitis caespitosa Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 68; Thuret & Bornet, 1878, p. 10, pl. 4.
Ph. Fascia var. *caespitosa* Farlow, Mar. Alg. New Engl., 1881, p. 62; Kjellman, 1883. p. 257.
Ph. Fascia β *caespitosa* Hauck, Meeresalg., 1885, p. 391, fig. 170.
Petalonia Fascia var. *caespitosa* Taylor, Mar. Alg. N.-E. Coast N. Amer., 1937, p. 173.

Habitat. Growing on rocks in the lower littoral belt. W. coast: Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '32). Aniwa Bay: Nobori (T., '35).

Distribution. Hokkaido and Saghalien; Pacific coast of North America; Atlantic coasts of North America and Europe; North Sea; Baltic Sea; Adriatic Sea.

Remarks. The present form is much nore common in our region than f. *typica.* In the external appearance, it resembles *Endarachne Binghamiae* J. Ag., which is distributed in Japan from Middle Honshû southwards and is often used for food. It is naturally supposed that *Ilea Fascia* may frequently be mixed in the preparation of *Endarachne*. However, in the northern part of Japan from Hokkaido northwards, where true *Endarachne* does not occur, *Ilea Fascia* has not been utilized in general, as far as the writer knows.

Family 13. Coilodesmaceae Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 577 ; Okamura, 1936, p. 234.

25. **Coilodesme** Stroemfelt

Meeresalg. Island, 1886, p. 173 ; Okamura, 1936, p. 235.

Key to the species

I. Fronds flaccid, light brown in color, always epiphytic
  A. Fronds narrowly cylindrical, less than 8 mm. diam .... 1. *C. Cystoseirae*
  B. Fronds broader, 8–50 mm. wide .... 2. *C. japonica*
II. Fronds moderately firm, dark brown in color, saxicolous or epiphytic
  A. Fronds saxicolous, medullary cells 1–2, mostly single layered .... 3. *C. bulligera*
  B. Fronds epiphytic, medullary cells 2–3 layered .... 3a. *C. bulligera* f. *fucicola*

1. ***Coilodesme Cystoseirae*** (Rupr.) Setchell et Gardner

Alg. N.-W. Amer., 1903, p. 241 ; Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 583 ; Yendo, 1909, p. 122 ; Kuckuck, 1930, p. 89, fig. 145, (figure only) ; Yamada, 1938, p. 119, pl. 19; Nagai, 1940, p. 62 ; Yamada & Tanaka, 1944, p. 61.

Asperococcus Cystoseirae Ruprecht, Tange Ochot. Meer., 1851, p. 370.

Hapalosiphon filiformis Ruprecht, *loc. cit.*, 1851, p. 369 (Lebashja specimen only, *fide* Yendo, On Hapalosiphon, 1913, pp. 115, 120).

Coilodesme linearis Saunders, Harrim. Alaska Exped., Alg., 1901, p. 421, pl. 48.

non *Coilodesme Cystoseirae* Okamura, Icon. Jap. Alg., IV, 1918, p. 55, pl. 144, figs. 10–13, (=*Coilodesme japonica* Yamada).

Japanese name. Hoso-yezobukuro (Yamada).

Habitat. Epiphytic on *Cystophyllum crassipes* associated with *Colpomenia sinuosa* f. *typica.* W. coast : Nishinotoro (T., '35). Aniwa Bay : Nagahama (T., '35). E. coast : Noto (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Alaska.

Remarks. For the breadth of his Ochotsk plant, Ruprecht gives 1/2–1 Linie (about 1.1–2.3 mm.) (1851, p. 370). Our Saghalien specimens at hand are alike very slender, being generally less than 2 mm., rarely attaining to 2.5 mm., in breadth. Setchell & Gardner (1925, p. 583) state : "The dimensions given by Ruprecht for his plants are far under those of the plants referred by us to his species, but his plants were probably very young, similar to the very young and slender individuals included by Saunders in the group figured by him. Ruprecht's plants, also, showed no reproductive bodies." However, the writer is of opinin that the large roundish cells described by Ruprecht as scattered among the cortical cells are nothing but immature unilocular sporania, and that Ruprecht's plants are by no means "very young", but represent a local form of the species. The Kurile specimens, which were referred by Nagai to the present species, are generally identical with the Alaskan plant, but some of them seem to be an intermediate form between that and the Ochotsk plant.

2. ***Coilodesme japonica*** Yamada

Notes on Some Jap. Alg., VIII, 1938, p. 120, pl. 20 ; Nagai, 1940, p. 62.

Coilodesme Cystoseirae Okamura (*non* Setch. et Gardn.), Nippon Sôrui Mei-i, ed. 2, 1916, p. 151 ; Icon, Jap. Alg., IV, 3, 1918, p. 55, pl. 164, figs 10–13 ; Mar. Alg. Mutsu Bay, I, 1927, p. 5 ; Nippon Kaisô-shi, 1936, p. 235 ; Kawabata, 1936, p. 202 ; Takamatsu, 1938*a*, p. 85.

Japanese name. Yezo-bukuro (Okamura).

Habitat. Epiphytic on *Cystophyllum crassipes.* W. coast : Shiranushi (T., '27), Nishinotoro (T., '35). Aniwa Bay : Chishiya (T., '35), Nobori (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien.

Remarks. This is the commonest and the largest species of *Coilodesme* in southern Saghalien. The largest specimen in the writer's possession, which was collected at Muroran, Hokkaido, by Mr. T. Inaba in June 1936, measures 75 cm. long and about 4 cm. wide in the broadest portion. The frond is as usual extremely wrinkled in larger specimens, but it is much less so in smaller ones.

3. ***Coilodesme bulligera*** Stroemfelt

Om Algenveg. vid. Isl. Kuster, 1886, p. 48, pl. 2, figs, 9–12 ; Neue Meeresalg. Island, 1886*a*, p. 173 ; Foslie, 1890, p. 94 ; Kjellman, 1890, p. 58 ; Rosenvinge, 1893, p. 862 ; De Toni, 1895*a*, p. 483 ; Saunders, 1901, p. 422 ; Yendo, 1909, p. 121 ; Setchell & Gardner, 1925, p. 581, pl 45, figs. 77, 78 ; Okamura, 1936, p. 235 ; Nagai, 1940, p. 61.

Japanese name. Ôba-yezobukuro (Okamura).

Habitat. Growing on shells in the lower littoral belt. E. coast : Yôman (T., '35).

Distribution. North Kuriles and Saghalien ; Pacific coast of North America (Alaska to Oregon) ; Arctic Ocean (Iceland, Greenland, and Norway).

Remarks. Although Nagai (1940, p. 62) has added Saghalien in the range of the distribution of the present species, the writer believes that the present account is the first definite report on the occurrence of the species in Saghalien.

3a. ***Coilodesme bulligera*** f. ***fucicola*** Yendo

Some New Alg. from Japan, 1913, p. 279, pl. 13, figs. 10–11 ; Tokida, 1932, p. 8, pl. 5, fig. a, text-fig. 2 ; Yamada, 1935, p. 12, pl. 2, fig. 2.

Coilodesme californica Kjellman, (*non* Ruprecht), Om Beringh. Algfl., 1889, p. 48 (*fide* Yendo, *loc. cit.*).

C. fucicola (Yendo) Nagai, Mar. Alg. Kurile Isls., I, 1940, p. 63, pl. 2, figs. 19, 20.

Japanese name. Hoso-e-bukuro (Yamada).

Habitat. Epiphytic on *Chordaria flagelliformis.* E. coast : Kaihyô-tô (T., '30).

Distribution. Middle Kuriles and Saghalien ; Kamtschatka ; Bering Island.

Remarks. The description of the Saghalien plant is given in the writer's paper above cited.

Family 14. Dictyosiphonaceae De Toni

Syst. Übers. Fucoid., 1891, p. 179 ; Syll. Alg., III. 1895*a*, p. 448 ; Okamura, 1936, p. 240.

26. **Dictyosiphon** Greville

Alg. Brit., 1830, p. 55 ; Okamura, 1936, p. 240.

1. ***Dictyosiphon foeniculaceus*** (Huds.) Greville

Alg. Brit., 1830, p. 56, pl. 8, figs. 1-4 ; J Agardh, 1848, p. 82 ; Kjellman, 1883, p. 269 ; 1889, p. 51 ; Hauck, 1885, p. 373, fig. 160 ; De Toni, 1895*a*, p. 450 ; Saunders, 1901, p. 422 ; Setchell & Gardner, 1925, p. 589, pl. 40, figs. 47-49 ; Yamada, 1928, p. 507, fig. 8 ; 1935, p. 14 ; Sinova, 1930, p. 97 ; 1933, p. 18 ; 1938, p. 43 ; Newton, 1931, p. 168, fig. 105 ; Kawabata. 1936, p. 204 ; Okamura, 1936, p. 240, fig. 132 ; Taylor, 1937, p. 183, pl. 12, fig. 4, pl. 14, fig. 2 ; Nagai, 1940, p. 64 ; Yamada & Tanaka, 1944. p. 62 ; Kylin, 1947*a* p. 78 (including *Dictyosiphon hippurioides* as a form) ; Waern, 1952, p. 162, (incl. *D. hipp.*).

Conferva foeniculacea Hudson, Fl. Angl., 1762, p. 594.

Scytosiphon foeniculaceus Ruprecht, Tange Ochot. Meer., 1851 p. 372.

Fucus subtilis Turner, Hist. Fuc., IV. 1819, p. 89, pl. 234,.

Japanese name. Uikyô-mo (Okamura).

Habitat. Growing on rocks or epiphytic on *Chordaria flagelliformis* and *Scytosiphon Lomentaria* in the littoral and upper sublittoral belts. W. coast : Sokorai (Miyabe, '06), Kushunnai (Miyabe, '06), Sôni (T., '26), Nishinotoro (T., '35), Kaiba-tô (T., '30). Aniwa Bay : Nobori (T., '26, '35), Merei (Miyabe, '06), Nagahama (T., '35), Tôbuchiko (Miyabe, '06 ; T., '26, '35). E. coast : Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of North America (Alaska to Washington) ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. The occurrence of this widely spread species on the Ochotsk Sea was first reported by Ruprecht (*loc. cit.*) from Grand Schantar Island and "Ujakonbucht." He did not find reproductive organs in his plant. In southern Saghalien this alga is very common, and the specimens collected in summer are nearly always fertile, bearing abundant unilocular sporangia.

2. ***Dictyosiphon hippurioides*** (Lyngb.) Kützing

Tab. Phyc., VI. 1856, p. 19, pl. 52 ; Farlow, 1881, p. 66 ; Kjellman, 1883, p. 268 ; 1889, p. 50 ; Hauck, 1885, p. 374 ; De Toni, 1895*a*, pl. 449 ; Setchell & Gardner, 1925, p. 589 ; Newton, 1931, p. 184 ; Taylor, 1937, p. 184.

Scytosiphon hippurioides Lyngbye, Hydr. Dan., 1819, p. 63, pl. 14, B.

Chordaria flagelliformis var. *β Hippurioides* J. Agardh, Sp. Alg., 1848, p. 66.

Dictyosiphon foeniculaceus f. *hippurioides* Levring, Stud. üb. Algenveget. von Blekinge, Südschweden. Akad. Abhandl., Lund, 1940, p. 59; Kylin, 1947, p. 78, pl. 13, fig. 43.

Japanese name. Futo-uikyômo (n. n.).

Habitat. Epiphytic on *Chordaria flagelliformis.* W. coast: Yenchishi (Miyabe, '06), Shiranushi (T., '27, '32).

Distribution. Saghalien; Bering Sea; Alaska; Atlantic coasts of North America and Europe; Arctic Ocean; North Sea; Baltic Sea.

"Frond solid, or occasionally slightly fistulose below, filiform, rigid, moderately branched, 15–60 cm. high, up to 1.25 mm. diam.; branches of different orders very similar, flagelliform., tapering but slightly; surface cells in the lower part of the frond arranged in horizontal series, but irregular above; color dark brown."

Remarks. The above description of the species is after Setchell & Gardner (*loc. cit.*). The writer was able to compare his specimens with the American specimen collected by Farlow at Eastport, Maine (Alg. Am. Bor., No. 95) and also with the Alaskan specimen which was collected and identified by Setchell. The Saghalien plant sometimes attains to about 1.5 mm. in width at the broadest portion in a pressed and dried state. The branches are often naked or sometimes beset with short branchlets more or less reduced in size, but fine ultimate branchlets such as we find in *D. foeniculaceus* are generally wanting.

Order 7. LAMINARIALES Kylin

Generationswech. u. Kernphasenwech., 1917, p. 308 (*fide* Kylin, 1933, p. 93); Okamura, 1936, p. 241.

Key to the Families

I. Fronds cylindrical, not differentiated into stipe and blade, with a central hollow cavity interrupted by diaphragms; paraphyses without hyaline appendages .. 15. ***Chordaceae***

II. Fronds diversely shaped, differentiated into holdfast, stipe and blade; paraphyses with hyaline appendages .... 16. ***Laminariaceae***

Family 15. Chordaceae Dumortier

Comm. Bot., 1822, p. 72; Okamura 1936. p. 242.

27. **Chorda** Stackhouse

Ner. Brit., ed. 1, 1797, p. xvi, ed. 2, 1816, p. xvi; Okamura, 1936, p. 242.

Chorda Filum (L.) Lamouroux

Essai, 1813, p. 26; Postels & Ruprecht, 1840, p. 19; Ruprecht, 1851, p. 268; Farlow, 1881,

p. 91, pl. 6, fig. 1 ; Kjellman, 1883, p. 245 ; Hauck, 1885, p. 394, fig. 172 ; De Toni, 1895, p. 53 ; 1895*a*, p. 318 ; Okamura 1901, p. 55, pl. 20 ; 1936, p. 243, fig. 134 ; Howe, 1924, p. 136 ; Setchell & Gardner, 1925, p. 592 ; Newton, 1931, p. 200, fig. 127 ; Sinova, 1930, p 100 ; 1938, p. 44 ; Takamatsu, 1936, p. 13 ; 1938, p. 21 ; 1938*a*. p. 94 ; 1939*a*, p. 40 ; Taylor, 1937, p. 14, fig. 3, pl. 15, fig. 1 ; Nagai, 1940, p. 65.

Fucus Filum Linnaeus, Sp. Plant., ed. 1, 1753, p. 1162 ; Turner, Hist. Fuc., II, 1809. p. 37, pl. 86.

Scytosiphon Filum Agardh, Sp. Alg., I, 1, 1820, p. 161 ; Syst. Alg., 1824, p. 257 ; J. Agardh, 1848, p. 126.

Japanese name. Tsurumo.

Habitat. Growing on stones and shells in very protected stations in the sublittoral belt. Aniwa Bay : Nagahama (T., '35), Tôbuchi-ko (T., '29, '35 ; Matsubara, '30). E. coast : Airô (T., '27).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, South Kuriles, Saghalien and Korea ; China ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Pacific coast of North America (from Alaska to the Straits of Juan de Fuca) ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. As could be understood by the distribution in Japan mentioned above, *Chorda Filum* is a temperate species and fairly widely spread on the Asiatic side of the Pacific Ocean, while it is said by Setchell & Gardner (1925, p. 592) to be "a plant of the colder waters" on the American side. It prefers to inhabit very protected places in bays and coves, and can invade into north-temperate or subarctic regions making its appearance sporadically in such places. On the eastern coast of Hokkaido washed by the cold current, the present plant has been known to be distributed as far east as Akkeshi (*sec.* spec. *leg.* T. Tanaka, July 1941). In the northern part of the Ochotsk Sea it has been reported from "Ajanbai" and "Ujakonbai (?)" by Ruprecht (1851, p. 368), and from Grand Schantar Island by Sinova (1930. p. 100). From the statement of Ruprecht (*loc. cit.*) we know that *Chorda Filum* (*sub* var. *β septigera* Post. et Rupr.) occurs even in Kamtschatka ("Awatschabai"), though it has not been enumerated by Sinova in her "Les Algues de Kamtschatka". It may possibly make its appearance there rather rarely as one of the casual annuals (cf. Knight & Parke, 1931). The entire absence of this species in the Kurile Islands except Tomari Bay, Kunashiri Island (Nagai, 1940, p. 66) may possibly be due to the want of a favourable protected station in the middle and northern parts of the archipelago.

Family 16. Laminariaceae Reichenbach

Conspect. Reg. Veg., 1828, p. 29 (*fide* Pfeiffer ; cf. Setchell & Gardner, *loc. cit.*, 1925, p. 593) ; Okamura, 1936, p. 244 (*s. lat.*).

Key to the genera

I. Thallus unbranched, blades without auricles near the base

A. Zoosporangial sori extended on the blade
  1. Thallus without longitudinal ribs
    a. Blade plane, sometimes with a row of bullae along both sides of the median fascia .... 28. *Laminaria*
    b. Blade with regularly and complicately arranged bullae ...... 29. *Kjellmaniella*
  2. Thallus with longitudinal ribs
    a. Rib single .... 30. *Agarum*
    b. Ribs several (as a rule five) .... 31. *Costaria*
B. Zoosporangial sori on special outgrowths confined to the stipe .... 33. *Alaria*

II. Thallus branched ; mature blades with auricles on both sides near the base .... 32. *Arthrothamnus*

28. ***Laminaria*** Lamouroux

Essai, 1813, p. 20 (*in part*) ; Okamura, 1936, p. 246.

Key to the species

I. Blade entire
  A. Mucilage lacunae absent from stipe
    1. Fronds with creeping rhizomes .... 1. *L. longipes*
    2. Fronds without rhizomes .... 2. *L. saccharina*
  B. Mucilage lacunae present in both stipe and blade
    1. Blade fairly thick even at the marginal portion ; holdfast of branched hapteres arranged in 2–5 vertical rows at the base of the stipe .... 3. *L. ochotensis*
    2. Blade comparatively thin at the marginal portion ; holdfast of branched hapteres arising verticillately at least while young .... 4. *L. diabolica*

II. Blade split more or less deeply into several segments .... 5. *L. dentigera*

1. ***Laminaria longipes*** Bory

in Dict. Class., IX, 1826, p. 189 ; J. Agardh, 1848, p. 133 ; Ruprecht, 1851, pp. 232, 351 ; Kjellman, 1889, p. 43 ; Setchell, 1899, p. 591, pl. 95 ; Yendo, 1909, p. 125 ; Setchell & Gardner, 1925, p. 597 ; Okamura, 1928, p. 53; 1933, p. 88 ; 1936, p. 251, fig. 139 ; Sinova, 1933, p. 24, figs, 8-10 ; Miyabe & Nagai, 1932, p. 196 ; 1933, p. 86 ; Miyabe, *in* Okamura, 1936, p. 288 ; Nagai, 1940, p. 67.

Laminaria saccharina β angustifolia Postels et Ruprecht, Illustr. Alg., 1840. p. 10, pl. 11.

Lessonia (vel *Laminaria*) *repens* Ruprecht, Tange Ochot. Meer., 1851 p. 350.

Laminaria Ruprechtiana Le Jolis, Examen, 1855, p. 71 or 590 (*fide* Setchell & Gardner, 1925, p. 597).

Arthrothamnus? longipes J. Agardh, De Lamin., 1867, p. 26 ; De Toni, Syll. Alg., III, 1895*a*, p. 370.

1a. ***Laminaria longipes*** f. ***typica*** Miyabe et Tokida, nom. nov.

Laminaria longipes f. *angustifolia* Miyabe et Nagai, *in* Nagai, *loc. cit.*, 1940, p. 68.

Japanese name. Hime-kombu (Yendo).

Habitat. Washed ashore. W. coast : Rorei (Miyake, '06).

Distribution. *Sp.* – Kuriles and Saghalien ; Kamtschatka ; Bering Sea ; Aleutian

Islands.

Remarks. Nagai (*loc. cit.*) has recently distinguished three forms in the present species, of which only the typical form is represented in our region by a few specimens collected by T. Miyake. In naming the typical form, Miyabe & Nagai have proposed to revive the old formal name f. *angustifolia* of Postels & Ruprecht, which was originally given by the authors to distinguish their plant from the normal form of *Laminaria saccharina*. It may be more appropriate to give the typical form in the definition given by Nagai a new formal name, f. *typica*.

The type locality of *Laminaria longipes* is the eastern coast of Kamtschatka. Excepting the Kuriles and Saghalien, it has never been reported to occur on the coasts of Ochotsk Sea (cf. Ruprecht, *loc. cit.*, p. 201 ; Sinova, 1930). It was rather unexpected to find this interesting plant at the restricted locality on the Ochotsk Sea coast of Saghalien. The writer's effort to re-collect the plant at Rorei and its vicinity has been unsuccessful.

2. ***Laminaria saccharina*** (L.) Lamouroux

Plate X, Figs. 3–7

Essai, 1813, p. 22 ; J. Agardh. 1848, p. 132 ; Kjellman, 1883, p. 229 ; Hauck, 1885, p. 398 ; De Toni, 1895*a*, p. 346 ; Setchell & Gardner, 1903, p. 261 ; 1925, p. 595 ; Sinova, 1930, p. 101 ; 1933, p. 23 ; 1938, p. 46 ; Miyabe, *in* Okamura, 1936, p. 287.

Fucus saccharinus Linnaeus, Sp. Pl., 1753, p. 1161 ; Turner, 1811, p. 69, pl. 163.

Laminaria latifolia Agardh, Sp. Alg., I, 1, 1820, p. 119 ; Postels & Ruprecht, 1840, p. 10, pl. 163.

L. cichorioides var. *sachalinensis* Tokida, (*non* Miyabe), Mar. Alg. Robben Isl., 1932, p. 9.

Japanese name. Karafuto-kombu (Miyabe), Karafuto-tororo-kombu (Miyabe).

Holdfast composed of 4–5 times dichotomously branched, filiform hapteres, arising verticillately from the basal portion of the stipe ; stipe usually short, but sometimes considerably elongated, 2.5–35 cm. in length, 4–9 mm. in diam., terete, becoming somewhat compressed at the apex, without mucilage ducts ; blade usually coriaceous, or membranaceous and fragile when growing in somewhat brackish and protected waters, dark brown to yellowish brown in color, linear to linear-lanceolate, or at times ovate-lanceolate, with a distinct row of fine bullae, permanent or sometimes partly disappearing, along both sides of the median fascia, plane or undulate to even roughly crispate on the margins, usually cuneate to rounded at times even cordate at the base, 90–390 cm. in length, 13–68 cm. in breadth at the broadest portion, with mucilage ducts of medium size, arranged in a row in subcortical layer ; sori formed in longitudinal patches on the under surface of the blade extending along the median fascia, sometimes also on the upper surface.

Remarks. The present species is known to be quite variable in form and widely distributed in the cooler waters of the northern hemisphere. Its occurrence in the Ochotsk Sea has been reported by Sinova (1930, 'd 101) from the Grand Schantar Island. According to her letter sent to the writer, it occurs on the Siberian coast of the Japan Sea rather rarely, but in the Tartar Strait and on the northern Saghalien coast plentifully. On examining some typical specimens from the eastern coast of southern Saghalien which had been sent to her, Sinova informed the writer that "if I should have found it I would consider them as a strict form of *Laminaria saccharina* (L.) Lam.,"

The writer previously referred his specimens of *Laminaria* from Kaihyô-tô to *L. cichorioides* var. *sachalinensis* Miyabe stating erroneously that they had mucilage ducts in the stipe. The entire lacking of the ducts from the stipe seems to be a remarkable character of our plant.

Key to the forms

I. Blade coriaceous
  A. Blade linear lanceolate, usually plane at the margin .... a. f. *linearis*
  B. Blade broad lanceolate, strongly waved or crisped at the margin .... b. f. *bullata*
II. Blade fragile, thin membranaceous, elliptic in outline, strongly waved at the margin .... c. f. *membranacea*

2a. ***Laminaria saccharina*** f. ***linearis*** J. Agardh

De Lamin., 1867, p. 12 ; Setchell & Gardner, 1903, p. 261 ; 1925. p. 596 ; Sinova. 1930, p. 102.

Habitat. Growing on rocks in the sublittoral belt, in more or less exposed localities. W. coast ; ? Pilevo (Miyabe, '06), ? Sokorai (Miyabe, '06), ? Nayoshi (Miyabe, '06), ? Ushiro (Miyabe, '06), Yenchishi (Miyabe, '06), Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '26). Aniwa Bay : Chishiya (Miyabe, '06), Nobori (T., '26, '35), Merei (T., '26), Nagahama (T., '35), Sattô (T., '32), Shiraiwa (T., '32). E. coast : Hota (T., '32), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29), Unetonnai (Miyabe, '06), Shikuka (Miyabe, '06) Taraika (Miyabe, '06), Kaihyô-tô (Kubo, '06 ; T., '35).

Distribution. Sp. - Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Pacific coast of North America ; Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. The specimens which the writer refers to the present forma are of a narrow linear and less ruffled blade. They represent the typical form of this species in our region. The stipe is short, several hapteres arising verticillately at its base. The blade is coriaceous, linear to linear-lanceolate, attaining a considerable length. It is usually plane on the margin, and cuneate to rounded at the base. The typical form of the bullae and of the zoosporangial sori are shown diagrammatically in Pl. XII, Figs. 3–4 & 6–7 respectively. The rejuvenating blade is frequently met with in summer at Sakaehama. Forma *linearis* occurs almost all along the coast of southern Saghalien, flourishing especially on the eastern coast, where the present species seems to be the only *Laminaria*, except *L. longipes*, at least form Airô northward. As to the localities with a query in the above list, they are represented at present by quite young specimens only.

2b. ***Laminaria saccharina*** f. ***bullata*** Agardh

Syn. Alg. Scan., 1817, p. 18 ; Börgesen, 1902, p. 451.

Habitat. Growing in somewhat sheltered localities. W. coast : Hishitoma (T., '26). Aniwa Bay : Chishiya (T., '26), Merei (T., '26). E. coast : Sakaehama (T., '29).

Remarks. The specimens referred to forma *bullata* are of a broader lanceolate blade which has a more or less strongly waved, sometimes even crisped, marginal area. The stipe is short. The blade is usually short, coriaceous, strongly bullate on the surface, rounded to cordate at the base. The color is dark brown. This forma seems to prefer somewhat sheltered localities. It is fairly abundant at Merei in Aniwa Bay.

2c. ***Laminaria saccharina*** f. ***membranacea*** J. Agardh

De Lamin., 1867, p. 13 ; Setchell & Gardner, 1903, p. 261 ; 1925. p. 596.

Habitat. Growing on stones and shells in the interior of a lagoon. Aniwa Bay : Tôbuchi-ko (T., '35 ; Ohmi, '40).

Remarks. The specimens referable to this forma are marked by their broad, thin membranaceous, and fragile blade, which is often elliptic in outline with a strongly waved marginal area. The stipe is often considerably long, up to 35 cm. in length, sometimes slightly inflated at the middle portion. The hapteres usually arise verticillately at the base of the stipe, but often also in vertical rows extending along the stipe for a considerable length. In the latter case, while the undermost hapteres are firmly attached to some matter such as a shell, the upper ones are entangled among the aegagropiloid masses of *Ahnfeltia plicata* var. *tobuchiensis* which are heaped up on the larger part of the bottom of the lagoon. The blade is narrow cuneate to rounded or even cordate at the base, up to 320 cm. in length, and up to 68 cm. in breadth. The color is light brown. Mucilage lacunae are wanting not only in the stipe but also in the hapteres, while they are present in the hapteres in other forms.

In the middle of July 1935, a large rejuvenating plant of this forma was observed by the writer. Its blade was 2 m. long and up to 53 cm. broad. At the top of the blade, there remained a decaying old blade, which was 25 cm. long, strongly crisped on the margin.

The present forma occurs confinedly in Lake Tôbuchi. Approaching to the exit of the lagoon, an intermediate form between the present and the preceding makes its appearance. It has a stipe much variable in length, and a long broad linear blade attaining 370 cm. in length and 33 cm. in breadth at the broadest portion which lies at about two-third of the total length from the base. Forma *membranacea* found in Lake Tôbuchi may be considered to be a variation of forma *bullata* under the influence of the protected habitat.

3. ***Laminaria ochotensis*** Miyabe

Laminariac. Hokkaido, 1902, p. 23, pl. 2 ; *in* Proc. 3rd Pan-Pacific Sci. Congr., Tokyo, 1928, p. 956 ; *in* Okamura, Nippon Kaisô-shi, 1936, p. 285 ; Miyabe & Nagai, 1933, p. 89 ; Okamura, 1902, p. 130 ; 1916, p. 170.

Laminaria japonica f. *angusta* Okamura, Lamin. of Japan 1896, p. 88 (*in part*).

L. japonica Okamura (non Aresch.), Nippon Kaisô-shi, 1936, p. 248 (*in part*).

L. japonica var. *ochotensis* Okamura, Nippon Kaisô-shi, 1936. p. 249, fig. 138 (sub *L. ochotensis* Miyabe).

Japanese name. Rishiri-kombu.

Habitat. Growing on rocks in the sublittoral belt, from the low water mark to the depth of more than five fathoms. W. coast: Rakuma (T., '26, '27), Hirochi (T., '26, '27), Chinehira (T., '26), Honto (T., '27), Tokushi (T., '27), Kaiba-tô (T., '30). Aniwa Bay: Ishihama (T., '26), Chishiya (T., '35). Nobori (T., '35), Merei (T., '26), Nagahama (T., '35), Sattô (T., '32), Shiraiwa (T., '32). E. coast: Hota (T., '32).

Distribution. Japan Sea and Ochotsk Sea sides of Hokkaido, South Kuriles, Saghalien and Korea.

Remarks. The present alga is one of the most highly valued seaweeds in southern Saghalien. On the coasts of the Japan Sea and Aniwa Bay, it is found almost everywhere except south-western extremities of both the Nishinotoro and the Nakashiretoko Peninsulas. But it seems to be entirely absent from the eastern coast at least from Airô northward, where we find no other *Laminaria* than *L. longipes* and *L. saccharina* f. *linearis*. The length of lamina is variable corresponding to conditions of the habitat. On the eastern coast of the Peninsula Nakashiretoko, it is said to reach more than 15 m., while it is considerably short in Aniwa Bay.

4. ***Laminaria diabolica*** Miyabe

Laminariac. Hokkaido. 1902, p. 29.

Key to the forms

I. Stipe 6-15 cm. long .... a. f. *genuina*
II. Stipe 30-70 cm. long .... b. f. *longipes*

4a. ***Laminaria diabolica*** f. ***genuina*** Miyabe et Nagai

in Nagai, Mar. Alg. Kurile Isls., I. 1940, p. 72.

Laminaria diabolica Miyabe, *loc. cit.*, 1902, pl. 7 ; *in* Okamura, Nippon Kaisô-shi, 1936, p. 285.

Laminaria longipedalis Okamura var. *diabolica* Miyabe, *in* Proc. 3rd Pan-Pacific Sci. Congr., Tokyo, 1928, p. 956 ; Miyabe & Nagai, Laminariac. Kurile Isls., 1933, p. 88 ; Okamura, 1936, p. 250.

Japanese name. Oni-kombu.

Habitat. Growing on rocks in the sublittoral belt. Aniwa Bay : Moi (Miyabe, '06).

Distribution. *Sp.* – Hokkaido, Kuriles and Saghalien.

Remarks. Two specimens collected by Miyabe in July 1906 at Moi on the south-western coast of Nakashiretoko Peninsula are referred to the present forma. They have moderately long stipes which measure 13 and 15 cm. in length respectively.

4b. ***Laminaria diabolica*** f. ***longipes*** Miyabe et Tokida

in Okamura, Nippon Kaisô-shi, 1936, p. 285 ; Nagai, 1940, p. 72.

Laminaria longipedalis Sinova (*non* Okamura), Alg. Mar. Jap., (Phaeopyc.), 1929, p. 39.

Japanese name. Enaga-onikombu (Miyabe).

Habitat. Growing on rocks in the sublittoral belt. W. coast : Hishitoma (T., '26), Shiranushi (T., '26, '32, '35). Aniwa Bay : Ishihama (T., '26), Nobori (T., '26).

Distribution. Kuriles and Saghalien ; Japan Sea coast of Siberia.

Remarks. This giant kelp attains a remarkable development in the cold water region of Nishinotoro Peninsula, often exceeding 8 m. in total length. It is always furnished with an exceptionally long stipe, measuring from 30 to 70 cm. in length. The lamina is broadly lanceolate, gradually tapering twoard the base, 20–40 cm. in breadth at the broadest portion, with a broad median fascia, 7–11 cm., rarely up to 20 cm. in width. The zoosporangial sori are usually formed only from the broadest portion of lamina upward, on both surfaces of the median fascia as longitudinal bands and also on the marginal portions as scattered small patches. The mucilage lacunae are of comparatively small size and roundish in cross section, arranged in one row in the cortical layer of both stipe and lamina.

In southern Saghalien this kelp is distributed along both western and eastern sides of the Peninsula of Nishinotoro, as far north as Muitomari respectively. The maximum of frequency seems to be found in the vicinity of Shiranushi and Hishitoma where the beach is sometimes heaped up with the tangled masses of this kelp. At Tokushi, this kelp grows together with *Laminaria ochotensis* in the approximate proportion of 100 of the former to 30 of the latter in number. The lamina of the present kelp is pretty thick while fresh and looks to promise high economical value, but it becomes considerably thin on drying, particularly in the marginal portion which usually turns into a thin membrane, quite fragile in texture.

5. ***Laminaria dentigera*** Kjellman

Om Beringhafv. Algfl., 1889, p. 45, pl. 2, figs. 10–14 ; De Toni, 1895*a*, p. 342 ; Yendo, 1909, p. 124 ; Setchell & Gardner, 1925, p. 604 ; Miyabe, 1928, p. 955 ; *in* Okamura 1936, p. 289 ; Miyabe & Nagai, 1932, p. 202, fig. 4 ; 1933, p. 90 ; Sinova, 1933, p. 19 ; Okamura 1936, p. 256 ; Nagai, 1940, p. 82.

Japanese name. Kumade-kombu (Yendo).

Habitat. Cast ashore. W. coast : Shiranushi (T., '26).

Distribution. Kuriles and Saghalien ; Kamtschatka ; Bering Island ; Alaska.

Remarks. Only one specimen is before us. The holdfast is composed of a mass of hapteres arised verticillately from the basal part of the stipe. The stipe is cylindrical, 11 cm. long. The blade splits deeply into several lobes. The mucilage lacunae are present in both stipe and blade. In the cross section of stipe, the lacunae are closely arranged in the cortical tissue while they are situated in the subcortical layer of the stipe in a well grown specimen from the northern Kuriles.

29. **Kjellmaniella** Miyabe

Laminariac. Hokkaido, 1902, p. 43 : Okamura, 1936, p. 256.

Kjellmaniella crassifolia Miyabe

loc. cit., 1902, p. 46. pl. 17 ; *in* Proc. 3rd Pan-Pacific Sci. Congr .Tokyo, 1928, p. 957 ; *in* Okamura, *loc. cit.*, 1936, p. 291 ; Okamura, 1925, p. 89, pl. 224 ; 1936, p. 257 ; Kanda, 1938, pp. 100-104, pl. 17. fig. 7, text-figs. 16–20.

Japanese name. Gagome.

Habitat. Growing on rocks in the sublittoral belt. W. coast : Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '27).

Distribution. Northern Honshû, Hokkaido and Saghalien.

Remarks. *Kjellmaniella crassifolia* is one of very characteristic species of Laminariaceae in our boundary. Its peculiar shaped, regular gyrations on the blade are excellently clearly illustrated by Kanda (*loc. cit.*, fig. 16), It is distributed in Hokkaido along the coasts from Muroran to Hokodate, preferring exposed and projecting localities. It has recently been reported to extend also beyond the Tsugaru Strait as far as Ôma, Prov. Mutsu (cf. Miyabe, in Okamura, 1936, p. 291). On the other hand, the occurrence of this kelp in Saghalien is restricted to the cold water region on the west coast of Nishinotoro Peninsula. The blade of the Saghalien plant is long elliptical or elliptico-lanceolate in shape, measuring up to 180 cm. in length and 20–51 cm. in breadth at the broadest portion, while that of the plant from Hokkaido is described as being broadly linear-lanceolate in shape, measuring 1–2 m. in length and 15–30 cm. in breadth. In other respects, there is no essential difference between them.

30. **Agarum** (Bory) Postels et Ruprecht

Bory, *in* Dict. Class., IX, 1826, p. 193, *emend.* Postels & Ruprecht, Illustr. Alg., 1840, p. 11 ; Okamura, 1936, p. 257.

Agarum cribrosum Bory

loc. cit., 1826, p. 193 (*in part*) ; Setchell, 1912, p. 155 ; Setchell & Gardner, 1925, p. 615, pl. 63 ; Tokida, 1932, p. 10 ; Miyabe & Nagai, 1933, p. 94 ; Kawabata, 1936, p. 206 ; Okamura, 1936, p. 258, fig. 142 ; Miyabe. *in* Okamura, 1936, p. 293 ; Taylor, 1937, p. 197. pl. 22, fig. 1 ; Takamatsu, 1938, p. 21 ; 1938*a*, p. 94 ; Nagai, 1904, p. 94.

Fucus Agarum Turner, Hist. Fuc., II, 1809, p. 10, pl. 75.

F. cribrosus Mertens, *in* Linnaea, IV, 1829, p. 52.

Agarum Gmelini Postels et Ruprecht, *loc. cit.*, 1840, p. 11, pls. 20, 21 ; J. Agardh, 1848, p. 141 ; Saunders, 1901, p. 430, pl. 61 ; Okamura, 1902, p. 129 ; Sinova, 1929, p. 32 ; 1933, p. 26.

A. Turneri Postels et Ruprecht, *loc. cit.*, 1840, p. 12, pl. 22, ; J. Agardh, 1848, p. 141 ; Ruprecht, 1851, p. 353 ; Kjellman, 1883, p. 222 ; 1889, p. 42 ; De Toni, 1895, p. 52 ; 1895*a*, p. 334 ; Saunders, 1901, p. 431 ; Miyabe, 1902, p. 59, pl. 27 ; Okamura, 1902, p. 129 ; 1916, p. 167 ; 1925, p. 90. pl. 225 ; 1928, p. 53 ; Yamada 1928, p. 516 ; Sinova, 1933, p. 26 ; 1938, p. 45.

A. pertusum Postels et Ruprecht, *loc. cit.*, 1840, p. 12, pl. 23.

Japanese name. Aname.

Habitat. Growing on rocks usually in deep water, and frequently found cast ashore. W. coast : Pilevo (Miyabe, '06), Nayoshi (Miyabe, '06), Hishitoma (T., '26), Shiranushi (T., '27). Aniwa Bay : Nobori (T., '26), Merei (Miyabe, '06). E. coast : Airô (Miyabe, '06 ; T., '27), Ochibo (Miyabe, '06), Kashiho (Miyabe, '06), Unetonnai (Miyabe, '06) ,Kaihyô-tô (T., '30, '32, '35), Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Pacific coast of North America (from Alaska to Washington) ; Atlantic coast of North America ; Arctic Ocean (American Arctic Sea and Baffin Bay).

Remarks. As understood by the above listed localities the present alga is widely distributed all around the coasts of sourthern Saghalien. In the northern part of Ochotsk Sea it has hitherto been represented by only two incomplete specimens cast ashore near the mouths of Uda River and of a rivulet at Dshukdshandran (Ruprecht, 1851, p. 353). Ruprecht states :" ... es bildet daher noch ganz ungewiss, ob diese Art irgendwo im Ochotskischen Meere ansteht, oder nur durch die Strömung aus dem offenen Ocean dahin getrieben wird." Of these two opinions of Ruprecht, the former is considered to be reasonable judging from the wide distribution of the species in southern Saghalien.

This kelp is, in Hokkaido and Saghalien, generally the inhabitant of deep water and its drifted fronds only are collected by us on the sea shore. However, the writer was once able to observe several fronds growing on rocks at 2–3 feet depth beneath the low water mark at Cape Nishinotoro, in April 1937.

31. **Costaria** Greville

Alg. Brit., 1830, p. xxxix ; Okamura, 1936, p. 258.

Costaria costata (Turner) Saunders

in Bot, Gaz., XX, 1895, p. 57 ; Setchell & Gardner, 1925, p. 610, pl. 56 b, pl. 79 a ; Miyabe & Nagai, 1933, p. 93 ; Yamada, 1935, p. 18 ; Kawabata, 1936, p. 205 ; Okamura 1936, p. 294 ; Takamatsu, 1936*a*. p. 54 ; 1938, p. 22 ; 1938*a*, p. 95 ; Nagai, 1940, p. 92.

Fucus costatus Turner, Hist. Fuc., IV, 1819, p. 72, pl. 226.

Laminaria costata Agardh, Sp. Alg., I, 1. 1820, p. 109 ; Syst., 1824, p. 269.

Costaria Turneri Greville, Alg. Brit., 1830, p. xxxix ; Postels & Ruprecht, 1840, p. 12 ; J. Agardh, 1848, p. 139 ; De Toni. 1895, p. 51 ; 1895*a*, p. 316 ; Saunders, 1901, p. 431 ; Miyabe, 1902, p. 50, pl. 20 ; Okamura, 1925, p. 99. pl. 226 ; Yamada, 1928, p. 516 ; Sinova, 1929, p. 4 ; 1938, p. 47.

Japanese name. Sujime (Okamura), Zarame.

a. ***Costaria costata*** f. ***cuneata*** Miyabe et Nagai

in Nagai, *loc. cit.*, 1940, p. 93.

Costaria Turneri var. *pertusa* Harvey, Charact. New Alg., 1859 p. 329 ; De Toni, 1895*a*, p. 362 ; Sinova, 1929, p. 42 (*sub* forma).

Habitat. Growing on rocks in the lower littoral and sublittoral belts. W. coast : Pilevo (Miyabe, '06), Ushiro (Miyabe, '06), Tomarioru (T., '30), Rakuma (T., '27), Yenchishi (T., '26), Shiranushi (T., '26, '27), Nishinotoro (T., '26), Kaiba-tô (T., '30). Aniwa Bay : Nobori (T., '35) Tôbuchi-ko (T., '35), Shiraiwa (T., '32), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (Miyabe, '06).

Distribution. Sp. – Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of North America (from Alaska to California).

Remarks. Costaria costata is widely distributed in the North Pacific region, and is hitherto only known from that region. Turner (*loc. cit.*, p. 72) states in his description in English that his material was collected "On the west coast of South America" by Menzies. But his Latin description of the habitat (p. 73) is read as follows : "Habitat in Occidentalibus Americae septentrionalis littoribus." There must have happened possibly a misprint in the former. Quoting only the English passage from Turner, Setchell & Gardner (1925, p. 611) stated that they felt fairly certain that the citation of South America was erroneous.

Miyabe & Nagai have lately distinguished two forms in the present species, namely f. *cuneata* Miyabe et Nagai and f. *latifolia* (Post. et Rupr.) Miyabe et Nagai. The Saghalien specimens in the writer's hand are mostly referable to the former, but there are also a few specimens of an intermediate form, the blade of which being nearly oblong in shape but cuneate at the base. That the forma *latifolia* should also be present in southern Saghalien is beyond doubt. *Costaria costata* is, however, considered to be an exceedingly variable species, and the writer is strongly inclined to endorse the view of Setchell & Gardner who concluded after a thorough discussion that they were not able to state the limits of forms. The number of the longitudinal ribs on the blade is five in the typical form, but sometimes shows a considerable variation. Ruprecht (1852, p. 82) and Harvey (*loc. cit.*) observed, in *Costaria quadrinervia* and *C. Turneri* var. *pertusa* respectively, plants possessing four ribs, which are rarely met with also on the coasts of Saghalien. According to the observation of Kinoshita (1933. p. 91, figs. 1–12) on the considerable number of specimens collected in May 1933 at Okushiri Island, Hokkaido, the number of ribs varies from three to eight. Other abnormalities of the ribs, such as ramification, are also illustrated by the same author. *Costaria costata* is perennial, and two years old plants just in the course of the rejuvenescens of blade were collected by the writer in April 1937, at Shiranushi and Nobori.

32. **Arthrothamnus** Ruprecht

Bemerk. Gros. Algen-Stämme, 1848, p. 67 (11) ; Okamura, 1936, p. 263.

Arthrothamnus kurilensis Ruprecht

loc. cit., 1848, p. 67, pl. 6 ; De Toni, 1895*a*, p. 369 ; Miyabe, 1902, p. 48, pl. 19 ; 1928, p. 955 ; 1936, *in* Okamura p. 295 ; Okamura, 1925, p. 103 pl. 228 ; 1936, p. 265 ; Miyabe & Nagai, 1933, p. 95 ; Yamada, 1935, p. 19, fig. 8 ; Tokida, 1937, pp. 60 66, figs. 1-5 ; Nagai, 1940, p. 100.

Japanese name. Chishima-nekoashikombu (Miyabe), Kidachi-mimikombu (Miyabe).

Habitat. Growing on rocks in the sublittoral belt, from near the low water mark downward. W. coast : Yenchishi (T., '26), Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '26, '27), Nishinotoro (T., '35, '37).

Distribution. South and Middle Kuriles and Saghalien.

Remarks. The present rare kelp which has been considered to be strictly endemic to the Middle and South Kuriles is found in Saghalien only in the cold water district on the Japan Sea side of the Peninsula of Nishinotoro. It is often thrown up ashore in enormous quantities at the localities above mentioned between Cape Nishinotoro and Yenchishi.

A contribution to the morphology of this kelp was published by the writer in 1937 (*loc. cit.*). He has observed at Sôni a large specimen which was provided with a stem eight times dichotomously branched. This is the maximal record of the branching in Saghalien specimens. Judging from the number of branching, it must have been nine years of age and would have had two hundred and fifty six blades if all of them survived. Nagai (*loc. cit.*, p. 101) has made an error in considering a plant bearing "twenty blades on a single original stipe" as being ten years of age. Ruprecht's plant is illustrated (*loc. cit.*, pl. 6) to have about thirteen or at least eleven successive scars on the stem, from which it may be considered to be fourteen or at least twelve years of age.

33. **Alaria** Greville

Alg. Brit. Syn., 1830, p. xxxix, p. 25 ; Okamura, 1936, p. 274.

Key to the species

I. Midrib fistulose at intervals .... 1. *A. fistulosa*
II. Midrib thoroughly solid
  A. Blade finely corrugated in the upper part, with or without cryptostomata
    1. Blade without cryptostomata ; sporophylls dropped with petioles .... 2. *A. macroptera*
    2. Blade frosted with numerous cryptostomata ; sporophylls dropped leaving petioles on the stipe .... 3. *A. ochotensis*
  B. Blade smooth in the upper part, without cryptostomata .... 4. *A. dolichorhachis*

1. ***Alaria fistulosa*** Postels et Ruprecht

Illustr. Alg., 1840, p. 11. pl. 16 ; J. Agardh, 1848, p. 144 ; Kjellman, 1889, p. 40 ; De Toni, 1895, p. 52 ; 1895*a*, p. 332 ; Saunders, 1901, p. 426, pl. 57 ; Miyabe, 1902, p. 52, pl. 21 ; 1928, p. 957 ; 1936, *in* Okamura, p. 293 ; Yendo, 1919, p. 76, pl. 1 ; Setchell & Gardner, 1925, p. 644, pl. 72 ; Sinova, 1933, p. 18 ; Miyabe & Nagai, 1933, p. 96 ; Yamada, 1935, p. 15 ; Kawabata, 1936, p. 204 ; Okamura, 1936, p. 275, fig. 154 ; Nagai, 1940, p. 105.

Phasganon fistulosum Ruprecht, Tange Ochot. Meer., 1851, p. 355.

Japanese name. Oni-wakame (Miyabe).

Habitat. Growing on rocks in sublittoral belt around the rock called Nijô-Iwa and drifted ashore at several localities. W. coast : Minaminayoshi (Miyabe, '06), Yenchishi (Miyabe, '06 ; T., '27), Shiranushi (T., '26), Kaiba-tô (Miyabe, '06). Sôya Strait : Nijo-Iwa (Nakamura, '06). Aniwa Bay : East side of Cape Nishinotoro (Miyabe, '06), Merei (Miyabe '06).

Distribution. Kuriles and Saghalien ; Kamtschatka ; Bering Island ; Aleutian Islands ; Alaska.

Remarks. This giant species of *Alaria* grows in Saghalien on Nijô-Iwa or the Krilion Danger Reef in Sôya Strait and on the ledge of the west coast of the Peninsula of Nishinotoro. On July 14, 1906, Miyabe collected several complete specimens cast on the beach at Merei. They must have been carried so far there by the current from Nijô-Iwa. In Hokkaido proper this kelp is sometimes also cast ashore at several points in Prov. Kitami and Prov. Kushiro, having been transported by currents from its growing ground in Saghalien or in the Kuriles.

Of the two forms distinguished by Setchell in Setchell & Gardner (1903, pp. 276, 277) under the present species, f. *stenophylla* is that which has been met with in Saghalien.

2. *Alaria macroptera* (Rupr.) Yendo

Monogr. Alaria, 1919, p. 79, pl. 2 ; Miyabe & Nagai, 1933, p. 99 ; Yamada, 1935, p. 16 ; Kawabata, 1936, p. 204 ; Okamura, 1936, p. 276 ; Miyabe, *in* Okamura, 1936, p. 297 ; Nagai, 1940, p. 108.

Phasganon macropterum Ruprecht, Tange Ochot. Meer., 1851, p. 353.

Alaria corrugata. Miyabe, Laminariac. Hokkaido, 1902, p. 55, pl. 24 ; Okamura, 1902, p. 127 ; 1916, p. 165.

A. macrophylla Miyabe, *loc. cit.*, 1902, p. 56, pl. 25 ; Okamura, 1902, p. 127; 1916, p. 166.

A. esculenta latifolia Postels et Ruprecht, Illustr. Alg., 1840, p. 11, pl. 17.

A. esculenta pinnatifida Postels et Ruprecht, *loc. cit.*, 1840, p. 11.

?*A. laticosta* Saunders (*non* Kjellman), Harrim Alaska, Exped., Alg., 1901. p. 425, pl. 55.

Japanese name. Chishima-wakame (Yendo).

Habitat. E. coast : Tonnai (*fide* Yendo).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; ? Alaska.

Remarks. The present species is enumerated here on the authority of Yendo. The writer could not find any specimen referable to this species in his collection as well as in the Herbarium of the Hokkaido University.

3. *Alaria ochotensis* Yendo

Monogr. Alaria, 1919, p. 84, pl. 3, pl. 19, figs. 1-3 ; Miyabe, 1928, p. 958 ; *in* Okamura, 1936, p. 297 ; Okamura 1928, p. 52 ; 1936, p. 276 ; Tokida, 1932, p. 10 ; Nagai, 1933, p. 15.

Japanese name. Karafuto-wakame (Yendo).

Habitat. Growing on rocks in the sublittoral belt. W. coast : Pilevo (Miyabe, '06), Ambetsu (Miyabe, '06), Nayoshi (Miyabe, '06 ; T., '26), Sôni (T., '26), Hishitoma (T., '26 ; '32), Shiranushi (T., '26, '27), Nishinotoro (Miyabe, '06 ; T., '35), Kaiba-tô (T., '30). Sôya Strait : Nijô-Iwa (Nakamura, '06). Aniwa Bay : Ishihama (T., '26), Nobori (T., '26, '35), Satto (T., '32), Shiraiwa (T., '32), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (Miyabe, '06 ; T., '27), Ochibo (Miyabe, '06), Sakaehama (Miyabe, '06 ; T., '29), Unetonnai (Miyabe '06), Jimutaki (Miyabe, '06), Chiriye (Miyabe, '06), Taraika Bay coast and Ochotsk coast of Kitafunakoshi (Miyabe, '06), Kaihyô-tô (T., '30), Kita-shiretoko (T., '35), Yôman (T., '35).

Distribution. Saghalien ; Kamtschatka.

Remarks. This well marked, interesting species of *Alaria* had been considered to be strictly endemic to southern Saghalien until it was reported by Okamura (1928) and Nagai (1933) from Kamtschatka. Tha most striking character of this kelp is that the petioles of the dropped sporophylls remain persistently on the stipe. The blade, which is extremely thin and finely corrugated, is frosted with abundant cryptostomata on the surface and provided with numerous, peculiarly ramified, glandular cells in the superficial tissue. The content of the glandular cells is stained brilliant scarlet red with p-dimethyl-amidobenzaldehyde, hence it was considered to contains some phenol compounds. For the microchemical test of the content just mentioned, we are indebted to Dr. K. Miyabe. This kelp was harvested in early summer and sold on the market as a foodstuff in Saghalien.

4. *Alaria dolichorhachis* Kjellman

Alg. Arct. Sea, 1883, p. 217, pl. 20, pl. 21, pl. 25, figs, 11–18 ; Om Beringhafv. Algfl., 1889. p. 36 ; De Toni, 1895*a*, p. 328 ; Yendo, 1919, p. 89, pl. 5 ; Setchell & Gardner, 1925, p. 642 ; Miyabe, 1928, p. 957 ; 1936, *in* Okamura, p. 298 ; Miyabe & Nagai, 1933, p. 99 ; Okamura, 1936, p. 277 ; Nagai, 1940, p. 110.

Alaria elliptica Kjellman, Alg. Arct. Sea, 1883, p. 221, pl. 23, pl. 25, figs, 25, 26 ; De Toni, 1895a, p. 329 ;

A. crispa Kjellman, Om Beringhafv. Algfl., 1889, p. 37, pl. 3, figs, 5–7 ; De Toni, 1895*a*. p. 330.

Japanese name. Enaga-wakame (Miyabe & Nagai).

Key to the forms

I. Stipe short, up to 20 cm. long. .... a. f. *typica*
II. Stipe long, 30–50 cm. long. .... b. f. *longipes*

4a. *Alaria dolichorhachis* f. *typica* Miyabe et Nagai

in Nagai, Mar. Alg. Kurile Isls., I, 1940, p. 110.

Habitat. Growing on rocks in the sublittoral belt. W. coast : Moiretomari (Miyabe, '06), Rakuma (T., '27), Honto (T., '26), Yenchishi (T., '26), Sôni (T., '26), Hishitoma (T., '26), Shiranushi (Miyabe, '06 ; T., '27). Aniwa Bay : Chishiya (T., '35), Nobori (T., '35). E. coast : Chiriye (Miyabe, '06), Yôman (T., '35).

Distribution. Kuriles and Saghalien ; Kamtschatka ; Bering Sea ; Aleutian Islands ; Alaska ; Arctic Ocean.

Remarks. The present species of *Alaria* can be quite easily distinguished in the field from the preceding species by its plane and smooth blade destitute of any remarkable corrugations and of cryptostomata.

4b. *Alaria dolichorhachis* f. *longipes* Miyabe

in Proc. 3rd Pan-Pacific Sci. Congr. Tokyo 1928, p. 957 ; Tokida, 1934, p. 18 ; Okamura, 1936, p. 277 ; Nagai, 1940, p. 111.

Phasganon alatum var. *longipes* Ruprecht, Tange Ochot. Meer., 1851, p. 353 (*fide* Nagai, *loc. cit.*).

Habitat. Cast ashore. W. coast : Hishitoma (T., '32). E. coast : Kaihyô-tô (T., '32).

Distribution. Kuriles and Saghalien.

Remarks. The long stiped form of this kelp was first collected by the writer on August 9, 1926, at Hishitoma. The stipe of our specimens measures from 30 to

50 cm. in length. It is terete at the base for a short distance but flattened for the rest of the length. In the typical form of this species, it is described by Yendo to attain 20 cm. in length.

Subclass 2. APLANOSPOREAE Setchell et Gardner

Mar. Alg. Pacific Coast N. Amer. III, 1925, p. 649.

Order 8. DICTYOTALES Kjellman

in Engler & Prantl, Pflanzenfam., I, 2, 1896, p. 291 ; Okamura, 1936. p. 158.

Family 17. Dictyotaceae Harvey

Ner. Bor.-Amer., I, 1852, p. 99, *lim. mut*, Setchell & Gardner, Mar, Alg. Pacific Coast N. Amer., III, 1925, p. 650 ; Okamura, 1936, p. 158.

Key to the genera

I. Frond without mid-rib, apices with a single meristematic cell. .... 34. *Dictyota*
II. Frond with mid-rib, apices with several meristematic cells .... 35. *Dictyopteris*

34. **Dictyota** Lamouroux

Nouv. Bull. Soc. Philom., I, 1809, p. 331 ; *in* Desv. Journ. de Bot., II, 1809, p. 38 ; Okamura, *loc. cit.*, 1936, p. 159.

Dictyota dichotoma (Huds.) Lamouroux

in Desv. Journ. de Bot., II, 1809, p. 42 ; Essai, 1813, p. 58 ; J. Agardh, 1848, p. 92 ; Hauck, 1885, p. 304, fig. 126 ; De Toni, 1895*a*, p. 263 ; Okamura, 1904, p. 39 ; 1913, p. 39, pl. 111–113 ; 1927. p. 6 ; 1930, p. 101 ; 1936, p. 160, fig. 82 ; Yamada, 1925, p. 253 ; Newton, 1931, p. 212, fig. 134 ; Taylor, 1931, p. 17 ; Takamatsu, 1936*a*, p. 52 ; 1938, p. 19 ; 1938*a*, p. 92 ; 1939*a*, p. 31 ; Sinova, 1938, p. 47.

Ulva dichotoma Hudson, Fl. Angl., 1762, p. 476.

(For other references, see : De Toni, *loc. cit.*)

Japanese name. Amijigusa (Okamura).

Habitat. Growing on rocks and on other algae in the lower littoral belt. W. coast : Kaiba-tô (Morimoto, '27, '33, '37 ; T., '30).

Distribution. Formosa, Ryûkyû, Hachijô Island, Kyûshû, Shikoku, Honshû, Hokkaido, Saghalien and Korea ; Japan Sea coast of Siberia ; China ; Philippine ; Admiralty Islands ; Arafura Sea (Aru Islands) ; Australia (Sydney) ; New Zealand ; South Africa (Natal) ; Atlantic coasts of South America (Brazil) and of Europe ; North Sea ; Mediterranean Sea.

Remarks. This widely spread warm current species makes its appearance in our region occurring on Kaiba-tô Island. So far as the writer is aware, it does not invade into the water around the Saghalien Island proper. Among our specimens, there is, besides the typical form of the species, a form of narrow linear frond measuring about 1.5 mm. in breadth. It reminds us at a glance *Dictyota spathulata* Yamada, but it seems to differ from the latter in having segments not elongated towards the extremity and in having sori of tetrasporangia scattered more irregularly.

35. **Dictyopteris** Lamouroux

Dissert. sur plus especes de Fucus, I, 1805, p. 32 ; Observ. Phys. Alg. Mar., 1809, p. 332 ; *in* Jour. de Bot., II, 1809*a*, p. 129 ; Briquet, 1935, p. 86 (*in* "Nomina conservanda").

Neurocarpus Weber et Mohr, Beitr. zur Naturkunde, I, 1805, p. 300 ; Howe, 1914, p. 69 ; Briquet, 1935, p. 86 (*in* "Nomina rejicienda") ; Okamura, 1936, p. 171.

Haliseris Agardh, Sp. Alg., I, 1820, p. 141.

Dictyopteris divaricata (Okamura) Okamura

Distrib. Mar. Alg. Pacific Waters, 1932, p. 75.

Haliseris divaricata Okamura, Icon Jap. Alg., I, 3, 1907, p. 57, pl. 13, figs, 1–3, pl. 14, fig. 5 ; Nippon Sôrui Mei-i, ed. 2, 1916, p. 183 ; Mar. Alg. Mutsu Bay, I, 1927, p. 6.

Neurocarpus divaricatus (Okamura) Howe, Chin. Mar. Alg., 1924, p. 138 ; Okamura, 1928, p. 190 ; Tseng & Li, 1935, p. 213.

N. divaricata Okamura, Nippon Kaisô-shi 1936, p. 173.

Dictyopteris divaricata (Okam.) Tseng, Notes Some Chin. Mar. Alg., 1938, p. 594.

D. divaricata (Okam.) Nagai, Mar. Alg. Kurile Isls., I, 1940, p. 42.

Haliseris evanescens Yendo, Nov. Alg. Jap., 1920, p. 2 (*fide* Okamura, 1936, p. 173).

Japanese name. Yezo-yahazu (Okamura).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Kaiba-tô (Morimoto, '33 ; T., '43).

Distribution. Shikoku, Honshû, Hokkaido, Kuriles and Saghalien ; Kwantung (Dairen) ; China.

Remarks. The present widely spread temperate species is also represented in our region by a few specimens collected at Kaiba-tô. Observations on the peculiar cell contents and on the vegetative multiplication of the present alga have lately been reported by the writer and his collaborators, Mr. Masaki and Mr. Yabu (1952).

Subclass 3. CYCLOSPOREAE Areschoug

Phyc. Scand., (Repr.), 1846, p. 28 (*fide* Setchell & Gardner, 1925, p. 662).

Order 9. FUCALES Kylin

in Ber. d. deut. Bot. Ges., XXXV, 1917, p. 309 ; Okamura, 1936, p. 300.

Key to the Families

I. Frond differentiated into axial and lateral part. .... 19. **Sargassaceae**
II. Frond without differentiation into axial and lateral part. .... 18. **Fucaceae**

Family 18. Fucaceae Lamouroux

Essai, 1813, p. 8 (*in part*), *lim. mut.* Setchell & Gardner, Mar. Alg. Pacific Coast N. Amer., III, 1925, p. 663 ; Okamura, 1936, p. 300 (*s. lat.*).

Key to the genera

I. Frond with distinct percurrent midrib. .... 35. *Fucus*
II. Frond without midrib. .... 36. *Pelvetia*

36. **Fucus** (L.) Decaisne et Thuret

Rech. sur Antherid,. 1845, p. 13 ; Okamura, 1936, p . 301.
Fucus Linnaeus, Gen. Plant., 1737, p. 326 (*lim. mut.*).

Fucus evanescens Agardh

Sp. Alg., I, 1. 1820, p. 92 ; J. Agardh, 1848, p. 210 ; Kjellman, 1877, p. 3 ; 1883, p. 202 ; Ruprecht, 1851, p. 346 ; De Toni, 1895a, p. 201 ; Okamura, 1902, p. 137 ; 1936, p. 302 ; Yendo, 1907, p. 14, pl. 1, figs, 1, 2 ; *in* Okamura, 1916, p. 189 ; Gardner, 1922, p. 36, pl. 1. fig. 2 ; Setchell & Gardner, 1925, p. 681 ; Sinova, 1930, p. 103 ; 1933, p. 28 ; Yamada, 1934, p. 346, fig. 1 ; 1935, p. 20 ; Nagai, 1935, p. 324 ; 1940, p. 119 ; Kawabata, 1936, p. 206 ; Taylor, 1937, p. 207, pl. 23, fig. 4, pl. 24, fig. 2 ; Yamada & Tanaka, 1944, p. 56,

Fucus vesiculosus Postels et Ruprecht, Illustr. Alg., 1840, p. 12 (*in part*).

Halidrys vesiculosa Ruprecht, Tange Ochot. Meer., 1851, p. 345 (*in part*).

Japanese name. Hibamata (Okamura), Hibatsunomata (Tanaka).

Habitat. Growing on rocks in the littoral belt. W. coast : Pilevo (Miyabe, '06), Ambetsu (Miyabe, '06), Sokorai (Miyabe, '06), Ushiro (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '26), Shiranushi (T., '32, '35), Nishinotoro (T., '26, '32 ; Morimoto, '25), Kaiba-tô (Morimoto, '37). Aniwa Bay : Chishiya (Miyabe, '06 ; T., '26, '35), Merei (Miyabe, '06), Nagahama (Miyabe, '06 ; T., '35), Kochôbetsu (Matsubara, '33), Shiraiwa (T., '32), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29). Higashishiraura (T., '31) Waare (Miyabe, '06), Mototomari (T., '31), Kashiho (T., '31), Chiriye (Kitahara).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka : Bering Sea ; Pacific coast of North America (Alaska to Oregon) ; Atlantic coast of North America ; Arctic Ocean.

Remarks. As for the type locality of *Fucus evanescens*, C. A. Agardh (*loc. cit.*) states : "Ad Sachalin, Tilesius ; ad Kamtschatka, Chamisso ; unde specimina communicaverunt." On the specimens distributed by Chamisso, Ruprecht states: "Die von Chamisso mit "Kamtschatka" bezeichneten und verbreiteten Exemplare stammen von Redowski, der nie nach Kamtschatka kam, wohl aber an die Westküste des Ochotskischen Meeres" (1851, p. 320; also cf. pp. 194, 346).

This is quite a variable species and nearly twenty five forms have been distinguished by several authors such as Kjellman, Gardner, Nagai, etc. In preparing his monograph on the Japanese forms of *Fucus evanescens*, the last mentioned author examined a considerable amount of Saghalien specimens of various sources including Dr. Miyabe's and writer's collections, and distinguished among them eight forms viz., f. *stellatus* Gardn., f, *rudis* Kjellm., f. *intermedius* Gardn., f. *pergrandis* Kjellm., f. *fusiformis* Nagai, f. *pusillus* Nagai. f. *cornutus* Kjellm. and f. *marginatus* Gardn. So far as the writer's own experience goes, however, it is often rather difficult to decide with certainty whether a specimen should be placed in which of certain two nearly allied forms. The diversity of the external appearance of the alga seems to be attributed, to a certain extent, to individual variation rather than to admixture of a certain number of strains, or to any fixed local or seasonal variations. As understood by the above mentioned localities, *Fucus evanescens* is one of the most common and wide spread seaweeds in our region. In Hokkaido, it occurs on the Pacific side from Todohokke, Prov. Oshima, eastnorthward, on the Japan Sea side at Rishiri and Rebun Islands, and on the Ochotsk Sea coast. Floating detached fronds sometimes happen to be carried by currents far away from their original ground, and according to Okamura (*loc. cit.*), the drifted specimens are occasionally met with as far south as Chôshi near Cape Inuboe on the Pacific side of Middle Honshû.

37. **Pelvetia** Decaisne et Thuret

Rech. Fuc., 1845, p. 12; Okamura, 1936, p. 303.

Pelvetia Wrightii (Harv.) Yendo

Fucac. Jap., 1907, p. 20, pl. 1. figs. 4, 5; *in* Okamura, 1916, p. 189; Okamura, 1927, p. 7; 1928, p. 183, pl. 248; 1936, p. 303, fig. 160; Kawabata, 1936, p. 206; Takamatsu, 1938, p. 26; 1938*a*, p. 99; Nagai, 1940, p. 127; Yamada & Tanaka, 1944, p. 65.

Fucus Wrightii Harvey, Char. New Alg., 1859, p. 328; De Toni, 1895*a*, p. 209.

F. Babingtonii Harvey, *loc. cit.*, 1859, p. 329.

Pelvetia Babingtonii De Toni, Syll. Alg., III, 1895*a*, p. 216; Sinova, Alg. Petrov Isl., 1938, p. 48.

P. japonica Yendo, Prelim. List Jap. Fucac., 1905, p. 156.

Japanese name. Yezo-ishige (Okamura).

Habitat. Growing on rocks in the littoral belt. W. coast: Ambetsu (Miyabe, '06). Ushiro (Miyabe, '06), Shiranushi (T., '37), Nishinotoro (Morimoto, '25; T., '37), Kaiba-tô (T., '30; Morimoto, '37). Aniwa Bay: Nobori (T., '33), Ôtomari

(Idzumiyama, '06), Merei (Miyabe, '06), Nagahama (Miyabe, '06 ; T., '33), Kochôbetsu, (Matsubara, '33). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia.

Remarks. Yendo distinguishes in the present species three forms, viz., f. *typica*, f. *Babingtonii* and f. *japonica*. But it is sometimes very difficult to separate specimens into those forms with sharp distinction, as mentioned by Nagai (1940, p. 128). Okamura states also as follows : "Though Yendo distinguishes the three forms yet they seem to be not sharply defined and localized forms. If one compares the typical forms standing near the two extremities he will find a marked difference between them yet, there are many intermediate forms and it is very difficult to distinguish one from the other, especially so for f. *Babingtonii* ......" (1928, p. 185). Of these three forms, f. *japonica* is most frequently met with in southern Saghalien, nevertheless the other two also may not be lacking (for f. *typica*. cf. Okamura, 1928, p. 184).

Pelvetia Wrightii is found in our region usually associated with *Fucus evanescens*. However, it has somewhat different range of distribution as compared with the latter species, being distributed in the Kurile Islands as far noth as Urup Island, where Nagai has collected some drifted specimens (1940, p. 128), and in Korea along north-eastern, southern and western coasts as well as on the islet Saishû-tô (Okamura, 1928, p. 184). Along the Pacific side of Honshû it comes down as far south as Cape Inuboe. In Hokkaido, it does not occur along the whole coasts as mentioned by Okamura (*loc. cit.*, p. 184) but it is absent from the Japan Sea coast except the Islands Rishiri and Rebun. It is to be noted also that *Pelvetia* has never been reported from the northern part of the Ochotsk Sea nor from Kamtschatka.

Family 19. Sargassaceae De Toni

Syst. Uebers. Fucoid., 1891, p. 174 (*lim. mut.*) ; Setchell & Gardner, 1925, p. 704.

Key to the genera

I. Receptacles axillary or apparently axillary .... 39. *Sargassum*
II. Receptacles not axillary .... 38. *Cystophyllum*

38. **Cystophyllum** J. Agardh

Sp. Alg., I, 1848, p. 228 ; Okamura, 1936, p. 307.

Key to the species

I. Vesicles usually single ; receptacles comparatively small. .... 1. *C. geminatum*

II. Vesicles often seriate
- A. Two successive vesicles sharply separated by a short, delicate link ; receptacles of medium size .... 2. *C. crassipes*
- B. Two successive vesicles closely connected with shallow constrictions, seldom stalk-like, between them ; receptacles comparatively large. .... 3. *C. hakodatense*

1. ***Cystophyllum geminatum*** (Ag.) J. Agardh

Sp. Alg., I, 1848, p. 232 ; De Toni, 1895*a* p. 156 ; Setchell & Gardner, 1903 p. 285 ; 1925, p. 706 ; Okamura, 1902, p. 139 ; 1936, p. 309 ; Yendo, 1907 p. 28 ; *in* Okamura. 1916, p. 192 ; Sinova, 1930, p. 104 ; 1938, p. 49 ; Yamada, 1935, p. 20 ; Kawabata, 1936, p. 206 ; Nagai, 1940, p. 129.

Cystoseira geminata Agardh, Syst. Alg., I, 1824 p. 286.

Sirophysalis geminata Kützing, Sp. Alg., 1849 p. 602.

Cystoseira Spicigera Agardh, Sp. Alg., I, 1820 p. 64; Syst. Alg., 1824 p. 285, (*forma junior*).

Fucus spicigera Mertens, mscr. (*fide* Postels & Ruprecht, Illustr. Alg., 1840 p. 13,).

Cystoseira thyrsigera Postels et Ruprecht, *loc. cit.*, 1840, p. 13, pl. 38, fig. 1 ; Ruprecht, 1851, p. 348.

C. thyrsigera β Lepidium Postels et Ruprecht, *loc. cit.*, 1840 p. 13.

Fucus Lepidium Mertens, mscr. (*fide* Postels et Ruprecht, loc. cit., 1840 p. 13).

Cystoseira Lepidium Ruprecht, *loc. cit.*, 1851 p. 347.

C. hypocarpa Kützing, Tab. Phyc., X, 1860, pl. 52, fig. 2 ; De Toni, 1895*a*, p. 175.

Cystophyllum Lepidium Harvey, Coll. Alg. Vancouver Isl., 1862, p. 163 ; De Toni, 1895*a* p. 156 ; Saunders, 1901, p. 432.

Japanese name. Yezo-moku (Yendo).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. Aniwa Bay : Merei (Miyabe, '06). E. coast : Ochibo (Ishioka).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Pacific coast of North America from Alaska to Washington.

Remarks. The occurrence of the present alga in Saghalien was first mentioned by Ruprecht (1851, p. 347) under the name of *Cystoseira Lepidium.* He states : "... die in Mertens Herb. V, 124 mit der Bezeichnung 'e mari glaciali' und 'Insul. Kuril' sich vorfindenden Exemplare, scheinen von Krusenstern's Reise und eher aus Sachalin abzustammen." The identity of five species of *Cystoseira* listed above was pointed out by Setchell & Gardner (1903, p. 286), whose specific conception has been endorsed by Yendo. *C. geminatum* is very closely allied with *C. crassipes*, from which it is generally said to differ in having nearly exclusively single vesicles instead of seriate, compound ones. But there may exist some intermediate forms in respect to the character of the vesicle, and the separation of specimens into these two species merely on the basis of the relative frequency of simple or compound vesicles can not be helped to be quite artificial and inconsistent. After a careful study of many specimens of *Cystophyllum* deposited in our Herbarium which were determined by Yendo and Nagai, the writer has come to a conclusion that three species enumerated in the present account differ from each other in several points as explained below. *C. geminatum* differs from its allies in having comparatively smaller vesicles and receptacles, and in having usually no receptacle on the top of vesicles. Of two specimens from Saghalien which the writer refers to the present species, one from Merei was already determined by Yendo as *C. geminatum*, but the other from Ochopoka (Ochibo) was determined by the same author as *C. crassipes*.

2. *Cystophyllum crassipes* (Mert.) J. Agardh

Sp. Alg., I, 1848, p. 232 ; De Toni, 1895, p. 46 ; 1895*a*, p. 155 ; Yendo, 1907, p. 29, pl. 2, figs, 9–12 ; *in* Okamura, 1916, p. 191 ; Kawabata, 1936, p. 206 ; Okamura, 1936, p. 307 ; Nagai, 1940, p. 130 ; Yamada & Tanaka, 1944, p. 66.

Fucus crassipes Mertens, *in* Turner, Hist. Fuc., II, 1809, p. 154, pl. 131.

Cystoseira crassipes Agardh, Sp. Alg., I, 1820, p. 69 ; Syst. Alg., 1824, p. 286.

Sirophysalis crassipes Kützing, Sp. Alg., 1849, p. 602 ; Tab. Phyc., X, 1860, pl. 56, fig., 1 ; Martens, 1866, p. 128.

? *S. kakiloides* Kützing, Tab. Phyc., X, 1860, pl. 56, fig. 2, (forma *fructifera*) (*fide* De Toni, 1895*a*, p. 155).

? *Fucus kakiloides* Mertens, mscr. (*fide* De Toni. 1895*a*, p. 155).

Cystophyllum geminatum Tokida (*non* J. Agardh), Mar. Alg., Robben Isl., 1932, pl. 11.

Japanese name. Nebuto-moku (Yendo).

Habitat. Growing on rocks in the sublittoral belt. W. coast : Ushiro (Miyabe, '06), Shiranushi (T., '32), Nishinotoro (T., '35). Aniwa Bay : Chishiya (T., '37), Ōtomari (Idzumiyama, '06 ; T., '29), Merei (Miyabe, '06), Nagahama (T., '35), West side of Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29), Higashishiraura (T., '31), Waare (Miyabe, '06), Kashiho (T., '31), Chiriye (Miyabe, '06 ; T., '35), Kaihyô-tô (T., '30).

Distribution. Eastern Hokkaido, Middle and South Kuriles and Saghalien.

Remarks. To distinguish *C. crassipes* from *C. hakodatense*, Yendo has laid much stress on the relative extent of the depth of constriction between two successive vesicles as well as on the relative positions of the vesicles and receptacles (1907, p. 31 and 34). So far as the writer has examined, however, the vesicles crowned with a receptacular ramulet are often met with not only in *C. hakodatense* but also in the typical specimens of *C. crassipes*, as described by Nagai (1940, p. 131). In respect to the character of the vesicles, the writer has not rarely met with intermediate forms in which both types of the vesicle are borne on one and the same individual. In the writer's opinion, *C. crassipes* differs from *C. hakodatense* in being comparatively smaller in the size of the vesicles and the receptacles. The moniliform vesicles with shallow constrictions are practically lacking in the typical form but make their appearances not uncommonly in our Saghalien specimens which referable in other respects to the species under consideration.

3. *Cystophyllum hakodatense* Yendo

Fucac. Jap., 1907, pl. 2, figs. 13–16 ; *in* Okamura, 1916, p. 191 ; Okamura, 1924, p. 43. pl. 211 ; 1927, p. 8 ; 1936, p. 308 ; Takamatsu, 1936, p. 15 ; 1938, p. 25 ; 1938*a*, p. 98 ; Nagai, 1940,

p. 131 ; Yamada & Tanaka, 1944, p. 65.

Cystophyllum crassipes Okamura (*non* J. Agardh), Nippon Sôrui Mei-i, ed. 1. 1902, p. 139 (excl. syn.).

Japanese name. Uga-no-moku (Yendo).

Habitat. Growing on rocks in the sublittoral belt. W. coast : Sokorai (Miyabe, '06), Nayoshi (Miyabe, '06), Ushiro (Miyabe, '06), Tomarioru (Miyabe, '06), Honto (Morimoto, '25), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Nobori (T., '35), Nakashiretoko (Miyabe, '06). E. coast : Ochibo (Miyabe, '06), Waare (Miyabe, '06), Jimutaki (Miyabe, '06), Chiriye (Miyabe, '06).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea.

Remarks. This species of *Cystophyllum* is of more robust frond than either of the preceding ones and bears markedly larger receptacles. The vesicles in the typical specimens are sometimes solitary but more frequently are arranged in a moniliform series generally with shallow constrictions or occasionally deep, stalk-like ones between successive vesicles.

39. **Sargassum** Agardh

Sp. Alg., I, 1820, p. 1 ; Okamura, Nippon Kaisô-shi, 1936, p. 315.

Key to the species

I. Vesicles long, cylindrical .... 1. *S. Horneri*
II. Vesicles spherical to fusiform
    A. Leaves nearly always serrated ; receptacles complanated ...... 2. *S. serratifolium*
    B. Leaves entire or more or less sparingly dentated ; receptacles cylindrical or fusiform
        1. Basal leaves considerably large ; vesicles, except quite young ones, rounded at the apex
            a. Basal leaves generally entire .... 3. *S. confusum*
            b. Basal leaves often dentate .... 3a. *S. confusum* f. *validum*
        2. Basal leaves not considerably differing in size from the rest ; vesicles generally mucronate
            a. Vesiculiferous ramulets remarkably abbreviated
                i. Lateral branches always very short ; leaves broad .... 4a. *S Thubergii* f. *latifolium*
                ii. Lateral branches considerably long ; leaves narrow .... 4b. *S. Thunbergii* f. *nipponicum*
            b. Vesiculiferous ramulets not abbreviated
                i. Monoecious .... 5. *S. Kjellmanianum*
                ii. Dioecious .... 6. *S. Miyabei*

1. ***Sargassum Horneri*** Agardh

Sp. Alg., I, 1, 1820, p. 38 ; Syst. Alg., 1824, p. 307 ; J. Agardh, 1848, p. 290 ; 1889, p. 57; 1896, p. 50 (*nomen*) ; Hariot, 1891, p. 218 ; De Toni, 1895, p. 43 ; 1895*a*, p. 20 ; Okamura, 1902, p. 144 ; 1923, p. 3, pl. 202 ; 1927, p. 7 ; 1936, p. 328 ; Cotton, 1906, p. 367 : 1915, p. 109;

1907, p. 74, pl. 10 ; *in* Okamura 1916, p. 198 ; Yamada, 1925, p. 245 ; Takamatsu, 1936, p. 16 ; 1936*a*, p. 55 ; 1938, p. 28 ; 1938*a*, p. 100 ; 1939*a*, p. 43 ; Nagai, 1940, p. 133.

Fucus Horneri Turner, Hist. Fuc., I, 1808, p. 34, pl. 17.

Spongocarpus Horneri Kützing, *in* Bot. Zeit., I, 1843, p. 54 ; Phyc. Gen., 1843*a*,. p. 365 ; Tab. Phyc., X, 1860. pl. 89 ; Martens, 1866, pp. 116, 129 ; Suringar, 1870, pl. 26.

Sargassum Spathulatum J. Agardh, Sp. Sarg. Austr., 1889, p. 58, adnot. ; Anal Alg., Cont. III, 1896, p. 50.

S. Horneri var. *spathulatum* Okamura, Nippon Sôrui Mei-i, ed. 1. 1902, p. 144.

S. Fengeri J. Agardh, Sp. Sarg. Austr., 1889, p. 58 ; Anal. Alg., Cont. III, 1896, p. 50 (*nomen*) ; De Toni, 1895, p. 43 (excl. syn.) ; 1895*a*, p. 21 ; Okamura, 1902, p. 144.

S. polyodontum J. Agardh, Anal. Alg., Cont. III, 1896, p. 51 ; Okamura, 1902, p. 145.

Japanese name. Aka-moku.

Habitat. Habitat for Saghalien plant unknown. Northern Saghalien outside the mouth of the Amur (Fenger) (*fide* J. Agardh, 1889, p. 58).

Distribution. Formosa, Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China.

Remarks. *Sargassum Horneri* is a common temperate species widely spread around the coasts of Japan, Korea and China. The range of its distribution extends as far south as the Pescadores Islands on the one hand, and as far north as the southern Kuriles on the other. Its occurrence in Saghalien has been reported by J. Agardh under the names of *S. spathulatum* (1889, p. 58 ; 1896, p. 50) and *S. Fengeri* (1889. p. 58). His materials are said to have been collected by Navarcha Fenger in north-western Saghalien near the mouth of the Amur. According to Yendo (1907, pp. 78–79) these two species are not separable from *S. Horneri*. As far as the writer is aware, this alga has not been collected by anyone yet in southern Saghalien, but judging from the range of its distribution it may not be unreasonable to enumerate this species in the present paper.

Among the algae collected by Fenger near the mouth of Amur (? on the coast of Saghalien), there are two other species of *Sargassum* which have been reported by J. Agardh (1889, pp. 56, 58) under the names of *S. patens* and *S. Coreanum* J. Ag. The latter is, according to Yendo (1907, p. 149), nothing but the female plant of *S. Ringgoldianum* Harv. The last mentioned species has been known to be distributed as far north as Prov. Kushiro, Hokkaido, along the Pacific side of our territory but not beyond the Tsugaru Strait on the Japan Sea side (cf. Okamura, 1936, p. 333), while *S. patens* is more south in distribution and does not occur in Hokkaido. In spite of J. Agardh's report of their occurrence in northern Saghalien, their distribution in southern Saghalien is so questionable that the writer dares not count them as members of the marine flora of our region.

2. ***Sargassum serratifolium*** Agardh

Syst. Alg., 1824, p. 299 ; J. Agardh. 1848, p. 291 ; 1889, p. 59 ; 1896, p. 53 ; De Toni, 1895, p. 44 ; 1895*a*, p. 22 ; Okamura, 1902, p. 148 ; 1924, p. 23, pl. 207 ; 1936. p. 329, fig. 168 (4) ;

Yendo, 1907, p. 81, pl. 11, figs, 1–7 ; *in* Okamura, 1916, p, 199 ; Takamatsu, 1939*a*, p. 45.
Fucus serratifolius Agardh. Alg. Dec., No. 31, 1812–16.
Halochloa serratifolia Kützing, *in* Bot. Zeitg., I, 1843, p. 56 ; Tab. Phyc., X, 1860, pl. 99 ; Martens, 1866, p. 129.
Fucus. longifolius Turner, Hist. Fuc., III, 1811, p. 88, pl. 104, fig a.
F. longifolius var. *tenuifolius* Turner, *loc.cit.*, 1811. p. 88.
Halochloa longifolia Kützing, Phyc. Gen., 1843*a*. p. 367 ; 1860, pl. 100.
H. serratifolia β longifolia Kützing, Sp. Alg., 1849, p. 633 ; Martens, 1866, pp. 116, 129.
Sargassum corynocarpum Harvey (*non* J. Agardh), Char. New Alg., 1859, p. 328 ; De Toni, 1895, p. 45 ; 1895*a*, p. 25 ; Okamura, 1902, p. 151.

Japanese name. Nokogiri-moku.

Habitat. Probably found cast ashore. W. coast : Kaiba-tô (Miyabe, '06).

Distribution. Ryûkyû, Kyûshû, Shikoku, Honshû, Hokkaido and Saghalien; China ; Indian Ocean.

Remarks. Only a single specimen is now before us. However, it shows satisfactorily the characteristics of the present species in every respect, especially in its duplicato-serrated leaves. Martens listed in his "Tange" (1866, p. 129) "Liukiu-inseln und Nagasaki (Horner), Matsumai (Tilesius), Tschifu (Schottmüller)" for *H. serratifolia β longifolia* Kg. Of these localities, Matsumai (or Matumae), which is situated in the southern extremity of Hokkaido, is the northernmost locality ever known for *S. serratifolium.* It is rather unexpected, then, to find this alga in our region, but the possibility of a long-distance conveyance of floating detached fronds of a *Sargassum* by currents will afford an explanation of such rare collections as in the cases of the present and the preceding species.

3. ***Sargassum confusum*** Agardh

Syst. Alg., 1824, p. 301 ; J. Agardh, 1848, p. 294 ; 1889, p. 127 ; De Toni, 1895, p. 46 ; 1895*a*, p. 115 ; Okamura 1902, p. 158 ; 1927, p. 8 ; 1936, p. 335 ; Yendo, 1907, p. 106, pl. 14, figs, 1–12 ; *in* Okamura, 1916, p. 201 ; Cotton, 1915, p. 110 ; Howe, 1924, p. 137 (with query) ; Takamatsu, 1936, p. 18 ; 1936*a*, p. 55 ; 1938, p. 27 ; 1939*a*, p. 41 ; Sinova, 1938, p. 49 ; Nagai, 1840, p. 134.
Sargassum acinaria Agardh, Sp. Alg., 1820, p. 22 (excl. syn.) (*fide* J. Agardh) ; Martens, 1966, pp. 116, 128 ; Kützing, 1861, pl. 17, fig. II, (*fide* Yendo).
Fucus heterophyllus Agardh, Alg., Dec., No. 52. 1812–16.
? *F. pallidus* Turner, Hist, Fuc., I, 1808, p. 149, pl. 67 (*fide* Yendo).
? *Sargassum fuliginosum* Kützing, Sp. Alg., 1849, p. 612 ; Tab. Phyc., XI, 1861, pl. 19 ; ? Martens, 1866, pp. 116, 128 (*fidc* Yendo) ; Okamura, 1902, p. 158.

Japanese name. Fushisuji-moku (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Pilevo (Miyabe, '06), Rakuma (T., '30), Nishinotoro (Morimoto, '25 ; T., '37), Kaiba-tô (Morimoto, '33). Aniwa Bay : Ōtomari (Idzumiyama, '06), Tôbuchi-ko (T., '26).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and

Korea ; China ; Japan Sea coast of Siberia.

Remarks. Our specimens of *Sargassum* from Saghalien which bear spherical, non-apiculate vesicles are all referable to the present species. Their basal leaves, when present, are often more or less slightly serrated in part but rather rarely entire without an exception. Only one of our specimens, which is one of those collected at Rakuma, practically lacks the serrature on the margin of its basal leaves. Those which have remarkable serrature on the margin in most of their basal leaves are referred to the following forma. *S. confusum* is dioecious ; the male plant has longer receptacles than the female (cf. Inoh. 1930, p. 427).

3a. ***Sargassum confusum*** f. ***validum*** (J. Ag.) Yendo

Prelim. List Jap. Fucac., 1905, p. 160 ; Fucac. Jap., 1907, p. 108, pl. 14, figs. 8-12 (*sub* f. *valida*) ; *in* Okamura, 1916, p. 202 ; Okamura, 1936, p. 335.

? *Sargassum validum* J. Agardh, Anal. Alg., Cont. III, 1896, p. 59.

S. expansum J. Agardh, *loc. cit.* 1896, p. 60 (*fide* Yendo).

Habitat. The same as in the typical forma. W. coast : Hirochi (T., '27). Aniwa Bay : Ôtomari (Idzumiyama, '06), Tôbuchi-ko (Miyabe, '06 ; T., '26, '29).

Distribution. Honshû, Hokkaido, Saghalien and Korea.

Remarks. Besides Korea and Hokkaido, Yendo (1907, p. 112) has mentioned Iwami Prov. as one of the localities for the present forma. On the other hand, Okamura (1936, p. 335) states that the localities for forma *validum* are the same as in the case of the typical form. As a matter of fact, certain intermediate forms may be found at any place together with the typical form. The Kurile specimens referred by Nagai to forma *typica* are mostly provided with entire basal leaves, but some of them are furnished with the basal leaves slightly serrated in part. The basal leaves of our Saghalien specimens, which the writer has referred to this forma, are fairly distinctly serrated, occasionally even duplicato-serrated, at the margin. Although they are often lanceolate with a pointed apex in shape, especially in those from Tôbuchi-kô, the spathulate ones are also not uncommonly met with.

4. ***Sargassum Thunbergii*** (Mert.) Kuntze

Rev. Sarg., 1880, p. 215 ; Rev. Gen. Plant., III, 2, 1898, p. 427 ; Yendo, 1907, p. 114, pl. 15, fig. 5 ; *in* Okamura, 1916, p. 203 ; Okamura, 1936, p. 337 ; Takamatsu, 1936, p. 18 ; 1938, p. 29 ; 1938*a*, p. 101 ; 1939*a*, p. 45 ; Nagai, 1940, p. 134 ; Yamada & Tanaka, 1944, p. 66.

Fucus Thunbergii Mertens, *in* Roth, Catal, Bot., III, 1806, p. 104, pl. 3, figs. a, c-e ; Turner, 1809, p. 158, pl. 133.

Cystoseira Thunbergii Agardh, Sp. Alg., I, 1. 1820, p. 81.

Rhodomela Thunbergii Agardh, Syst. Alg., 1824, p. 199.

Cystophyllum Thunbergii J. Agardh, Sp. Alg., I, 1848, p. 233 ; De Toni, 1895, p. 47 ; 1895*a*, p. 157 ; Okamura, 1902, p. 140 ; Cotton, 1906, p. 368 ; 1915, p. 110 ; Collins, 1919, p. 205 ; Howe, 1924, p. 137.

Myagropsis Thunbergii Kützing, Sp. Alg., 1849, p. 635 ; Tab. Phyc., X, 1860, pl. 93, fig. II.

Turbinaria (?) *Thunbergii* Yendo. Prelim. List Jap. Fuc., 1905, p. 153.
Sargassum Thunbergii (Mertens) Okamura, Icon. Jap. Alg., V, 1. 1923, p. 6, pl. 203 ; Mar. Alg. Mutsu Bay, I, 1927, p. 8.

Key to the forms

I. Branches long. with narrow leaves and abundant vesicles .... b. f. *nipponicum*
II. Branches short, leaves broader, vesicles not so abundant .... a. f. *latifolium*

4a. ***Sargassum Thunbergii*** f. ***latifolium*** Yendo

Fucac. Jap., 1907, p. 115 ; *in* Okamura, Nippon Sôrui Mei-i, ed. 2, 1916, p. 204 ; Okamura, 1923. p. 8, pl. 203, fig. 3 ; 1936, p. 338.

Habitat. Growing on rocks in the littoral and upper sublittoral belts. W. coast : Nishinotoro (T., '37). Aniwa Bay : Chishiya (Nakamura, '06 ; T., '37), locality unknown (Miyake, '06).

Distribution. *Sp.* - Rhûkyû, Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China. Forma *latifolium*-Pacific side of Honshû, Hokkaido and Saghalien.

Remarks. All the specimens mentioned above are referable to this form. Yendo (1907, p. 116) states that forma *latifolium* lives in the colder seas and is found as far north as Etorofu Island, although he has omitted the Kuriles in the list of the localities for the present forma (p. 119). Nagai has referred all the Kurile specimens laid in his hand to forma *typicum*.

4b. ***Sargassum Thunbergii*** f. ***nipponicum*** Yendo

Fucac. Jap., 1907, p. 115, pl. 15, fig. 5 ; *in* Okamura, Nippon Sôrui Mei-i, ed. 2, 1916, p. 204 ; Okamura, 1923, pl. 203, fig. 5 ; 1936, p. 338,.

Habitat. Locality unknown (Yendo, 1907, p. 117).

Distribution. Kyûshû, Honshû, Hokkaido and Saghalien.

Remarks. Yendo (1907, p. 117) states : "This forma is most abundant on the Japan Sea side from Nagasaki as far as Saghalien. On the coast of the Pacific side it seems to be confined to the vicinity of the eastern entrance of the Tsugaru Strait." But he has not mentioned Saghalien in his list of the localities for this forma (p. 119). The writer could not see any specimen of this forma collected within our region.

5. ***Sargassum Kjellmanianum*** Yendo

Fucac. Jap., 1907, p. 102, pl. 15, figs. 1-4 ; *in* Okamura, Nippon Sôrui Mei-i, ed. 2, 1916, p. 202 ; Okamura, 1924, p. 45, pl. 212 ; 1936, p. 339 ; Takamatsu, 1936, p. 17 ; 1938*a*, p. 100 ; Nagai, 1940, p. 135.

Japanese name. Hahakimoku (Yendo).

Habitat. Locality unknown (cf. Yendo, 1916, p. 202 ; Okamura, 1924, p. 59 &

1936, p. 339).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, South Kuriles and Saghalien (?).

Remarks. In the herbarium of our University, there are kept some specimens of *Sargassum* from Sokorai and Merei (leg. Miyabe, 1906) and from Tôbuchi-ko (leg. Miyagi, 1906), which have been identified by Yendo to *Sargassum Kjellmanianum*. They mnst have been the grounds for adding "Saghalien" to Yendo's (1916) and Okamura's (1924 & 1936) lists of localities for this species. So far as the writer has examined, however, those specimens as well as any other specimens from Saghalien passed his had are not referable with certainty to the species under consideration. The above mentioned specimens appear to be more closely related with the next species, to which the writer refers them at present. Notwithstanding, the occurrence of the present widely spread species in southern Saghalien seems to be quite probable.

6. *Sargassum Miyabei* Yendo

Fucac. Jap., 1907, p. 112, pl. 14, figs, 13, 14 : *in* Okamura, Nippon Sôrui Mei-i, ed. 2, 1916, p. 205 ; Okamura, 1936, p. 340 ; Kawabata, 1936, p. 206 ; Takamatsu, 1938*a*, p. 100, (with query) ; Nagai, 1940, p. 136 ; Yamada & Tanaka, 1944, p. 66.

Japanese name. Miyabe-moku (Yendo).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Sokorai (Miyabe, '06), Hirochi (T., '27), Sôni (T., '27), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Nobori (T., '35), Merei (Miyabe, '06), Tôbuchi-ko (Miyabe, '06 ; T., '26, '35). E. coast : Hota (T., '32), Airô (T., '27), Rorei (T., '32), Higashishiraura (T., '31).

Distribution. Northern Honshû (?), Hokkaido, South Kuriles and Saghalien.

Remarks. As stated by Nagai (*loc. cit.*, p. 137), the writer feels also much trouble in determining which of the two species, *S. Kjellmanianum* and *S. Miyabei* is that to which a specimen should be referable. According to Inoh (1930, p. 426, text-fig. 2), *S. Kjellmanianum* is monoecious and "the male and female conceptacles are contained in the same cylindrical receptacle, which measured about 10–12 mm. long." Our Saghalien specimens under consideration are dioecious ; the receptacles are distinctly longer than the female ones, often measuring 10–15 mm., or sometimes up to 30 mm., in length, while the receptacles of the female plant measure 3–8 mm. in length. The writer failed to find out a hermaphroditic receptacle on either male or female plants. In this respect they differ essentially from *S. Kjellmanianum*. On the other hand, the plant which is commonly found in the Japan Sea coast of Hokkaido and identified by Dr. Yamada to *S. Miyabei* is dioecious. The sexuality of the plant is then considered to be one of the essential differences between the two nearly allied species. The root of *S. Miyabei*, the exact character of which has not been known to

Yendo (1907, p. 112) and Okamura (1936, p. 340), is described by Nagai as "a small, depressed, conical holdfast." However, it is not a simple conical disc, but so to speak a combination of discoid and ramose holdfasts. In this respect, this species differs from *S. Thunbergii* which has a simple discoid holdfast.

Division III. RHODOPHYTA Pascher

in Ber. d. deut. bot. Ges., XXXII, 1914, p. 137 : Smith, 1933, p. 10.

Class RHODOPHYCEAE Ruprecht

Tange Ochot. Meer., 1851, p. 205 ; *in* Mem. Acad. Sci. Nat., VII, 1852, p. 57 : Hauck, 1885, p. 8 ; Schmitz & Hauptfleisch, 1897, p. 298 ; Okamura, 1936, p. 365.

Rhodospermeae Harvey, Gen. South Afr. Pl. 1838, p. 397 ; Ner. Bor.-Amer., II, 1852, p. 1.

Florideae Lamouroux, Essai, 1813, p. 27 (*limit. ampl.*).

Heterocarpeae Kützing, Phyc. Gen., 1843, p. 369.

Key to the Subclasses

I. Plants unicellular or multicellular ; protoplasmic continuity between the cells absent ; carpospores, if present, formed directly by the division of the carpogonia .... 1. **Protoflorideae**

II. Plants multicellular ; protoplasmic continuity between the cells present ; carpospores formed on the gonimoblasts developed directly or indirectly from the capogonia .... 2. **Florideae**

Subclass 1. PROTOFLORIDEAE Rosenvinge

Mar. Alg. Denm., I, 1909, p. 55 (*nomen*) ; De Toni, 1924, p. 4 ; Newton, 1931, p. 238.

Bangiales Schmitz & Hauptfleisch, *in* Engler & Prantl, Natürl. Pflanzenfam., I. 2, 1897, p. 304 (*s. lat.*) : Okamura 1936, p. 365.

Bangioideae De Toni, Syll. Alg., IV, 1, 1897, p. 4 ; Kylin, 1937, p. 122.

Key to the Orders

I. Plants of solitary cells or of multicellular filaments ; monospores formed by the direct transformation of vegetative cells ; sexual reproduction absent ...... 1. **Porphyridiales**

II. Plants of multicellular filaments or membranes ; monospores formed by the division of vegetative cells or by the direct transformation of vegetative cells ; sexual reproduction present or unknown .... 2. **Bangiales**

Order 1. PORPHYRIDIALES Kylin

in Kungl. Fysiogr. Sallsk. Lund Forh., VII, 10. 1937, p. 122.

Family 1. Porphyridiaceae Kylin

loc. cit., 1937, p. 122.

1. **Goniotrichum** Kützing

Phyc. Gen., 1843, p. 244 (*in part*) ; Okamura, 1936, p. 369.

Goniotrichum Alsidii (Zanard.) Howe

Mar. Alg. Peru, 1914, p. 75 ; Inagaki, 1933, p. 12, fig. 5 ; Tseng, 1936, p. 32, pl. 4, fig. 15 ; Okamura, 1936, p. 369, fig. 175 ; Taylor, 1937, p. 215, pl. 28, figs. 1–4 ; 1939, p. 141 ; Segawa, 1936, p. 181 ; Nagai, 1941, p. 139, pl. 4, figs, 1, 2 ; Yamada & Tanaka, 1944, p. 66.

Bangia Alsidii Zanardini, *in* Bibl. Ital., XXVI, 1839, p. 136 ; Syn. Alg. Mar. Adriat., 1841, p. 115, pl. 6, fig. 7.

Bangia elegans Chauvin, Alg. Norm., (Exsicc.), no. 159, 1827 (*absque diagnosi*) ; Rech. sur l'org. d. plus genr. d'Alg., 1842, p. 33 ; Zanardini, 1858, p. 87 (*nomen nudum*) ; Harvey, 1851, pl. 246.

Goniotrichum elegans (Chauv.) Zanardini, Not. Cell. Mar. Ven., 1847, p. 69 ; Farlow, 1881, p. 113 ; Forti, 1907, p. 687.

G. elegans (Chauv.) Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 103 ; Hauck, 1885, p. 518, fig. 233 ; Rosenvinge, 1909, p. 75, figs, 15, 16 ; Hamel, Florid. d. France, II, 1924, p. 448 ; Kylin, 1925, p. 6, fig. 1 a–b ; 1941, p. 3 ; Newton, 1931, p. 246, fig. 150.

G. elegans var. *Alsidii* Zanardini, Icon. Phyc. Adr., III, 1873, p. 65, pl. 46, A, figs. 1, 2.

Japanese name. Benimidoro (Yamada & Tanaka).

Habitat. Epiphytic on other algae, e.g., *Rhizoclonium, Cladophora, Chorda* and *Ahnfeltia.* W. coast : Rakuma (T., '27). Aniwa Bay : Tôbuchi-ko (T., '29, '35).

Distribution. Middle Honshû, Hokkaido, Kuriles and Saghalien ; China ; Pacific coasts of North America (Washington and Gulf of California) and South America (Peru) ; Atlantic coasts of North and South America and of Europe ; North Sea ; Adriatic Sea ; Red Sea.

Remarks. This plant is hardly noticeable to the naked eye on account of its very thin filaments, about 20–25μ diam. in the middle portion, growing sparsely on other larger algae. Under the microscope, however, it readily attracts our attention by its small uniseriate cells containing refractive, nearly homogeneous substances in the specimens preserved in formalin-seawater.

Order 2. BANGIALES Schmitz et Hauptfleisch

in Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 304, (*lim. mut.*) ; Kylin, *in* Kungl. Fysiogr. Sallsk. Lund Forh., VII, 10, 1937. p. 4.

Family 2. Bangiaceae (Zanard.) Berthold

Bangiac. Golf. Neapel, 1882 ; Okamura, 1936,. p. 367.

Bangieae Zanardini, Classif. ficee, 1843, p. 16.

Porphyreae Kützing, Phyc. Gen., 1843, p. 382, (*excl.* gen. Peyssonelia et Hildenbrandtia).

Porphyraceae Rabenhorst, Fl. Eur. Algar., III, 1868, p. 397 (*in part*).

Key to the genera

I. Monospores formed by unequal division of vegetative cells ; sexual reproduction present or unknown (Subfam. **Erythrotrichieae**)
Frond of simple, erect filaments ; sexual reproduction present ...... 2. *Erythrotrichia*
II. Monospores formed by conversion of simple or equally divided vegetative cells ; sexual reproduction present (Subfam. **Bangieae**)
1. Frond filiform .... 3. *Bangia*
2. Frond membranaceous .... 4. *Porphyra*

Subfamily 1. Erythrotrichieae Rosenvinge

Mar. Alg. Denm., I, 1909, p. 56.

2. **Erythrotrichia** Areschoug

Phyc. Scand., 1850, p. 209 ; Okamura, 1936, p. 374.

Erythrotrichia carnea (Dillw.) J. Agardh

Plate XIII, Figs. 1-6

Till Alg. Syst., III, 1883, p. 15, pl. 1. figs. 8-10 ; De Toni, 1897, p. 25 ; 1924, p. 14 ; Rosenvinge, 1909, p. 67, fig. 8 a-f ; Hamel, 1924, p. 285, fig. 1 (1) ; Newton, 1931, p. 242, fig. 147 ; Yamada, 1935, p. 28 ; Okamura, 1936, p. 374, fig. 181 ; Taylor, 1937, p. 217, pl. 28, figs. 13-15 ; Yamada & Tanaka, 1944, p. 67.

Conferva carnea Dillwyn, Brit. Conf., 1809, pl. 84.

C. ceramicola Lyngbye, Hydro. Dan., 1819, p. 144, pl. 48 D.

Bangia ceramicola Chauvin, Rech. sur l'organ de Plus. gener. d'Algues, 1842, p. 33 ; Harvey, 1851, pl. 317 ; Hauck, 1885, p. 22, fig. 1 a, b, (*excl.* forma).

Erythrotrichia ceramicola Areschoug, Phyc. Scand., 1850, p. 210 ; Farlow, 1881, p. 113 ; Setchell & Gardner, 1903, p. 292 ; Lakowitz. 1929, p. 302, fig. 412.

Japanese name. Hoshino-ito (Yamada).

Habitat. Epiphytic on *Cladophora*. W. coast : Rakuma (T., '27).

Distribution. Hokkaido and Saghalien ; Pacific coast of North America (Alaska) ; Indian Ocean ; Atlantic coasts of North America and Europe ; North Sea ; Baltic Sea ; Adriatic Sea.

Remarks. The occurrence of the present old European species in the Japanese waters was first reported in 1935 by Yamada from Akkeshi, Hokkaido. His plant, which is said to be found epiphytic on *Spongomorpha* sp., measures about 14–24μ diam. The writer could find a few individuals of this alga among the specimens of *Cladophora* sp. collected at Rakuma, on August 25, 1927. Their filamentous erect thalli measure 12.5–13μ diam. near the base, 18–22.5μ diam. in the middle portion, and 15μ diam. at the apex. The monosporangia formed by an oblique wall at the shoulder of the sporangium-mother cells are observed in the middle portion of the filaments. The longitudinal vegetative division of the cells is rarely met with, as it has already been observed by some authors in this species (cf. Berthold, 1882, p. 25, J. Agardh, 1883, pp. 14–15, Rosenvinge, 1909, p. 67). When each of two daughter cells thus formed divides once more to produce a monosporangium, the filament appears at a glance to be partially polysiphonous. In such portions the filament attains sometimes even to 30μ in thickness.

Subfamily 2. Bangieae Rosenvinge

Mar. Alg. Denm., I, 1909, p. 56.

3. **Bangia** Lyngbye

Hydr. Dan., 1819, p. 82 ; Okamura, 1936, p. 377.

Bangia fusco-purpurea (Dillw.) Lyngbye

Hydr. Dan., 1819. p. 83, pl. 24 C ; Farlow, 1881, p. 112 ; Kjellman, 1883, p. 192 ; Hauck, 1885, p. 22, fig. 1 c–e ; De Toni, 1897, p. 11, (*ut* subsp. *Bangiae atropurpureae*) ; Rosenvinge, 1909, p. 56, figs, 1–4 ; Okamura, 1921, p. 87, pl. 171, figs. 6–12 ; 1927, p. 9 ; 1936, p. 377, fig. 183 ; Hamel, 1924, p. 446 ; Kylin, 1926, p. 6 ; Lakowitz. 1929, p. 296, figs, 402, 403 ; Newton, 1931, p. 238, fig. 145 ; Inagaki, 1933, p. 11, figs. 3–4 ; Takamatsu, 1936*a*, p. 56 ; 1938, p. 32 ; 1938*a*, p. 102, pl. 14, fig. 2 ; 1939, p. 46 ; Taylor, 1937, p, 218, pl. 28, figs. 10–12 ; 1939, p. 141 ; Yamada & Tanaka, 1944, p. 66.

Conferva fusco-purpurea Dillwyn, Brit. Conf., 1809, p. 92.

Bangia atropurpurea (Roth) β *fusco-purpurea* (Dillw.) Agardh, Syst. Alg., 1824, p. 76 ; J. Agardh, Till Alg. Syst., III, 1883, p. 36. pl. 1, figs. 34, 39 ; Setchell & Gardner, 1903, p. 288 (*sub* forma).

Japanese name. Ushike-nori (Okamura).

Habitat. Growing on stones and woodwork in the littoral belt, often at high-water mark. W. coast ; Kaiba-tô (T., '30 ; Morimoto, '38).

Distribution. Formosa, Kyûshû, Shikoku, Honshû, Hokkaido, Saghalien and Korea ; Pacific coast of North America (Alaska and Washington) ; Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea ; Adriatic Sea.

Remarks. This species is generally most abundant and luxuriant from winter to early spring, but it often almost or completely disappears in summer. As discussed by Rosenvinge (1909, p. 58–59), its occurrence varies considerably in different seasons and years, in consequence of high dependence of its growth to the spray of waves, or in other words to the action of the wind. During the writer's collecting tours in Saghalien, which were mostly undertaken in summer, this alga has never attracted his attention in the field. Once he could find it among the specimens of *Cladophora glaucescens*, which were collected in July 1930 on the shore of the island of Kaiba-tô and preserved in formalin-seawater. The other two sets of specimens referred here are in the collections of Mr. Morimoto which were made at the same island in December

1937 and March 1938. Although the occurrence of this alga has not been known in Saghalien Island proper and the Kurile Islands, nor in the northern part of the Ochotsk Sea, it is highly probable that careful searches in spring will possibly prove its much more wide distribution in those northern regions.

4. **Porphyra** Agardh

Syst. Alg., 1824, p. xxxii ; Okamura, 1936, p. 378.

Key to the species

I. Plants monostromatic (Subgen. **Euporphyra**)
  A. Vegetative blades usually less than 60μ thick
    1. Vegetative cells seen superficially quadrate with rounded corners .... 1. *P. umbilicalis*
    2. Vegetative cells angular .... 2. *P. pseudolinearis*
  B. Vegetative blades more than 60μ thick .... 3. *P. ochotensis*
II. Plants distromatic (Subgen. **Diploderma**)
  A. Plants dioecious ; sporocarps transversely twice divided .... 4. *P. variegata*
  B. Plants monoecious or dioecious ; sporocarps transversely once divided .... 5. *P. amplissima*

Subgenus 1. **Euporphyra** Rosenvinge

Grönlands Havalger, 1893, p. 830.

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

Till Alg. Syst., III, 1883, p. 66, pl. 2, fig. 61 ; Tokida, 1934a, p. 18 ; Yamada, 1935, p. 21 ; Kawabata, 1936, p. 207 ; Okamura, 1936, p. 388, Takamatsu, 1936*a*, p. 57 ; 1938, p. 31 ; 1938*a*, p. 103 ; Taylor 1937, p. 221, pl. 30, figs. 1–3 ; 1939, p. 141 ; Nagai, 1941, p. 141.

Tremella marina umbilicata Dillenius, Hist. Musc., 1741, p. 45, pl. 8, fig. 3.

Ulva umbilicalis Linnaeus, Sp. Plant., ed. 1, II, 1753, p. 1163, ed. 2, II, 1763, p. 1633.

Porphyra umbilicata (Dillen.) Ruprecht, Tange Ochot. Meer., 1851, p. 393.

Wildemania umbilicalis De Toni, Syll. Alg., IV, 1, 1897, p. 20 ; 1924, p. 12.

Porphyra umbilicalis (L.) Kylin, Algenfl. Schwed. Westk., 1907, p. 112 ; Kylin & Skottsberg, Subant. u. Antark. Meeresalg., II, 1919, p. 3.

P. laciniata Thuret, *in* Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 99.

Japanese name. Chishima-kuronori (Ueda).

Key to the forms

I. Fronds linear .... a. f. *linearis*
II. Fronds lanceolate to oblong .... b. f. *vulgaris*
III. Fronds ovate, oblong-obovate to nearly orbicular and umbilicate at the base while young, broadly expanded and laciniate above when matured .... c. f. *laciniata*

1a. ***Porphyra umbilicalis*** f. ***linearis*** (Grev.) Rosenvinge

Mar. Alg. Denm., I, 1909, p. 60, pl. 2, figs, 1 3 ; Hamel, Florid. d. Franc., II, 1924, p. 440 ; Ueda, 1932, p. 33, pl. 21. figs. 1 2 ; Okamura, 1936, p. 389 ; Taylor 1937, p. 222 ; Nagai, 1941, p. 141 ; Yamada & Tanaka, 1944, p. 67.

Porphyra linearis Greville, Alg. Brit., 1830, p. 170, pl. 18 ; Kützing, Tab. Phyc., XIX, 1869, pl. 79, figs. g–i ; J. Agardh, 1883, p. 71 : Kylin, 1907, p. 111 ; De Toni, 1924, p. 9.

Porphyra vulgaris f. *linearis* Harvey, Phyc. Brit., II, 1849. pl. 211, figs. 2, 3.

P. laciniata f. *linearis* Thuret, *in* Le Jolis, Alg, Mar, Cherb., 1863, p. 99.

Wildemania linearis De Toni, Syll. Alg., IV, 1, 1897, p. 22.

Ulva purpurea β elongata Lyngbye, Hydr. Dan., 1819, p. 29 (*fide* Rosenvinge).

Porphyra umbilicata var. *vulgaris b* Ruprecht, Tange Ocht. Meer., 1851, p. 394.

P. hiemalis Kylin, Algenf. Schwed. Westk., 1907, p. 112, pl. 3, fig. 2 (*fide* Rosenvinge).

Haibitat. Growing on rocks in the littoral belt. W. coast : Sôni (T., '27), Hishitoma (T., '26).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea side of Kamtschatka ; Atlantic coasts of North America snd Europe.

1b. ***Porphyra umbilicalis*** f. ***vulgaris*** (Ag.) Rosenvinge

Mar. Alg. Denm, I, 1909, p. 60 ; Hamel, 1924, p. 440 ; Newton, 1931, p. 241 ; Nagai, 1941, p. 141.

Porphyra vulgaris Agardh, *in* Flora, X, 1827, p. 642 ; 1829, pl. 28 ; Harvey, 1849, pl. 211, fig. 1 ; Kützing, 1869, pl. 82, figs. a, b.

Porphyra umbilicata var. *vulgaris* Ruprecht. Tange Ochot. Meer., 1851, p. 394 (*excl.* specimina ; *cf.* Yendo, 1913).

P. laciniata f. *vulgaris* Thuret, *in* Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 99.

Ulva purpurea Roth, Ctalecta, I, 1797, p. 209, pl. 6, fig. 1 (*fide* Harvey).

Porphyra umbilicalis Yamada, Mar. Alg. Urup, 1935, pl. 7.

Habitat. Growing on rocks in the littoral belt. W. coast : Sôni (T., '27), Hishitoma (T., '26), Shiranushi (T., '27 ; Yamaguchi, '33), Nishinotoro (T., '32). Aniwa Bay : Ishihama (T., '35), Nobori (T., '35). E. coast : Hota (T., '32).

Distribution. Kuriles and Saghalien ; Atlantic and Arctic coasts of Europe.

1c. ***Porphyra umbilicalis*** f. ***laciniata*** (Lightf.) Rosenvinge

Mar. Alg. Denm., I, 1909, p. 61, pl. 1, fig, 2 ; Tokida, 1934*a*, p. 19, pl. 2 ; Nagai, 1941, p. 142.

Ulva laciniata Lightfoot, *in* Fl. Scotia, 1777, p. 974, pl. 33.

U. umbilicalis Lyngbye, Hydr. Dan., 1819, p. 28 ; Fl. Dan., pl. 1663.

Porphyra laciniata Agardh, Syst. Alg., 1824, p. 191 ; Icon. Alg. Eur., III, 1829, pl. 27 ; Greville, Alg. Brit., 1830, p. 168 ; Harvey, 1846, pl. 92 ; Kützing, 1869, pl. 82, figs. c–e ; Farlow, 1881, p. 111 ; Kjellman, 1883, p. 190 ; Hauck, 1885, p. 26, fig. 2 ; Saunders, 1901, p. 433 ; Hus, 1902, p. 196 (*in part*); Setchell & Gardner, 1903, p. 289 ; Kylin, 1907, p. 111; Yendo, 1909, p. 127 ; Okamura 1916, p. 8 ; Kylin & Skottsberg, 1919, p. 3 ; Taylor, 1931, p. 20 (with query) ; Sinova, 1930, p. 105 ; 1933, p. 29.

P. laciniata var. *umbilicalis* Agardh, Icon. Alg. Eur., III, 1829, pl. 26 ; Setchell, 1899, p. 593; Setchell & Gardner, 1903, p. 289 (sub forma).

P. umbilicata var. *laciniata* Ruprecht, Tange Ochot. Meer. 1851, p. 394

P. laciniata f. *laciniata* Thuret, *in* Le Jolis, Liste Alg. Mar. Cherb., 1863, p. 99
P. laciniata f. *umbilicalis* Kleen, Om Nordl. Hafsalg., 1874, p. 23 ; Kjellman, Alg. Arct. Sea, 1883, p. 190.
P. laciniata f. *typica* Kjellman, Alg. Arct. Sea, 1883, p. 190.
Wildemania laciniata De Toni, Syll. Alg., IV, 1, 1897, p. 20 ; VI, 1924, p. 19.
? *Porphyra umbilicalis* f. *epiphytica* Collins, Notes on Alg., V, 1903, p. 212 ; Taylor. 1937, p. 222.
P. umbilicalis Newton, Handb. Brit. Seaw., 1931, fig. 146 A.
P. umbilicalis Taylor, *loc. cit.*, 1937, pl. 30, fig. 1.

Habitat. Growing on rocks and other algae. e.g., *Fucus evanescens*, *Odonthalia*, *Ptilota*, etc., in the littoral and sublittoral belts. W. coast : Ushiro (Miyake, '06), Sôni (T., '26), Shiranushi (T., '26, '27, '32) ; Yamaguchi, '33), Nishinotoro (Morimoto, '25 ; T., '27, '32). Aniwa Bay : Ishihama (T., '35), Chishiya (T., '35). Nobori (T., '26. '35). Shiraiwa (T., '32). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Sakaehama (Miyake, '06 ; Inoue, '30), Sôya near Maguntan (Miyake, '06), Kotankeshi (Miyake, '06), Kaihyô-tô (T., '32, '35), Yôman (T., '35).

Distribution. Sp. - Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; Pacific coast of North America ; Atlantic coasts of North America, Europe, and of Africa ; Arctic Ocean ; Southern Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea. Forma *laciniata*-Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; Pacific coast of North America (Alaska and ? California) ; Atlantic coasts of North and South America (? Brazil) and of Europe ; Arctic Ocean ; Southern Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea.

Remarks. Kjellman states (1883, p. 190) : "Thuret has pointed out that what is set down by algological authors under the name of *P. linearis*, *P. vulgaris* or *P. purpurea*, and *P. laciniata*, sometimes as separate species, sometimes as forms of the same species, is in fact nothing but one and the same plant at different stages of development." Thuret (1863. p. 99) has distinguished the following three forms under *P. laciniata* (Lightf.) Ag. : - 1. forma *linearis* (planta junior)-Syn. *P. linearis* Grev ; 2. forma *vulgaris*-Syn. *Ulva purpurea* Roth, *Porphyra purpurea* Chauv., *P. vulgaris* Harv. ; 3. forma *laciniata*-Syn. *Ulva umbilicalis* Engl. Bot., *P. laciniata* Harv. Ruprecht precedes Thuret by twelve years, however, in expressing just the similar idea, although his description was quite brief and his specimens referred to *P. umbilicata* var. *vulgaris a* were identified by Yendo (1918) as *Wildemania bulbopes* Yendo. The just mentioned Russian author states : "Der Name *umbilicata* (nicht der unrichtige *umbilicalis*) kommt zuerst in Ray's ("Ray's" is the misprint of "Rajus"-author) Syn. stirp. brit. edit. 3. Dilleniana (1724) vor. Allmälig trennte man diese Art in *Ulva* oder *Porphyra laciniata*, *vulgaris*, *linearis* u. a. Harvey ist (Phyc. brit.) mir in der Vereinigung dieser Arten zum Theile vorangegangen, indem er *P. linearis* für dem jungeren Zustand von *P. vulgaris* erkannte. In nordlichen stillen Ocean kann man folgende Formen unterscheiden. 1. *P. umbilicata* (Dillen. Tab. 8, Fig. 3). 2. Var. *laciniata* (Lightfoot Fl. Scot. 1777, Tab. 33). 3. Var. *vulgaris* Ag ... Diese lässt sich oft in zwei Formen trennen : *a*) Breitere, kürzere, getheilte od. ungetheilte .. *b*) Längere, schmälere, ungetheilte, am Rande krause (*Ulva purpurea* Roth 1797, Tab. 6, Fig. 1), indie *P. linearis* Grev. übergehende ." The last mentioned forma *b* of var. *vulgaris* is possibly identical with f. *linearis*. The forma *linearis*, which is now represented by only a few individuals in the collections in the writer's hand, is generally considered to be a juvenile winter form of forma *vulgaris* (cf. Harvey, 1849), and the forma *vulgaris* to be of an intermediate stage of development between forma *linearis* and forma *laciniata* (cf. Thuret *in* Le Jolis, 1863, p. 100 ; Rosenvinge, 1909, p. 61–62). However, as discussed by Ueda (1932, p. 33), these three forms should not be considered as representing merely the different stages of development, because linear individuals do not always become broader in development, and juvenile stages of orbicular individuals are not always linear. Most of our specimens of this species are referable to forma *laciniata* in broader sense. The smallest individuals of forma *laciniata* in the writer's hand, which were collected in summer at Chishiya and Nishinotoro, are nearly orbicular in shape, measuring 1–2 cm. in height. The specimens from Kaihyô-to and Yôman are oblong-obovate to broadly oblong in shape, beautiful blood-red in color, and are epiphytic on the thalli of various sublittoral red algae, e.g., *Euthora, Membranoptera, Odonthalia, Ptilota, Rhodophyllis,* etc. They are possibly identical with forma *sanguinea* of Ruprecht (1851, p. 393).

The present alga flourishes most luxuriantly in early summer on the reefs around the Cape of Nishinotoro. The fishermen in the neighbourhood of the Cape harvested the plant in the ebb tide and were engaged in the manufacture of "Asakusanori".

2. ***Porphyra pseudolinearis*** Ueda

in Jour. Imp. Fish. Inst., XXVIII, 1932, p. 29, pl. 6, figs. 17–18, pl. 7, figs. 1–5, pl. 19, figs. 1–2 ; Inagaki, 1933, p. 15 ; Yamada, 1935, p. 20 ; Kawabata, 1936, p. 207 ; Okamura, 1936, p. 387 ; Takamatsu, 1936*a*, p. 56 ; 1938, p. 31 ; 1938a, p. 102 ; 1939, p. 48 ; Nagai, 1941, p. 144.

Porphyra linearis Yendo (non Greville), Notes Alg. new to Japan, III, 1915, p. 106.

Japanese name. Uppurui-nori (in Shimane prefecture).

Habitat. Growing on rocks in the upper littoral belt, on exposed coasts. W. coast : Muitomari (Satio, '30), Kaiba-to (Morimoto, '37).

Distribution. Honshû, Hokkaido, Kuriles, Saghalien and Korea.

Remarks. This species of *Porphyra* is very closely related to *P. umbilicalis* f. *linearis* (Grev.) Rosenv. The formulae of the division of the sporocarp and of the spermatangium are quite similar in both species, excepting that the spermatangium of *P. umbilicalis* may happen to divide transversely one more time. Irregularly ramified spots of a deep red color occasionally visible to the naked eye on the sporocarpic part of the frond are not also peculiar to either of the two species. However, *P. pseudolinearis* can be readily distinguished from the allied species in having angular cells arranged irregularly as seen from surface instead of roundish cells somewhat regularly arranged, and also in its secondary transverse division of the sporocarp being often irregularly oblique.

Among the specimens referred here, those from Muitomari, which we owe to Mr. Y. Saitô, who informed us that they had been gathered on the artificial reef built by pouring cement over the rocky shore for the object of cultivating this alga, are found growing gregariously there from middle autumn to late winter. Those from the Island of Kaiba-tô were collected by Mr. T. Morimoto in November and December in 1937.

3. ***Porphyra ochotensis*** Nagai

Mar. Alg. Kurile Isls, II, 1941, p. 144, pl. 4, figs. 3 8, pl. 6, figs. 1-2.

Porphyra perforata Ueda (non J. Agardh), *in* Jour. Imp. Fish. Inst., XXVIII, 1, 1932, p. 26, pl. 5, figs. 15-17, pl. 17, figs. 3-4 ; Tokida, 1932, p. 11, fig. 3 ; Yamada, 1934, p. 347 ; 1935, p. 21 ; Kawabata, 1936, p. 207 ; Okamura, 1936, p. 386.

Japanese name. Ana-amanori (Ueda).

Habitat. Growing on rocks in the littoral belt. E. coast : Kaihyô-tô (T., '30), '35), Yôman (T., '35).

Distribution. Kuriles and Saghalien ; ? northern part of the Ochotsk Sea.

Remarks. A difference between the Japanese plant passed among us by the name *Porphyra perforata* as it was identified so by Ueda and the American *P. perforata* lies in the dividing mode of the sporocarp, the formula of which corresponding to 32 (a/2, b/4, c/4) (given by Ueda) and 32 (a/4, b/4, c/2) (given by Hus) respectively. Ueda (*loc. cit.*, p. 27) has attributed the paucity of division parallel to the frond surface in the American plant to the immaturity of the specimens studied by Hus, but Nagai (*loc. cit.*, p. 147), after a careful examination of the Californian specimens has concluded that the Japanese plant should better be treated as differing specifically from the Californian, the sporocarps of the latter having been ascertained to divide always according to the formula given by Hus. With regard to the dividing mode of the reproductive organs, *Porphyra ochotensis*, *P. pseudolinearis* and *P. umbilicalis* fall together, generally speaking, under the same category. *P. ochotensis* differs from the latter two species in having a thicker frond measuring about 60–100μ thick.

De Toni (1897, p. 21) has treated *P. umbilicata* Rupr. as a synonym to his *Wildemania perforata* (J. Ag.). As far as *P. umbilicata* f. *perforata* Rupr. from Ajan is concerned, De Toni's judgement may be correct. But it should seem to be more probable that the last mentioned form of Ruprecht is identical with the species under consideration.

Subgenus 2. **Diploderma** (Kjellm.) Rosenvinge

Grönl. Havalg., 1893, p. 826.

Diploderma Kjellman, Alg. Arct. Sea, 1883, p. 188 (sub geno).

Wildemania De Toni, Framm. Algol., VII, *in* Nuova Notar., I, 3, 1890, p. 143 ; 1897, p. 20:

1924, p. 12.

non *Diploderma* Link, Diss., II, 1795, p. 44 (genus Fungiorum).

4. ***Porphyra variegata*** Kjellman

in Hus, Prelim. Notes West Coast Porphyras, 1900, p. 69 ; 1902, p. 225, pl. 21, fig. 18 ; Setchell & Gardner, 1903, p. 291 ; Kylin, 1925, p. 8 ; Ueda, 1932, p. 38, pl. 9, fig. 7, pl. 10, figs. 1-3, pl. 23, fig. 2, pl. 24, fig. 1 ; Kawabata, 1936, p. 207 ; Okamura, 1936, p. 391 ; Takamatsu, 1938*a*, p. 103, pl. 13, fig. 3 ; Nagai, 1941, p. 148 ; Yamada & Tanaka, 1944, p. 67 ; Nakamura, 1947, p. 39, figs. 1-3.

Diploderma variegatum Kjellman, Om Beringhafv. Algfl., 1889, p.33, pl. 2, figs. 1-4.

Wildemania variegata De Toni, Syll. Alg., IV, 1, 1897, p. 23, VI, 1924, p. 13.

Porphyra occidentalis Setchell et Hus, *in* Hus, Prelim. Notes West Coast Porphyras, 1900, p. 69 ; 1902, p. 228, pl. 21, figs. 15a–17b (planta masculina *Porphyrae variegatae-fide* Setchell & Gardner 1903, p. 292) ; Kawabata, 1936, p. 207 ; Nagai, 1941, p. 147, pl. 4, figs. 9–12, pl. 6, fig. 3.

Japanese name. Fuiri-tasa (Ueda), Tomoe-nori (Okamura).

Habitat. Growing on other algae, e.g., *Odonthalia*, or detached and cast ashore. W. coast : Shiranushi (T., '35), Nishinotoro (T., '26, '27). Aniwa Bay : Locality unknown (Nagai, 1941, p. 149). E. coast : Hota (T., '32).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Bering Island ; Pacific coast of North America.

Remarks. Only a few fragmental specimens collected by the writer at the above localities are referable to the present species. They are all of a thick and variegated frond. Some specimens from Nishinotoro and Hota have a characteristically recurved frond. One of the specimens from Shiranushi has a frond divided by a longitudinal line into two halves, one side being deep colored and the other light yellowish, just alike the monoecious plant of *P. umbilicalis*. Apparently monoecious plant of this kind is not uncommonly met with in the specimens of *P. variegata* collected at Muroran in Hokkaido. The antheridial character of the yellowish part has been ascertained by Nakamura (1947). Besides the present species, *P. occidentalis* Setch. et Hus has been enumerated from the Kuriles by Nagai, as well as by Kawabata. However, Setchell himself, with his collaborator Gardner, says : "To this species (*P. variegata*) must be joined *P. occidentalis* Setchell and Hus, since farther search on the coast of California has brough other more luxuriant, thicker specimens to light and it has been made certain that it is the antheridial plant of *P. variegata*." (Setchell & Gardner, 1903, p. 292). On the other hand, the Kurile specimens referred by Nagai to *P. occidentalis* are of a considerable thin membrane, being described as 48–63μ thick in the antheridial part, and as cuneate and shortly stipitate at the base. In these respects, they are clearly distinguished from *P. variegata* which has a frond measuring about 100-200μ thick, and being rounded or cordate and sessile at the base. We can not decide at present whether they really represent the antheridial individual of the Kurile plant of *P. variegata* or not.

5. ***Porphyra amplissima*** (Kjellm.) Setchell et Hus

in Hus, Prelim. Notes West Coast Porphyras, 1900, p. 67 ; Tokida, 1934a, p. 19 ; Kawabata, 1936, p. 207 ; Okamura, 1936, p. 392 ; Nagai, 1941, p. 149.

Diploderma amplissima Kjellman, Alg. Arct. Sea, 1883, p. 188, pl. 17, figs. 1-3, pl.18, figs. 1-8.

Porphyra miniata f. *amplissima* Rosenvinge, Grönl. Havalg., 1893, p. 827 ; Börgesen, 1902., p. 347 ; Woronichin, 1931, p. 147 (*sub* var.) ; Taylor, 1937, p. 222 (*sub* var).

Japanese name. Beni-tasa (Ueda).

Habitat. Growing on rocks in the littoral belt at Nishinotoro, or floating and cast ashore at other localities. W. coast : Nishinotoro (T., '32). Aniwa Bay : Ishihama (T., '35), Nagahama (T., '35). E. coast ; Kaihyô-tô (T., '32).

Distribution. Kuriles and Saghalien ; Kamtschatka ; Pacific coast of N. America from Alaska to Washington ; Atlantic coasts of N. America and Europe ; Arctic Ocean.

Remarks. According to Setchell & Hus, the shape of the frond of the present species varies from broadly elliptical to ovate-lanceolate and there exist many intermediate forms between the two extremities. Nagai has proposed to distinguish two forms, i.e., f. *elliptica* and f. *lanceolata* under this species, in addition to f. *crassa* of Kawabata. Our Saghalien specimens are all referable to forma *elliptica* Nagai. With the fresh material collected at Nagahama, the writer could observed that the frond was partly monostromatic. The cells in the monostromatic part always contain a single stellate plastid in the center, just alike in the case of *P. abyssicola* Kjellm. illustrated by Rosenvinge (1893, fig. 4 A) under the name of *P. miniata* f. *abyssicola* Rosenv. Here we have a solution of one of the problems presented by the writer himself in 1935 (Phyc. Observ., II, "On the structure of *Porphyra Onoi* Ueda," p. 113). In Fig. 4 B, Rosenvinge has shown two monostromatic cells in the distromatic part, of which one is containing a single central plastid while the other, which seems to be just prior to the transverse division, is containing two eccentric ones. The monostromatic cells containing two plastids, however, do not play a special role in the construction of the thallus in that species, while they construct most of the monostromatic part of the thallus in *Porphyra Onoi*, which represents the subgen. *Diplastidia* Tokida (*loc. cit.*, p. 113). So far as the writer is aware, two other species are known to have two eccentric plastids in monostromatic cells. They are *Porphyra lanceolata* (Setch. et Hus) G. M. Smith (*in* Smith & Hollenberg, 1943, p. 213. figs. 8-10) and *P. pulchra* Hollenberg (*in* Smith & Hollenberg, 1943, p. 213, figs. 11-12).

Subclass 2. FLORIDEAE (Lamour.) Schmitz et Hauptfleisch

in Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 304 ; Okamura, 1936, p. 392.

Florideae Lamouroux, Essai, 1813, p. 27 (*in part*).

Eufiorideae De Toni, Syll. Alg., IV, 1, 1897, p. 33.

Key to the Orders

I. Typical auxiliary cell absent.
  A. Haplobiontic ; tetrasporophyte absent .... 3. **Nemalionaies**
  B. Diplobiontic ; tetrasporophyte present .... 4. **Gelidiales**
II. Typical auxiliary cell present.
  A. Auxiliary cells born on special accessory branches .... 5. **Cryptonemiales**
  B. Auxiliary cell constituted from a normal intercalary cell of the mother plant .... 6. **Gigartinales**
  C. Auxiliary cell cut off from a daughter cell of the supporting cell of the carpogonial branch before fertilization .... 7. **Rhodymeniales**
  D. Auxiliary cell cut off from the supporting cell of the carpogonial branch after fertilization .... 8. **Ceramiales**

Order 3. NEMALIONALES Schmitz

Syst. Uebers. Florid., 1889,p. 4 ; Florideae, *in* Engler, Syll. Vorles. üb. Bot., 1892, p. 2 ; Okamura, 1936, p. 398.

Family 3. Helminthocladiaceae (Harv.) Schmitz

Syst. Uebers, Florid., 1889, p.4 ; Okamura, 1936, p. 410.
Helminthocladiae Harvey, *in* Hooker, Fl. Nov. Zeland., 1855, p. 245.
Nemalionaceae Howe, Mar. Alg. Peru, 1914, p. 83 (foot-note).

5. *Nemalion vermiculare* Suringar

Illustr. Alg. Jap., I, 1872, p. 91, pl. 54 ; Okamura, 1916, p. 28, pl. 158, figs. 1-16 ; 1927, p. 9 ; 1936, p. 413, fig. 191 ; Takamatsu, 1936a, p. 57 ; 1938, p. 32 ; 1938a, p. 105 ; 1939, p. 48.
Nemalion helminthoides Inagaki (non Batters), Mar. Red Alg. Oshoro Bay, 1933, p. 16, fig. 7.
N. elminthoides var. vermiculare Tseng, Notes Some Chin. Mar. Alg., 1938, p. 598.

Japanese name. Umizômen.

Habitat. Growing on rocks and shells in the upper littoral belt. W. coast : Kaiba-tô (T., '43).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, Saghalien, Korea ; China.

Remarks. The present temperate species is known to be distributed in the Japan Sea as far north as the Island of Kaiba-tô.

Order 4. GELIDIALES Kylin

Stud. Entwickl. Florid., 1923, p. 132 ; Okamura, 1936, p. 453.
Gelidieae J. Agardh, Alg. Lieb., 1847, p. 11 (excl. gen.) ; Sp. Alg., II, 2, 1852, p. 464.

Family 4. Gelidiaceae Kützing

Phyc. Gen., 1843, p. 390 (*in part*) ; Kylin, 1928, p. 25 ; Okamura, 1936, p. 453.
Gelidieae Schmitz, Syst. Uebers. Florid., 1889, p. 5 (*ut* Subfam. Fam. Gelidiacearum).

6. **Gelidium** Lamouroux

Essai, 1813. p. 41 ; Okamura, 1936, p. 454.

Key to the species

I. Frond rather small, 5-10 cm. high ; fertile ramuli fine and small with short pedicels elegantly arranged along branches near to each other .... 2. *G. vagum*

II. Frond moderately large, 10-15 cm. high ; fertile ramuli not fine, more or less long-pedicelled .... 1. *G. Amansii*

1. ***Gelidium Amansii*** Lamouroux

in Kützing, Tab. Phyc., XVIII, 1868, p. 16, pl. 44 ; Sp. Alg., 1849, p. 766 ; Martens, Preus. Exped. Ost-Asien, Tange, 1866, p. 118 ; Okamura, 1913, p. 25, pl. 106 ; 1927, p. 9 ; 1934, p. 52, pl. 19-22, pl. 31, figs. 3-7 ; 1936, p. 458, figs. 210-212 ; Cotton, 1915, p. 111 ; Takamatsu, 1939, p. 49.

Fucus Amansii Lamouroux, Dissert., 1805, p. 48, pl. 26, figs. 2-5.

Sphaerococcus cartilagineus β setaceus Agardh, Sp. Alg., I, 2, 1822, p. 288 (*fide* Martens).

Gelidium cartilagineum Harvey, *in* Gray, 1856, p. 331 (*fide* Martens).

Japanese name. Makusa (Okamura) or Tengusa.

1a. ***Gelidium Amansii*** f. ***typicum*** Okamura

Gelid. & Pterocl. Jap., 1934, p. 55, pl. 19 (*sub* f. *typica*) ; 1935, p. 51, pl. 326 ; 1936, p. 460, fig. 210 ; Segawa, 1935, p. 74 ; Takamatsu, 1936, p. 20 ; 1936a, p. 58 ; 1938, p. 34 ; 1938a, p. 107,

Habitat. Growing on rocks in the sublittoral belt. W. coast : Kaiba-tô (Morimoto, '33).

Distribution. Sp. - Formosa, Kyûshû, Shikoku, Honshû, Hokkaido, Saghalien and Korea. Forma *typicum*-Japan ("very common and widely distributed in the Pacific and the Japan Sea"-Okamura, 1934, p. 55).

Remarks. Only two specimens collected by Morimoto at Kaiba-tô in August of 1933 are before us. The genus *Gelidium* is represented in Saghalien by the present and the next species which grow in small quantities on the coast of the Island mentioned above. They do not invade into the coast of Saghalien Island proper.

2. ***Gelidium vagum*** Okamura

in Inagaki, Mar. Red Alg. Oshoro Bay, 1933, p. 21 ; Okamura, 1934, p. 58, pl. 25, pl. 32, figs. 8-10 ; 1935, p. 56, pl. 333, pl. 335, figs. 3-5 ; 1936, p. 463 ; Takamatsu, 1936, p. 21 ; 1936a, p. 58 ; 1938, p. 35 ; 1938a, p. 106 ; 1939, p. 50.

Japanese name. Yore-kusa (Okamura).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Kaiba-tô (Morimoto, '37 : T., '43).

Distribution. Honshû, Hokkaido and Saghalien.

Remarks. The present species is characterized by the branches not uniform in breadth, which are "usually broader in primary segments (2–3 mm.) and gradually or abruptly tapering upward to filiform segments." The writer could collect this alga at the villages Kamomezawa and Tomarizawa of the Island of Kaiba-tô. It is said to be gathered there by a few villagers for home consumption to prepare "tokoroten".

Order 5. CRYPTONEMIALES Schmitz (*emend.* Kylin)

Syst. Uebers. Florid., 1889, 8 ; Kylin, 1932, p. 74 ; Okamura, 1936, p. 472.

Key to the Families

- I. Sterile auxiliary cells present in the carpogonial branch
  - A. Carpogonial branches and auxiliary-cell branches scattered .... 5. **Dumontiaceae**
  - B. Carpogonial branches and auxiliary-cell branches gathered in nemathecia on the frond surface
    - 1. Nemathecium without a special wall ; frond crustaceous, free from lime .... 6. **Squamariaceae**
    - 2. Nemathecium surrounded by a special wall ; frond crustaceous or erect, encrusted with lime .... 7. **Corallinaceae**
- II. Sterile auxiliary cells absent
  - A. Carpogonial branches and auxiliary-cell branches on separate branch axes .... 8. **Grateloupiaceae**
  - B. Carpogonial branches and auxiliary-cell branches on the same branch axes
    - 1. Frond with an axial cell-row .... 9. **Endocladiaceae**
    - 2. Frond without an axis
      - a. Carpogonial branch and auxiliary cell in a separate axis on the same supporting cell .... 10. **Tichocarpaceae**
      - b. Supporting cell of the carpogonial branch serves as the auxiliary cell .... 11. **Callymeniaceae**

Family 5. Dumontiaceae (Bory) Schmitz

Syst. Uebers. Florid., 1889, p. 19 ; Schmitz & Hauptfleisch, *in* Engler & Prantl, 1897, p. 515 ; Okamura, 1936, p. 474.

Dumontia Bory, Crypt., *in* Voy. Ant., 1829, p. 197 (*excl.* Asperococco et Solenia).

Dumontieae Trevisan, Alghe Coccotalle, 1848, p. 106.

7. **Dumontia** Lamouroux (emend. J. Ag.)

Essai, 1813, p. 45 ; J. Agardh, 1852, p. 348 ; Okamura, 1936, p. 475.

Key to the species

- I. Frond filiform, cylindrical or slightly compressed .... 1. *D. incrassata*

II. Frond flat membranaceous, oblanceolate or linear-oblong, usually simple but rarely once divided near the base .... 2. *D. simplex*

1. ***Dumontia incrassata*** (Fl. Dan.) Lamouroux

Essai, 1813, p. 45 ; Kylin 1907, p. 191 ; 1923, p. 10 ; Dunn, 1916, p. 271-281 ; 1917, p. 425-467 ; Rosenvinge, 1917, p. 155, figs. 74, 75 ; Lakowitz, 1929, p. 378 ; Newton, 1931. p. 275, fig. 168 ; Fritsch, 1935, fig. 4 D, E ; Taylor, 1937, p. 249, pl. 35, fig. 7, pl. 41, fig. 6,

Ulva incrassata Fl. Dan., 1775, pl. 653.

U. purpurascens Smith (non Hudson), *in* Engl. Bot., 1799, pl. 641.

Halymenia ? purpurascens Agardh, Sp. Alg., I, 2. 1822, p. 220.

Chondria purpurascens Greville, Fl. Edinens., 1824, p. 290.

Ulva filiformis Turner (? non Hudson), Synops. Brit. Fuc., 1802, p. 381 (*fide* Ruprecht).

U. filiformis Wahlenberg, Fl. Lappon., 1812, p. 508, no. 971 (*fide* Ruprecht).

non *Ulva filiformis* Hornemann, *in* Fl. Dan., 1813, pl. 1480. fig. 2 (*fide* Ruprecht).

Gastridium filiforme Lyngbye, Hydr. Dan., 1819, p. 68, pl. 17.

G. filiformis var. *incrassata* Lyngbye, *loc. cit.*, p. -Hornemann, *in* Fl. Dan., pl. 1664.

Halymenia filiformis Agardh, Sp. Alg., I, 2, 1822, p. 214 ; Syst. Alg., 1824, p. 245.

Dumontia filiformis Greville, Alg. Brit., 1830, p. 165, pl. 17 ; Tokida, 1934*a*, p. 20 ; Yamada, 1935, p. 21 ; Okamura, 1936, p. 219 ; Kawabata, 1936, p. 208 ; Nagai, 1941, p. 158 ; Yamada & Tanaka, 1944, p. 68.

vix *Fucus contortus* Gmelin, Hist. Fuc., 1768, p. 181, pl. 22, fig. 1.

Dumontia contorta Ruprecht, Tange Ochot. Meer., 1851, pp. 295-313 (*in part ? -fide* De Toni).

Japanese name. Ryûmonsô (Okamura).

Habitat. Growing on rocks in shallow water and tide pools, in somewhat protected localities ; in Kaihyô-tô, found washed ashore. W. coast : Shiranushi (T., '37). Aniwa Bay : Chishiya (T., '37). E. coast : Airô (Miyabe, '06), Tonnai (Saitô, '28), Higashishiraura (T., '31), Kashiho (T., '31), Kaihyô-tô (T., '32), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; ? Bering Sea ; Pacific coast of North America (Alaska) ; North Atlantic coasts of North America and Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. Many of our specimens are tetrasporic, but young female plants are also met with. The writer cannot recognize any difference in the external appearance between the sporophyte and the gametophyte, as it has been observed in the Kurile plant by Nagai.

The current conception of the genus *Dumontia* is that defined by J. Agardh (1852) who has limited the genus as containing a single species *D. filiformis*, which was established by Greville (1830) on the basis of *Ulva filiformis* Hornemann (*in* Fl. Dan., pl. 1480, fig. 2, 1813) (not *Conferva filiformis* as erroneously introduced at first by Lyngbye (1819). According to Ruprecht (1851, p. 302), who has elaborately discussed the synonymy of the plant under consideration, the authentic specimen of *Ulva filiforme* Lyngb. in the Herb. Mertens' XI, 297 is nothing but *Cystoclonium purpurascens* (Huds.) Kütz. (Syn. *Ulva purpurascens* Hudson, Fl. Ang., ed. 2, 1778, p. 569). The genus *Dumontia* was originally established by Lamouroux on the basis of *Ulva* *incrassata* Fl. Dan. (pl. 653). The author of the last mentioned binomial is said to be Müller (according to Lyngbye and Hornemann) or Oeder (according to the postscript by Müller himself in Fl. Dan.) (cf. Ruprecht, 1851, p. 304). Ruprecht expresses again his doubt with regard to the identity between *Ulva incrassata* and *Dumontia contorta* Rupr. (*D. filiformis* J. Ag.) and suggests the closer relation of the former to *Halosaccion*. His *Dumontia contorta* is based on *Fucus contortus* Gmelin which he considers as the oldest of the names really designating the plant under consideration. Besides that species, he placed also four other species under his *Dumontia*, all of which, however, are not true *Dumontia*, three belonging to *Gloiopelis* and one to *Helminthocladia*. On the other hand, judging from the figure in Historia Fucorum, Gmelin's plant seems to differ from the typical *Dumontia incrassata* (*D. filiformis*) in having rather repeatedly ramified branches. Such being the case, the writer follows Kylin, Rosenvinge and others in adopting Lamouroux's original name, *Dumontia incrassata*.

According to Mr. Y. Saitô, who kindly sent the writer a considerable amount of the dried material of this alga, it grows abundantly on the reefs in the vicinity of Tonnai, where the villagers collect and utilize it as food or as a substitute for *Gloiopeltis*.

2. ***Dumontia simplex*** Cotton

Mar. Alg. fr. Corea, 1906, p. 372 ; Okamura, 1927, p. 17 ; 1928, p. 182, pl. 247, figs. 1-8 ; 1936, p. 476 ; Takamatsu, 1938, p. 42 ; 1938a, p. 114.

Japanese name. Hera-ryûmon (Okamura).

Habitat. Growing on rocks in the littoral belt. W. coast : Shiranushi (T., '32).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien, Korea (Genzan) and Kwantung (Dairen).

Remarks. Only a single tetrasporiferous individual of the present alga is found among the specimens of *Porphyra* collected at Shiranushi on the 18th of July in 1932. It measures about 22 cm. in length and about 3.5 cm. in breadth at the broadest portion. In Hokkaido, this species is rather commonly found to grow in the littoral belt from winter to early summer, but disappears in the midsummer. In the writer's herbarium are kept three large cystocarpiferous specimens from Muroran collected by T. Inaba on the 3rd of June 1936, and three large male specimens collected at Suribachi-wan of Paramushiro Island, the North Kuriles, on the 27th of June 1935 (the collecter not certainly known). Nagai has not enumerated this species in his work on the marine algae of the Kurile Islands.

8. **Neodilsea** Tokida

in Bot. Mag., LVII, 674, 1943, p. 96.

Neodilsea Yendoana Tokida

in Bot. Mag., LVII, 674, 1943, p. 96, figs. 1-9.

Dilsea edulis Yendo (*non* Stackhouse), Notes on Alg. New to Japan, 1909, p. 133 ; Okamura, 1916, p. 114 ; 1921, p. 115, pl. 180 ; 1927, p. 17 ; 1936, p. 483, fig, 225 ; Inagaki, 1933, p. 28 ; Kawabata, 1936, p. 208 ; Takamatsu, 1936, p. 25 ; 1936*a*, p. 61 ; 1938, p. 42 ; 1938*a*, p. 113 ; Nagai, 1941, p. 160 ; Yamada & Tanaka, 1944, p. 68.

? *Sarcophyllis edulis* Sinova (non J. Agardh), Alg. Petrov Isl., 1938, p. 70.

Japanese name. Akaba or Akahata.

Habitat. Growing on rocks in the littoral belt. W. coast : Nayoshi (Miyabe, '06), Rakuma (T., '27), Shiranushi (T., '32), Nishinotoro (T., '26), Kaiba-tô (Miyake, '06 ; T., '30, '43 ; Morimoto, '33, '37). Aniwa Bay : Ishihama (T., '26), Chishiya (T., '35), Nobori (T., '26, '35), Ōtomari (Idzumiyama, '06), Merei (Miyabe, '06), Shiraiwa (T., '32). E. coast : Sakaehama (T., '29), Higashisôya (T., '29).

Distribution. Northern Honshû, Hokkaidô, Kuriles and Saghalien ; ? Japan Sea coast of Siberia.

Remarks. The present alga, according to Yendo (1909, p. 133) was first referred to *Schizymenia edulis* J. Ag. (=*Dilsea edulis* Stackh.) by Harvey. Since that identification was approved by Yendo it has long passed among us by that name. However, the writer pointed out recently that there exist several essential differences between our Japanese alga and the European *Dilsea edulis*, and he established the new genus, *Neodilsea*, on the basis of the former.

Sinova has reported *Sarcophyllis edulis* J. Ag. from Petrov Island in the Sea of Japan. Her plant is supposed to be identical with the present species. The writer's specimens collected at Sakaehama and Higashisôya, on the eastern coast of Saghalien, are of a markedly thinner frond. The carpogonial branches are composed of about ten cells, the fourth cell from above being the largest. The lower cells of the carpogonial branch are usually destitute of a branchlet. In these respects, they are comparable with *Dilsea integra* (Kjellm.) Rosenv. (cf. Rosenvinge, 1898, p. 21, fig. 3). The tetrasporangia, which have not yet been known to *Dilsea integra*, are formed in these specimens just in the same manner as in the typical form of *Neodilsea Yendoana*. If these specimens should be proved in future to be identical with *Dilsea integra*, this binomial must be changed as *Neodilsea integra*. The female plant of *N. Yendoana* which bears ripe cystocarps has been rarely met with at the Island of Kaiba-tô toward the end of September (Kamomezawa, *leg.* Tokida, Sept. 29, 1943).

N. Yendoana is one of the commonest seaweeds in the northern part of Japan. Since about 1934, it has become to be utilized as one of the mixing materials of the algal plaster prepared mainly from the highly valued "Ginnan-sô" (*Iridophycus cornucopiae* and *Rhodoglossum pulchrum*).

9. **Farlowia** J. Agardh

Sp. Alg., III, 1. (Epicr.), 1876, p. 261 ; Okamura, 1936, p. 482.

Farlowia irregularis Yamada

Notes on Some Jap. Alg., V, 1933, p. 280, pl. 11 ; Okamura, 1936, p. 482, fig. 224 ; Nagai, 1941, p. 160 ; Yamada & Tanaka, 1944, p. 68.

Japanese name. Nise-karekigusa (Yamada).

Habitat. Growing on rocks in the littoral and upper sublittoral belts. W. coast : Tomarioru (Miyabe, '06 ; T., '30), Rakuma (T., '30), Nishinotoro (Ishii, '28), Kaiba-tô (Morimoto, '37). Aniwa Bay : Chishiya (T., '35), Nobori (T., '26), Ōtomari (T., '29), Merei (Miyabe ,'06), Yôman (Matsubara, '33), Shiraiwa (T., '32). E. coast : Hota (T., '32), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29 ; Miyake, '06), Kashiho (T., '31), Horonaiho (Ishii, 19..), Unetonnai (Miyabe, '06), Nairo (Miyabe, '06), Chiriye (Miyabe, '06 ; T., '30), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien.

Remarks. This is the only representative of the genus *Farlowia* in southern Saghalien, while in the Kuriles Nagai (1941, p. 159) has reported *F. mollis* (Bail. et Harv.) Farl. et Setch. in addition to the present species. While our specimens collected in July and August are all sterile, a dried specimen collected in September by Miyake at Maguntan and that collected in December by Morimoto at the Island of Kaiba-tô are found to be fertile, bearing auxiliary cell branches characteristic of the Dumontiaceae, the latter being also provided with young cystocarps.

10. **Constantinea** Postels et Ruprecht

Illustr. Alg., 1840, p. 17 ; Okamura, 1936, p. 484.

Constantinea Rosa-marina (Gmel.) Postels et Ruprecht

loc. cit., 1840, p. 17, pl, 30. pl. 40, figs. 84-87 ; J. Agardh. 1851, p. 295 ; Kjellman, 1889, p. 30 ; Setchell, 1899, p. 595 ; 1906, p. 9 ; Saunders, 1901, p. 441 ; De Toni, 1905, p. 1637 ; 1924, p. 566 ; Okamura, 1902, p. 93 ; 1916, p. 115 ; 1910, p. 91, pl. 77, pl. 78, figs.8-13 ; 1936, p. 485, fig. 226 ; Setchell & Gardner, 1903, p. 355 ; Nagai, 1935*a*, pp. 780-783, fig. 1 ; 1941, p. 161 ; Yamada & Tanaka, 1944, p. 69.

Fucus rosa marina Gmelin, Hist. Fuc., 1768, p. 102, pl. 5, figs. 2, 2a.

Constantinea Sitchensis Postels et Ruprecht. *loc. cit.*, 1840, p. 17, pl. 40, fig. 88 ; Kützing, 1849, p. 744 ; J. Agardh, 1851, p. 295 ; De Toni, 1905, p. 1638.

Kallymenia rosa marina Endlicher, Gen. Pl. Suppl., III, 1843, p. 40.

Neurocaulon rosa marina Kützing, Sp. Alg., 1849, p. 744 ; Tab. Phyc., XVII, 1867, pl. 83, fig. d.

Japanese name. Okitsu-bara (Okamura).

Habitat. Found cast ashore. W. coast : Hishitoma (T., '26), Shiranushi (T., '27), Nishinotoro (Morimoto, '25). E. coast : Rorei (T., '32), Sakaehama (T., '27), Kashiho (T., '31), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Kamtschatka ; Bering Island ; Pribilof Islands ; Alaska.

Remarks. The specimens at hand are all sterile. The sister species of the present, *C. subulifera* Setch., which has been reported by Nagai (1935*a*, figs. 2, 3; 1941, p, 162) to occur in the eastern Hokkaido and the Kuriles, is not yet known in southern Saghalien. Masaki (1952) has recently reported his observations on the reproductive organs of these two species collected at Kushiro, Hokkaido.

11. **Hyalosiphonia** Okamura

Icon. Jap. Alg., II, 3, 1909, p, 50 ; Nippon Kaisô-shi, 1936, p. 478.

Hyalosiphonia caespitosa Okamura

Icon. Jap. Alg., II, 3, 1909, p. 51, pl. 64, pl. 65, figs. 1-6 ; 1916, p. 113 ; 1927, p. 17 ; 1936 p. 478, fig. 221 ; De Toni, 1924, p. 564 ; Inagaki, 1933, p. 27 ; Takamatsu, 1938, p. 42 ; 1938a, p. 114 ; 1939, p. 51.

Japanese name. Iso-umemodoki (Okamura).

Habitat. Found cast ashore. E. coast : Airô (T., '27).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, Saghalien, Korea, China.

Remarks. Only a single specimen is before us. But it shows satisfactorily all the characteristics of the present species. Ripe cystocarps are present.

Family 6. Squamariaceae (Zanard.) Ardissone

Phyc. Medit., I, 1883, p. 225 ; Okamura, 1936, p. 492.
Squamarieae Zanardini, Syn. Alg. Adriat., 1841, p. 225.

12. **Rhododermis** Crouan

in J. Agardh, Sp. Alg., II, 2, 1852, p. 504 ; Okamura, 1936, p. 494.

Rhododermis Georgii (Batt.) Collins

in Collins, Holden & Setchell, Phyc. Bor.-Amer., (Exsicc.), no. 1299 ; Collins, 1906, p. 160 ; Rosenvinge, 1917, p. 199, figs. 119, 120 ; De Toni, 1924, p. 597 ; Taylor, 1937, p. 253.

Rhodophysema Georgii Batters, New or Crit. Brit. Mar. Alg., 1900, p. 377, pl. 414, figs. 8-13 ; Kylin, 1907, p. 194, fig. 41 ; De Toni, 1905, p. 1712 ; Newton, 1931, p. 448, fig. 269.

Rhododermis Van Heurckii Heydrich, Über Rhododermis Crouan, 1903, p. 246, pl. 17 ; De Toni, 1905, p. 1711.

Japanese name. Fuchitoribeni (n. n.).

Habitat. Growing on *Zostera*, fringing the margins of the leaves. Aniwa Bay : Tôbuchi-ko (T., '41).

Distribution. Hokkaido and Saghalien ; Atlantic coasts of North America and

Europe ; North Sea.

Frond epiphytic on the leaves of *Zostera*, gregarious, minute, 0.1–1.0 mm. diam., partly disc-shaped and 4–5 (–7) cells thick, partly globose or pear-shaped, 0.3–1 mm. high, being inflated by the transformation of the inner cells as well as of a part of the basal ones into large vesicular cells ; unicellular hyaline hairs scattered ; tetrasporangia in convex sori, 37–44 (–48) μ high, 28–36 (–39) μ diam., cruciately divided ; paraphyses 3–5 (–6) celled, 5–7μ thick, up to 60μ long.

Remarks. Our plant agrees quite well with the descriptions of the present species given in the works cited above, except the dimensions of the tetrasporangia and paraphyses (cf. Tokida, 1934, Table I). In the dimensions of those organs it surpasses even var. *fucicola* Tokida. The difference between that variety and the typical form of the species can not then be said to lie in the larger dimensions of the former, as previously considered by the writer. However, var. *fucicola* differs still from the typical form in the habitat, in the absence of hairs, and in having the basal cells of the inflated frond never enlarged but always remained unchanged in their original shape and size.

Outside Saghalien, *Rhododermis Georgii* was once collected by the writer at Usu, Prov. Iburi in Hokkaido, in March 1938. It may possibly be of rather wide distribution in the northern waters of Japan.

Family 7. Corallinaceae (Gray) Harvey

Ner. Bor.-Amer., II, 1853, p. 80 ; Okamura, 1936, p. 497.
Corallideae Gray, Nat. Arrang. Brit. Pl., I, 1821, p. 339,
Corallineae Meneghini, Cenni Organogr. Alg., 1838, p. 33.

Key to the genera

I. Frond without genicula (Subfam. 1. **Melobesieae**)
 Frond crustaceous, epiphytic, composed of a single layer of cells in the vegetative parts .... 13. *Heteroderma*

II. Frond with genicula (Subfam. 2. **Corallineae**)
 A. Mother-cells of the propagating cells generated in the cortex ; genicula unizonal ; conceptacles prominent on the margins of the compressed articuli, or on the surface of cylindrical articuli .... 14. *Amphiroa Sect. Marginisporum*
 B. Mother-cells of the propagating cells generated in the medulla ; genicula unizonal ; conceptacles stalked, mostly taking the place of a segment .... 15. *Corallina*

Subfamily 1. Melobesieae

13. **Heteroderma** Foslie

Alg. Not., VI, 1909, p. 56 ; Okamura, 1936, p. 507.

Heteroderma zostericola Foslie

loc. cit., 1909, p. 56 ; Yendo, *in* Okamura, 1916, p. 125 ; Okamura, 1936, p. 507.

Lithophyllum zostericolum Foslie, Five New Calc. Alg., 1900, p. 5 ; 1900a, p. 20 ; Yendo, 1902, p. 4 ; De Toni, 1905, p. 1795 ; Cotton, 1915, p. 113.
Melobesia zostericola Foslie, Alg. Not., IV, 1907, p. 25 ; De Toni, 1924, p. 648.

Japanese name. Mokasa (Yendo).

Habitat. Growing on the leaves of *Zostera marina* and *Phyllospadix iwatensis.* W. coast : Pilevo (Miyabe, '06), Kushunnai (Miyabe, '06), Rakuma (T., '26), Hirochi (T., '27), Shiranushi (T., '26), Nishinotoro (T., '26). Aniwa Bayô : Chishiya (T., '37), Nobori (T., '26). E. coast : Airô (T., '27), Higashishiraura (Saitô, '28).

Distribution. Honshû, Hokkaido, Saghalien, Korea ; China.

Remarks. This alga is quite a common epiphyte on the leaves of the sea-grasses in our region.

Subfam 2. Corallineae

14. **Amphiroa** Lamouroux

in Bull. Phil. III, 1812 ; Hist. des Pol. coral. fléx., 1816, p. 294 ; Okamura, 1936, p. 515.

Amphiroa cretacea Endlicher

Gen. Plant., Suppl., III, 1843, p. 49 ; Kützing, 1849, p. 701 ; 1858, pl. 45 ; Areschoug, *in* J. Agardh, 1852, p. 533; Harvey, 1853, p. 86; Kjellman, 1889, p. 20; Setchell, 1899, p. 595; Yendo, 1902, p. 7, pl. 1, fig. 4, pl. 4, fig. 2 ; 1902a, p. 5 ; 1905, p. 10 ; *in* Okamura, 1916 p. 135 ; De Toni, 1905, p. 1811; Woronichin, 1928, p. 163 ; Sinova, 1933, p. 39; 1938, p. 72 ; Okamura, 1936, p. 521 ; Takamatsu, 1938, p. 43 ; 1938*a*, p. 115 ; Nagai, 1941, p. 166 ; Yamada & Tanaka, 1944, p. 69.
Corallina cretacea Postels et Ruprecht, Illustr. Alg., 1840, p. 20, pl. 40, figs. 104.

Japanese name. Isokiri (Yendo).

a. ***Amphiroa cretacea*** f. ***typica*** Nagai

Mar. Alg. Kurile Isls., II, 1941, p. 167.

Habitat. Growing on rocks in the littoral and sublittoral belts. W. coast : Kushunnai (Miyabe, '06), Rakuma (T., '26), Hirochi (T., '27), Shiranushi (T., '26, '32) ; Kaiba-tô (Morimoto, '37 ; T., '43). Aniwa Bay : Ishihama (T., '26), Nobori (T., '26), Merei (Miyabe, '06). E. coast : Airô (Miyabe, '06), Kashiho (T., '31).

Distribution. Honshû, Hokkaido, Kuriles and Saghalien ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of N. America (Alaska and Port Renfrew).

Remarks. Mr. Morimoto's specimen, which was collected on the shore of Kaiba-tô in November 1937, has quite a robust frond, attaining to about 3 mm. diam. in the thickest articulation. Similar specimens were collected by the writer at the same island in September 1943. They appear to be nearly approaching to forma *rosariformis* Yendo but not identical with it. Sea-urchins are often found to bear several fragments of the thicker frond of this alga upon their tops.

15. **Corallina** Lamouroux

in Mem. du Mus., II, 1815, p. 227 ; Okamura, 1936, p. 525.

Corallina pilu'ifera Postels et Ruprecht

Illustr. Alg., 1840, p. 20, pl. 40, fig. 101 ; Ruprecht, 1851, p. 344 ; Areschoug, *in* J. Agardh, 1852, p. 563 ; Yendo, 1902, p. 30, pl. 3, figs. 14-16, pl. 7, figs. 14 16 ; 1902a, p. 11 ; 1905, p. 30 ; *in* Okamura, 1916, p. 139 ; De Toni, 1905, p. 1843 ; Cotton, 1915, p. 113 ; Sinova, 1930, p. 122 ; Yamada, 1934, p. 348 ; 1928, p. 534 ; Tseng, 1936, p. 39, pl. 4, figs. 20, 22 ; Okamura, 1936, p. 527 ; Takamatsu, 1936, p. 27 ; 1936*a*, p. 62 ; 1938, p. 46 ; 1938*a*, p. 119 ; 1939*a*, p. 52 ; Nagai, 1941, p. 168 ; Yamada & Tanaka, 1944, p. 69.

Corallina officinalis f. *pilulifera* Setchell et Gardner, Alg. N.-W. Amer., 1903, p. 366.

Japanese name. Pirihiba (Yendo).

a. ***Corallina pilulifera*** f. ***filiformis*** Ruprecht

Tange Ochot. Meer., 1851, p. 345 ; Yendo, 1902, p. 30, pl. 3, fig. 14, pl. 7, fig. 14 ; 1905., p. 30 ; *in* Okamura, 1916, p. 139 ; Okamura, 1936, p. 527 ; Nagai, 1941, p. 168.

Habitat. Growing on rocks in dense tufts, in the littoral belt and in tide pools. W. coast : Kushunnai (Miyake, '06), Tomarioru (Miyabe, '06), Rakuma (T., '26), Maoka (Miyake, '06), Sôni (T., '26), Shiranushi (T., '26, '32, '37), Nishinotoro (T., '26). Aniwa Bay : Ishihama (T., '26), Nobori (T., '26), Merei (Miyabe, '06). E. coast : Airô (Miyabe, '06 ; T., '26), Higashishiraura (Miyake, '06), Noto (T., '35), Chiriye (Miyabe, '06).

Distribution. Sp. -- Formosa, Honshû, Hokkaido, Saghalien, Kuriles ; Ochotsk Sea ; China ; Alaska. Forma *filiformis*–Honshû, Hokkaido, Saghalien and Kuriles ; Ochotsk Sea.

Remarks. According to Ruprecht (1851, p. 344) the first collector of the present alga is Redowski, who collected it at a certain locality in the western coast of the Ochotsk Sea. As this is a variable plant, Ruprecht distinguished among his specimens from the Ochotsk Sea three varieties, i.e., α *flabellata*, β *sororia*, and γ *filiformis*, of which α *flabellata* is represented by Redowski's specimens, and is cited by Yendo (1902, p. 31), no doubt by mistake, as f. *typica* Rupr., giving a remark of its absence in the Japanese coast. Besides the two remaining forms of Ruprecht, Yendo has distinguished two more forms, i.e., f. *intermedia* Yendo (1902, p. 30, pl. 3, fig. 16, pl. 7, fig. 16) and f. *arbuscula* (Post. et Rupr.) Yendo (1905, p. 30) among his Japanese specimens referred to *Corallina pilulifera*. Of these four forms in Japan, forma *filiformis* is that to which all of our Saghalien specimens of *Corallina* appear, at present, to be referable. Nagai (1941, p. 169) has reported that most of his Kurile specimens were referable to forma *fliformis* and a few to forma *sororia* and forma *intermedia*. In his list of the localities, some are placed separately under each formal name, but many others are placed otherwise, as if to elucidate the collecting places of the typical form of the species. But it seems to be doubtful that he could collect forma *flabellata* Rupr. (f. *typica* Yendo) at so many localities in the Kuriles.

Family 8. Grateloupiaceae Schmitz

Syst. Uebers, Florid., 1889, p. 18 ; Okamura, 1936, p. 532.

16. **Grateloupia** Agardh

Sp . Alg., I, 2, 1822, p. 221 ; Okamura, *loc. cit.*, 1936, p. 537.

Key to the species

I. Frond cartilaginous, repeatedly dichotomously branched .... 1. *G. divaricata*
II. Frond membranaceous
  A. Frond narrow, slightly dichotomously branched, rich in pinnae proliferating from the margins .... 2. *G. prolongata*
  B. Frond broad, not dichotomously branched, with an entire or laciniate margins .. .. 3. *G. turuturu*

1. ***Grateloupia divaricata*** Okamura

in Bot. Mag., Tokyo, IX, 106, 1895, p. 482, pl. 9, figs. 1, 2 ; Nippon Sôrui Mei-i, ed. 2, 1916, p. 167 ; Icon. Jap. Alg., III, 4, 1913, p. 55, pl. 116, pl. 117, figs. 12–18 ; Mar. Alg. Mutsu Bay, I, 1927, p. 16 ; Nippon Kaisô-shi, 1936, p. 541 ; Takamatsu, 1936, p. 24 ; 1938, p. 39 ; 1938*a*, p. 110 ; 1939, p. 53 ; Yamada & Tanaka, 1944, p. 69.

Japanese name. Katanori (Okamura).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Kaiba-tô (Morimoto, '37). E. coast : Sakaehama (T., '29.)

Distribution. Honshû, Hokkaido, Saghalien and Korea.

Remarks. Our specimens from Sakaehama are of a rather small narrow frond, scarcely surpassing 10 cm. in height, while those from the Island of Kaiba-tô attains to 17 cm. in height.

2. ***Grateloupia prolongata*** J. Agardh ?

Alg. Lieb. 1847, p. 10 ; Sp. Alg., II, 1851, p. 181 ; III, 1, (Epicr.), 1876, p. 154 ; Kützing. 1862, pl. 24, fig. I ; De Toni, 1905, p. 1565 ; Yendo, 1914, p. 279 ; Okamura 1936, p. 540.

Grateloupia filicina Okamura (non Agardh), Alg. Jap. Exsic., no 32 (*in part*).

Japanese name.

Habitat. Unknown for our Saghalien specimens. W. coast : Kaiba-tô (Miyake '06).

Distribution. Kyûshû, Honshû, Hokkaido and Saghalien ; Pacific coast of Mexico ; Indian Ocean (Ceylon Island).

Remarks. Our specimens, which were determined by the late Dr. K. Okamura as the present species with query, are tetrasporiferous and of simple or slightly branched lanceolate frond, 8–10 cm. high and up to 1.2 cm. broad, with small pinnae proliferating from the margins. The principal segments are about 80–95μ thick in the middle portion.

3. *Grateloupia turuturu* Yamada

Notes on Some Jap. Alg., IX, 1941, p. 205, pl. 46.
Halymenia turuturu Okamura, *in* Herb. (*fide* Yamada).

Japanese name. Tsurutsuru (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Shiranushi (T., '32). Aniwa Bay: Shiraiwa (T., '32). W. coast: Hota (T., '32).

Distribution. Honshû, Hokkaido and Saghalien.

Remarks. Our specimens are all sterile, but they show fairly well the characteristics of the present species in their external and internal structures.

Family 9. Endocladiaceae Kylin

Entwicklungsgesch. Florideenstud., 1928, p. 41 (*in* Ord. Gigartinales); Ueber Entwicklungsgesch. d. Florid., 1930, p. 16 (*in* Ord. Cryptonemiales); Okamura, 1936, p. 559.

17. **Gloiopeltis** J. Agardh

Alg. Mar. Med. et Adr., 1842, p. 64; Sp. Alg., II, 1, 1851, p. 234, III, 1, (Epicr.), 1876, p. 274; Okamura, 1936, p. 561.

Gloiopeltis furcata (Post. et Rupr.) J. Agardh

Sp. Alg., II, 1, 1851, p.235, III, 1, (Epicr.), 1876,p. 275; Harvey, 1853, p.183; Kjellman, 1889, p. 28; Saunders, 1901, p. 440; Okamura, 1902, p. 84; 1916, p. 102; 1927, p. 164, pl. 244; 1927, p. 16; 1936, p. 562, fig. 264; Setchell & Gardner, 1903, p. 348; De Toni, 1905, p. 1534; 1924, p. 533; Kylin, 1925, p. 16; 1930, p. 17; Sjöstedt, 1926, p. 9; Yamada, 1934, p. 347, fig. 2; Tseng, 1936, p. 39; Kawabata, 1936, p. 208; Takamatsu, 1936, p. 22; 1936a, p. 59; 1938, p. 37; 1938a, p. 109; Sinova, 1938, p. 69; Nagai, 1941, p. 169; Yamada & Tanaka, 1944, p. 69.

Dumontia furcata Postels et Ruprecht, Illustr. Alg., 1840, p. 19; Kützing, 1849, p. 719; Ruprecht, 1851, p. 310.

Japanese name. Fukuro-funori or Funori.

a. *Gloiopeltis furcata* f. *coliformis* (Harv.) Okamura

Icon. Jap. Alg., V. 9, 1927, p. 166; Nippon Kaisô-shi, 1936, p. 563; Nagai, 1941, p. 170.

Gloiopeltis coliformis Harvey, Char. New Alg., 1859, p. 332; Suringar. 1870, p. 32, pl. 19; 1872, p. 12 cum plur. tab.; De Toni, 1924, p. 533; Howe, 1924, p. 141.

G. furcata var. *coliformis* J. Agardh, Sp. Alg., III, 1, (Epicr.), 1876, p. 275; De Toni, 1905, p. 1534; Okamura, 1902, p. 84; 1916, p. 102; 1930, p. 94.

Japanese name. Kita-funori (Yendo), Fukuro-funori or Funori.

Habitat. Growing on rocks and stones in the upper littoral belt. W. coast:

Sôni (T., '27), Shiranushi (T., '32), Nishinotoro (T., '37), Kaiba-tô (T., '30 ; Morimoto, '37). Aniwa Bay : Chishiya (T., '37), Nobori (T., '26), Merei (Miyabe, '06). E. coast : Kashiho (T., '31).

Distribution. Sp. – Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia ; China ; Bering Island ; Pacific coast of North America (Alaska to Washington). Form *coliformis*-Honshû, Hachijô Island, Hokkaido, Kuriles and Saghalien ; China.

Remarks. This is one of the highly valued economic seaweeds in our region, but its annual yield is not very high, amounting to 8, 232 kgr. and 3. 837 yen in 1935.

Family 10. Tichocarpaceae Kylin

Florideenordn. Gigartinales, 1932, p. 69 (*Trichocarpaceae*) ; Okamura, 1936, p. 564.

Tichocarpeae Schmitz, Syst. Uebers. Florid., 1889, p. 8 ; Schmitz & Hauptfleisch, *in* Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 369.

18. **Tichocarpus** Ruprecht

Tange Ochot. Meer., 1851, p. 320 ; Okamura, 1936, p. 565.

Tichocarpus crinitus (Gmel.) Ruprecht

Tange Ochot. Meer., 1851, p. 320, pl. 17 ; Tokida, 1932, p. 20 ; Kylin, 1932, p. 69, fig. 22 (*Trichocarpus crinitus*) ; Inakgai, 1933. p. 35 ; Yamada, 1934. p. 349 ; Okamura, 1936, p. 565, fig. 265 ; Kawabata 1936, p. 210 ; Takamatsu, 1938, p. 55, pl. 5, fig. 2 ; 1938*a*, p. 128 ; Sinova, 1938, p. 55 ; Nagai, 1941, p. 170 ; Yamada & Tanaka, 1944, p. 70.

Fucus crinitus Gmelin, Hist. Fuc., 1768, p. 160. pl. 18, fig. 2 ; Turner, 1809, p. 136, pl. 123 ; Agardh, 1812, no. 5.

Sphaerococcus crinitus Agardh, Sp. Alg., I, 2, 1822, p. 275 ; Syst. Alg., 1824, p. 224 ; Postels et Ruprecht, 1840, p. 17.

Gelidium crinitum Kützing, Sp. Alg., 1849, p.766 ; Tab., Phyc., XVIII, 1868, pl. 45. figs. c–f.

Prionitis ? crinita J. Agardh, Sp. Alg., II, 1. 1851, p. 191.

Japanese name. Karekigusa (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. cosat : Pilevo (Enomoto, '22), Nayoshi (Miyabe, '06), Ushiro (Miyabe, '06), Tomarioru (Miyabe, '06 ; T., '30), Rakuma (T., '27), Hirochi (T.,' 27), Honto (Morimoto, '27 ; T., '26), Yenchishi (Miyabe, '06), Sôni (T., '27), Shiranushi (T., '27, '35), Nishinotoro (Morimoto, '25 ; T., '26), Kaiba-tô (Morimoto, '33, '37, '38). Aniwa-Bay : Ishihama (T., '26), Chishiya (Nakamura, '06 ; Miyabe, '06 ; T., '35), Nobori (T., '26, '35, '37), Dorokawa (T., '35), Ōtomari (T., '26), Merei (Miyabe, '06 ; T., '26), Nagahama (Miyabe, '06 ; T., '35), Yaman (Matsubara, '33), Moi (Miyabe, '06), Nakashiretoko (Miyabe, '06 ; Nagai '32). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Airô (Miyabe, '06), Sakaehama (T., '29), Waare (Miyabe, '06), Kashiho (T., '30, '32), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Northern Honshû. Hokkaido, Kuriles, Saghalien and Korea; Ochotsk Sea; Japan Sea coast of Siberia; ? Kamtschatka.

Remarks. This is one of the commonest seaweeds in our region. The plant is nearly always sterile in summer, but the writer could observe a few scattered cystocarps in some of the specimens collected by Dr. Miyabe in 1906 at Merei and Nagahama on the 14th and 15th of July respectively. The female plant provided with abundant ripe cystocarps has been collected by Morimoto at Kaiba-tô in November 1937 and in February to March 1938, and by the writer himself at Shiranushi and Chishiya in April 1937. The antheridial and tetrasporic specimens are also found in the just mentioned winter collections of Morimoto. In the external appearances they differ form the cystocarpic ones in having scarcely any pinnate branchlets. The antheridia from a continuous layer on nearly the whole surface of the male frond; they are cut off by oblique walls from the superficial cells. The tetrasporangia were first discovered by the late Dr. Okamura (1933, p. 11, pl. 307, fig. 6) in the specimens collected on the shore of Island of Bayô-tô in Korea, in the summer of 1928. The sporangia, in our specimens, are very large, 135–240μ X 75–120μ, zonately divided; in cross-section of the frond, they are arranged in one row just beneath the superficial layer of the frond.

The type locality of the species was once thought to be the Kamtschatka Sea, since Gmelin mentioned it in his Historia Fucorum (cf. Turner, 1809, p. 136, C. Agardh, 1822, p. 275 and J. Agardh, 1851, p. 191). According to Ruprecht (1851, p. 320, 412), however, *Tichocarpus crinitus* was not collected by anyone certainly outside the western coast of the Ochotsk Sea, from "Ajan" (Ayan) to "Tugurbai" (Tugurskii Bay), and from the eastern coast of Saghalien Island (cf. C. Agardh, 1812, no. 5, De Toni, 1897, p. 385). It should be noted that this species has not been enumerated in the works referring to the marine algae of Kamtschatka written by Woronichin (1914), Okamura (1928), Nagai (1933), and by Sinova (1933).

Family 11. Callymeniaceae (J. Ag.) Kylin

Entwicklungsgesch. Florideenstud., 1928, p. 56 (*in* Ord. Gigartinales); Florideenordn. Gigartinales, 1932, p. 4 (*in* Ord. Cryptonemiales); Okamura, 1936, p. 566.

Callymenieae J. Agardh, Sp. Alg., II, 1, 1851, pp. 233, 283 (*Kallymenieae*) (*excl. gen.*), III, 1, (Epicr.), 1876, p. 176 (*in part*); Schmitz, 1889, p. 7.

Key to the genera

I. Medullary layer of the frond consisting of big parenchymatous cells and small rhizoidal cells mixed together
  A. Frond very narrow, richly branched; medullary rhizoidal cells rather rare ...... 19. *Euthora*
  B. Frond broader, several times more or less dichotomously branched; medullary rhizoidal cells few but constantly present between the big cells closely set ......

.... 20. *Callophyllis*

C. Frond broad, irregularly orbicular or obovate, irregularly laciniate; medullary rhizoidal cells few to many between the big cells more or less loosely set .. 21. *Pugetia*

II. Medullary layer of the frond consisting of intertwined filamentous cells
Frond large, orbicular, reniform, or broadly cuneate, with an entire or more or less laciniate margins .... 22. *Callymenia*

19. **Euthora** J. Agardh

Alg. Lieb., 1847, p. 11; Sp. Alg., II, 2, 1852, p. 383 (excl. subgen. *Stictophyllum*), III, 1, (Epicr.), 1876, p. 359; Okamura, 1936, p. 574.

Euthora fruticulosa (Rupr.) J. Agardh

Sp. Alg., II, 2, 1852, p. 705, III, 1, (Epicr.), 1876, p. 360; Tokida, 1932, p. 15, fig. 4, pl. 2, figs. c, d, pl. 6, figs. b, c; Okamura, 1933, p. 90; 1936, p. 575, fig. 269; Kawabata, 1936, p. 210; Nagai, 1941, p. 175.

Nereidea fruticulosa Ruprecht, Tange Ochot. Meer., 1851, p. 255.

Japanese name. Yûsora (Okamura).

Habitat. Found cast ashore, frequently attaching to other algae, e.g., *Odonthalia, Ptilota,* and *Rhodophyllis.* W. coast: Tomarioru (T., '03), Shiranushi (T., '27). E. coast: Kashiho (T., '31), Kaihyô-tô (T., '30; '32, '35), Yôman (T., '35).

Distribution. Kuriles and Saghalien; Ochotsk Sea; Kamtschatka; Bering Sea; Pacific coast of North America (Washington).

Remarks. The description of our Saghalien specimens referred to the present species is given in the writer's previous paper cited above. The type locality of *Euthora fruticulosa* is Kamtschatka (Avatschenskaya Bay), where it was first collected by Wormskjold in 1816. His specimens were referred by C. Agardh to *Delesseria glandulosa,* and by J. Agardh to *Rhodomenia Fabriciana,* but Ruprecht (1851, p. 256) identified them as *Nereidea fruticulosa.* This alga seems to be rather rarely found in that bay, because it has not been reported by anyone who studied the algal collections from there since Ruprecht's work was published. In the writer's herbarium, there is kept a single specimen from Palanski (Palana) on the west coast of the Kamtschatka Peninsula, which was sent from Mr. Z. Tsutsui, who collected it in July 1935. Except in southern Saghalien, it has not been reported from the Ochotsk Sea by anyone since Ruprecht, who reported the discovery of a single, but complete, specimen among the algal collection from Ayan.

20. **Callophyllis** Kützing

Phyc. Gen., 1843, p. 400; Sp. Alg., 1849, p. 744; Okamura, 1936, p. 567.

Callophyllis rhynchocarpa Ruprecht

Tange Ochot. Meer., 1851, p. 260, pl. 13 (*Calliphyllis rhynchocarpa*) ; Martens, 1866, p. 118 ; J. Agardh, 1876, p. 236 ; Kjellman, 1889, p. 30 ; De Toni, 1897, p. 284 ; Okamura, 1902, p. 31 ; 1916, p. 34 ; 1936, p. 571 ; Woronichin, 1928, p. 149 ; Nagai, 1941, p. 172 ; Yamada & Tanaka, 1944, p. 70.

Japanese name. Hime-tosakamodoki (Okamura).

Distribution. Sp. – Kyûshû, Honshû, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; Bering Island.

Remarks. Ruprecht has established the present species on the basis of two cystocarpiferous specimens from Ayan, which are both illustrated in his Tange des Ochotskischen Meeres, Taf. 13 under the varietal names forma *acutiloba* and forma *obtusiloba* respectively. On the page 262 of that work, he mentions ; "Im nördlichen Ocean zwischen Asien und Amerika ist die Gattung Calliphyllis durch verschiedene Formen representiert." And he describes four forms, of which two are named *Calliphyllis cristata* Rupr. and *Calliphyllis incisa* Rupr. He did not dare to treat those northern forms as the varieties of *C. rhynchocarpa* as misinterpreted by Setchell & Gardner (1903, p. 306), Sinova (1930, p. 109 ; 1933, p. 32), and by Nagai (1941, p. 173), although Ruprecht himself mentioned as follows (*loc. cit.*, p. 263) : "*C. rhynchocarpa* scheint mir daher eine sehr eigentümliche Art zu sein, wennauch die übrigen nordischen Formen sich später nur als Abarten derselben herausstellen sollten. Die aussergewöhnliche Formenverschiedenheit der *C. variegata*, welche Montagne, J. D. Hooker und Harvey bezuegen, konnten einer solchen Vermughung Raum geben." Studying the various forms of *Callophyllis* from Saghalien, the writer has come to a conclusion that all of them, except a single sterile specimen from Nobori in Aniwa Bay (T., '26), are to be considered after all as belonging to a single species, *C. rhynchocarpa* in such a broader sense as comprising at least two of the four northern forms enumerated by Ruprecht, viz., *C. cristata* and *C. incisa*. The specimen from Nobori seems to stand near by *C. rhynchocarpa* f. *subsimplex* Nagai. In the writer's opinion, the last mentioned form is a distinct species, possibly identical with that which occurs in the southern Kuriles and along the south-eastern coast of Hokkaido.

The occurrence of *C. rhynchocarpa* in Japan was first reported by Martens in 1866, who identified the plant collected by Ott Schottmüller at Nagasaki to the present species (cf. De Toni, 1897, p. 284). In 1901, it was first suggested by Okamura (1901, p. 64) that the species occurs also in Saghalien. On the Pacific coast of Honshû, it is said to have been collected at Matsushima Bay, Prov. Rikuzen, and at Nemoto, Prov. Bôshû (Okamura, 1936, p. 571).

Key to the forms

I. Frond pinnato-subdichotomously branched ; middle segments usually narrow
 A. Segments not much elongated, usually broadened at the frond apex . . a. f. *obtusiloba*

B. Segments often elongated and linear, usually narrowed at the frond apex . b. f. *incisa*
II. Frond pinnato-flabellately branched ; middle segments considerably broadened in part .... c. f. *cristata*

a. ***Callophyllis rhynchocarpa*** f. ***obtusiloba*** Ruprecht

Tange Ochot. Meer. 1851, p. 431, pl. 13, figs. b, bd, bda ; Nagai, 1941, p. 173.

Habitat. Found cast ashore. E. coast : Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Kuriles and Saghalien ; Ochotsk Sea (Ayan) ; Kamtschatka.

Remarks. Specimens which agree quite well with Ruprecht's figures are found in the collection from Yôman. Some larger specimens, which attain about 14 cm. in height, are also referred here. The ultimate lobes are generally obtuse, but acute ones are also not lacking. Nevertheless, the writer has not met with a plant of a certainly intermediate character between the present form and f. *acutiloba* Rupr. According to Woronichin (1928, p. 149), his two cystocarpiferous specimens from the Gulf of Kronotski on the eastern coast of Kamtschatka resemble f. *obtusiloba* Rupr. very closely.

b. ***Callophyllis rhynchocarpa*** f. ***incisa*** (Rupr.) Setchell et Gardner

Alg. N.-W. Amer., 1903, p. 306 ; Sinova, 1930, p. 109 ; 1933, p. 32.
Calliphyllis incisa Ruprecht, Tange Ochot. Meer., 1851, pp. 262, 263.

Habitat. Found cast ashore, sometimes epiphytic on *Ptilota asplenioides*. Aniwa Bay : Dorokawa (T., '35), Merei (Miyabe, '06), Otai (Miyabe, '06), Naion (Miyabe, '06). E. coast : Airô (T., '27), Higashisôya (T., '29), Kashiho (T., '31).

Distribution. Saghalien ; Ochotsk Sea ; Kamtschatka ; Alaska (Sitka or ? Unalaska).

Remarks. In the description of his *Callophyllis japonica*, Okamura (*in* De Toni & Okamura, 1984, p. 77 and Okamura, 1901, p. 64) states : "This species is most closely resembling to *C. rhynchocarpa* Rupr. and, beyond any question, it has colse affinity with the latter." His statement is right as far as one of the forms of *C. rhynchocarpa*, which the writerrefers to forma *incisa*, is concerned. In her works on the algae from the Ochotsk Sea and from Avatschinskaya Bay of Kamtschatka (1930. p. 109 ; 1933, p. 32), Sinova has cited Okamura's Illustrations of the Marine Algae of Japan, p. 63, pl. 22 under *Callophyllis rhynchocarpa* f. *incisa* Rupr., without giving any remarks on the identity between the last mentioned species and the Okamura's *C. japonica*. Sinova's plant must be bearing a colse resemblance to *C. japonica* in general aspects ; it is most probably idenitcal with our plant under consideration.

c. *Callophyllis rhynchocarpa* f. *cristata* (Rupr.) Setchell et Gardner

Alg. N.-W. Amer., 1903, p. 306.
Calliphyllis cristata Ruprecht, Tange Ochot. Meer., 1851, p. 262.
Callophyllis rhynchocarpa Tokida, Mar. Alg. Robben Isl., 1932, p. 15.

Habitat. Found cast ashore. W. coast : Nishinotoro (Morimoto, '25). E. coast : Higashishiraura (T., '31), Maguntan (Miyabe, '06), Higashisôya (T., '29), Kashiho (T., '31), Kaihyô-tô (T., '30, '32), Kitashiretoko (T., '35).

Distribution. Hokkaido, and Saghalien ; Alaska (Unalaska).

Remarks. Ruprecht (1851, p. 262) expresses his idea that the Ochotsk Sea forms (forma *acutiloba* & *obtusiloba*) may possibly be nothing but "einige Stucke" of his *Calliphyllis cristata*. The specimens which the writer refers to forma *cristata* are of a comparatively large frond, attaining 19 cm. in height and frequently more than one cm. in width at the boradened portions in middle and upper segments. The branching above the broadened portion of segments is usually more or less pinnato-flabellate. In the herbarium of our University is deposited a specimen collected by Miyabe in July 1894 at Kushiro, Hokkaido, which is also referable to the present form.

21. **Pugetia** Kylin

Mar. Red Alg. Friday Harb., Wash., 1925, p. 30 ; Smith, 1944, p. 253 ; Tokida, 1948, p. 39.
Microcoelia J. Agardh, Sp. Alg., III, 1, (Epicr.), 1876, p. 226, (non *Microcoelia* Lindley, 1830, p. 60, genus Familiarum Orchidacearum, *fide* Kylin, 1941, p. 15) ; Okamura, 1901, p. 9 ; 1916, p. 35.

Pugetia palmatifolia Tokida

Notes on some new or little known marine algae, (2), 1948, p. 37 figs. 7-9.

Japanese name. Yatsude-kinuhada (Tokida).

Habitat. Found cast ashore, attaching to a small piece of sand stone. E. coast : Higashisôya (T., '29).

Distribution. Endemic.

Remarks. A thorough description of the present species, as well as that of the genus *Pugetia*, is given in the writer's paper cited above.

22. **Callymenia** J. Agardh

Alg. Mar. Med. et Adr., 1842 (*Kallymenia*) ; Sp. Alg. II, 1, 1851, p. 284, III, 1, (Epicr.), 1876, p. 219 ; Okamura, 1936, p. 575.

Callymenia reniformis (Turn.) J. Agardh

Alg. Mar. Med. et Adr., 1842, p. 99; Sp. Alg., II, 1, 1851, p. 286, III, 1, (Epicr.), 1876, p. 221; Harvey, 1846, pl. 13; De Toni, 1897, p. 297; 1924, p. 221; ? Holmes, 1895, p. 258; Newton, 1931, p. 417; Taylor, 1937, p. 276; Ueda & Okada, 1938, p. 234, fig. 1.

Fucus reniformis Turner, Hist. Fuc., II, 1809, p. 109, (*in part*), pl. 113, figs. b-g.

non *Euhymenia reniformis* Martens (*non* Kütz.), Preus. Exped. Ost-Asien, Tange, 1866, p. 118 (*fide* Yendo, 1916, p. 257).

a. ***Callymenia reniformis*** var. ***cuneata*** J. Agardh

Sp. Alg., III, 1. (Epicr.), 1876, p. 221; Tokida, 1932, p. 14, pl. 2, fig. b, pl. 6, fig. a; Yamada, 1934, p. 348 (with query); Okamura, 1936, p. 569; Nagai, 1941, p. 177 (with query).

Japanese name. Yezo-tsukasanori (n. n.).

Habitat. Found cast ashore, sometimes attaching to shells. E. coast: Kaihyô-tô (T., '30, '32, '35), Kita-shiretoko (T., '35), Yôman (T., '35).

Distribution. *Sp*. – Honshû; Pacific coast of North America (British Columbia (?) and California); Atlantic coasts of North America and Europe. Var. *cuneata*- Northern Honshû, Hokkaidô, Kuriles, (?) and Saghalien; Alaska; Atlantic coast of Europe.

Remarks. A brief description of the plant collected on the Islet of Kaihyô-tô (Robben Island) was given in the writer's paper cited above. Besides the immature female plant, which was described and illustrated in that paper (p. 14, pl. 2, fig. b), male and tetrasporiferous plants have also been met with in our specimens. The frond is shortly stipitate, expanded into a reniform or cuneate blade, irregularly and more or less profoundly cleft. Not rarely we find both reniform and cuneate blades arising on one and the same holdfast.

Callymenia reniformis J. Ag. has been reported to occur in the Japanese water around Honshû by Martens in 1866, by Holmes in 1896, and lately also by Ueda & Okada in 1938. According to Yendo (1916, p. 257), Martens' original specimen appeared to him to be *Microcoelia chilensis* Okamura (*Pugetia japonica* Kylin, 1941, p. 15–16) and Holmes' specimen referred to this species seems to have been lost. Ueda & Okada's plant (1938, p. 234, fig. 1) has been dredged in deep water off the Japan Sea and the Pacific coasts of Middle Honshû. It bears a colse resemblance, in the external appearance, to the British plant of *C. reniformis* illustrated by Harvey in his Phycologia Britannica, Vol. I. pl. 13, fig. 3. The markedly diminished size of the Japanese plant is possibly due to the unusual depth of its habitat. According to Newton (1931), the frond of the British plant varies in breadth from 2.5 cm. to 20 cm. or even to 35 cm. As regards the habitat, she writes: "In deep shady pools, at extreme low-water mark." In the Ochotsk Sea, besides the present variety, only var. *undulata* J. Ag. hadbeen reported to occur (Sinvoa, 1930, p. 110).

Order 6. GIGARTINALES Schmitz (*emend.* Kylin)

Syst. Uebers. Florid., 1889, p. 6 (*Gigartineae*) ; Florideae, *in* Engler, Syll. Vorles. Bot., 1892, p. 3 ; Kylin, 1932, pp. 4, 76 ; Okamura, 1936, p. 580.

Key to the Families

I. Tetrasporangia, if present, zonate
   A. Growth from an apical meristem ; procarp absent .... 13. **Solieriaceae**
   B. Growth from an apical cell ; procarp present .... 14. **Rhodophyllidaceae**
II. Tetrasporangia, if present, cruciate
   A. Growth from an apical cell ; frond cylindrical or flat .... 15. **Gracilariaceae**
   B. Growth from an apical meristem ; frond flat or compressed
      1. Tetrasporangia scattered over the frond surface ...... 12. **Nemastomaceae**
      2. Tetra- or monosporangia in superficial nemathecia, often seriate .... 16. **Phyllophoraceae**
      3. Tetrasporangia in immersed sori .... 17. **Gigartinaceae**

Family 12. Nemastomaceae (J. Ag.) Schmitz (*emend.* Kylin)

Syst. Uebers. Florid, 1889, p. 19 (*s. lat.*) ; Kylin, 1932, p. 6 (*s. str.*) ; Okamura, 1936, p. 583.
Nemastomeae J. Agardh. Alg. Medit., 1842, pp. 66, 89.

23. **Schizymenia** J. Agardh

Sp. Alg., II, 1. 1851, p. 169 ; Okamura, 1936, p. 587.

Schizymenia Dubyi (Chauv.) J. Agardh

Sp. Alg., II, 1. 1851, p. 171, III, 1, (Epicr.), 1876, p. 123 ; De Toni, 1905, p. 1648; 1924, p. 571 ; Yendo, 1917, p. 93 ; Yamada, 1928, p. 532, fig. 24 ; Newton, 1931, p. 281, fig. 172 ; Inagaki, 1933, p. 38, fig. 18 ; Okamura, 1933, p. 10, pl. 307, figs. 1-5, pl. 308, fig. 12 ; 1936, p. 587, fig. 275 ; Takamatsu, 1936, p. 31 ; 1938*a*. p. 120 ; 1939, p. 58 ;
Halymenia Dubyi Chauvin, *in* Duby, Bot. Gall., 1830, p. 944.
Kallymenia Dubyi Harvey, Phyc. Brit., II, 1849, pl. 123 (excl. syn.).
Euhymenia Dubyi Kützing, Sp. Alg., 1849, p. 743 (excl. syn.).

Japanese name. Benisunago (Okamura).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Kaiba-tô (T., '43).

Distribution. Shikoku, Hachijô-shima, Honsû, Hokkaido, and Saghalien ; Atlantic coasts of Europe ; Mediterranean Sea.

Remarks. Mature cystocarpiferous specimens of this temperate species have been collected by the writer at the Island of Kaiba-tô toward the end of September in 1943.

Family 13. Solieriaceae Kylin

Florideenordn. Gigartinales, 1932, p. 13 ; Okamura, 1936, p. 590.

24. **Turnerella** Schmitz

Syst. Uebers. Florid., 1889, p. 7 ; Okamura, 1936, p. 597.

Turnerella Mertensiana (Post. et Rupr.) Schmitz

loc. cit., 1889. p. 7 ; Tokida, 1932, p. 18 ; Sinova, 1933, p. 32 ; 1938, p. 54 ; Yamada, 1934, p. 349 ; 1935, p. 22 ; Okamura, 1936, p. 597, fig. 280 ; Kawabata, 1936, p. 210 ; Nagai, 1941, p. 178 ; Yamada & Tanaka, 1944, p. 71.

Iridaea Mertensiana Postels et Ruprecht. Illustr. Alg., 1840, p. 18, pl. 33.

Japanese name. Yezo-nameshi (Okamura), Ôba-sô (in Hokkaido).

Habitat. Found washed ashore. W. coast : Yenchishi (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '26), Shiranushi (T., '27, '37), Kaiba-tô (Morimoto, '37). Aniwa Bay : Nobori (T., '26, '35). E. coast : Hota (T., '32,) Airô (Miyabe, '06), Higashishiraura (T., '31), Higashisôya (T., '29), Unetonnai (Miyabe, '06), Kaihyô-tô (T., '30 ; Nakashima, '32, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Kamtschatka ; Japan Sea coast of Siberia ; Bering Island ; Pacific coast of North America (Alaska and Washington).

Remarks. While most of our specimens, which were collected in summer, are sterile, a single specimen collected by Morimoto in December 1937 at the Islet of Kaiba-tô is provided with mature cystocarps densely scattered over the whole surface.

The southernmost locality reported for the present species is Shizukawa, Prov. Rikuzen in northern Honshû (Okamura, 1914, p. 84, 1936, p. 589). Excepting this, it has not been collected at any locality in northern Honshû by any one, even by Takamatsu, who studied thoroughly the marine flora of that region. In Hokkaido, it is known to be distributed on the Pacific coast but not on the Japan Sea coast. It has been utilized since about 1925 as a raw material of algal slime. As this alga grows in deep water, the fishermen gather drifted plants only. The annual yield for the year of 1937 amounts to 15, 96 kg., ninety per cent of which being produced in the Province of Nemuro.

Family 14. Rhodophyllidaceae Schmitz (*emend.* Kylin)

Syst. Uebers Florid., 1889, p. 7 (*s. lat.*) ; Kylin 1932, p. 38 (*s. str.*) ; Okamura, 1936, p. 600.

25. **Rhodophyllis** Kützing

in Bot. Zeit., 1847, p. 23 ; Sp. Alg., 1849, p. 786 ; Okamura, 1936, p. 601.

Key to the species

I. Frond flat, narrow band-shaped, often ciliately proliferated on the margins .... 1. *R. dichotoma*

II. Frond terete and capillary throughout, with no proliferations ...... 2. *R. capillaris*

1. ***Rhodophyllis dichotoma*** (Lepech.) Gobi

Algenfl. Weiss. Meer., 1878, p. 95 ; Tokida, 1932, p. 18, pl. 7, text-figs. 5, 6 ; 1932*b*, pl. 1, figs. 7-9 ; Okamura, 1936, p. 602, fig. 284 ; Taylor, 1937, p. 289, pl. 60, fig. 1.

Fucus dichotomus Lepechin, *in* Comm. Petropol., 1775, p. 479, pl. 22.

Japanese name. Hige-amihada (n. n.).

Habitat. Found cast ashore, epiphytic on other algae, e.g., *Ptilota*, *Odonthalia*, etc., and on Hydrozoan coenosarcs. E. coast : Hota (T., '32), Higashisôya (T., '29), Kashiho (T., '31), Kaihyô-tô (T., '30, '32, '35 ; Nakashima, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Saghalien ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Pacific coast of North America (Alaska) ; Atlantic coast of North America ; Faeröe Islands ; Arctic Ocean (White Sea).

Remarks. Of the two forms distinguished by Kjellman (1889) in the present species, forma *typica* is only represented by our Saghalien specimens, a thorough description of which is given in the writer's paper (1932) cited above.

2. ***Rhodophyllis capillaris*** Tokida

in Suisangaku-Zasshi 1932*b*, no. 35, p. 13, pl. 1, figs. 1-6, text-figs. 1, 2 ; Okamura, 1936, p. 603 ; Nagai, 1941, p. 180, pl. 5, figs. 1-3.

Japanese name. Ito-amihada (n. n.).

Habitat. Growing on the thallus of *Odonthalia kamtschatika*. E. coast : Airô (T., '27).

Distribution. Hokkaido, Kuriles and Saghalien.

Remarks. The Saghalien plant referred to this species is the tetrasporophyte, bearing scattered zonate tetrasporangia. It is of small frond, attaining to 23.5 mm. in height, while the Kurile plant is described by Nagai to have a larger frond, measuring 7–9 cm. in height and ca. 0.5 mm. in diam. below.

Family 15. Gracilariaceae Kylin

Ueber die Entwicklungsgeschichte der Florideen, 1930, p. 54 ; Okamura, 1936, p. 625.

26. **Gracilaria** Greville

Alg. Brit., 1830, p. 121 ; Okamura, 1936, p. 626.

Gracilaria verrucosa (Huds.) Papenfuss

in Hydrobiologia, II, 3, 1950, p. 195 ; Silva, 1952, pp. 265, 293.

Fucus verrucosus Hudson, Fl. Ang., ed. 1, 1762, p. 470.

Fucus confervoides Hudson, *loc. cit.*, 1762, p. 474.

Fucus confervoides Linnaeus, Sp. Pl., ed. 2, 1763, p. 1629 (which is a later homonym of *F. confervoides* Hudson).

Gracilaria confervoides (L.) Greville, Alg. Brit., 1830, p. 123 ; Tokida, 1932, p. 21; Inagaki, 1933, p. 35, figs. 10, 11 ; Tseng & Li, 1935, p. 219 ; Tseng, 1936, p. 46 ; Okamura, 1936, p. 628, fig. 298; Taylor, 1937, p. 293, pl. 38, fig. 1 ; Kawabata, 1936, p. 210 ; Takamatsu, 1936, p. 33 ; 1938, p. 56 ; 1938*a*, p. 128 ; 1939, p. 60 ; Sinova, 1938, p. 56 ; Nagai, 1941, p. 180 ; Yamada & Tanaka, 1944, p. 70.

Japanese name. Ogonori.

Habitat. Growing on pebbles in the lower littoral and upper sublittoral belts, in shallow quiet bays and lagoons. Aniwa Bay : Nagahama (Herb. Rakuma), Tôbuchi-ko (T., '26, '35 ; Matsubara, '30 ; Ohmi, '40). E. coast : Minabetsu-ko (Saitô, '31), Horoto (Matsubara, '33).

Distribution. Formosa, Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien, Korea ; China ; Japan Sea coast of Siberia ; Pacific coast of N. America (British Columbia, Washington and California) ; Philippine Islands ; Atlantic coasts of N. and S. America, of Europe and of southern Africa (Cape of Good Hope) ; North Sea ; Baltic Sea ; Mediterranean Sea.

Remarks. As for the adoption of the present specific name in place of the long accustomed *Gracilaria confervoides*, the writer refers the readers to Papenfuss (1950). This widely spread temperate species is distributed in northern Japan as far north as the South Kuriles (Shikotan and Kunashiri) and southern Saghalien. Mr. H. Ohmi has informed the writer that this alga was found growing abundantly in two small lagoons near Minabetsu, Minabetsu-ko and Horoto by name. The cultivation of this alga in those lagoons was considered promising. Since 1929, the present plant has been gathered at the lagoon of Saroma-ko, Prov. Kitami in Hokkaido, to be used as a mixing material in the manufacture of agar-agar from *Gelidium*. Its gelose was once considered to be so inferior in quality that it cannot be used as the principal material of agar industry. However, it has lately become utilizable as the principal material by some special method in Japan as well as in California.

Family 16. Phyllophoraceae Kylin

Florideenordn. Gigartinales, 1932, p. 68 ; Okamura, 1936, p. 639.

Tylocarpeae Schmitz et Hauptfleisch, *in* Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 358 (as a Subfam. in Gigartinaceae).

Key to the genera

I. Frond cylindrical below, more or less compressed above ; the medullary cells of moderate diameter .... 27. *Gymnogongrus*

II. Frond cylindrical throughout ; the medullary cells very narrow in some species .... 28. *Ahnfeltia*

27. **Gymnogongrus** Martius

Fl. Bras., I, 1833, p. 27 ; Okamura, 1936, p. 642.

Gymnogongrus Griffithsiae (Turn.) Martius

loc. cit., 1833, p. 27 ; Tokida, 1948*a*, p. 103, figs. 29 31.

Fucus Griffithsiae Turner, Hist. Fuc., I, 1808, p. 79, pl. 37.

Japanese name. Ito-okitsunori (Tokida).

Habitat. Growing in the sublittoral belt, entangled with the thallus of *Ahnfeltia plicata* var. *tobuchiensis*. Aniwa Bay : Tôbuchi-ko (T., '26, '35 ; Matsubara, '30).

Distribution. Saghalien ; Japan Sea coast of Siberia ; Atlantic coasts of North and South America and of Europe ; Mediterranean Sea ; Adriatic Sea.

Remarks. The occurrence of this interesting species in Saghalien was reported by the writer in his paper cited above.

28. **Ahnfeltia** Fries

Fl. Scan., 1835, p. 310 ; Okamura, 1936, p. 646.

Ahnfeltia plicata (Huds.) Fries

Fl. Scan., 1835, p. 310 ; J. Agardh, 1851, p. 311; 1876, p. 206 ; Harvey, 1853, p. 168 ; Farlow, 1881, p. 147 ; Kjellman, 1883, p. 166 ; 1889, p. 30 ; De Toni, 1897, p. 254 ; 1924, p. 201 ; Saunders, 1901, p. 435 ; Setchell & Gardner, 1903, p. 305 ; Cotton, 1906, p. 369 ; Kylin, 1907, p. 130 ; 1925, p. 30 ; 1941, p. 26 ; Kylin & Skottsberg, 1919, p. 9 ; Skottsberg, 1923, p. 10 ; Sinova, 1930, p. 108 ; 1938, p. 52, fig. 3 c, d, e ; Rosenvinge, 1931*a*, p. 554 ; Newton, 1931, p. 414, fig. 246 ; Okamura, 1933, p. 89 ; 1936, p. 646 ; Taylor, 1937, p. 295, pl. 37, fig. 1, pl. 40, fig. 6.

Fucus plicatus Hudson, Fl. Angl., ed. alt., 1762, p. 589 ; Turner, 1811, p. 107, pl. 180.

Gigartina plicata Lamouroux, Essai, 1813, p. 48 ; Lyngbye, 1819, p. 42 ; Postels & Ruprecht, 1840, p. 16.

G. fastigiata Postels et Ruprecht, *loc. cit.*, 1840. p. 16.

Gymnogongrus plicatus Harvey, Phyc. Brit., I, 1847, p. xxi (no. 108), III, 1851, pl. 288 ; Kützing, 1849, p. 789 ; 1869, pl. 66 ; Ruprecht, 1851, p. 326 ; Hauck, 1885, p. 138.

Japanese name. Netsuki-itanigusa (n. n.).

Habitat. Growing on rocks and pebbles in the sublittoral belt ; in Lake Tôbuchi sometimes detached from the substratum and entangled with var. *tobuchiensis*. W. coast : Kushunnai (Kajiwara, '26). Aniwa Bay : Tôbuchi-ko (T., '35, '26). E. coast : Sakaehama (T., '29, '32), Naibuchi (Miyake, '06), Higashishiraura (T., '31).

Distribution. Hokkaido, Saghalien and Korea ; Ochotsk Sea ; Japan Sea coast of Siberia ; Bering Sea ; Pacific coast of North America (Alaska to Washington) ;

Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; Antarctic Ocean ; North Sea ; Baltic Sea ; Mediterranean Sea (Nice-*fide* Turner).

Remarks. The present widely spread species is rather rarely found cast ashore at the above mentioned localities in southern Saghalien except at both Lake Tôbuchi and Sakaehama. At Sakaehama it seems to grow luxuriantly on rocks in the sublittoral belt and a considerable amount of fully grown specimens attaining to 15–20 cm. in height was found cast ashore in August 1932. In Lake Tôbuchi, it grows on pebbles near the mouths of rivers (cf. Kanno & Matsubara, 1933, p. 63) and is rather sparsely found entangled with the Aegagropiloid thalli of var. *tobuchiensis*. It may sometimes happen to have an Aegagropiloid thallus being detached from the substratum, but it can be easily distinguished from var. *tobuchiensis* by its thicker frond, irregularly, often laterally, branched. According to Okamura (1936, p. 646), *Ahnfeltia plicata* has been known to occur in Hokkaido at Rebun Island, Esashi (Prov. Kitami), and Kushiro. It has recently been reported by Kinoshita (1941) to occur also at Yoichi, about 90 km. south-west from Otaru Harbour, where it is said to be not uncommonly washed ashore after a storm in autumn (September-October). This is, at present, the southernmost locality for the species within the Japanese waters.

The morphology of the vegetative organs of *A. plicata* is described in detail by Rosenvinge (1931a. pp. 555–560, figs. 542–551), and that of the reproductive organ, the nemathecium, as well as its development and the germination of the spores, has been thoroughly investigated by Gregory (1930), Chemin (1930) and by Rosenvinge (1931 ; 1931a, pp. 560–567, figs. 552–563). The namathecia are frequently met with in our Saghalien specimens.

a. ***Ahnfeltia plicata*** var. ***tobuchiensis*** Kanno et Matsubara

in Jour. Fish., no. 35, 1932, p. 128, pl. 1, figs. A, B, 6, pl. 2, figs. 1, 2, 8 ; Okamura, 1936, p. 646 ; Nagai, 1941, p. 182.

Ahnfeltia plicata f. *setosa* Gail, *in* Bull. Far East Br. Acad. Sci. U. S. S. R., XX, 1936, pp. 115–124, figs. 1-4.

Japanese name. Itanigusa (Sugiura).

Habitat. Entangled with each other, forming turfy beds on the sandy bottom, at the depth of 3–5 meters in the lagoon of Tôbuchi, and often abundantly cast ashore. Aniwa Bay : Tôbuchi-ko (T., '26, '29, '35).

Distribution. Kuriles, Hokkaido, Saghalien and Korea ; Japan Sea coast of Siberia (Peter the Great Bay).

Remarks. The present variety is readily distinguishable from the typical form of the species by the remarkable thinness of the frond and by the more regular dichotomous branching. It has an Aegagropiloid thallus which is destitute of a holdfast and entangled with each other to form turfy beds, 15–25 cm., rerely up to

1 m., in thickness, on the sandy bottom at the depth of 3–5 meters in Lake Tôbuchi. Nearly one fourth of the whole area of the lake bottom is covered by the beds of this alga. It propagates by the vegetative division of the thallus only. Nagai states: "Kanno and Matsubara reported the presence of nemathecia on the Saghalien specimens all the year round, but the present writer failed to find them in the Kurile specimens, collected in August." Kanno & Matsubara (1932, pp. 129, 130) have not reported, however, the presence of nemathecia in their variety. The present alga is the most important among the economic seaweeds in southern Saghalien. Since the year of 1916 it has been utilized as the raw material for the manufacture of agar-agar in Saghalien.

A similar loose form has been reported by Rosenvinge (1913*a*, p. 568, fig. 563 bis) under the name f. *tenuior* (Lyngb.) Rosenv. to be found in sheltered localities in the inner Danish waters. In general characters it bears a close resemblance to var. *tobuchiensis*, but it seems to be much smaller in dimensions. Forma *pumila* Lakowitz (1907, p. 17, tezt-fig. 9, pl. 1, fig. 11 ; 1929, p. 325, fig. 443) is also a loose from reported from "Danziger-Bucht", in the Baltic Sea. It is beyond question identical with forma *tenuior*.

Family 17. Gigartinaceae Schmitz (*emend.* Kylin)

Syst. Uebers. Florid., 1889, p. 6 (*s. lat.*) ; Kylin, 1932, p. 68 (*s. str*) ; Okamura, 1936, p. 648.
Gigartineae J. Agardh, Sp. Alg., II, 1, 1851, p. 243 (excl. *Gloiodermate*), III, 1, (Epicr.), 1876, p. 175.

Key to the genera

I. Gonimoblast usually not surrounded by a medullary pericarp ; cystocarps immersed in the thallus ; tetrasporangia formed on accessory branches arised on the medullary cells .... 29. *Chondrus*
II. Gonimoblast usually surrounded by a medullary pericarp
  A. Frond papillated ; cystocarps superficial and projecting; tetrasporangia formed by the direct transformation of the subcortical cells .... 30. *Gigartina*
  B. Frond not papillated ; cystocarps immersed in the thallus
    1. Tetrasporangia formed on accessory branches arised on the medullary cells .... 31 *Iridophycus*
    2. Tetrasporangia formed by the direct transformation of the subcortical cells .... 32 *Rhodoglossum*

29. **Chondrus** Stackhouse

Ner. Brit., ed. 1, 1797, p. xv ; Okamura, 1936, p. 652.

Key to the species

I. Frond tereti-compressed, usually very densely and irregularly branched in divaricatodichotomous and pinnate manner; branchlets subcylindrical, spine-like or filiform, with a spinose apex. .... 1. *C. armatus*

II. Frond compressed, regularly, sometimes more or less irregularly, branched in dichotomous manner, often furnished with short pinnules on the margins; branchlets compressed, with a subulate or blunt apex. .... 2. *C. pinnulatus*

1. ***Chondrus armatus*** (Harv.) Okamura

Icon. Jap. Alg., VI, 3, 1930, p. 21, pl. 262, pl. 263, figs. 7-12; 1936, p. 657; Inagaki, 1933, p. 29; Takamatsu, 1938, p. 47; 1938*a*, p. 121; 1939, p. 63.

Cystoclonium ? armatum Harvey, *in* Gray, List of plants collected in Japan, 1856, p. 332; J. Agardh. 1876, p. 239; De Toni, 1897, p. 316 (excl. syn.); 1895, p. 26 (excl. syn.); Okamura, 1916, p. 36.

non *Cystoclonium ? armatum* Hariot, Alg. de Yokoska, 1891, p. 222, no. 32, (*fide* Yamada, 1931, p. 4).

non *Cystoclonium ? armatum* Okamura, *in* Bot. Mag., Tokyo, VIII, 83, 1894, pp. 1-3 (*fide* Okamura, 1936, p. 657).

Japanese name. Togetsunomata (Okamura).

Habitat. Growing on rocks and pebbles in the lower littoral and sublittoral belts. W. coast: Kaiba-tô (T., '30; Morimoto, '33, '37). Aniwa Bay: Tôbuchi-ko (T., '26, '29, '35).

Distribution. Northern Honshû, Hokkaido and Saghalien.

Remarks. As to be inferred from the above cited localities, the present species seems to prefer warmer water in Saghalien. In Tôbuchi-ko, it grows very luxuriantly. It attaches at first to pebbles but later on detaches from the base and is found entangled with the Aegagropiloid thallus of *Ahnfeltia plicata* var. *tobuchiensis*.

2. ***Chondrus pinuulatus*** (Harv.) Okamura

Icon. Jap. Alg., VI, 3, 1930, p. 19, pl. 261, pl. 263 figs. 1-6; 1936, p. 657; Tokida, 1932, p. 13, pl. 5, fig, b; Kawabata, 1936, p. 209; Takamatsu, 1936, p. 29; 1938, p. 49; 1938*a*, p. 122, pl. 14, fig. 1; Sinova. 1938, p. 50; Nagai, 1941, p. 188; Yamada & Tanaka, 1944, p. 71.

Gymnogongrus pinnulatus Harvey, *in* Gray, List of plants collected in Japan, 1856, p. 332; Martens, 1866, p. 133; J. Agardh, 1876, p. 214 (*nomen*); De Toni, 1897, p. 253; Okamura, 1916, p. 33.

Japanese name. Hirakotoji, or Hirasaimi (Okamura).

Key to the forms & subforms

I. Branch apices broadened, often cristate .... 2f. f. *cervicornis*

II. Branch apices with long or short, narrow and mostly subulate segments

  A. Frond coriaceous, narrow

    1. Frond subdichotomously and laterally branched, with abundant pinnae on the margins .... 2a. f. *typicus*

    2. Frond dichotomo-flabellately branched, with sparse pinnae on the margins .... 2b. f. *flabellatus*

  B. Frond carnoso-membranous, partly somewhat broadened

    1. Terminal segments elongate .... 2c. f. *longicornis*

2. Terminal segments short ; frond densely ciliato-pinnate on the margins
   a. Branches not much broadened ; pinnae minute teeth-shaped in the upper part of the frond .... 2d. f. *ciliatus* subf. *angustus*
   b. Branches remarkably broadened ; pinnae not so minute .... 2e. f. *ciliatus* subf. *latus*

2a. ***Chondrus pinnulatus*** f. ***typicus*** Nagai

Plate XIV, Figs. C D

Mar. Alg. Kurile Isls., II, 1941, p. 188.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Nayoshi (Miyabe, '06), Kushunnai (Miyabe. '06), Tomarioru (T., '30) Yenchishi (Miyabe, '06), Hishitoma (T., '26), Shiranushi (T., '27), Nishinotoro (T., '37), Kaiba-tô (Morimoto, '33, '37). Aniwa Bay : Nobori (T., '35, '37), Ôtomari (T., '26, '29), Merei (Miyabe, '06 ; T., '26). Nagahama (T., '35), Yaman (Matsubara, '33) Nakashire-toko (Miyabe, '06). E coast : Hota (T., '32), Airô (Miyabe, '06 ; Wada, '05), Sakaehama (Miyake, '06 ; Miyabe, '06 ; T., '29), Higashishiraura (T., '31), Higashisôya (T., '29), Kashiho (T., 31), Unetonnai (Miyabe, '06), Nairo (Miyake, '06), Chiriye (Miyabe, '06 ; T., '35), Kaihyô-tô (T., '30).

Distribution. *Sp.* – Northern Honshû, Hokkaidô, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia.

2b. ***Chondrus pinnulatus*** f. ***flabellatus*** Tokida, f. nov.

Plate XIV, Fig. E

Fronde coriaceo-cartilaginea, repetite dichotomo-flabellata, pinnulis brevibus paucis ; segmentis terminalibus brevibus subulatis.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Shiranushi (T., '27). Aniwa Bay : Dorokawa (T., '35). E. coast : Sakaehama (T., 29).

Distribution. Endemic.

2c. ***Chondrus pinnulatus*** f. ***longicornis*** Tokida, f. nov.

Plate XV, Figs. A–B

Fronde carnoso-membranacea, 5–8–plo dichotome ramosa ; segmentis terminalibus longis, marginibus saepe sparse dentatis, epinnatis ; segmentis subterminalibus frondis juvenilis margine integra, maturae margine pinnulis longis densissime ornata.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Nayoshi (Miyabe, '06). Aniwa Bay : Merei (Miyabe, '06), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Unetonnai (Miyabe, '06).

Distribution. Endemic.

2d. ***Chondrus pinnulatus*** f. ***ciliatus*** subf. ***angustus*** Tokida, f. & subf. nov.

Plate XIV, Fig. A

Fronde carnoso-membranacea, siccitate usque ad 8 mm. lata, repetite dithotomo-lateraliter ramosa; segmentis terminalibus brevibus, subulatis; segmentis subterminalibus ciliatis, pinnulis brevibus et angustis densissime ornatis.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Sôni (T., '27). Aniwa Bay: Ishihama (T., '26), Ôtomari (T., '29), Nagahama (T., '35). E. coast: Minabetsu (Matsubara, '33), Airô (Miyabe, '06), Mototomari (T., '31), Kashiho (T., '31).

Distribution. Endemic.

2e. ***Chondrus pinnulatus*** f. ***ciliatus*** subf. ***latus*** Tokida, f. & subf. nov.

Plate XIV, Fig. B

Fronde carnoso-membranacea, siccitate usque ad ca. 15 mm. lata, 3–5–plo dichotome ramosa, margine ciliata, pinnulis brevibus, latis, simplicibus vel 1–2–plo dichotome divisis, densissime ornata.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Hota (T., '32), Minabetsu (Matsubara, '33), Kaihyô tô (Kubo, '06).

Distribution. Endemic.

2f. ***Chondrus pinnulatus*** f. ***cervicornis*** Tokida, f. nov.

Plate XV, Figs. C-E

Fronde coriaceo-cartilaginea, dichotome-lateraliter sparse vel irregulariter repetite ramosa, segmentis terminalibus dilatatis, apicibus saepe cristatis; segmentis subterminalibus frondis juvenilis margine plus minus aspere dentato-papillata, maturae margine pinnulis brevibus vel longis sparse ornata.

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Nishinotoro (Morimoto, '25). E. coast: Kaihyô-tô (T., '30, '32), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Endemic.

Remarks. The specimens which the writer refers to *Chondrus pinnulatus* are very variable in their external characters. Most of them are referable to forma *typicus* Nagai, but among the others, the writer can distinguish at least four or five forms as described above. Forma *conglobatus* Nagai, which has been described by

Nagai from his Kurile specimens, is not represented by any of our Saghalien ones. Forma *cervicornis* is so distinctly characterised as to lead one to incline strongly to treat it as a distinct species. It is distributed in the cold water region of the Peninsula of Nishinotoro and in the northernmost localities on the eastern coast from Kaihyô-tô northward.

30. **Gigartina** Stackhouse

in Mem. Soc. Nat., II, 1809, pp. 55, 74 ; Okamura, 1936, p. 649.

Key to the species

I. Frond narrow linear throughout or narrowly cuneate above, marginal papillae usually rather sparse or almost lacking while the plant is sterile. .... 1. *G. ochotensis*

II. Frond broadly cuneate above, marginal and superficial papillae usually numerous. .... 2. G. *pacifica*

1. ***Gigartina ochotensis*** (Rupr.) Ruprecht

in Litt. Herb. Acad. Petropol. (*fide* Yendo) ; *in* Kjellman, Om Beringhafv. Algfl., 1889, p. 31, (*nomen*) ; De Toni, 1897, p. 228 (*nomen*) ; 1924, p. 182 ; Yendo, 1916, p. 57, fig. 4 ; Okamura, 1927, p. 11 ; 1928, p. 183, pl. 247, fig. 9 ; 1936, p. 651 ; Woronichin, (Jap. Transl.), 1928, p. 148 ; Sinova, 1930, p. 107 ; 1933, p. 30 ; Inagaki, 1933, p. 34 ; Setchell & Gardner, 1933, p. 296 ; Takamatsu, 1938, p. 49, pl. 5, fig. 1 ; Nagai, 1941, p. 186, pl. 4, figs. 33, 34 ; Yamada & Tanaka, 1944, p. 71.

Chondrus mamillosus var. *ochotensis* Ruprecht, Tange Ochot. Meer., 1851, p. 318.

Japanese name. Hoso-ibonori (Okamura).

Habitat. Growing on rocks in the littoral belt and in tide-pools. W. coast : Shiranushi (T., '37), Nishinotoro (T., '27), Kaiba-tô (Morimoto, '38). Aniwa Bay : Nobori (T., '35), Nagahama (T., '35). E. coast : Sakaehama (T., '29), Higashishiraura (T., '31), Higashisôya (T., '29), Kashiho (T., '31).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Ochotsk Sea ; Kamtschatka.

Remarks. The present species, together with its sister microspecies (*Gigartina unalaschcensis* Rupr., *G. sitchensis* Rupr., and *G. pacifica* Kjellm.), has been classified by Setchell & Gardner (1933) under the section *Pacificae* in the subgenus *Mastocarpus* (Kütz.) Setch. et Gardn., which is placed in the series *Palmatae*, one of three series segregated by the same authors under the genus *Gigartina*. Series *Palmatae* is said to be very closely related to *Chondrus*, especially in the lack of a differentiated "concentric inner pericarpic layer" or a medullary pericarp. Unfortunately, no tetrasporic plant has been recorded for the species of *Mastocarpus*, the only subgenus in *Palmatae*. According to Ruprecht (1851) and Setchell & Gardner (1903, 1933), *Chondrus crispus* bears a close resemblance to the species of *Pacificae* or even all the members of Series *Palmatae*. Although Ruprecht (1851, p. 314) and Sinova (1930,

p. 106 ; 1938, p. 50) have reported *Chondrus crispus* to be distributed in the south-western part of the Ochotsk Sea and at Petrov Island on the Japan Sea coast of Siberia, the writer could find no true *Chondrus ocellatus.* f. *crispus* in southern Saghalien. Some of the specimens which the writer referred to *G. ochotensis* are entirely devoid of papillate processes or lobules, so that one may feel inclined to take them for a certain form of *Chondrus.*

2. ***Gigartina pacifica*** Kjellman

Om Beringhafv. Algfl., 1889, p. 31, pl. 1, figs. 21, 22 ; De Toni, 1897, p. 217 ; Okamura, 1908, p. 165, pl. 34, figs. 1-8 ; 1916, p. 31 ; Yamada, 1934, p. 348 ; Setchell & Gardner, 1933, p. 296.

Gigartina unalaschcensis Yendo (non Ruprecht), Notes Alg. New to Jap., IV, 1916, p. 54, fig. 2 ("*unalaskensis*") ; Yamada, 1928, p. 517 ; Sinova, 1930, p. 107 ; Inagaki, 1933, p. 33 ; Tokida, 1934*a*, p. 20 ; Okamura, 1936, p. 652, fig. 310 ; Takamatsu, 1938, p. 50 ; Nagai, 1941, p. 183, pl. 4, figs, 31, 32 ; Yamada & Tanaka, 1944, p. 71.

Japanese name. Ibonori (Okamura).

Habitat. Growing on rocks in the littoral belt and in tide-pools. W. coast : Tomarioru (Miyabe, '06), Sôni (T., '26, '27), Shiranushi (T., '23, '35). Aniwa Bay : Kochôbetsu (Matsubara, '33). E. coast : Hota (T., '32), Airô (T., '27), Kaihyô-tô (T., '32).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Bering Island.

Remarks. Gigartina pacifica was originally proposed by Kjellman to include the three varieties of Ruprecht (1851, p. 318), i.e., *Chondrus mamillosus* var. *ochotensis*, var. *unalaschcensis* and var. *sitchensis* (cf. Setchell & Gardner, 1933, p. 282). As the description and figures of *G. pacifica* given by Kjellman were considered by Setchell & Gardner (1903, p. 301) and by Yendo (1916, p. 55) to be applicable to some forms of var. *unalaschcensis*, Yendo has amalgamated the species with *Gigartina unalaschcensis* Rupr. In their later work, however, Setchell & Gardner (1933, pp. 282, 283) express their opinion that the plant figured by Kjellman (1889, pl. 1, figs. 21, 22) may be a broad form of *G. ochotensis* Rupr., and that the type of *G. unalaschcensis* Rupr. in their mind is "the short, crisped, almost stipeless form, with incurved margins and numerous fairly broad lobes, with cystocarps largely on the terminal lobes but also to some extent along the margins and in patches on the surface." Among the Saghalien specimens of *Gigartina*, the writer could find those referable to *G. ochotensis* and *G. pacifica*, but none typical of *G. unalaschcensis* characterized as above. Of these forms segragated by Nagai in his Kurile specimens of *G. unalaschcensis*, forma *grandifolia* corresponds to nothing but the typical form of *G. pacifica* and forma *typica* to the narrower form of *G. pacifica* verging toward *G. ochotensis.* Forma *irregularis* of Nagai, which is said to be characteristic in the irregular branching of the processes, has been rarely met with among the typical specimens of *G. pacifica* collected at Sôni.

31. **Iridophycus** Setchell et Gardner

in Proc. Nat. Acad. Sci., XXII, 8, 1936, pp. 469, 470 ; *in* Univ. Calif. Publ. Bot., XIX, 6, 1937*a*, p. 197 (Diagn.) ; Smith, 1944, p. 287,

Iridea Bory, *in* Dict. class, d'hist. nat., IX, 1826, p. 15 (*pro parte*) ; J. Agardh, Sp. Alg., III, 1, (Epicr.) 1876, p. 179 ("*Iridaea*") (*pro max. parte*) ; Okamura, 1936, p. 658 ; Papenfuss, 1947, p. 12 ; Silva, 1952, p. 283.

non *Iridea* Stackhouse, Ner. Brit., ed. 2, 1816, p. ix, xii. (= *Desmarestia* Lamour., 1813).

Mazzaella De Toni f., Not. Nomen. Alg. VII, 1936, p. [4].

Key to the species

I. Frond simple or rarely twice dichotomous .... 1. *I. cornucopiae*
II. Frond 3-4 times repeatedly subdichotomo-palmate .... 2. *I. subdichotomum*

1. ***Iridophycus cornucopiae*** (Post. et Rupr.) Setchell et Gardner

in Proc. Nat. Acad. Sci., XXIII, 3, 1937, p. 170 ; Nagai, 1941, p. 189 ; Yamada & Tanaka 1944, p. 72.

Iridaea cornucopiae Postels et Ruprecht. Illustr. Alg., 1840, p. 18, pl. 38, b.

I. laminarioides var. *cornucopiae* Yendo (non J. Agardh), Notes Alg. New to Jap., VI, 1917, p. 78, figs. 1, 2 ; Okamura, 1927, p. 11 ; 1936, p. 658, fig. 313 ; Yamada, 1934, p. 348 ; 1935, p. 23.

I. laminarioides Inagaki (non Bory), Mar. Red Alg., Oshoro Bay, 1934, p. 30, fig. 9.

I. laminarioides Takamatsu (non Bory), Mar. Alg. Kinkwazan Ial., 1936*a*, p. 65 ; 1938, p. 51 ; 1938*a*, p. 124.

I. laminarioides Sinova (non Bory), Alg. Petrov Isl. 1938, p. 51.

non *Iridaea Laminarioides* var. α *Cornucopiae* Agardh, Sp. Alg., II, 1, 1851, p. 253 (= *Iridophycus Boryanum* Setch. et Gardn., 1936, p. 470 ; 1937*a*, p. 202).

Japanese name. Kuroba- or Atsuba-ginnansô.

Habitat. Growing on rocks in the littoral belt. W. coast : Tomarioru (Miyabe, '06), Rakuma (T., '27), Sôni (T., '27), Shiranushi (T., '27, '35, '37), Nishinotoro (T., '32, '35), Kaiba-tô (Miyake, '06 ; T., '30 ; Morimoto, '33). Sôya Strait : Nijô-Iwa (Nakamura, '06). Aniwa Bay : Ishihama (T., '26), Chishiya (Nakamura, '06 ; T., '37), Nobori (T., '35), Merei (Miyabe, '06 ; T., '26), Nagahama (T., '35), Kochôbetsu (Matsubara, '33), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '42).

Distribution. Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia ; Kamtschatka.

Remarks. The present species is the most important among the algae produced in northern Japan as the raw material of algal slime. Comparing with *Rhodoglossum pulchrum*, which is also utilized as the raw material of slime, it has thicker frond of much more gelatinous character, and consequently is more highly esteemed in the market. The frond tissue is composed of three layers, cortical, intermediate and medullary. The intermediate layer lies between the cortex of small subglobular cells and the central medulla of filamentous cells mostly vertically arranged. It is composed of beautiful networks of fibrous cells. The tetrasporangia are formed as accessory branches on the cells of this intermediate reticular layer, but not on the cells of the central medulla. In *Rhodoglossum pulchrum*, the intermediate layer ot similar kind is almost lacking and the medulla is composed of somewhat thicker filaments arranged mostly in vertical direction.

2. ***Iridophycus subdichotomum*** Nagai

Mar. Alg. Kurile Isls., II, 1941, p. 191, pl. 6, fig. 5.

Japanese name. Chishima-ginnan (Nagai).

Habitat. Growing on rocks in the littoral belt. W. coast : Shiranushi (T., '35), Nishinotoro (T., '37). Aniwa Bay : Chishiya (T., '35), Nagahama (Miyabe, '06).

Distribution. Hokkaido, Kuriles and Saghalien.

Remarks. Of our Saghalien specimens which the writer refers to the present species, those from Chishiya and Nagahama are of a repeatedly subdichotomo-palmate frond, and those from Shiranushi are of a dwarf frond which is more or less confusedly proliferous on the margins. In the internal structure, they agree quite well with the Saghalien plant of *I. cornucopiae*. The substance is not so firmly cartilaginous as in the case of the type from the Kuriles.

32. **Rhodoglossum** J. Agardh

Sp. Alg., III, 1, (Epicr.), 1876, p. 183 ; Florid. Morfol., 1879, pl. 11.

Tetrasporangia in sori formed just beneath the superficial layer, developing from the inner cortical cells by their direct transformation, arranged in anticlinal series, cruciately divided. The rest characters are generally the same as in *Iridophycus*.

Rhodoglossum pulchrum (Kütz.) Setchell et Gardner

in Proc. Nat. Acad. Sci., XX, 8. 1936, p. 472 ; Nagai, 1941, p. 193 ; Yamada & Tanaka, 1944, p. 72.

Iridaea pulchra Kützing, *in* Bot. Zeit., 1847, p.24; Sp. Alg., 1849, p. 725 ; Tab., Phyc., XVII, 1867, p. 2, pl. 5, figs. c, d ; J. Agardh, 1876, p. 183 (*nomen*) ; De Toni, 1924, p. 174 ; Yendo, 1917, p. 81 ; Inagaki, 1934, p. 31 ; Kawabata, 1936, p. 209 ; Okamura, 1936, p. 660 ; Takamatsu, 1936, p. 65 ; 1938, p. 51 ; 1938*a* p. 124, pl. 16, fig. 1 ; 1939, p. 65.

Japanese name. Akaba- or Usuba-ginnansô.

Key to the forms

I. Terminal lobes broad, cuneato-obovate, simple or bi- (tri-) furcate
  A. Frond simple or 1–2 times dichotomous .... a. f. *typicum*
  B. Frond 3–5 times dichotomous .... b. f. *divergens*
II. Terminal lobes narrow, linear-cuneate, simple or bifurcate ; frond repeatedly dichotomous

.... c. f. *luxurians*

a. ***Rhodoglossum pulchrum*** f. ***typicum*** Nagai

Mar. Alg. Kurile Isls., II, 1941, p. 194.

Habitat. Growing on rocks in the littoral belt. W. coast : Ushiro (Miyabe, '06), Rakuma (T., '30), Maoka (Nakamura, '06), Honto (Morimoto, '25), Yenchishi (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '26, '32), Nishinotoro (Morimoto, '25). Aniwa Bay : Ishihama (T., '26), Chishiya (T., '35), Nobori (T., '37), Merei (Miyabe, '06), Nagahama (Miyabe, '06). E. coast : Hota (T., '32).

Distribution. Sp. – Northern Honshû, Hokkaidô, Kuriles and Saghalien ; Kamtschatka.

b. ***Rhodoglossum pulchrum*** f. ***divergens*** Nagai

loc. cit., 1941, p. 194.

Habitat. The same as in forma *typicum*. W. coast : Rakuma (T., '30), Sôni (T., '27), Hishitoma (T., '32), Shiranushi (T., '27), Kaiba-tô (Morimoto, '33, '37). Aniwa Bay : Merei (Miyabe, '06), Kochôbetsu (Matsubara, '33). E. coast : Higashishiraura (T., '31), Kashiho (T., '31).

Distribution. Kuriles and Saghalien.

c. ***Rhodoglossum pulchrum*** f. ***luxurians*** Nagai

loc. cit. 1941, p. 194.

Habitat. The same as in forma *typicum*. E. coast : Higashishiraura (T., '31).

Distribution. Kuriles and Saghalien.

Remarks. The type locality of *Iridaea pulchra* Kütz. is Kamtschatka. When Yendo reported the occurrence of this species in Japan, he noted that his specimens were all cystocarpic (1917, p. 82). Setchell and Gardner (1936) have transferred this species to the genus *Rhodoglossum*, without giving any remark. The tetrasporangial sori of the Japanese plant were first critically examined by the writer. He has illustrated the intercalary sporangia formed by the direct transformation of the inner cortical cells (1938, figs. 1, 2).

Among his Kurile specimens referred to the present species, Nagai has segregated three forms, which are all represented also in our Saghalien specimens as mentioned above. They are of course more or less closely linked with each other by some intermediate forms.

Order 7. RHODYMENIALES Schmitz

Syst. Uebers. Florid., 1889, p. 8 ; *in* Engler, Syll. Vorles. üb. Bot., 1892, p. 2 ; Okamura, 1936, p. 662.

Key to the Families

I. Longitudinal filamentous cells entirely absent ; procarp with a single auxiliary cell .. .. 18. **Rhodymeniaceae**
II. Longitudinal filamentous cells present in the medulla ; procarp with a single or two auxiliary cells .... 19. **Champiaceae**

Family 18. Rhodymeniaceae (Naeg.) J. Agardh (*emend.* Bliding)

Sp. Alg., III, 1, (Epicr.). 1876, p. 307 (*pro parte*) ; Bliding, 1928, p. 63; Okamura, 1936, p. 662.
Rhodomeniaceae Naegeli, Gatt. einzell. Alg., 1849, (*pro parte*).

Key to the genera

I. Frond flat, solid .... 33. *Rhodymenia*
II. Frond tubular to complanate, more or less fistulose .... 34. *Halosaccion*

33. **Rhodymenia** Greville

Alg. Brit., 1830, pp. xlviii, 84 (*Rhodomenia*) (*pro parte*) ; Okamura, 1936, p. 673.

Key to the species

I. Frond membranaceous, obovate, simple or dichotomously divided near the base, usually with perforations .... 1. *R. pertusa*
II. Frond membranaceous to coriaceous, simple or palmato-flabellately divided, without perforations .... 2. *R. palmata*

1. ***Rhodymenia pertusa*** (Post. et Rupr.) J. Agardh

Sp. Alg., II, 2, 1852, p. 376, III, 1, (Epicr.), 1876, p. 329 ; Tokida, 1932, p. 17 ; Inagaki, 1933, p. 46 ; Okamura, 1936, p. 673, fig. 322 (2, 3) ; Kawabata, 1936, p. 209 ; Takamatsu, 1938, p. 53, pl. 9, fig. 1 ; 1938*a*, p. 125 ; Sinova, 1938, p. 58 ; Nagai, 1941, p. 200 ; Yamada & Tanaka, 1944, p. 72.

Japanese name. Ana-darusu (Okamura).

Habitat. Growing on rocks in the sublittoral belt. Aniwa Bay : Tôbuchi-ko (Matsubara, '30), Naion (Miyabe, '06). E. coast : Hota (T., '32), Higashisôya (T., '29), Kashiho (T., '31), Flat Bay (Miyabe, '06), Kaihyô-tô (T., '30, '32, '35 ; Nakashima, '33).

Distribution. Honshû, Hokkaidô, Kuriles, Saghalien, Korea ; Ochotsk Sea ; Kamtschatka ; Bering Sea ; Pacific coast of N. America from Alaska to Washington ; Arctic Ocean.

Remarks. Both cystocarpiferous and tetrasporiferous plants have been met with.

In our specimens, they do not show any noticeable difference in the size of the frond between them, while we always experience in Hokkaido (Oshoro, Usu and Hakodate) that the tetrasporophyte is much more ample than the female plant just as in the American waters (Setchell & Gardner, 1903) and in the Kuriles (Nagai, 1941). In the vicinity of Hakodate Harbour, as well as at Usu, the tetrasporophyte of this species attains to a remarkable size, reaching not rarely one meter in length and 40–50 cm. in width. The tetrasporangia are always found scattered over the frond surface in the writer's specimens, while they are described by Sjöstedt (1926, p. 35) to "occur both scattered in the cortical layer and aggregated in sori, ..." The spermatangia, as far as the writer knows, have not been observed by anyone in the present species. Sjöstedt's remark on that organ in his work cited above (p. 35) is nothing more than a review on the descriptions of the male organ of *Rhodymenia palmata* given by previous investigators.

2. ***Rhodymenia palmata*** (L.) Greville

Alg. Brit., 1830, p. 93, ; Tokida, 1932, p. 16 ; Okamura, 1933, p. 90 ; 1936, p. 674, fig. 322 (1) ; Inagaki, 1933, p. 46 ; Yamada, 1934, p. 349 ; 1936, p. 23 ; Kawabata, 1936, p. 209 : Takamatsu, 1936*a*, p. 66 ; 1938, p. 52 ; 1938*a*, p. 125 ; Taylor, 1937, p. 306, pl. 41, fig. 7, pl. 42, fig. 3 ; Nagai, 1941, p. 195, pl. 6, fig. 6 ; Yamada & Tanaka. 1944, p. 72.

Fucus palmatus Linnaeus, Sp. Pl., ed. 2, 1763, p. 1636 ; Turner, 1809, p. 114, pl. 115.

Fucus dulcis Gmelin, 1768, p. 189, pl. 26.

Halymenia palmata Agardh, Sp. Alg., I, 1, 1820, p. 204 ; Postels et Ruprecht, 1840, p. 18, pl. 34.

Sphaerococcus palmatus Kützing, Sp. Alg., 1849, p. 781 ; Tab. Phyc., XVIII, 1868, pl. 89, 90.

Fucus expansa palmam humanam referens Morison, Pl. Hist. Univ. Oxon., 1699 (*fide* Ruprecht).

Palmaria expansa (Morison) Ruprecht, Tange Ochot. Meer., 1851, p. 268, pl. 16, figs. r, s.

Japanese name. Darusu (Okamura).

Remarks. This widely distributed alga is known to be very variable in external forms, and several varieties, forms and subforms have been described by previous authors, of which one variety and three forms are represented among our Saghalien specimens as mentioned below. For reproductive organs of *Rhodymenia palmata*, both tetrasporangia and spermatangia have long been known to occur but female organs and cystocarps have not yet been discovered by anyone with certainty. So-called trichogynes described by Grub (1923, p. 151) are considered to be nothing but the hyaline unicellular hairs born on the superficial cells of the young fronds as well as of the young segments of the mature tetrasporophytes and male plants (cf. Resenvinge, 1931*a*, p. 574). Cystocarp-like bodies were first described and figured as "tuberculi" by Mertens & Roth in *Fucus sarniensis* Mertens (*in* Roth, 1806, p. 103, pl. 1 ; cf. Turner, 1808, p. 95 & 96, pl. 44 c, and Harvey. Phyc. Brit., pl. 218), and secondly by Ruprecht (1851, pp. 266–267, pl. 16, figs. r, s) as "Samenhaufenfrucht" in *Palmaria expansa* var. *marginifera* (Harv.) Rupr. (= *Rodymenia palmata* f. *typica* subf.

marginifera (Harv.) Setch. et Gardn.) from Finmark, as well as in the typical form of the species from Russian Lapland. While Ruprecht's descriptions enter into details, Mertens & Roth's remark is so simple and superficial that the true nature of the "tuberculi" is far from being comprehensible. Judging from his descrptions and figures, the "Samenhaufenfrucht" of Ruprecht's plants has nothing to do with the genuine cystocarp as already pointed out by Carruthers (1890), but appears to be a foreign body possibly belonging to a certain parasitic animal (cf. Barton, 1891). Similar bodies are often met with in the Kurile specimens which were referred by Nagai to *Callymenia ornata* (Post. et Rupr.) J. Ag. Yendo (1911, p. 662) once stated that he could observe the supposed female plant of *R. palmata* in Hokkaido, in July and August ; the frond of which was quite illdeveloped as compared with that of the tetrasporophyte, the total length of the blade being about 9–12 cm., and the supposed cystocarps were hemispherically elevated and scattered over both surfaces of the frond. But he has given no anatomical notes on the so-called cystocarp. As far as the writer knows, no one has been successful to rediscover the problematic body in the present alga. In his description of forma *typica*, Okamura (Icon. Jap. Alg., VII. 9, 1937, p. 67–*in Japanese*) states of the cystocarp that it is small, hemispherically swollen and scattered over the frond surface. But he gives neither figure nor special remark on the organ, which has been so repeatedly searched for by many phycologists in vain. His description on the cystocarp is suspected to be not based on his own discovery of the organ in the present species. Rosenvinge (1931*a*. p. 575) concludes that it seems probable that female sex organs and cystocarps are really wanting in *R. palmata*. And he states : "According to the facts known it must most likely be assumed that the reduction division on the tetrasporangia is initiated but not fulfilled owing to the wanting process of fertilization." (cf. Westbrook. 1928 ; Rosenvinge, 1931*a*. p. 574)

Rhodymenia palmata is one of the most popular seaweeds that are used as food among the coastal residents in Europe and America. It is rather curious to say that this alga has not been utilized for almost any purpose among our people, the well-known consumers of so many kinds of seaweeds. The writer was once informed by Mr. T. Taniguchi that the fishermen in Hidaka Province of Hokkaido were aware of the fact that this alga could be eaten.

Key to the varieties and forms

I. Frond mostly of very narrow segments, 0.5–5 mm. wide, repeatedly filiform-dissected
  A. Frond dwarf, 3–9 cm. high ; upper segments expanding upwards and often with short tooth-like lobules at their apices .... 2d. f. *sobolifera*
  B. Frond rather small but not so dwarf as above ; upper segments linear or expanding upwards, without teeth .... 2c. f. *sarniensis*

II. Frond broader, simple to repeatedly laciniate
  A. Frond with abundant proliferations on the margin and sometimes also on the surface ; segment up to 3 cm. wide .... 2b. f. *prolifera*

B. Frond with, if any, a few proliferations or none ; segments up to 13-(15) cm. wide .... 2a. f. *typica*

2a. *Rhodymenia palmata* f. *typica* Kjellman

Alg. Arct. Sea, 1883, p. 147 ; Okamura, 1933, p. 90, pl. IV, figs. 4, 5 ; 1936, p. 675 ; 1937, p. 76 (67), pl. 343, figs. 4-9, pl. 344, fig. 6 ; Nagai, 1941, p. 196.

Habitat. Growing on rocks in the littoral belt. W. coast : Rakuma (T., '27), Yenchishi (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '26, '32), Shiranushi (T., '27, '37), Nishinotoro (Morimoto, '25 ; T., '27, '35, '37), Kaiba-tô (T., '30). Aniwa Bay : Chishiya (T., '35), Yaman (Matsubara, '33). E. coast : Minabetsu (Matsubara, '33), Airô (Miyabe, '06 ; T., '27), Higashishiraura (T., '31), Waare (Miyabe, '06), Mototomari (T., '31), Kashiho (T., '31), Higashisôya (T., '29), Unetonnai (Miyabe, '06), Nairo (Miyake, '06), Flat Bay (Miyabe, '06), Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35 ; Nakashima, '32), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. *Sp*. and forma *typica* - Northern Honshû, Hokkaido, Kuriles, Saghalien and Korea ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Pacific coast of North America (Alaska to Washington) ; Atlantic coasts of North and South America and of Europe ; Arctic Ocean ; North Sea ; Baltic Sea.

Remarks. The specimens here referred to seem to be separable again into three or four subforms, but the writer does not attempt, at present, to do so, because those forms are more or less closely linked with each other by intermediate ones. The frond is not coriaceous, as is so in the Kuriles specimens, but usually membranaceous except the basal portion. The specimen collected by Mr. Nakashima in November 1932 at Kaihyô-tô is of an old coriaceous frond. As already mentioned above, Okamura's description (1937, p. 67) on the cystocarp under the present form seems to give no reliable evidence of the discovery of the organ in *Rhodymenia palmata*.

2b. *Rhodymenia palmata* f. *prolifera* (Kütz.) Kjellman

Alg. Arct. Sea, 1883, p. 148 ; Nagai, 1941, p. 197.
Sphaerococcus palmatus γ *prolifer* Kützing. Sp. Alg., 1849, p. 871.

Habitat. Growing on rocks in the littoral belt. W. coast : Nayoshi (Miyabe, '06), Shiranushi (T., '27, '32). E. coast : Higashishiraura (T., '31), Higashisôya (T., '29), Kaihyô-tô (T., '30, '32).

Distribution. Kuriles and Saghalien ; Atlantic coast of Europe ; Arctic Ocean.

Remarks. The specimens here referred to are mostly of a narrow, repeatedly branched frond, as in the Kurile specimens, but one from Shiranushi, collected in July 1932, is of a simple frond, measuring 3 cm. at the broadest portion in a dried state, densely fringed on the margin by short proliferations. It is to be noted here that the present species, at Oshoro in Hokkaido, reaches its full maturity mainly in spring, and from May to June are found old tetrasporophytes covered densely with small proliferations which may really be sporelings grown up *in situ* from the tetraspores.

2c. ***Rhodymenia palmata*** f. ***sarniensis*** (Mert.) Greville

Alg. Brit., 1830, p. 93; J. Agardh, 1852, p. 377; 1876, p. 329; Farlow, 1881, p. 150; Kjellman, 1883, p. 148; Setchell & Gardner, 1903, p. 316; Newton, 1931, p. 436; Inagaki, 1933, p. 47 (*sub* var.); Okamura, 1936, p. 676 (*sub* var.); 1937, p. 77, pl. 344, figs. 7-8; Taylor, 1937, p. 306 (*sub* var.); Nagai, 1941, p. 197.

Fucus sarniensis Mertens, *in* Roth, Cat. Bot., III, 1806, p. 103, pl. 1; Turner, 1808, p. 95, pl. 44.

Halymenia palmata ε Sarniensis Agardh, Sp. Alg., I, 2, 1822, p. 206.

Sphaerococcus sarniensis Kützing, Phyc. Gen., 1843, p. 409; Sp. Alg., 1849, p. 779.

Habitat. Growing on rocks in the littoral belt. W. coast: Ushiro (Miyabe, '06), Shiranushi (T., '27, '35), Nishinotoro (Morimoto, '25), Kaiba-tô (Morimoto, '37). Aniwa Bay: Otai (Miyabe, '06). E. coast: Hota (T., '32), Higashishiraura (T., '31), Kaihyô-tô (T., '30).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien; Alaska; Altantic coasts of North and South America and of Europe; Arctic Ocean.

Remarks. As already mentioned above, cystocarp-like tubercles were once observed by Mertens & Roth in *Fucus sarniensis* Mert. The writer's specimens, collected at Kaihyô-tô and referred to the present form, are sometimes provided with vein-like thickenings (cf. Okamura, Icon. Jap. Alg., VII, 9, pl. 343, fig. 8) as well as a few deep colored, minute roundish tubercles, ca. 0.5–0.8 mm. diam. The tubercles are slightly elevated on one or both surfaces of the frond. They appear superficially to be young cystocaprs, but nothing cystocarp-like structures can be seen in their internal tissue.

2d. ***Rhodymenia palmata*** var. ***sobolifera*** (Fl. Dan.) J. Agardh

Sp. Alg., II, 2. 1852, p. 377; III, 1. (Epicr.), 1876, p. 330; Newton, 1931, p. 436; Okamura, 1936, p. 676.

Fucus Soboliferus Fl. Dan., pl. 1066; Turner, 1808, p. 97, pl. 45.

Rhodymenia sobolifera Greville, Alg. Brit., 1830, p. 95.

Halymenia Sobolifera Agardh, Sp. Alg., I, 2. 1822, p. 218.

Callophyllis ? Sobolifera Kützing, Sp. Alg., 1849, p. 747.

Sphaerococcus Soboliferus Kützing. Sp. Alg., 1849, p. 782.

Habitat. Growing on rocks in the littoral belt. W. coast: Sôni (T., '26).

Distribution. Saghalien; North Atlantic coast of Europe; Arctic Ocean.

"Frond stipitate, membranaceous, branches very narrow below, much divided, expanding upwards into wedge-shaped jagged and laciniate lobes." (Newton, 1931, p. 436).

Remarks. This is the smallest among the various forms of the present species found in our region. The frond is 3–9 cm. in height and up to ca. 8 mm. in width, in a dried state, in the broadest portion beneath the forking, membranaceous in the upper portion but cartilaginous and almost black in color in the lower portion, which is attenuated below ending into a short stipe, 2–5 mm. in length. The present variety closely resembles the preceding form, as early mentioned by Turner, *loc. cit.*, p. 98 (cf. also Setchell & Gardner, 1903, p. 316). According to Turner, the substance in his specimens of *Fucus soboliferus* was almost as thin as gold-brater's skin, while in *F. sarniensis* it was rather thick. The writer's specimens of these varieties do not show any noticeable difference in the substance of the frond. In enumerating var. *sobolifera* in his Nippon Kaisô-shi, Okamura has given no mention of the locality for it. It is represented in southern Saghalien only by several specimens collected at Sôni, in August 1926.

34. **Halosaccion** Kützing

Phyc. Gen., 1843, p. 439 ; Okamura, 1936, p. 679.

Key to the species

I. Frond saxicolous or epiphytic, saccate, simple or rarely once divided, non-proliferous .. .. 1. *H. saccatum*

II. Frond saxicolous, narrow-linear to cuneate, tubular or complanate, simple or more or les repeatedly divided, often proliferous .... 2. *H. ramentaceum*

1. ***Halosaccion saccatum*** Kützing (*emend.* Yendo)

Tab. Phyc., XVI, 1866, pl. 78, figs. a, b (*s. str.*) ; Yendo, 1909, p. 129 (*s. lat.*) ; Tokida 1932, p. 17 ; Yamada, 1934, p. 349 ; 1935, p. 24 ; Okamura, 1936, p. 680, fig. 325 ; Kawabata, 1936, p. 209 ; Nagai, 1941, p. 201 ; Yamada & Tanaka. 1944, p. 73.

Fucus saccatus Turner, Hist. Fuc., IV, 1819, p. 104, pl. 241, figs. a, b, c.

Dumontia saccata Kützing, Sp. Alg., 1849, p. 719 (*pro parte*).

non *Fucus saccatus* Lepechin, *in* Nov. Comm. Acad. Petrop., XIX, 1775, p. 478, pl. 21 (= *Halosaccion Lepechini* Rupr.).

non *Halosaccion saccatum* Kjellman, Alg. Arct. Sea, 1883, p. 157 (= *Halosaccion Lepechini* Rupr.).

? *Ulva glandiformis* Gmelin, Hist. Fuc., 1768, p. 232.

Halosaccion glandiforme Ruprecht, Tange Ochot. Meer., 1851, p. 279, pl. 16, figs. a-q ; Setchell & Gardner, 1903, p. 318 (*pro parte*) ; Kylin, 1925, p. 43 ; 1931, p. 27.

Dumontia hydrophora Postels et Ruprecht, Illustr. Alg., 1840, p. 19, pl. 35, fig. C.

Halosaccion Hydrophorum Kützing, Tab. Phyc., XVI, 1866, pl. 78, fig. c.

H. Hydrophora J. Agardh, Sp. Alg., II, 2, 1852, p. 358 ; III, 1, (Epicr.), 1876, p. 258 ; De Toni, 1900, p. 604 ; 1924, p. 318 ; Okamura, 1902, p. 47 ; Sinova, 1930, p. 114 ; 1933, p. 33 ; 1938, p. 60.

Dumontia fucicola Postels et Ruprecht, Illustr. Alg., 1840, p. 19, pl. 35, fig. A, pl. 40, figs. 80, 81 ; Kützing, 1849, p. 720.

Halosaccion fucicola Ruprecht, Tange Ochot. Meer., 1851, p. 293 ; J. Agardh, 1852, p. 358 ; 1876, p. 258 ; Kjellman, 1889, p. 29 ; De Toni, 1900, p. 604 ; 1924, p. 318 ; Saunders, 1901, p. 436.

Dumontia decapitata Postels et Ruprecht, Illustr. Alg., 1840, p. 19, pl. 35, fig. E ; Kützing, 1849, p. 720.

Halosaccion decapitatum Kützing, Tab. Phyc., XVI, 1866, p. 28, pl. 79, figs. a-h.

Japanese name. Benifukuronori (Okamura).

Habitat. Growing on rocks in the littoral and upper sublittoral belts, or on other algae, e.g., *Corallina pilurifera, Rhodymenia palmata, Halosaccion ramentaceum, Ptilota pectinata, Odonthalia aleutica* and *Rhodomela Larix.* W. coast : Sôni (T., '26, '27), Hishitoma (T., '26), Shiranushi (T., '35, '37). Aniwa Bay: Chishiya (T., '35), Nakashiretoko (Nagai, '32). E. coast : Minabetsu (Matsubara, '33), Higashishiraura (T., '31), Waare (Miyabe, '06), Chiriye (T., '35), Kaihyô-tô (T., '30, '32), Kitashiretoko (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Island ; Pacific coast of North America (from Alaska to Washington, or to ? Mexico).

Remarks. Most of our specimens, either saxicolous or epiphytic, which the writer refers to *H. saccatum*, are of an elliptico-obovate, subcoriaceo-membranaceous frond, which attenuates more or less abruptly at the base into a short stipe. They agree very well in the external appearance, with the figure of *Dumontia Hydrophora* Post. et Rupr. (1840, pl. 35, fig. C). The specimens from Higashi-shiraura, which are epiphytic on other algae, resemble closely *Dumontia fucicola* illustrated by Postels and Ruprecht (1840, pl. 35, fig. A) and *Halosaccion microsporum* var. *subsimplex* illustrated by Ruprecht (1851, pl. 15, fig, d). Their fronds are narrowly obconical or nearly cylindrical, more or less gradually attenuated toward the base, attaining the length of 24.5 cm. and the breadth of 3 or 3.5 cm. in the longest specimens. The tetrasporangia are scattered in the upper portion of the frond. The writer is strongly inclined to refer these specimens to a distinct species, which may be identical with *H. fucicola* (Post. et Rupr.) Rupr. But the extreme form represented by them seems to be linked by some intermediate ones with the typical form of *H. saccatum.* In the North and Middle Kuriles, *H. saccatum* has often been observed to grow "in a gregareous manner on the rocks between the tidal marks, so compactly as to leave no room between the contiguous fronds" (Yendo, 1901, p. 130 ; cf. also Yamada, 1935, p. 4 and Nagai, 1941, p. 201). The writer has once met with such a dense association of rather small individuals of this alga on littoral rocks at the Cape of Kitashiretoko.

As to the distribution of the present and the allied species of *Halosaccion* in the Pacific coast of North America, Setchell & Gardner (1903, p. 318) state : "*Halosaccion glandiforme*, in our extended sense (incl. *H. firmum*), ranges from the Sea of Ochotsk to the east and southeast along the coasts of North America down to the northwestern coast of Mexico." (Cf. also Kylin, 1931, p. 27). On the other hand, *H. microsporum* Rupr. was once reported by Gepp (1904, p. 163) from Weihaiwei, China. From these data is known that the geographical distribution of the genus *Halosaccion* is not restricted in the Arctic and Subarctic regions but extends to the North Temperate or even to the Subtropical.

2. *Halosaccion ramentaceum* (L.) J. Agardh

Sp. Alg., II, 2, 1852, p. 358 ; III, 1, (Epicr.), 1876, p. 260 ; Tokida & Ohmi, 1941, p. 432 ; Tokida, 1951, p. 167, figs. 31-35.

Fucus ramentaceus Linnaeus, Syst. Nat., ed. 12, II, 1765, p. 718, no. 54.

Dumontia ramentacea Greville, Alg. Brit., 1830, p. LXII.

Halymenia ramentacea Agardh, Syn., 1817, p. 37; Sp. alg., I, 2, 1822, p. 216 ; Syst., 1824, p. 245.

Ulva sobolifera Oeder, *in* Fl. Dan., VII, 1767, pl. 356 ; Enum. Pl. Fl. Dan., 1770, p. 14.

Dumontia sobolifera Postels et Ruprcht, Illustr. Alg., 1840, p. 19 ; Kützing, 1849, p. 719.

Halosaccion soboliferum Ruprecht, Tange Ochot. Meer., 1851, p. 268 ; Kützing, 1866, pl. 81, figs. d, e.

Fucus barbatus Gunnerus, Fl. Norveg., II, 1772, p. 129, no 1007 (*fide* Ruprecht).

Fucus tubulosus Lepechin, *in* Nov. Comm. Acad. Petrop., XIX. 1775, p. 476.

Dumontia tubulosa Postels et Ruprecht, Illustr. Alg., 1840, p. 19 et introd. p. II.

Halosaccion tubulosum Ruprecht, Tange Ochot. Meer., 1851, p. 272, 292.

non *Fucus soboliferus* Fl. Dan., 1792, pl. 1065 (= *Rhodymenia palmata* var. *sobolifera*).

Japanese name. Hoso-benifukuronori (Tokida).

Remarks. Descriptions and remarks of the Saghalien specimens referable to the present species and its forms are given in the writer's paper cited above.

Key to the forms

I. Frond narrow, up to 4 or 8 mm. broad, always much proliferated
  A. Proliferations 0.5-4 mm. broad, simple or scarcely branched
    1. Proliferations membranous .... 2a. f. *robustum*
    2. Proliferations cartilaginous .... 2b. f. *densum*
  B. Proliferations 5-8 mm. broad, membranous, more or less repeatedly subflabellato-di-polychotomous .... 2c. f. *ramosum*
II. Frond broad, up to 10 (-15) mm. broad, cartilaginous, often subflabellato-di-polychotomously branched
  A. Frond not proliferated .... 2d. f. *Tilesii*
  B. Frond much proliferated .... 2da. f. *Tilesii* subf. *proliferum*

2a. *Halosaccion ramentaceum* f. *robustum* Kjellman

Alg. Arct. Sea, 1883, p. 153, pl. 12, fig. 4, pl. 13, figs. 1, 2 ; Tokida, 1951, p. 168.

Habitat. Growing on rocks in the littoral and upper sublittoral belts, and often cast ashore. W. coast : Nayoshi (Miyabe, '06), Tomarioru (T., '30). Aniwa Bay : Merei (Miyabe, '06). E. coast : Sakaehama (Miyabe, '06), Higashishiraura (T., '31), Waare (Ishii, 19..), Kashiho (T., '31), Chiriye (Miyabe, '06).

Distribution. Sp. - Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Kamtschatka ; Alaska ; North Atlantic Ocean (Iceland, Faeröes, Norway) ; Arctic Ocean. Forma *robustum* - Hokkaido, Kuriles and Saghalien ; North Atlantic Ocean ; Arctic Ocean.

2b. *Halosaccion ramentaceum* f. *densum* Kjellman

Alg. Arct. Sea, 1883, p. 154 ; Tokida, 1951, p. 168.

Fucus ramentaceus Turner, Hist. Fuc., III, 1811, pl. 149.
Scytosiphon ramentaceus Lyngbye, Hydr. Dan., 1819, p. 61.
Halosaccion ramentaceum Areschoug, Alg. Scand. Exsicc., no. 205 (*fide* Kjellman).

Habitat. Growing on rocks in the littoral and sublittoral belts, often cast ashore. W. coast : Kushunnai (Miyabe, '06), Tomarioru (Miyabe, '06). Aniwa Bay : Nagahama (T., '35). E. coast : Kashiho (T., '31), Unetonnai (Miyabe, '06), Nairo (Miyabe, '06).

Distribution. Saghalien ; Iceland ; Arctic Ocean.

2c. ***Halosaccion ramentaceum*** f. ***ramosum*** Kjellman

Alg. Arct. Sea, 1883, p. 154, pl. 13, fig. 4 ; Tokida, 1951, p. 169, fig. 31.
Fucus tubulosus Lepechin, *in* Nov. Comm. Acad. Petrop., XIX. 1775, p. 476 (*α major* Kjellm., 1883, p. 154).

Habitat. Growing on rocks in the sublittoral belt. Aniwa Bay : Ôtomari (T., '29), Merei (Miyabe, '06), Tôbuchi-kô (T., '35, '41), Locality unknown (Miyake, '70).

Distribution. Hokkaido and Saghalien ; Atlantic coast of North America ; North Atlantic Ocean (Iceland and Faeröes) ; Arctic Ocean.

2d. ***Halosaccion ramentaceum*** f. ***Tilesii*** (Kjellm.) Tokida

Plate XXXII, A & B

Notes on some new or little known marine algae, (6), 1951, p. 170, figs. 32-33.
Halosaccion Tilesii Kjellman, Om Beringhafv. Algfl., 1889, p. 29, pl. 1, figs. 16-19 (f. *nuda*) ; Setchell & Gardner, 1903, p. 319 ; Saunders, 1901, p. 436.

Habitat. Growing on rocks in the littoral and upper sublittoral belts, and often found cast ashore. W. coast : Kushunnai (Miyabe, '06), Nishinotoro (T., '26). Aniwa Bay : Chishiya (T., '35), Ôtomari (Idzumiyama, '06), Yaman (Matsubara, '33).

Distribution. Saghalien ; Bering Island.

2d*a*. ***Halosaccion ramentaceum*** f. ***Tilesii*** subf. ***proliferum*** (Kjellm.) Tokida

loc. cit. 1951, p. 171, figs. 34-35.
Halosaccion Tilesii f. *prolifera* Kjellman, Om Beringhafv. Algfl., 1889, p. 29, pl. 1, fig. 20.

Habitat. Growing on rocks in the littoral and upper sublittoral belts, and often found cast ashore. W. coast : Pilevo (Miyabe, '06), Kushunnai (Miyabe, '06), Tomarioru (Miyabe, '06), Hishitoma (T., '26), Shiranushi (T., '32, Nishinotoro (Miyabe, '06 ; Morimoto, '25). Aniwa Bay : Chishiya (T., '35), Kochôbetsu (Matsubara, '33). E. coast : Sakaehama (T., '29), Waare (Miyabe, '06), Jimutaki (Miyabe, '06).

Distribution. Hokkaido and Saghalien ; Bering Island.

Family 19. Champiaceae Bliding

Stud. üb. Florideenordn. Rhodymeniales, 1928, p. 5 ; Okamura, 1936, p. 681.

35. **Lomentaria** Lyngbye

Hydr. Dan., 1819, p. 101 ; Okamura, 1936, p. 682.

Lomentaria hakodatensis Yendo

Nov. Alg., Jap., 1920, p. 6 ; Okamura, 1927, p. 12 ; 1936, p. 684 ; Yamada, 1928, p. 518 ; Inagaki, 1933, p. 41, Figs. 14, 15 ; Segawa, 1935, p. 84 ; Takamatsu, 1936, p. 31 ; 1938, p. 54 ; 1938*a*, p. 127 ; 1939*a*, p. 67, pl. 12, fig. 1 ; Tseng, 1938, p. 600 ; Yamada & Tanaka, 1944, p. 72.

Lomentaria sinensis Howe, Chin. Mar. Alg., 1924, p. 139, pl. 1, fig. 1 ; Tseng & Li, 1935, p. 221.

Japanese name. Kosuji-fushitsunagi (Okamura).

Habitat. Growing on other algae, e.g. *Sargassum* and *Corallina*. W. coast : Rakuma (T., '27), Hirochi (T., '26), Chinehira (T., '26), Honto (T., '26), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Ôtomari (Idzumiyama, '06).

Distribution. From middle to northern Honshû, Hokkaido, and Saghalien ; China.

Remarks. The present temperate species appears in the marine flora of southern Saghalien inhabiting only at those localities washed by the warm current. Both tetrasporiferous and cystocarpiferous plants have been met with in our specimens.

Order 8. CERAMIALES Oltmanns

Morph. u. Biol. d. Algen. ed. 1, I, 1904, p. 700 ; Okamura, 1936, p. 690.

Key to the Families

I. Cystocarps without a pericarp, naked or enveloped by branchlets. Thallus formed of monosiphonous filaments, naked or corticated .... 20. **Ceramiaceae**
II. Cystocarps enclosed by an ostiolate pericarp
  A. Thallus foliaceous, with or without a midrib .... 21. **Delesseriaceae**
  B. Thallus polysiphonous, usually cylindrical, occasionally flat .. 22. **Rhodomelaceae**

Family 20. Ceramiaceae (Bonnem.) Naegeli

Neu. Algensyst., 1849, p. 196 (*pro parte*) ; Okamura, 1936, p. 691.
Ceramieae Bonnemaison, *in* Jour. Phys., XCIV, 1822, p. 190.

Key to the genera

I. Frond composed of ecorticate monosiphonous filaments, sometimes partly corticated by rhizoidal filaments .... 36. *Antithamnion*
II. Frond corticated by small subparenchymatous cortical cells, wholly over the monosiphonous axis, or at least at its nodes
  A. Frond cylindrical, di-, tri-, or tetrachotomously branched
    1. Ramification always dichotomous ; frond-base a conical disc composed of rhizoidal

cells ; rhizoidal cells present in the cortex .... 39. *Campylaephora*
2. Ramification not as above ; frond-base consisting of free rhizoids ; rhizoidal cells absent from the cortex .... 38. *Ceramium*
B. Frond compressed, pectinato-pinnately branched .... 37. *Ptilota*

36. **Antithamnion** Naegeli

Neu. Algensyst., 1847, p. 200 ; Okamura, 1936, p. 704.

Key to the species

I. Frond ecorticated ; glandular cells present
 A. Each cell in the main branches with two opposite branchlets ; glandular cell rests on two or three cells
  1. Branchlets semi-pinnately pectinate on the upper side ; ultimate ramuli with tapering, but not acute, tips ; chromatophore disc-shaped ...... 1. *A. sparsum*
  2. Branchlets pinnately pectinate on both sides ; ultimate ramuli with tapering, sometimes acute, tips ; chromatophore band-shaped in larger cells .... 2. *A. nipponicum*
 B. Each cell in the main branches usually with whorls of four branchlets ; ultimate ramuli with acute tips ; glandular cell rests on a single cell .... 3. *A. Corallina*
II. Frond corticated below by intramatrical rhizoidal filaments issued from the basal cell of branches and branchlets ; chromatophore band-shaped in larger cells ; glandular cell absent .... 4. *A. corticatum*

1. ***Antithamnion sparsum*** Tokida

in Trans. Sapp. Nat. Hist. Soc., XII, 2 & 3, 1932*a*, p. 105, text-figs. 1-2, pl. 3, fig. a ; Okamura, 1936, p. 706.

Japanese name. Kinuito-yotsugasane (Tokida).

Habitat. Growing on the shells of *Ostrea* at about 4–5 meters depth. Aniwa Bay : Tôbuchi-ko (Matsubara, '30 ; T., '30).

Distribution. Endemic.

Remarks. As stated in the writer's paper cited above (p. 108), *Antithamnion sparsum* stands close by *A. defectum* Kylin. In the nature of the glandular cells, they fall together also under the same category. So far as the writer has studied, we can distinguish among the known species of *Antithamnion* at least three types of the glandular cells with respect to their location on the plant body. These types are named and defined as follows :

1. Lateral-type : A single glandular cell rests laterally on a single segment of pinnae and pinnulae, at about the middle portion of the segment when it is short but near the upper end of the segment when it is longer ; the segment which bears the glandular cell is solitary or sometimes seriate. Herein belong many species such as *A. Corallina* (Rupr.) Kjellm., *A. Plumula* (Ellis) Thur., *A. glanduliferum* Kylin, *A. Miharai* Tokida, etc. *A. ramulosum* (Reinsch) Kylin, which is characterized to have seriate glandular cells in the subapicall portions of the pinnae and the pinnulae, may

also belong here.

2. Scaphoid-type : A single glandular cell rests laterally on two or three apical and subapical segments of the specialized short pinnulae which sit on the upper side of the lower segments of the pinnae. Herein belong *A. cruciatum* (Ag.) Naegeli, *A. defectum* Kylin, *A. setaceum* Gardn., *A. sparsum* Tokida, and *A. nipponicum* Yamada et Inagaki.

3. Terminal-type : Glandular cells are terminal on the specialized (fructiferous) pinnulae or occupying the position of a small pinnula. Herein belong *A. densiusculum* Gardn. and *A. Baylesiae* Gardn.

The glandular cell of the Scaphoid-type reminds one of the monosporangia of *Scaphospora*, a brown algal genus in the Fam. Tilopteridaceae. In *A. defectum*, it rests usually on two segments, apical and subapical, of the specialized short pinnulae (cf. Kylin, 1925, fig. 27 b), while it rests, in *A. sparsum*, usually on three segments, apical and subapical or wholly subapical (cf. Tokida, 1932, text-figs. 1 e & 2 a). *A. nipponicum* bears also glandular cells of the *Scaphoid-type* which rest on two or three segments, apical and subapical or more frequently basal, of the normal, usually rather short but by no means specialized, pinnulae (cf. Yamada & Inagaki, 1935, figs. 2 D, 3 A).

The tetrasporangia of *A. defectum* is on a one- or two-celled pedicel (cf. Kylin, 1925, fig. 27 a, b), while those of *A. sparsum* are sessile or pedicellate, in the latter case sitting on usually one-celled, but very rarely two-celled, pedicels. Secondary tetrasporangia are frequently found in the latter species to attach to the pedicel of the primary one by means of their own one-celled pedicel. They can grow large after the fall of the primary one and get at last to have apparently two-celled pedicels.

2. ***Antithamnion nipponicum*** Yamada et Inagaki

in Sci. Pap. Inst. Algol. Res., Hokk. Imp. Univ., I, 1, 1935, p. 37, text-figs. 1-3 ; Okamura, 1936, p. 706 ; Takamatsu, 1938, p. 57 ; 1939, p. 68.

Acrothamnion pulchellum Yendo (*non* J. Agardh), Notes Alg. New to Japan, V, 1916, p. 262 ; Yamada, 1928, p. 528, fig. 22 a, b.

Antithamnion applicitum Yendo (*non* J. Agardh), Notes Alg New to Japan, VII, 1917, p. 206, fig. 2 (*fide* Yamada & Inagaki, 1935, p. 37-38).

Japanese name. Futatsu-gasane (Yamada & Inagaki).

Habitat. Epiphytic on the thallus of *Amphiroa cretacea,* which grows on the vertical surface of rocks facing to the open sea, just beneath the low-water mark, and epizoic on *Potamilla myriops* Marenzeller. W. coast : Kaiba-tô (T., '43).

Distribution. Northern Honshû, Hokkaido and Saghalien.

Remarks. A careful search for the present minute alga on the shells of *Mytilus* or on the thallus of a calcareous alga at the margin of a reef exposed to the surf will usually prove successful in the summer and autumnal months in the Japan Sea coast of Hokkaido. So far as the writer could have studied, it is distributed in the Japan

Sea as far north as the Island of Kaiba-tô. The chromatophore of this species is as a rule in numerous slender bands, although it may sometimes be in numerous minute discs in smaller segments of the branchlets.

3. *Antithamnion Corallina* (Rupr.) Kjellman

Algenveg. Murm. Meer., 1877, p. 24 ; Tokida, 1932, p. 23, text-figs. 7 8, pl. 3, figs. b-d, pl. 8, fig. a ; 1932*a*, p. 12, 17 ; Okamura, 1936, p. 705 ; Yamada, & Tanaka, 1944, p. 73.

Callithamnion Corallina Ruprecht, Tange Ochot. Meer., 1851, p. 341, pl. 18, figs. n-q.

Antithamnion boreale f. *corallina* Kjellman, Alg. Arct. Sea, 1883, p. 180, pl. 16, figs. 4-5 ; De Toni 1903, p. 1402 ; Sinova, 1930, p. 120.

A. Plumula var. *boreale* f. *corallina* Börgesen, Mar. Alg. Faeröes, 1902, p. 386, fig. 59.

Japanese name. Karafuto-yotsugasane (Okamura).

Habitat. Epiphytic on other algae, e. g., *Ptilota asplenioides*, *P. pectinata*, *Pseudophycodrys Rainosukei*. E. coast : Kaihyô-tô (T., '30, '32, '35).

Distribution. Hokkaido and Saghalien; Ochotsk Sea; North Atlantic Ocean (Faeröes); Arctic Ocean.

Remarks. The description of the specimens from Kaihyô-tô is given in the first one of the writer's papers cited above. In the latter paper, the writer has reported the discovery of the present species on an athecate hydroid attached to the shells of *Pecten yezoensis* hauled up probably at the entrance of Muroran Harbour, Hokkaido.

4. *Antithamnion corticatum* Tokida

in Trans. Sapp. Nat. Hist. Soc., XII, 2 & 3, 1932*a*, p. 108, text-figs. 3-5, pl. 3, figs. b-d ; Okamura, 1936, p. 708.

Japanese name. Benihanemo (Tokida).

Habitat. Growing on the shells of *Ostrea* and on the body of *Styela*. at the depth of about 4–5 meters. Aniwa Bay : Tôbuchi-ko (Matsubara, '30 ; T., '30).

Distribution. Hokkaido and Saghalien.

Remarks. This is quite a characteristic species with a beautiful feathery appearance to the naked eye, hence the Japanese name has been given. It belongs to a distinct group of species in *Antithamnion* differing from the other three mentioned above in the absence of glandular cells. *A. Shimamuranum* Nagai is also characterized in the absence of glandular cells (cf. Nagai, 1941, p. 208). The abundance or paucity of glandular cells, however, is not always constant in a species but may be fairly variable in accordance with the age of individuals and the habitat. According to Rosenvinge (1923/24, p. 370), glandular cells may be present or wanting in *A. boreale* (Gobi) Kjellm., and f. *baltica* Reinke of that species is considered to be distinct from the type form chiefly by their absence.

The writer once observed an *Antithamnion* epizoic on *Chelyosoma siboja* Oka collected by Hikita and Nojima at Zenibako, Prov. Shiribeshi, Hokkaido, on the 25th of January 1935. It appears in general aspects to be referable to the present species.

37. **Ptilota** C. Agardh

Syn. Alg. Scand., 1817, p. XIX ; Okamura, 1936, p. 727.

Key to the species

I. Simple pinnulae usually densely serrate or pectinate on both margins
A. Involucres of the cystocarp linear, simple, entire or serrate on the margins .... 1. *P. pectinata*
B. Involucres of the cystocarp foliose, pinnately branched .... 2. *P. californica*
II. Simple pinnulae entire or slightly serrate on the margins ; involucres of the cystocarp linear, slightly pinnate .... 3. *P. asplenioides*

1. ***Ptilota pectinata*** (Gunn.) Kjellman

Alg. Arct. Sea, 1883, p. 174, pl. 15, figs. 1-6 ; 1889, p. 32 ; Tokida, 1932, p. 21 ; Yamada, 1935, p. 24 ; Okamura, 1936, p. 728 ; Kawabata, 1936, p. 211 ; Sinova, 1938, p. 67 ; Takamatsu, 1938*a*, p. 132 ; Nagai, 1941, p. 211 ; Yamada & Tanaka, 1944, p. 73 (f. *litoralis* Kjellm.).

Fucus pectinatus Gunnerus, Fl. Norv., II, 1772, p. 122.

Ptilota serrata Kützing, *in* Bot. Zeit., 1847, p. 36,.

P. plumosa var. *serrata* Kützing, Sp. Alg., 1849, p. 670 ; 1862, pl. 55, figs. e, f.

Plumaria pectinata Ruprecht, Tange Ochot. Meer., 1851, p. 334 ; Taylor, 1937, p. 329.

Japanese name. Kushi-benihiba (Okamura).

Habitat. Growing on rocks and other algae in the lower littoral and sublittoral belts. W. coast : Ushiro (Miyabe, '06), Kushunnai (Miyabe, '06), Tomarioru (Miyabe, '06 ; T., '30), Rakuma (Ishii, 19.. ; T., '27), Honto (Morimoto, '25), Hishitoma (T., '26), Shiranushi (T., '27), Nishinotoro (Morimoto, '25 ; T., '26, '35), Kaiba-tô (Miyake, '06 ; Morimoto, '30, '33). Aniwa Bay : Chishiya (Nakamura, '06 ; T., '35, '37), Nobori (T., '35, '37), Merei (Miyabe, '06), Otai (Miyabe, '06), Shiraiwa (T., '32), Nakashiretoko (Miyabe, '33). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Sakaehama (Miyabe, '06 ; T., '29), Higashisôya (T., '29), Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35 ; Nakashima '32, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of N. America from Alaska to ? Washington ; Atlantic coast of N. America ; Arctic Ocean ; Faeröes ; North Sea.

Remarks. This is one of the commonest seaweeds in southern Saghalien, and is frequently found cast ashore in considerable amount. It is often infected by several kinds of epiphytic algae such as *Phycodrys fimbriata*, *Euthora fruticulosa*, etc.

The simple pinnulae of this species are mostly smaller than the compound ones, but in the apical portion of the branches they are usually larger as in *P. asplenioides*. They are as a rule densely serrate or pectinate on both margins or sometimes merely on the outer (under) margin, while in the just mentioned species they are mostly entire, but sometimes slightly serrate on both margins or more frequently on the upper margin close to their axil (cf. Okamura, 1909, pl. 48, figs. 6 & 7).

2. ***Ptilota californica*** Ruprecht

in Harvey, Ner. Bor.-Amer., II, 1853, p. 222 ; Tokida, 1932, p. 22, pl. 3, fig. a ; Okamura, 1936, p. 728 ; Sinova, 1938, p. 68.

Plumaria californica Ruprecht, mscr. (*sec.* Cramer).

Pterota californica Cramer, Ceram, 1863, p. 49, pl. 3, fig. 7, pl. 6, fig. 6, pl. 8, figs. 1–3.

Japanese name. Kashiwaba-benihiba (Okamura).

Habitat. Cast ashore. E. coast : Kaihyô-tô (Kubo, '06).

Distribution. Saghalien ; Japan Sea coast of Siberia ; Pacific coast of N. America (British Columbia and California).

Remarks. The illustrations of the present species given by Okamura in his Icones of Japanese Algae, vol. I, no. 10, pl. 49, figs. 1–8 are no doubt drawn from a specimen distributed by R. Kubo who made a rich collection of marine algae at the Islet of Kaihyô-tô (Robben Island) in 1906. One of the specimens of *Ptilota* distributed by the same collector and deposited in the herbarium of our University agrees in general aspect with the Plate 49, fig. 1 of the Icones. It bears no cystocarps but antheridia, so that the writer's identification cannot help to be unsatisfactory. It is to be noted that the present Californian species was not enumerated by Kylin in his work entitled "Californische Rhodophyceen" who studied several collections including the herbarium of J. Agardh.

3. ***Ptilota asplenioides*** (Turn.) Agardh

Sp. Alg., I, 2, 1822, p. 387 ; Tokida, 1932, p. 22, pl. 9, figs. b, c ; Sinova, 1933, p. 38 ; 1938, p. 69 ; Okamura, 1936, p. 729, fig. 348 ; Yamada, 1934, p. 349 ; 1935, p. 24 ; Kawabata, 1936, p. 211 ; Nagai, 1941, p. 210 ; Yamada & Tanaka, 1944, p. 73.

Fucus asplenioides Esper, Icon. Fucor., 1802, p. 78, pl. 147 ; Turner, Hist. Fucor., I, 1808, p. 139, pl. 62.

Ptilota plumosa α asplenioides Agardh, Syn. Alg. Scand., 1817, p. 39.

Rhodocallis asplenioides Kützing, Sp. Alg., 1849, p. 671 ; 1862, pl. 58.

Plumaria asplenioides Ruprecht, Tange Ochot. Meer., 1851, p. 334.

Pterota asplenioides Cramer, Ceram,. 1863, p. 46, pl. 7, figs. 6–10.

Japanese name. Katawa-benihiba (Okamura).

Habitat. Growing on rocks and other algae in the lower littoral and sublittoral belts. W. coast : Tomarioru (Miyabe, '06), Yenchishi (Miyabe, '06), Sôni (T., '26, '27), Hishitoma (T., '26), Shiraunshi (T., '37), Nishinotoro (Morimoto, '25 ; T., '35). Aniwa Bay : Chishiya (Nakamura, '06), Merei (Miyabe, '06). E. coast : Hota (T., '32), Rorei (T., '32), Sakaehama (Miyabe, '06 ; T., '29), Maguntan (Miyabe, '06), Unetonnai (Miyabe, '06), Chiriye (T., '35), Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35 ; Nakashima, '32, '33), Kitashiretoko (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of N. America from Alaska to

Puget Sound ; Arctic Ocean (Siberia).

Remarks. *Ptilota asplenioides* is as widely spread in southern Saghalien and the Kuriles as *P. pectinata*, but it does not invade as that species into the warm current regions of Hokkaido, being distributed only along the cold current from Prov. Hidaka north-eastward. On the American side of the North Pacific, it is also an inhabitant of subarctic regions, being reported principally from Alaska, but once also from Puget Sound (Bailey & Harvey, 1862, p. 163 ; cf. Setchell & Gardner, 1903, p. 340), although Kylin (1925, p. 3–4) has not mentioned it in his list of the species of Red algae from that region. From the northern part of the Ochotsk Sea, it has not been reported by anyone since Ruprecht suggested its absence in that sea (1851, p. 335). The writer was once presented by Mr. Z. Tsutsui with a single specimen of this alga collected in July 1935 at Palanski (Palana) on the Ochotsk Sea coast of Kamtschatka Peninsula.

As stated by the writer in his previous paper cited above, one can distinguish at least three forms among the specimens of this species from southern Saghalien. The most common form that agrees very well with the figure given by Okamura (1909, pl. 48, fig. 1) is to be considered as typical of the species (forma *typica*). The second form (forma *alternans*) differs from the typical in having somewhat larger pinnulae and in being frequently destitute of compound-pinnulae especially in the upper part of the branches (Tokida, 1932, pl. 8, fig. c). It is represented by some fertile specimens collected at Kaihyô-tô, Kitashiretoko and Yôman. The third form (forma *latifolia*) is characterized by the large foliose simple pinnulae, up to 2 cm. long and 4 mm. broad in dried state (Tokida, 1923, pl. 8, fig. b). It is found among the specimens from Shiranushi ('37), Hota, Kaihyô-tô, Kitashiretoko and Yôman. It appears to be of a two years old frond, the old axis of which being clothed with newly issued submembranous light-colored branches. All of the specimens, except that from Hota, are sterile. These forms are, however, more or less closely linked with each other by some intermediate forms, so that the writer dares not, at present, treat them as distinct forms. The formal names mentioned above are no more than provisional.

38. **Ceramium** (Roth) Lyngbye

Hydr. Dan., 1819, p. 117 ; Okamura, 1936, p. 735.
Ceramium Roth, Catal. Bot., I, 1797, p. 146, II, 1800, p. 161 (*pro parte*).

Key to the species

I. Frond corticate only at the nodes ; cortical bands very narrow, consisting of 1-3 (usually 2) transversal rows of cells . . . . 1. *C. cimbricum*

II. Frond corticate throughout

- A. Frond di-, tri-, or tetrachotomous . . . . 2. *C. Kondoi*
- B. Frond pinnate . . . . 3. *C. japonicum*

1. *Ceramium cimbricum* Petersen

in Rosenvinge, Mar. Alg. Denm., III, 1923/24, p. 378, figs. 318, 319 ; Tokida, 1948, p. 100, figs. 10–28 ; Nakamura, 1954, p. 18, fig. 1 (1–10), fig. 5 (1), fig. 17 (1–2), fig. 18 (11–12).

Japanese name. Matsubara-igisu (Tokida).

Habitat. Epiphytic on the thallus of young *Laminaria* growing on *Ahnfeltia plicata* var. *tobuchiensis* or directly on that of the latter (in Lake Tôbuchi), or epizoic on *Potamilla myriops* Marenzeller (at Kaiba-tô). W. coast : Kaiba-tô (T., '43). Aniwa Bay : Tôbuchi-ko (T., '29 ; Matsubara, '30).

Distribution. Hokkaido ; Saghalien ; Denmark.

Remarks. The writer's paper cited above was the first report on the occurrence of the present delicate species outside its type locality in Denmark. Dr. T. Nakamura of the Institute of the Algological Research at Muroran, Hokkaido, has told the writer that this species was also found not rarely in Hokkaido.

2. *Ceramium Kondoi* Yendo

Novae Alg. Jap. Decas I–III, 1920, p. 9 ; *emend.* Nakamura, 1950, p. 160, figs. 4–5.

Ceramium rubrum Okamura (*non* Agardh), Nippon Sôrui-meii, ed. 1, 1902, p. 82 (*ex parte*) ; 1916, p. 99 ; 1927, p. 14 ; 1936, p. 738.

Japanese name. Igisu.

Remarks. For the identification of the present species the writer follows the opinion of Dr. T. Nakamura, who kindly examined the Saghalien specimens of *Ceramium* sent to him.

Key to the forms

I. Main branches usually dichotomous, rarely trichotomous ; supporting rhizoid absent
  A. Cortex very thin, so that the axis appears to be banded in surface view .... b. f. *ambiguum*
  B. Cortex thin, but not as above ; main branches bearing a branchlet at each axil in opposite directions by turn .... a. f. *typicum*
II. Main branches usually trichotomous, often tetrachotomous ; supporting rhizoids present ; cortex thick .... c. f. *trichotcmum*

2a. *Ceramium Kondoi* f. *typicum* Nakamura

New *Ceramiums* and *Campylaephoras* from Japan, 1950, p. 163,

Habitat. Growing on rocks and other algae in the littoral and sublittoral belts. W. coast : Tomarioru (T., '30), Rakuma (T., '27), Hirochi (T., '26), Honto (Morimoto, '25), Hishitoma (T., '32), Shiranushi (T., '32), Nishinotoro (T., '26), Kaiba-tô (Morimoto, '33, '37). Aniwa Bay : Nobori (T., '26, '35, '37), Ôtomari (T., '26). E. coast : Hota (T., '32), Sakaehama (T., '29), Higashishiraura (T., '31), Mototomari (T., '31), Kashiho (T., '31), Chiriye (T., '30), Kitashiretoko (T., '35), Kaihyô-tô (T., '30), Yôman

(T., '35).

Distribution. Hokkaido and Saghalien.

2b. ***Ceramium Kondoi* f. *ambiguum*** Nakamura

loc. cit., 1950, p. 164.

Habitat. Growing on rocks and other algae in the littoral and sublittoral belts. E. coast : Rorei (T., '32), Chiriye (T., '30).

Distribution. Hokkaido and Saghalien.

2c. ***Ceramium Kondoi* f. *trichotomum*** Nakamura

loc. cit., 1950, p. 164.

Habitat. Growing on rocks and other algae in the littoral and sublittoral belts. W. coast : Rakuma (T., '27), Honto (T., '26). Aniwa Bay : Tôbuchi-ko (T., '41).

Distribution. Hokkaido and Saghalien.

3. ***Ceramium japonicum*** Okamura

in Bot. Mag., Tokyo, X, 111, 1896, p. 38, pl. 3, figs. 24-28 ; 1902, p. 82 ; 1916, p. 100 ; 1914, p. 91, pl. 124, figs. 14-22 ; 1927, p. 14 ; 1936, p. 742 ; De Toni, 1903, p. 1459 ; 1924, p. 508 ; Cotton, 1906, p. 370 ; Collins, 1919, p. 206 ; Howe, 1924, p. 141 ; Takamatsu, 1936, p. 35 ; 1938, p. 59 ; 1938*a*, p. 130 ; 1939*a*, p. 69 ; Nagai, 1941, p. 215 ; Yamada & Tanaka, 1944, p. 74.

Japanese name. Hane-igisu (Okamura).

Habitat. Epiphytic on other algae, e.g., *Amphiroa cretacea*, *Corallina pilulifera*, *Chondrus pinnulatus*, *Ptilota pectinata*. etc. W. coast : Hirochi (T., '27). Aniwa Bay : Chishiya (T., '35), Nobori (T., '35).

Distribution. Honshû, Hokkaido, Kuriles, Saghalien and Korea ; China.

Remarks. This species of *Ceramium* is characterized by beautiful reddish color, pinnate branching, and nearly straight branch tips of short articulations tapering abruptly toward the apices into the growing point. Under the microscope, the tips of young lateral branchlets as well as those of some main branches are found to be slightly curved inward. As compared with the plant commonly found at Oshoro in Hokkaido, our Saghalien specimens are of somewhat a thinner and smaller frond, measuring at most ca. 5 cm. in height. They are, however, provided with abundant mature tetrasporangia.

39. **Campylaephora** J. Agardh

Sp. Alg., II, 1851, p. 149 ; *emend.* Nakamura, 1950, p. 165.

Key to the species

I. Sickle-shaped portions of the frond present .... 2. *C. hypnaeoides*
II. Sickle-shaped portions of the frond absent .... 1. *C. crassa*

1. ***Campylaephora crassa*** (Okamura) Nakamura

loc. cit., 1950, p. 166, figs. 6–7.
Ceramium crassum Okamura, Icon. Jap. Alg., VI, 1930, p. 26, pl. 269. figs. 1–10.

Japanese name. Futo-igisu (Okamura).

Remarks. For the identification of the present species the writer owes to Dr. T. Nakamura. The just mentioned author has segregated four forms in this species as shown in the following key, of which three are represented in our region.

Key to the forms

I. Cortex very thin, with less developed rhizoidal cells .... 1a. f. *cymosa*
II. Cortex not as above
  A. Branches (intetrasporic plant) elongated .... 1b. f. *elongata*
  B. Branches not as above
    1. Proliferous branchlets usually scarce, sometimes lacking, if present always secundly seriate mainly on the adaxial side of branches .... f. *typica*
    2. Proliferous branchlets on nearly every segment and on all sides of branches .. .. 1c. f. *borealis*

1a. ***Campylaephora crassa*** f. ***cymosa*** (Okamura) Nakamura

loc. cit., 1950, p. 168, fig. 7.
Ceramium cymosa Okamura, *in* Herb. (*ex parte*) (*fide* Nakamura).

Habitat. Growing on *Phyllospadix* and algae in the sublittoral belt. W. coast Rakuma (T., '27), Hirochi (T., '27).

Distribution. Honshû, Hokkaido and Saghalien.

1b. ***Campylaephora crassa*** f. ***elongata*** Nakamura

loc. cit., 1950, p. 169, fig. 6, a–e.

Habitat. Growing on *Rhodomela Larix*, other algae, and *Phyllospadix.* W. coast : Hirochi (T., '27),

Distribution. Japan Sea coast of Honshû ; Ochotsk Sea coast of Hokkaido ; Saghalien.

1c. ***Campylaephora crassa*** f. ***borealis*** (Okamura) Nakamura

loc. cit., 1950, p. 170.
Ceramium boreale Okamura, in Herb. (*fide* Nakamura).

Habitat. Growing on *Rhodomela Larix* and other various algae. W. coast :

Hirochi (T., '26), Honto (T., '26), Nishinotoro (T., '26).

Distribution. Hokkaido and Saghalien.

2. ***Campylaephora hypnaeoides*** J. Agardh

Sp. Alg., II, 1, 1851, p. 150, III, 1, (Epicr.), 1876, p. 108 ; Martens, 1866, p. 117 ; Suringar, 1870, p. 28, pl. 14, figs. 1-4 ; Hariot, 1891, p. 229 ; De Toni, 1903, p. 1503 ; 1924, p. 526 ; 1895, p. 36 ; Okamura, 1902, p. 83 ; 1916, p. 100 ; 1910, p. 99, pl. 79 ; Collins, 1919, p. 206 ; Sinova, 1938, p. 67 ; Nakamura, 1950, p. 170, fig. 6, f.

Ceramium hypnaeoides (J. Ag.) Okamura, *in* Bot. Mag., Tokyo, XLI, 484, 1927, p. 366, figs. A, B, fig. in p. 368 ; 1927*a*, p. 14 ; 1936, p. 740, fig. 354 ; Kawabata, 1936, p. 210 ; Takamatsu, 1936, p. 35 ; 1938, p. 58 ; 1938*a*, p. 130 ; 1939*a*, p. 69, pl. 13, fig. 3 ; Nagai, 1941, p. 213 ; Yamada & Tanaka, 1944, p. 74.

Ceramium hamatum Cotton, Mar. Alg. fr. Corea, 1906, p. 370.

Japanese name. Egonori or Ego.

Habitat. Epiphytic on other algae, e. g., *Cystophyllum geminatum*, *Sargassum confusum*, *Chondrus pinnulatus*, *Rhodomela Larix*, etc. W. coast : Rakuma (T., '27), Muitomari (Ishii, 19..), Nishinotoro (Morimoto, '25), Kaiba-tô (Miyake, '06). Aniwa Bay : Chishiya (T., '37) Nobori (T., '26, '35, '37), Ôtomari (Idzumiyama, '06 ; T., '29). E. coast : Airô (T., '27): Chiriye (T., '35).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido, Kuriles, Saghalien ; Korea ; China ; Japan Sea coast of Siberia.

Remarks. The specimens here referred to are all rather young and sterile. They agree very well with the figure of a young plant given by Okamura (1910) in his Icones of Japanese Algae, II, 6, pl. 79, fig. 1, and are referable to f. *typica,* one of the two formae described by Nakamura (1950, p. 171). The cystocarps of this species had been unknown to us (cf. Okamura, 1910, p. 100) until it was discovered and described by Okamura in 1927.

Family 21. Delesseriaceae (Naegeli) Schmitz

in Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 406 ; Okamura, 1936, p. 749.

Key to the genera

I. Procarps formed on the midrib of the fertile blade ; apical growing point with laterally jointed primary apical cells ; no intercalary division in the primary cell-row ; descending rhizoids present in main ribs (Subfam. 1. **Delesserieae**)
  A. Apical cells of the 3rd order series of the cells all attain to the margin of the frond (**Hypoglossum**-group)
    1. Blade monostromatic except the midrib .... 39. *Branchioglossum*
    2. Blade thoroughly polystromatic .... 40. *Laingia*
  B. Not all of the apical cells of the 3rd order series of the cells attain to the margin of the frond (**Membranoptera**-group) .... 41. *Membranoptera*

II. Procarps scattered over the fertile part of the frond (Subfam. 2. **Nitophylleae**)
  A. Apical growing point with laterally jointed primary apical cells ; intercalary division

in the primary cell-row present
1. Descending rhizoids present in main ribs (**Pseudophycodrys**-group) ...... 42. *Pseudophycodrys*
2. Descending rhizoids absent
   a. Branching from the margin of the frond (**Phycodrys**-group) .... 43. *Phycodrys*
   b. Branching from the midrib (**Yendonia**-group) .... 44. *Hypophyllum*

B. Apical growing point without laterally jointed apical cells; intercalary division present; descending rhizoid absent; branching from the margin of the frond
1. Microscopic veins absent; gonimoblast with seriate carpospores (**Myriogramme**-group)
   a. Parasitic on *Phycodrys* .... 46. *Polycoryne*
   b. Not parasitic .... 45. *Myriogramme*
2. Microscopic veins present; gonimoblast with end-sitting carpospores (**Cryptopleura**-group) .... 47. *Acrosorium*

Subfamily 1. Delesserieae (Kütz.) Schmitz

Syst. Uebers. Florid., 1889, p. 11; Kylin, 1924, p. 5; Okamura, 1936, p. 757.
Delesserieae Kützing, Phyc. Gen., 1843, p. 442 (*pro parte*); 1849 p. 867 (*excl.* gen. fere omn.).

Group 1. Hypoglossum-group

Kylin, *loc. cit.*, 1924, p. 6.

40. **Branchioglossum** Kylin

Stud. üb. Delesseriac., 1924, p. 8; Okamura, 1936, p. 759.

Branchioglossum nanum Inagaki

in Sci. Pap. Inst. Algol. Res., Hokk. Imp. Univ., I, 1, 1935, p. 45, fig, 3; Okamura, 1936, p. 760; Tokida, 1948, p. 103.

Japanese name. Hime-murasaki (Inagaki).

Habitat. Epizoic on *Laonome* sp. W. coast; Kaiba-tô (T., '43).

Distribution. Hokkaido and Saghalien.

Remarks. The occurrence of this minute red alga in Saghalien was reported by the writer in his paper cited above.

41. **Laingia** Kylin

Delesseriac. Neu-Seelands, 1929, p. 5; Okamura, 1936, p. 763.

Laingia pacifica Yamada

Notes Some Jap. Alg., III, 1932, p. 122; Tokida, 1934*a*, p. 22; Kawabata, 1936, p. 211; Okamura, 1936, p. 763, fig. 366; Nagai, 1941, p. 216; Yamada & Tanaka. 1944, p. 74.
Delesseria crassifolia Okamura (*non* Ruprecht), Icon. Jap. Alg., IV, 4, 1921, p. 72, pl. 168.

Pseudophycodrys pacifica Yamada, Notes Some Jap. Alg., I, 1930, p. 32, pl. 2, fig. 1.

Japanese name. Konoha-nori (Okamura).

Habitat. Found washed ashore. W. coast: Nayoshi (Miyabe, '06), Ushiro (Nakamura, '06), Kushunnai (Miyabe, '06), Rakuma (T., '30), Hirochi (T., '27), Tarantomari (T., '26), Honto (Morimoto, '25), Hishitoma (T., '27), Shiranushi (T., '27), Kaiba-tô (Morimoto, '37). Aniwa Bay: Nobori (T., '26), Otai (Miyabe, '06), Naion (Miyabe, '06). E. coast: Hota (T., '32), Minabetsu (Matsubara, '33), Airô (T., '27), Higashishiraura (T., '31), Kashiho (T., '31), Higashisôya (T., '29), Nairo (Miyake, '06), Kaihyô-tô (T., '30, '32, '35; Nakashima, '32, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles, Saghalien and Korea; Penjinskii Bay (Cape Povorotnuii; Okamura, 1921, p. 74, 1936, p. 765); Kamtschatka (*fide* Okamura, 1936, p. 765).

Remarks. That the present alga is related most closely to the type species of the genus *Laingia*, *L. Hookeri* Kylin, was first pointed out by Kylin (cf. Yamada, 1932, p. 123). So far as the writer is aware, no one has ever described either tetrasporophyte or male plant for the present species (cf. Okamura, 1921, p. 73, 1936, p. 764). The writer was fortunate enough to be able to observe tetrasporangia in the specimens cellected by the late Mr. R. Kanno at Horoizumi, Prov. Hidaka in Hokkaido, in December 1934. They are found scattered irregularly over the surface of the blade. In this respect, *L. pacifica* agrees also with *L. Hookeri* but not with *Yendonia crassifolia* (Ruprecht) Kylin, in which the sporangia are formed on special leaflets given off along the midribs and side-veins (Ruprecht, 1851, p. 232; Kylin, 1924, p. 53). The male plant has been met with in the specimens from Kitashiretoko and Yôman, collected in the end of July 1935. The spermatangial sori are formed just within the margin of the blade and spread gradually downwards to occupy the larger part of the surface of the blade. The glandular cells such as we find in *Phycodrys rubens* are not always present in our specimens of *Laingia pacifica*, but are rarely found to be fairly abundant in some specimens.

The occurrence of *L. pacifica* in the Kamtschatka Peninsula was first mentioned by Okamura, who added "the eastern coast of Kamtschatka" to the list of the localities of the species.

Group 2. Membranoptera-group

Kylin, Stud. üb. Delesseriac., 1924, p. 14.

42. **Membranoptera** Stackhouse

Tent. Mar. Crypt., 1809, p. 85; Kylin, 1924, p. 15; Okamura, 1936, p. 765.

Membranoptera robbeniensis Tokida

Mar. Alg., Robben Isl., 1932. p. 25, text-figs. 9, 10, pl. 4, figs, a, b ; 1943, p. 21, figs. a-d ; Okamura, 1936, p. 765, fig. 367.

Japanese name. Hoso-beniyabanegusa (Tokida).

Habitat. Epiphytic on other algae, e. g., *Rhodophyllis dichotoma*, *Ptilota asplenioides*, *P. pectinata*, *Odonthalia aleutica*, etc., and growing on the coenosarc of a *Hydrozoa*. E. coast : Sakaehama (Ikari-*fide* Okamura, 1936, p. 766), Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35 ; Nakashima, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Endemic.

Remarks. The present beautiful red alga is known only from the eastern coast of southern Saghalien. It appears to be within the bounds of possibility that Ruprecht (1851, p. 239) has confused the present alga with his *Delesseria Baerii* (Post. et Rupr.) Rupr. when he identified his Ochotsk Sea plant to that Arctic species. The thallus of the typical *Delesseria Baerii* (=*Pantoneura Baerii* (Post. et Rupr.) Kylin, 1924, p. 8) differs from that of a *Membranoptera* in lacking entirely lateral monostromatic membrane.

Subfamily 2. Nitophylleae (Naeg.) Schmitz

Syst. Uebers. Florid., 1889, p. 11 ; Okamura, 1936, p. 770.
Nitophylleae Naegeli, Neuere Algensyst., 1847 (excl. gen.).

Group 3. Pseudophycodrys-group

Kylin, Stud. üb. Delesseriac., 1924, p. 26.

43. **Pseudophycodrys** Skottsberg

Mar. Alg., 2. Rhodophyc., 1923, p. 32 ; Okamura, 1936, p. 771.

Pseudophycodrys Rainosukei Tokida

Mar. Alg., Robben Isl., 1932, p. 27, text-figs. 11, 12, pl. 10 (excl. pl. 9) ; Okamura, 1933, p. 93 ; 1936, p. 771, fig. 370 ; Nagai, 1941, p. 218, pl. 5, fig. 7.

Japanese name. Rainosuke-konoha (Tokida).

Habitat. Found washed ashore, sometimes epiphytic on *Odonthalia aleutica*. W. coast : Sôni (T., '26, '27), Shiranushi (T., '27). E. coast : Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35 ; Nakashima, '32, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Remarks. The reference of the present species to the genus *Pseudophycodrys* has become more reasonable than before as Nagai reported lately that he had once observed the intercalary cell division in the primary cell row in his Kurile specimens.

Nevertheless, such a feature appears to be very rare, as the writer has not been successful yet to detect it in the specimens from Saghalien. According to Nagai, this species is distributed in the Middle Kuriles as far south as Urup Island. Mr. Kumagai of the Nemuro Branch of the Hokkaido Fisheries Experimental Station presented the writer a cystocarpic specimen of the species collected in March 1938 at Shibotsu Island near Shikotan Island, in the South Kuriles.

Group 4. Phycodrys-group

Kylin, Stud. üb. Delesseriac., 1924, p. 27.

44. **Phycodrys** Kützing

Phyc. Gen., 1843, p. 444 ; Kylin, 1924, p. 44 ; Okamura, 1936, p. 774.

Key to the species

I. Glandular cells present ; tetrasporangial sori at the apices of the veins and on the lateral leaflets ; cystocarps 0.3–0.5 mm. in diam. .... 1. *P. rubens*
II. Glandular cells absent ; tetrasporangial sori on the lateral leaflets and on the surface of the blade along both sides of the veins ; cystocarps 0.5–1.0 mm. in diam. 2. *P. fimbriata*

1. ***Phycodrys rubens*** (Huds.) Batters

Catal. Brit. Mar. Alg., 1902, p. 76 ; Tokida, 1944, p. 213.
Fucus rubens Hudson, Fl. Angl., 1762, p. 475.
Fucus crenatus Gmelin, Hist. Fuc., 1768, p. 184, pl. 24, fig. 1.
Delesseria crenata Ruprecht, Tange Ochot. Meer., 1851, p. 231.
Fucus roseus Müller, Fl. Dan., 1775, pl. 652.
F. sinuosus Goodenough et Woodward, *in* Transact. Linn. Soc., III, 1797, pp. 111, 113 ; Turner, Hist. Fuc., I, 1808, p. 74, pl. 35.
Delesseria sinuosa Lamouroux, Essai, 1813, p. 124 ; Lyngbye, Hydr. Dan., 1819, p. 7, pl. 2 B ; Postels & Ruprecht, 1840, p. 14 ; Montagne, 1846, p. 112 ; Harvey, 1851, pl. 259 ; J. Agardh, 1852, p. 691 ; 1876, p. 486 ; Farlow, 1881, p. 162 ; Kjellman, 1883, p. 136 ; 1889, p. 25 ; Hauck, 1885, p. 177, fig. 74 ; Saunders, 1901, p. 437 ; Setchell & Gardner, 1903, p. 322 ; Kylin, 1907, p. 136 ; Woronichin, 1928, p. 157 ; Sinova, 1930, p. 116 ; 1933, p. 35 ; 1938, p. 62.
Phycodrys sinuosa Kützing, Phyc. Gen., 1843, p. 444, pl. 68, II ; 1866, pl. 20 ; Kylin, 1923, p. 64, figs. 43–51.
non *Delesseria sinuosa* Okamura (*non* Lamour.), Nippon Sôrui Mei-i, ed. 1, 1902, p. 50 (= *Phycodrys fimbriata*).

Japanese name. Kashiwabakonoha-modoki (Tokida).

"Plant of stalked, lanceolate-ovate or later lobed blades, bright purple-red, to 10-15 (–30) cm. tall, 2–5 (–12) cm. wide ; blade of one cell layer except for the veins, which consist of midrib and distinct opposite lateral veins, which consist of midrib and distinct opposite lateral vein systems for each major lobe, the veins evident, disappearing in the margin of the blade, which somewhat sinuate serrate ; lateral lobes may develop similar to the primary blade in size and form; tetrasporangial sori at the ends of the veinlets near the margins of the primary blades or ultimately occupying little lateral leaflets; spermatangia forming a narrow band just within the margin of the blade; procarps scattered irregularly over the surface of the blade; cystocarps covered with a pericarp, usually on the veinlets of the primary blade or in old specimens of special lateral leaflets". (Taylor, 1937, p. 351).

1a. ***Phycodrys rubens*** f. ***quercifolia*** (Turn.) Newton

Handb. Brit. Seaw., 1931, p. 329 (*sub* var.); Tokida, 1944, p. 214, figs. 1-3.
Fucus sinuosus γ *quercifolius* Turner, Hist. Fuc., I, 1808, p. 74.
Delesseria crenata var. *quercifolia* (Turn.) Ruprecht, Tange Ochot. Meer., 1851, p. 233.
D. sinuosa f. *quercifolia* (Turn.) Kjellman, Alg. Arct. Sea, 1883, p. 136.

Japanese name. Hiroha-kashiwabakonoha-modoki (Tokida).

Habitat. Found cast ashore, growing on shells. Aniwa Bay: Chishiya (T., '35), Nobori (T., '26). E. coast: Waare (Miyabe, '06), Higashisôya (T., '29), Higashishirutori (Saitô, '28), Unetonnai (Miyabe, '06), Nairo (Miyabe, '06), Kaihyô-tô (T., '30, '32; Nakashima, '32, '33).

Distribution. Sp. – ? Kuriles (*fide* Postels & Ruprecht); Japan Sea coast of Siberia; Ochotsk Sea; Kamtschatka; Bering Sea; Pacific coast of North and South America (Alaska & ? Peru); Atlantic coasts of North America and Europe; Arctic Ocean; North Sea; Baltic Sea. Forma *quercifolia* – Hokkaido and Saghalien; Europe (Irish Sea, Atlantic coast of Norway & Flensborg-Fjord of Jütland); Arctic Ocean.

"Laciniae of the frond rounded, margins naked." (Turner, 1808, p. 74).

Remarks. The specimens which the writer refers to the present species resemble very closely *Phycodrys fimbriata*, from which they differ in having glandular cells among the superficial cells, in being deeper reddish purple in color, in having smaller and much more abundant marginal leaflets, in having tetrasporangial sori at the apices of the lateral veins and on the marginal leaflets, and in having smaller cystocarps. The glandular cells are formed by cutting laterally from some of the superficial cells in the intercostal part of the frond, sometimes more or less deeply penetrated by a protoplasmic strand given off from their mother cells. In dried specimens, they may happen to be taken for a lenticular thickening of the cell-wall. Staining tests with various pigments and reagents, such as Chlorzinc Iodide, Potassium Iodide Iodine, Methylen Blue, Magdala Red and Neutral Red. have revealed that the body in question is not a thickened cell-wall but a cavity filled with a hyaline, refractive, homogeneous content. The content becomes light yellowish in drying; it dyes light orange-yellow in Neutral Red, and Protein-test with Millon's Reagent gives negative result. So far as the writer knows, glandular cells have not hitherto been described by anyone for either *Phycodrys rubens* or *Ph. fimbriata*. On examining some authentic specimens of *Ph. rubens* deposited in the Herbarium of our University, all of which seem to represent forma *typica*, the writer could observe glandular cells in the specimens from Spitzbergen (*leg.* F. R. Kjellman, 1872-12) and from Finmarken (*leg.* F. R. Kjellman, 1876), both of which have been distributed from the Botanical Museum of Stockholm through the kindness of Dr. T. Arwidsson, and also in the specimens from Nordsee (*leg.* P. Magnus, 1872), which was presented by Dr. Farlow to Dr. Miyabe. On the other hand, three specimens from Massachusetts (*leg.* K. Miyabe, 1887), as well as one specimen which has been distributed from the Herbarium of the Royal Botanic Garden, Edinburgh (Greville Collection), are found to be destitute of glandular cells.

The lateral leaflets or processes of our Saghalien specimens are usually very small and often densely fringe the margins of the blade. In the specimens from Prov. Nemuro, Hokkaido (*leg.* J. Tokida, 1925), the minute processes are rather rare on the margin but sometimes quite abundant on the surface of the blade. The lateral leaflets of *Ph. fimbriata*, which are sometimes fairly abundant in the tetrasporiferous plant, are somewhat larger and less abundant than those of *Ph. rubens*. On the difference between *Ph. fimbriata* and *Ph. sinuosa* (*Ph. rubens*), Kylin also states : "Diese Art steht *Ph. sinuosa* sehr nahe, unterscheidet sich aber von dieser dadurch, dass die Nerven undeutlicher und die sporangientragenden Fortsäze kräftiger sind als bei *Ph. sinuosa.*"

The tetrasporangial sori are formed at the apices of the veinlets near the margins of the blades and on the lateral processes, but not on the intercostal part of the blade along the both sides of the vein as in *Ph. fimbriata*. The cystocarps of *Ph. rubens* are described by Taylor to be formed "usually on the veinlets of the primary blade or in old specimens of special lateral leaflets." Nevertheless, it may by no means be unreasonable to find scattered cystocarps in *Ph. rubens* because its procarps are found to be "scattered irregularly over the surface of the blade." In our Saghalien and Hokkaido specimens, the cystocarps are scattered over the blade just in the same manner as in *Ph. fimbriata*. The mature cystocarps of *Ph. rubens*, in our specimens, are 0.3–0.5 mm. in diam., while those of *Ph. fimbriata* 0.5–1.0 mm. in diam. A male plant provided with the spermatangial sori just within the margin of the blade has been met with in the specimens from Kombumori, Prov. Nemuro in Hokkaido.

Phycodrys rubens is a variable species. Turner (1808) distinguished two varieties, *β incrassata* and *γ quercifolia*, besides the type form (f. *typica* Kjellm., 1883, p. 136) among his specimens of *Fucus sinuosus*. About four more forms have been added by others. Of these forms, forma *quercifolia* is most commonly represented by our Saghalien and Hokkaido specimens. *Delesseria crenata* var. *serratiloba* Rupr. (Ruprecht, 1851, p. 231, cf. Woronichin, 1928, p. 158) has been reported by Ruprecht to be widely distributed in the Ochotsk Sea and by Woronichin to be found also in Kamtschatka. In the writer's opinion, that variety may most likely belong to *Ph. fimbriata* and not to *D. crenata* (*Ph. rubens*). It may be allowable to pass a conjecture that Sinova (1930, 1933, 1938) has also confused these nearly allied species with each other.

2. ***Phycodrys fimbriata*** (De la Pyl.) Kylin

Stud. üb. Delesseriac., 1924, p. 44 ; Tokida, 1932, p. 29 ; Yamada 1934, p. 349 ; 1935, p. 24 ; Okamura, 1936, p. 774, fig. 373 ; Nagai, 1941, p. 219 ; Yamada & Tanaka, 1944, p. 74.

Delesseria fimbriata De la Pylaie, *in* J. Agardh, Sp. Alg., II, 2, 1852, p. 690, III, 1, (Epicr.), 1876, p. 486, III, 3, (Disp. Delesser.), 1898, p. 160 ; De Toni, 1900, p. 704 ; 1924, p. 341 ; Okamura, 1910, p. 114 ; 1916, p. 58.

D. sinuosa Okamura (*non* Lamouroux), Nippon Sôrui Mei-i, ed. 1, 1902, p. 50.

Japanese name. Kashiwaba-konohanori (Okamura).

Habitat. Found cast ashore, epiphytic on other algae, e.g., *Ptilota, Odonthalia,* etc. W. coast : Pilevo (Miyabe, '06), Nayoshi (Miyabe, '06), Kushunnai (Miyabe, '06), Tomarioru (T., '30), Yenchishi (Miyabe,'06), Shiranushi (T., '27), Nishinotoro (Morimoto, '25) Aniwa Bay : Chishiya (T., '35), Nobori (T., '26), Merei (Miyabe, '06). E. coast : Hota (T., '32), Rorei (T., '32), Sakaehama (Miyabe, '06 ; T., '29), Higashishiraura (Saitô, '28 ; T., '31), Maguntan (Miyabe, '06), Kashiho (T., '31), Higashisôya (T., '29), Kaihyôt-ô (T., '30, '32, '35), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Penjinskii Bay (Cape Povorotnuii-*fide* Okamura, 1910, p. 117) ; Arctic Ocean (Terra Nova).

Remarks. The occurrence of the present species in southern Saghalien was first reported by Okamura (1910, p. 116) who has given a figure of a sterile plant from the eastern coast of Saghalien in the Plate 83, fig. 1 of his work just cited. The female plant which Okamura failed to find out among his specimens (1910, p. 117 ; 1936, p. 775) is not uncommonly met with in our Saghalien specimens, being associated with male and tetrasporiferous plants. The cystocarps are scattered over the blade ; they measure 0.5–1.0 mm. in diam. The tetrasporangial sori are formed on the surface of the blade along both sides of the veins, as well as on the lateral leaflets. The leaflets are sometimes entirely lacking but in some specimens they are fairly abundant, arising usually on the margin of the blade or rarely on the surface as well.

The type locality of this species is "Terra Nova" in the Arctic Ocean. Harvey (1853, p. 94) has once reported it from Newfoundland, but according to Taylor (1937, p. 352), it is probable that Harvey's plant belongs to *Ph. rubens.*

Group 5. Yendonia (Ruprechtiella)-group

Kylin, Stud. üb. Delesseriac., 1924, p. 52 (Die Ruprechtiella-Gruppe).

45. **Hypophyllum** Kylin

Stud. üb. Delesseriac., 1924, p. 53 ; Okamura, 1936, p. 777.

Hypophyllum Middendorffii (Rupr.) Kylin

loc. cid., 1924, p. 53, fig. 42, f ; Tokida, 1932, p. 30 ; Inagaki, 1933, p. 53 ; Okamura, 1936, 778, fig. 375 ; Nagai, 1941, p. 222 ; Yamada & Tanaka, 1944, p. 74.

Delesseria Middendorffii Ruprecht, Tange Ochot. Meer., 1851, p. 237, pl. 12 ; J. Agardh, 1852, p. 696; 1876, p. 497; 1898, p. 161; De Toni, 1900, p. 708; 1924, p. 343; Okamura, 1902, p. 50; 1916, p. 59 ; 1910, p. 118, pl. 84, pl. 85, figs. 1 7 ; 1922, p. 174, pl. 191, figs. 8 11 ; Sinova, 1930, p. 115.

Japanese name. Nagakonohanori (Okamura).

Habitat. Found cast ashore, in Lake Tôbuchi, entangled among the Aegagropiloid thalli of *Ahnfeltia plicata* var. *tobuchiensis*. W. coast ; Nayoshi (Miyabe, '06), Kushunnai (Miyabe, '06), Tomarioru (Miyabe, '06), Yenchishi (Miyabe, '06), Shiranushi (T., '27). Aniwa Bay : Chishiya (T., '35), Merei (Miyabe, '06), Tôbuchi-ko (T., '26, '29 ; Matsubara, '31 ; Ohmi, '40), Shiraiwa (T., '32), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (Miyabe, '06 ; T., '27), Rorei (T., '32), Sakaehama (Miyabe, '06 ; T., '29), Taraika-ko (Miyake, '06), Jimutaki (Miyabe, '06), Chiriye (T., '30), Kaihyô-tô (Kubo, '06 ; T., '30), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Tartary Strait and Kamtschatka (*fide* Okamura, 1936, p. 779).

Remarks. The present alga is widely spread in southern Saghalien. Sterile portion of a two years old specimen from Saghalien has been illustrated by Okamura, in his Icon. Jap. Alg., II, pl. 84, fig. 2. As for the utilization of this alga, the same author states (*loc. cit.*, p. 119) : "This plant is known to the people inhabiting in the neighborhood of the Cape Povorochini as edible seaweeds under the name of 'Chikaputsuro' or 'Setakemaa'."

Nagai (1941, p. 221) has discovered in the Kuriles an intermediate form between *Hypophyllum Middendorffii* and *Yendonia crassifolia* and named it *Yendonia japonica*. It may possibly be identical with *Delesseria kurilensis* Rupr. reported by Ruprecht (1851, p. 233) from Urup Island, but it is impossible at present to decide the matter because Ruprecht's description on his original specimens, in which he could not observe any fruit, is altogether simple.

Group 6. Myriogramme-group

Kylin, Stud. üb. Delesseriac., 1924, p. 53.

46. **Myriogramme** Kylin

loc. cit., 1924, p. 55 ; Okamura, 1936, p. 779.

Myriogramme yezoensis Yamada et Tokida

in Yamada, Notes Some Jap. Alg., VI, 1935, p. 30, pl. 13, fig. 2, pl. 14 ; Okamura, 1936, p. 781 ; Yamada & Tanaka. 1944, p. 75.

Japanese name. Atsuba-sujiginu (Yamada & Tokida).

Habitat. Growing in deep water, usually found washed ashore. E. coast: Higashishirutoru (Saitô, '28), Kaihyô-tô (Kubo, '06 T., '35).

Distribution. Hokkaido and Saghalien.

Remarks. In 1935, the writer collected off the Islet of Kaihyô-tô a few specimens of the present alga which had been brought up from deep water hanging on a crab-net. The blade of these specimens is often finely crispate on the margin, where we find numerous short rhizoidal processes composed of a bundle of elongated cells and a small number of minute initials of proliferous branchlets. These branchlets are provided with a laterally jointed primary apical cell at their apices while very young. Kylin (1924, p. 60, fig. 46, b–d) has also observed such kind of apical cell in minute marginal processes of *Myriogramme denticulata* (Harv.) Kylin, *M. Gunniana* (Harv.) Kylin and *M. pristoidea* (Harv.) Kylin. When the branchlets grows little larger, the primary apical cell becomes hardly detectable.

47. **Polycoryne** Skottsberg

in Kylin & Skottsberg, Subant. u. Ant. Meeresalg., II, 1919, p. 36; Okamura, 1936, p. 781.

Polycoryne denticulata Tokida

Phyc. Observ., I, 1934, p. 199, text-figs. 1, 2; 1934, p. 21; Okamura, 1936, . 781, fig. 377.

Japanese name. Porikorine (Okamura).

Habitat. Parasitic on *Phycodrys fimbriata.* E. coast: Higashi-sôya (T., '29), Kaihyô-tô (T., '30).

Distribution. Endemic.

Remarks. The present interesting parasitic alga was first discovered by the writer on *Phycodrys fimbriata* from Robben Island (Kaihyô-tô). It has been met with also on the same alga collected at Higashisôya, but never on its sister species *Phycodrys rubens.* When the host plant is dried on paper, it becomes very hard, if not impossible, to recognize the minute delicate thallus of the parasite.

48. **Acrosorium** Zanardini (*emend.* Kylin)

in Kützing, Tab. Phyc., XIX, 1869, p. 4 (*nom. nud.*); Kylin, 1924, p. 76; Okamura, 1936, p. 785.

Acrosorium Yendoi Yamada

Notes Some Jap. Alg., I, 1930, p. 33, pl. 5, fig. 4; Inagaki, 1933, p. 54, fig. 23; Okamura, 1936, p. 786; Takamatsu, 1936, p. 36; 1938, p. 61; 1938*a*, p. 132; 1939, p. 71

Nitophyllum monanthos Yendo (*non* J. Agardh), Notes Alg. New to Japan, VIII, 1918, p 69; Yamada 1928, p. 520, fig. 15.

Japanese name. Hai-usubanori (Yamada).

Habitat. Epiphytic on other algae, e.g., *Sargassum Thunbergii.* E. coast : Kaiba-tô (T., '43).

Distribution. Kyûshû, Honshû, Hokkaido and Saghalien.

Remarks. According to the list of localities given by Yendo, this plant is rather widely spread along the coasts of Japan washed by the warm current, from Kyûshû as far north as Rishiri Island, Hokkaido. Lately the writer could collect it at Kaiba-tô which is located about one degree of Latitude north from Rishiri Island. The tetrasporangial sori have been observed by Yendo (1918, pp. 69–70) and by Inagaki (1933, p. 54, fig. 23, b, c), but no one has described cystocarps for the present species, as far as the writer knows.

Family 20. Rhodomelaceae (Reichb.) Harvey

Ner. Bor.-Amer., II, 1853, p. 9 ; Okamura, 1936, p. 807.
Rhodomeleae Reichenbach, Consp. Reg. Veget., 1828, p. 136.

Key to the genera

I. Axial cell-row discernible only in the vertical section through the apical portion of the branches just beneath the growing point (Subfam. **Laurencieae**)
  A. Frond large, not parasitic .... 48. *Laurencia*
  B. Frond small, parasitic .... 49. *Janczewskia*
II. Axial cell-row discernible throughout the whole length of the frond and surrounded as a rule by 3–20 pericentral cells
  A. Pericentral cells as a rule not divided laterally
    1. Polysiphonous axis covered entirely by a well developed parenchymatous cortex ; pericarps thick (Subfam. **Chondrieae**) .... 50. *Chondria*
    2. Polysiphonous axis naked or covered by a cortex consisting of rhizoidal or rarely parenchymatous cells ; pericarp thin
      a. Frond cylindrical, radial or dorsiventral, erect portion alternate-spirally branched in every side (Subfam. **Pterosiphonieae**)
        i. Frond radial, dioecious .... 51. *Polysiphonia*
        ii. Frond dorsiventral, monoecious .... 52. *Enelittosiphonia*
      b. Frond cylindrical or more or less complanate, alternate-distichously branched (Subfam. **Polysiphonieae**) .... 53. *Pterosiphonia*
  B. Pericentral cells early divided laterally and vertically in various ways (Subfam. **Rhodomeleae**)
    1. Frond cylindrical ; hairs present at the tips of branches ...... 54. *Rhodomela*
    2. Frond bilateral, flattened ; hairs absent .... 55. *Odonthalia*

Subfamily 1. Laurencieae (Harv.) Zanardini

Icon. Phyc. Medit. et Adriat., III, 1871, p. 540 ; Okamura, 1936, p. 851.

49. **Laurencia** Lamouroux

Essai, 1813, p. 42 ; Okamura, 1936, p. 851.

Key to the species

I. Lenticular thickenings present in the walls of the medullary cells ...... 1. *L. nipponica*
II. Lenticular thickenings absent .... 2. *L. glandulifera*

1. ***Laurencia nipponica*** Yamada

Notes on Laurencia, 1931, p. 209, pl. 9 ; Inagaki, 1933, p. 56, fig. 24 ; Okamura, 1936, p. 855, fig. 400 ; Takamatsu, 1938, p. 65 ; 1939, p. 75 ; Nagai, 1941, p. 229.

Japanese name. Ura-sozo (Yamada).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Kaiba-tô (T., '43).

Distribution. Honshû, Hokkaido, Kuriles and Saghalien ; China.

Remarks. The specimens referred to the present species were collected at Kaiba-tô toward the end of September 1943. They are of a rather undeveloped frond, 10–15 cm. in height, but tetrasporangia and cystocarps are already formed in some of the upper branchlets. The plant was often found to be infected by tubercular bodies of a parasitic red alga belonging to the genus *Janczewskia,* which the writer describes below as a new species under the name of *J. Morimotoi.*

2. ***Laurencia glandulifera*** Kützing

Sp. Alg., 1849, p. 855 ; Tab. Phyc., XV, 1865, pl. 59, figs. c, d ; Yamada, 1931, p. 218 ; Inagaki, 1933, p. 57 ; Okamura, 1936, p. 858 ; Takamatsu, 1936, p. 38 ; Nagai, 1941, p. 229 ; Yamada & Tanaka, 1944, p. 76.

Chondria glandulifera Kützing. Phyc. Germ., 1845, p. 329.

C. obtusa var. *paniculata* Agardh, Sp. Alg., I, 2, 1822, p. 343 (*pro parte*).

Laurencia paniculata J. Agardh, Sp. Alg., II, 3, 1853, p. 775, III, 1, (Epicr.), 1876, p. 651 (*pro parte*) ; Okamura, 1902, p. 54; 1916, p. 68.

L. paniculata f. *patentiramea* (Kütz.) Hauck, Meeresalg., 1885, p. 207.

Japanese name. Ô-sozo (Yamada).

Habitat. Growing on rocks in the sublittoral belt. W. coast : Tomarioru (T., '30), Rakuma (T., '27), Chinehira (T., '26), Kaiba-tô (T., '30 ; Morimoto, '33, '37). Aniwa Bay : Nobori (T., '26, '35), Merei (Miyabe, '06), Shiraiwa (T., '32). E. coast : Airô (Miyabe, '06 ; T., '27).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Adriatic Sea.

Remarks. Most of our Saghalien specimens of *Laurencia* are referable to *L. glandulifera,* which is characterized by the lack of lenticular thickenings in the wall of the medullary cells.

50. **Janczewskia** Solms-Laubach

Note sur le Janczewskia, *in* Mem. Soc. Sci. Nat. de Cherb., XXI, 1877, p. 29 ; Schmitz

& Falkenberg, 1897, p. 432 ; De Toni, 1903, p. 811 ; 1924, p. 376 ; Smith, 1944, p. 381.

Thallus small, parasitic on red algae (*Laurencia, Chondria* & *Cladhymenia*), penetrating at the base into the host by means of hyphal branched filaments, globular to flattened reniform, composed of a basal solid tubercle and more or less developed radiating free branches, light reddish or creamy white in color ; tetrasporangia subepidermal, lining the walls of conceptacles immersed in the tubercle or scattered on the surface of the free branches, tripartite or cruciate ; antheridia in conceptacles immersed in the tubercle or in the upper part of the free branches ; cystocarps prominent on the surface of the tubercle or immersed in the tips of the free branches.

Janczewskia Morimotoi Tokida

Notes on some new or little known marine algae, (1), 1947, p. 127, figs. 1-6.

Japanese name. Morimoto-sozomakura (Tokida).
Habitat. Parasitic on *Laurencia nipponica.* W. coast : Kaiba-tô (T., '43).
Distribution. Endemic.

Thalli perfectly or more or less flattened globular, up to 4–5 mm. in the maximum diameter, light reddish purple in color, composed of a basal solid tubercle and radiating free branches ; tetrasporangial plant with numerous cylindrical, simple or branched, slender, free branches, 0.30–2.15 mm. long ; antheridial plant with numerous clavate, simple free branches, 0.45–1.72 mm. long ; cystocarpic plant with numerous clavate, simple, free branches, 0.42–1.30 mm. long ; tetrasporangia subepidermal, scattered on the outer surfaces of free branches, dividing tetrahedrally ; antheridia in narrow plumose tufts, which line the entire cavity of the antheridial conceptacle radiating toward the center ; cystocarps subglobose, single or more often in groups, sitting on the tips of the free branches, with a moderately thick pericarp and a small round carpostome.

Remarks. The genus *Janczewskia* was for the first time added to the marine flora of the Far East when the present species was described in the writer's paper cited above. Mr. Y. Hasegawa of the Hokkaido Fisheries Experimental Station has informed the writer that a species of *Janczewskia* parasitic on *Laurencia* was collected at Okushiri Island in Hokkaido.

Subfamily 2. Chondrieae (Kütz.) Schmitz

in Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 432 ; Okamura, 1936, p. 840.
Chondrieae Kützing, Phyc. Gen., 1843, p. 413 (*pro minima parte*).

51. **Chondria** Agardh (*emend.* Harvey)

Syn. Alg. Scan., 1817, p. XVIII ; Sp. Alg., I, 2, 1822, p. 336 ; Harvey, 1853, p. 19 ; Okamura, 1936, p. 841.

Chonaria dasyphylla (Woodw.) Agardh

Sp. Alg., I, 2, 1822, p. 350 ; Harvey, 1853, p. 20 ; Kützing, 1865, pl. 43, e-i ; Falkenberg, 1901, p. 197, pl. 22, figs. 4-18 ; Okamura, 1902, p. 57; 1916, p. 71 ; 1927, p. 13 ; 1936, p. 843 ; De Toni, 1903, p. 842 ; Kylin, 1907, p. 138 ; 1928, p. 79 ; 1934, p. 15 ; Rosenvinge, 1923/24, p. 406 ; Taylor, 1928, p. 170 ; 1937, p. 359, pl. 54, figs. 5, 6 ; 1939, p. 158 ; Newton, 1931, p. 342, fig. 211 ; Takamatsu, 1938, p. 63 ; 1938*a*, p. 134 ; 1939, p. 74, pl. 13, fig. 4 ; Yamada & Tanaka, 1944, p. 75.

Fucus dasyphyllus Woodward, *in* Trans. Linn. Soc., II, 1794, p. 239, pl. 23, figs. 1-3.

Chondriopsis dasyphylla J. Agardh, Sp. Alg., II, 3, 1853, p. 809 ; Farlow, 1881, p. 166.

Chondria tenuissima Okamura (*non* Agardh), Nippon Sôrui Mei-i, ed. 2, 1916, p. 71.

Japanese name. Yanagi-nori (Okamura).

Habitat. Growing on pebbles and rocks ; in Lake Tôbuchi, sometimes also on the stipe of *Laminaria* and on the thallus of *Ahnfeltia plicata* var. *tobuchiensis*. W. coast : Hirochi (T., '26), Chinehira (T., '26), Honto (T., '26). Aniwa Bay : Nobori (T., '35), Ôtomari (*fide* Okamura, 1936, p. 843), Tôbuchi-ko (T., '26, '35, '41 ; Matsubara, '30).

Distribution. Kyûshû, Shikoku, Honshû, Hokkaido and Saghalien; Indian Ocean; Atlantic coasts of North and South America and of Europe ; North Sea ; Skagerak ; Mediterranean Sea ; Adriatic Sea.

Remarks. Okamura (1936, p. 843) has noted that the plant becomes in sheltered localities very slender and soft, sometimes also dwarf. Our specimens from Chinehira and Tôbuchi-ko appear to approach closely to *C. tenuissima* (Good. et Woodw.) Ag. in the slenderness of the branches and in the shape of the ultimate branchlets. However, the tetrasporiferous branchlets are always clavate in shape and more or less truncate at the apex. Some sterile specimens from Tôbuchi-ko are provided nearly all over the surface of the frond with numerous adventitious rhizoidal processes.

Subfamily 3. Polysiphonieae (Kütz.) Schmitz et Falkenberg

in Engler & Prantl, Natürl. Pflanzenfam., I, 2, 1897, p. 436 ; Okamura, 1936, p. 821.

52. **Polysiphonia** Greville

Fl. Edin., 1824, p. 308 (*emend.*) ; Okamura, 1936, p. 821.

Key to the species

I. Trichoblast arising from each segment near branch tips ; tetrasporangia on ultimate and penultimate branchlets .... 1. *P. japonica*

II. Trichoblast wanting or scarce
   - A. Tetrasporangia on ultimate branchlets .... 2. *P. urceolata*
   - B. Tetrasporangia on stichidial branchlets arising tuftly in branchlet axils .... 3. *P. Morrowii*

1. ***Polysiphonia japonica*** Harvey

Algae, *in* Gray, List of dried plants collected in Japan, 1856, p. 331; Martens, 1886, p. 133; De Toni 1895, p. 33, n. 93; 1924, p. 393; Gepp, 1904, p. 163, pl. 460, figs. 4–6; Inagaki, 1933, p. 63; Okamura, 1936, p. 830; Nagai, 1941, p. 228; Segi, 1951, p. 228, pl. 8, fig. 3, text-fig. 22.

Polysiphonia mollis Yendo (non Hook. et Harv.), Notes on Alg. new to Japan, V, 1916, 261 (with ?); Okamura, 1936, p. 829.

P. violacea Yamada (non Grev.), Mar. Alg. Mutsu Bay, II, 1928, p. 524, fig. 18; Okamura, 1936, p. 833.

P. Savatieri Okamura (non Hariot), Nippon Kaisô-shi, 1936, p. 830.

Japanese name. Kiburi-itogusa (Okamura).

Habitat. Growing on *Zostera*, *Laminaria* and other algae. W. coast: Hirochi (T., '27), Honto (T., '26), Kaiba-tô (T., '30). Aniwa Bay: Chishiya (T., '35), Nobori (T., '26).

Distribution. Honshû, Hokkaido, Saghalien.

Remarks. For the identification of the present and the next species, the writer owes to Dr. T. Segi, who has published an excellent monograph on the genus *Polysiphonia* from Japan (1951).

2. ***Polysiphonia urceolata*** (Dillw.) Greville

Flora Edinensis, 1824, p. 309; Yendo, 1916, p. 60; Yamada, 1928, p. 522; Lakowitz, 1929, p. 338, fig. 456; Inagaki, 1933, p. 62; Okamura, 1936, p. 824, fig. 388; Yamada & Tanaka, 1944, p. 75; Segi, 1951, p. 239, pls, 10. 11, fig. 1, text-figs. 26–27. (For further references, see Segi, *loc. cit.*).

Conferva urceolata Dillwyn, Brit. Conf., 1809, p. 82.

Japanese name. Shôjô-kenori (Matsumura).

Habitat. Growing on rocks in the littoral belt. E. coast: Sakaehama (Inoue, '27).

Distribution. Honshû, Hokkaido, Saghalien; Atlantic coasts of N. America and Europe; Mediterranean Sea; North Sea; Baltic Sea; Arctic Ocean.

Remarks. Segi distinguished three forms in the present species, of which f. *typica* Kjellm. (1883, p. 118) is represented by the specimen from Sakaehama.

3. ***Polysiphonia Morrowii*** Harvey

Algae. *in* Gray, List of dried plants collected in Japan, 1856, p. 331; De Toni, 1895, p. 33; 1903, p. 960; 1924, p. 393; Okamura, 1914, p, 104, pl. 127, figs. 1–8; 1936, p. 826, fig. 390, 1–5; Inagaki, 1933, p. 59; Tseng & Li, 1935, p. 223; Takamatsu, 1936, p. 38; 1938, p. 67; 1938*a*, p. 136; 1939, p. 72; Nagai, 1941, p. 226; Yamada & Tanaka, 1944, p. 75; Segi, 1951, p. 244, pl. 11.

Orcasia Morrowii (Harv.) Kylin, Calif. Rhodophyc., 1941, p. 35.

Japanese name. Moroitogusa (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast: Ushiro (Miyabe, '06), Rakuma (T., '26, '27), Chinehira (T., '26), Kaiba-tô (T., '30 ; Morimoto, '33). Aniwa Bay : Otai (Miyabe, '06).

Distribution. Northern Honshû, Hokkaido, South Kuriles, Saghalien ; China.

Remarks. The rare occurrence of the hairs in the present species, which has recently been first reported by Nagai in his Kurile specimens, answers Kylin's following statement in his diagnosis of the genus Orcasia : "Trichoblasten nur in seltenen Ausnahmefällen vorhanden." One of the striking characteristics of this species is that the stichidia form dense clusters in the axils of ramuli.

Subfamily 4. Pterosiphonieae Falkenberg

Rhodomelac., 1901, p. 723 ; Okamura, 1936, p. 860.

53. **Pterosiphonia** Falkenberg

in Schmitz, Syst. Uebers. Florid., 1889, p. 14 (*nomen*) ; *in* Engler & Prantl, 1897, p. 443 ; Okamura, 1936, p. 861.

Pterosiphonia bipinnata (Post. et Rupr.) Falkenberg

Rhodomelac., 1901, p. 273 ; Okamura, 1933, p. 94 ; 1936, p. 863 ; Tokida, 1932, p. 30 ; Sinova, 1933, p. 37 ; 1938, p. 65 ; Yamada, 1935, p. 24 ; Kawabata, 1936, p. 212 ; Kylin, 1941, p. 39 ; Nagai, 1941, p. 230 ; Yamada & Tanaka, 1944, p. 76.

Polysiphonia bipinnata Postels et Ruprecht, Illustr. Alg., 1840, p. 22 ; J. Agardh, 1853, p. 1040 ; Kjellman, 1889, p. 25.

Polyostera gemmifera Ruprecht, Tange Ochot. Meer., 1851, p. 226, pl. 11.

? *Pterosiphonia robusta* Gardner, New Rhodophyc., VI, 1927, p. 102, pls. 26–29 ; Nagai, Mar. Alg. Kurile Isls., II, 1941, p. 232, pl. 5, fig. 15, pl. 6, fig. 2.

Japanese name. Itoyanagi (Okamura).

Habitat. Growing on rocks in the littoral and upper sublittoral belts, and often found cast ashore. W. coast : Tomarioru (T., '30), Honto (Morimoto, '25), Sôni (T., '26), Hishitoma (T., '32), Shiranushi (T., '27, '35, '37). Aniwa Bay : Nobori (T., '26), Merei (Miyabe, '06). E. coast : Higashishiraura (T., '31), Kashiho (T., '31), Chiriye (T., '35), Kaihyô-tô (Kubo, '06 ; Tokida, '30, '32, '35), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido ; Kuriles ; Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Island ; Aleutian Islands ; Pacific coast of N. America from Alaska to Washington.

Remarks. The number of the pericentral cells of the present species is, according to Setchell and Gardner (1903, p. 328), very variable, varying from 11 to 18. The diagnosis given by J. Agardh (1853, p. 1041) reads : "...sectione transversali vidi siphones circiter 12, nunc plures 15–16..." In our Saghalien specimens it is generally 15 or 16 in the main branches, while it is about 10 in ramuli. In describing the Kurile species of *Pterosiphonia*, Nagai has given (1941, pp. 231 & 232) 11–14 for the number of the pericentral cells of *P. bipinnata* and 15–16 for that of *P. robusta* Gardn. On the other hand, Kylin (1941, p. 39) has expressed his doubt about the specific distinction between *P. bipinnata* and *P. robusta*. On examining the Kurile specimens determined by Nagai, the writer is also unable to detect with certainty any essential differences between those referred to either of the two species of *Pterosiphonia*.

The writer has once enumerated *Pterosiphonia arctica* Setch. et Gardn. in his list of the marine algae from Robben Island (1934, p. 23) on the authority of Okamura (1933, p. 94), who added "Robben Island" to the list of distribution of that species. Through the kind permission of Prof. Y. Yamada, the writer searched carefully in Okamura's herbarium for a specimen of *P. arctica* collected at Robben Island but in vain. There was found, however, a sheet of paper on which he mounted one specimen of *P. bipinnata* from Robben Island which was sent from the writer together with several Aleutian specimens of *P. arctica* collected by Y. Kobayashi. This might have been a cause of his possible error. In his later work (1936, p. 862), Okamura enumerates "Shimushu (Yendo)" and "Robben Island (Tokida)" as the localities of *P. arctica* in Japan. However, in point of fact, the writer has never collected the plant at that island. Nagai (1941, p. 233) has added "Hokkaido" to his list of the distribution of *P. arctica*. However, so far as the writer is aware, no one has ever reported its occurrence in Hokkaido proper.

Subfamily 5. Rhodomeleae Falkenberg

Rhodomelac., 1901, p. 591 ; Okamura, 1936, p. 897.

54. **Rhodomela** C. Agardh

Sp. Alg., 1823, p. 368 ; Okamura, 1936, p. 898.

Key to the species

I. Frond robust, with thick, setaceous branchlets densely covering nearly the whole surface . . . . 1. *R. Larix*
II. Frond gracile, with slender, rather sparsely arising branchlets . . . . . . 2. *R. macracantha*

1. ***Rhodomela Larix*** (Turn.) Agardh

Sp. Alg., I, 2, 1822, p. 376 ; Postels et Ruprecht, 1840, p. 14, pl. 38, fig. h ; Harvey, 1853, p. 24 ; J. Agardh, 1853, p. 886 ; Kjellman, 1883, p. 117 ; 889, p. 24 ; Falkenberg, 1901, p. 600, pl. 11 ; Okamura, 1902, p. 66 ; 1916, p. 81 ; 1922, p. 154, pl. 188, figs. 1–4 ; 1933, p. 94 ; 1936, p. 898 ; De Toni, 1924, p. 431 ; Setchell & Gardner, 1903, p. 330 ; Kylin, 1925, p. 75 ; Woronichin, 1928, p. 159 ; Sinova, 1930, p. 117 ; 1933, p. 37 ; 1938, p. 65 ; Inagaki, 1933, p. 65 ; Kawabata, 1936, p. 212 ; Takamatsu, 1938, p. 68, pl. 4, fig. 2 ; 1938*a*, p. 137 ; 1939, p. 78 ; Nagai, 1941, p, 235 ; Yamada & Tanaka, 1944, p. 77.

Fucus Larix Turner, Hist. Fuc., IV, 1819, p. 23, pl. 207.

Lophura Larix Kützing, Sp. Alg., 1849, p. 850 ; Tab. Phyc., XV. 1865, pl. 39, figs. a–c.
Fuscaria Larix Ruprecht, Tange Ochot. Meer., 1851, p. 219.

Japanese name. Fujimatsumo (Okamura).

Habitat. Growing on rocks in the littoral and upper sublittoral belts. W. coast : Rakuma (T., '27), Hirochi (T., '27), Honto (T., '26), Hishitoma (T., '32), Shiranushi (T., '27, '32), Nishinotoro (T., '26, '35), Kaiba-tô (Miyake, '06 ; T., '30, '43 ; Morimoto, '33, '37). Aniwa Bay : Ishihama (T., '26), Chishiya (Miyabe, '06), Nobori (T., '26, '35), Otai (Miyabe, '06), Merei (Miyabe, '06), Nagahama (Miyabe, '06 ; T., '35). E. coast : Kochôbetsu (Matsubara, '33), Hota (T., '32), Airô (T., '27), Sakaehama (T., '29), Naibuchi (Miyake, '06), Higashishiraura (Miyabe, '06 ; T., '31), Kashiho (T., '31).

Distribution. Northern Honshû, Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Sea ; Pacific coast of North America (Alaska to Washington) ; Arctic Ocean.

Remarks. The present species is one of the commonest seaweeds in northern Japan, growing often gregariously on shallow reefs. Some of the specimens collected at Kaiba-tô on July 26, 1930, are cystocarpiferous, and some of those collected at Chishiya on August 2, 1935, spermatangiferous. The tetraspores are also met with in the specimens from various places, collected in summer, from about the end of June.

Since 1941, the present species has attracted the special attention of some Japanese chemists by its high content of Bromine (ca. 3% of dry weight). In the summer months of 1943, a heavy crop of this alga was gathered by fishermen nearly all along the coast of Hokkaido, to supply raw material for the manufacture of bromine.

2. ***Rhodomela macracantha*** (Kütz.) Setchell

in Tokida, Mar. Alg. Robben Isl., (Suppl. Rept.), 1934a, p. 25 ; Tokida, 1949, p. 69.
Lophura macracantha Kützing, Tab. Phyc., XV, 1865, p. 14, pl. 39, figs. d–g.
Odonthalia floccosa f. *macracantha* Setchell et Gardner, Alg. N.-W. Amer., 1903, p. p. 135.
Rhodomela subfusca Okamura (*non* Agardh), Icon. Jap. Alg., IV, 8, 1922, p. 151, pls. 186, 187, figs. 1–13 (*pro parte*) ; 1936, p. 899, fig. 421 (*pro parte*) ; Nagai, 1941, p. 235.

Japanese name. Niretsu-fujimatsu (Okamura).

Habitat. Growing on rocks in the littoral and upper sublittoral belts. W. coast : Sôni (T., '27), Nishinotoro (T., '26, '32, '35). Aniwa Bay : Ishihama (T., '26), Chishiya (T., '35), Nobori (T.,' 26, '35), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Airô (Miyabe, '06 ; T., '27), Sakaehama (T., '29), Higashishiraura (T., '31), Higashisôya (T., '29), Kashiho (T., '31), Chiriye (T., '35), Kaihyô-tô (T., '30 ; '32 ; Nakashima, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Kamtschatka ; Aleutian Islands ; Pribilof Islands , Alaska ; British Columbia.

55. **Odonthalia** Lyngbye

Hydr. Dan., 1819, p. 9 ; Okamura, 1936, p. 901.

Key to the species

I. Frond flat ; reproductive organs on minute marginal branchlets
  A. Midrib absent .... 1. *O. corymbifera*
  B. Midrib present .... 2. *O. dentata*
II. Frond subterete below, compressed above ; minute marginal branchlets absent
  A. Frond narrow throughout the whole length ; midrib absent ...... 3. *O. aleutica*
  B. Frond narrow below, more or less broadened above ; midrib absent .... 4. *O. kamtschatica*
III. Frond nearly cylindrical, but slightly compressed .... 5. *O. floccosa*

1. ***Odonthalia corymbifera*** (Gmel.) J. Agardh

Sp. Alg., II, 3, 1863, p. 894 ; Okamura, 1902, p. 66 ; 1916, p. 81; 1912, p. 143 ; 1936, p. 902 ; De Toni, 1903, p. 1136; 1924, p. 432 ; Sinova, 1933, p. 36 ; 1938, p. 66 ; Yamada, 1935, p. 25 ; Kawabata, 1936, p. 212 ; Nagai, 1941, p. 237 ; Yamada & Tanaka, 1944, p. 76.

Fucus corymbiferus Gmelin, Hist. Fucor., 1768, p. 124, pl. 9.

Rhodomela corymbifera Agardh, Sp. Alg., I, 2, 1822, p. 371.

Odonthalia Gmelini Postels et Ruprecht, Illustr. Alg., 1840, p. 14, pl. 28 ; Kützing, Sp. Alg., 1849, p. 847.

Atomaria corymbifera Ruprecht, Tange Ochot. Meer., 1851, p. 213.

Japanese name. Hakesaki-nokogirihiba (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Nayoshi (Miyabe, '06), Tomarioru (T., '30), Sôni (T., '26), Hishitoma (T., '26), Shiranushi (T., '27, '37), Nishinotoro (Morimoto, '25 ; T., '32, '37), Kaiba-tô (Morimoto, '33). Aniwa Bay: Chishiya (Miyabe, '06), Nobori (T., '26, '35, '37), Yaman (Matsubara, '33), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Airô (T., '27), Rorei (T., '32), Flat Bay (Miyabe, '06).

Distribution. Hokkaido, Kuriles, Saghalien and Korea ; Japan Sea coast of Siberia ; Kamtschatka.

Remarks. The present alga, as in the Kurile Islands (cf. Nagai, 1941, p. 237), is a widely distributed species in southern Saghalien. According to the analysis performed in the chemical laboratory of our Fisheries Institute, it surpasses any other algae tested in the quantity of the bromine content, which reaches nearly 6% of dry weight. Then it is the most promising material for the bromine manufacture from seaweeds in our country.

2. ***Odonthalia dentata*** (L.) Lyngbye

Hydr. Dan., 1819, p. 9, pl. 3 ; Tokida, 1949, p. 70.

Fucus dentatus Linnaeus, Mant. Pl., 1767, p. 35 ; Turner, 1808, pl. 13.

Atomaria dentata Ruprecht, Tange, Ochot. Meer., 1851, p. 209.

(For further references, see Tokida, *loc. cit.*).

Japanese name. Nokogirihiba (Tokida).

Habitat. Growing on rocks in the upper sublittoral belt. W. coast : Tomarioru (T., '30).

Distribution. Saghalien ; Ochotsk Sea ; Kamtschatka ; Bering Sea (St. Lawrence Island) ; British Columbia (Victoria) ; Arctic Ocean ; Atlantic coasts of North America and of Europe ; Kattegat ; Baltic Sea.

Remarks. A few sterile specimens in the writer's hand are referable to the present species as reported in the paper cited above.

3. ***Odonthalia aleutica*** (Mert.) J. Agardh

Hist. Alg. Symb., 1841, p. 28 ; Sp. Alg., II, 3, 1863, p. 895 ; Tokida, 1934*a*, p. 23, pl. 3, pl. 4, fig. a ; 1950, p. 149 ; Yamada & Tanaka, 1944, p. 76.

Fucus aleuticus Mertens, mscr. in Herb. Chamissoi (*fide* J. Agardh).

Japanese name. Aryûshan-nokogirihiba (Okamura).

Habitat. Growing on rocks in the lower littoral and upper sublittoral belts. W. coast : Tomarioru (Miyabe, '06), Yenchishi (Miyabe, '06), Sôni (T., '27), Hishitoma (T., '32), Shiranushi (T., '27, '35, '37), Nishinotoro (Morimoto, '25 ; T., '26, '32, '37). Aniwa Bay : Ishihama (T., '26), Chishiya (T., '35, '37 ; Nakamura, '06), Nobori (T., '26, '35), Merei (Miyabe, '06). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Higashisôya (T., '29), Kashiho (T., '31), Kaihyô-tô (Kubo, '06 ; T., '30, '32 ; Nakashima, '33), Kitashiretoko (T., '35), Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien ; Ochotsk Sea ; Japan Sea coast of Siberia ; Kamtschatka ; Bering Island ; Aryûshan Island ; Alaska.

Remarks. In the papers cited above, the writer gave some notes on the Saghalien specimens referred to this species.

4. ***Odonthalia Kamtschatica*** (Rupr.) J. Agardh

Sp. Alg., II, 3, 1863, p. 896 ; Tokida, 1934*a*, p. 24, pl. 4, fig. b, pls. 5, 6 ; 1950, p. 150 ; Yamada & Tanaka, 1944, p. 77.

Atomaria Kamtschatica Ruprecht, Tange Ochot. Meer., 1851, p. 214.

(For other synonyms, refer to Tokida, 1950, 150)

Japanese name. Kamchakka-nokogirihiba (Okamura).

Habitat. Found cast ashore. W. coast : Sokorai (Miyabe, '06), Nayoshi (Miyabe, '06), Kushunnai (Miyabe, '06), Tomarioru (T., '30), Ushiro (Nakamura, '06). Aniwa Bay : Otai (Miyabe, '06), Nakashiretoko (Miyabe, '06). E. coast : Hota (T., '32), Minabetsu (Matsubara, '33), Rorei (T., '32), Sakaehama (Miyabe, '06 ; T.' '29), Higashishiraura (T., '29), Maguntan (Miyake, '06), Higashisôya (T., '29), Kashiho (T., '31), Unetonnai (Miyabe, '06), Nairo (Miyake, '06), Kaihyô-tô (Kubo, '06 ; T., '30, '32, '35; Nakashima, '32, '33), Kitashiretoko (T., '35). Yôman (T., '35).

Distribution. Hokkaido, Kuriles and Saghalien; Kamtschatka; Bering Island; Pacific coast of North America (Alaska to Washington).

Remarks. In the papers cited above, the writer gave notos on the present determination.

5. ***Odonthalia floccosa*** (Esper) Falkenberg

Rhodomelac., 1901, p. 607; Tokida, 1950, p. 150.
Fucus floccosus Esper, Icon. Fuc., II, 1802 ; Turner, 1808, p. 16, pl. 8.
(For other synonyms, refer to Tokida, 1950, p. 150).

Japanese name. Fusa-nokogirihiba (Yamada).

Habitat. Growing on rocks in the littoral and upper sublittoral belts. W. coast : Tomarioru (T., '30), Rakuma (T., '27, '30), Hirochi (T., '27), Honto (Morimorto, '25), Shiranushi (T., '27), Nishinotoro (T., '37), Kaiba-tô (Morimoto, '37). Aniwa Bay : Ishihama (T., '26), Chishiya (T., '37), Nobori (T., '26), Otai (Miyabe, '06), Merei (Miyabe, '06), Shiraiwa (T., '32). E. coast : Hota (T., '32), Airô (T., '27).

Distribution. Hokkaido, Kuriles and Saghalien ; Bering Island ; Pacific coast of North America (Alaska to Washington, and ? California) ; Hudson Bay.

Remarks. In the papers cited above, the writer gave some notes on the Saghalien specimens referable to this species and on its geographical distribution.

Division IV. CYANOPHYTA Schussnig

Betracht. System nied. Pfl., 1924/25 ; Geitler, *in* Rabenhorst's Kryptog.-Flora, XIV. 1, 1930, p. 88.

Class 4. CYANOPHYCEAE Sachs

Lehrb. Bot., ed. 4, 1874, p. 248.

Order CHAMAESIPHONALES Wettstein

Handb. Syst. Bot., ed. 3, 1924.

Family Pleurocapsaceae Geitler

in Rabenhorst's Kryptog.-Flora, XIV, 2, 1931, p. 315.
Pleurocapsales Geitler, Synopt. Darst. Cyanophyc., 1925, p. 238.

Xenococcus Thuret (*emend.* Geitler)

Essai class. Nostoch., 1875, p. 373 ; Geitler, Synopt. Darst. Cyanophyc., 1925, p. 244.

Xenococcus pyriformis Setchell et Gardner

Plate II, Fig. 5 ; V, Figs. 1-2 ; IX, Fig. 9

in Gardner, New Pac. Coast Mar. Alg., III, 1918, p. 463, pl. 39, fig. 12 ; Setchell & Gardner, 1919, p. 34, pl. 5, fig. 2 ; Geitler, 1931, p. 336, fig. 172.

Japanese name. Nashigata-kusenoawoko (n. n.).

Habitat. Epiphytic on *Rhizoclonium tortuosum.* W. coast : Nishinotoro (T., '35).

Distribution. Saghalien ; Pacific coast of North America.

"Colonies small, single or occasionally confluent, young cells somewhat angular, pyriform to subspherical at maturity, 10–15μ diam., 12–20μ long ; protoplast bright blue-green, cell wall conspicuous, dense, hyaline ; gonidangia the same shape and size as the cells ; gonidia 2.8–3.5μ diam., formed by successive divisions of the protoplast." (Gardner, 1918, p. 463).

Remarks. For the present identification, the writer owes to Dr. H. Hirose of the Kôbe University, who was once a colleague in our Botanical Laboratory of the Fisheries Institute, who is an expert of the blue-green algae. The Saghalien plant agrees well with the original description of the species cited above, except that the gonidia are much smaller, measuring 1–1.5μ in diameter' and that the upper part of the gonidangium is often converted completely into gonidia before the basal portion is. In these respects it seems to resebmle *X. Gildeyae* Setch. et Gardn., but differs from the latter in being as a rule colonial and in having conspicuous cell wall.

During the present study on the marine algae of southern Saghalien, some other blue-green algae have also happened to be met with among certain materials of various algae, but their identification are left for future investigations.

Summary

1. In the present contribution are enumerated all the species of the algae belonging to the classes of Phaeophyceae and Rhodophyceae, and also most of the Chlorophyceae, which are determined to occur on the coast of the southern half of the Island of Saghalien including both the Island of Kaiba-tô and the Islet of Kaihyô-tô. All the species except only one belonging to the Cyanophyceae are left undetermined at present for a future study.

2. The materials of the present study consist mainly of the specimens collected by Dr. K. MIYABE in 1906 and by the writer himself during his ten botanizing excursions from 1926 to 1943.

3. The species here enumerated amount to 182 in all, which are classified into 111 genera and 50 families. Of which 28 species belogn to Chlorophyceae, 66 to Phaeophyceae, 87 to Rhodophyceae, and one to Cyanophyceae. They are all marine except two species and one variety which are the fresh-water or terrestrial forms. The largest family in Chlorophyceae is the Cladophoraceae, comprising 11 species, in Phaeophyceae the Laminariaceae, comprising 13 species, and in Rhodophyceae the Rhodomelaceae, comprising 16 species.

4. In the course of the present study, the writer has established by himself or jointly with Prof. Emer. Dr. K. MIYABE or with Prof. Dr. Y. YAMADA, in the present (*) or in previous papers, the following 2 new genera, 14 new species, one subvariety, 9 forms, 3 subforms, and 2 new combinations :

New genera –

Phaeophyceae : – *Heterosaundersella*

Rhodophyceae : – *Neodilsea*

New species –

Chlorophyceae : – *Aegagropila Kannoi* (*), *Monostroma crassidermum* (*).

Phaeophyceae : – *Streblonema Eudesmide* (*), *Chordaria Nagaii*, *Heterosaundersella Hattoriana*.

Rhodophyceae : – *Neodilsea Yendoana*, *Pugetia palmatifolia*, *Antithamnion sparsum*, *A. corticatum*, *Membranoptera robbeniensis*, *Pseudophycodrys Rainosukei*, *Myriogramme yezoensis* YAMADA et TOKIDA (*in* YAMADA, 1935), *Polycoryne denticulata*, *Janczewskia Morimotoi*.

New subvarieties, forms and subforms –

Chlorophyceae : – *Spongomorpha Mertensii* f. *tenuis*, *Codium dichotomum* var. *typicum* subvar. *yezoense* (*).

Phaeophyceae : – *Heterochordaria abietina* f. *simplex* (*), *Scytosiphon Lomentaria* f. *cylindricus* subf. *nanus* (*), *Laminaria longipes* f. *typicum* MIYABE et TOKIDA (*), *L. diabolica* f. *longipes* MIYABE et TOKIDA (*in* OKAMURA, 1936).

Rhodophyceae : – *Chondrus pinnulatus* f. *typicus*, f. *flabellatus*, f. *longicornis*,

f. *ciliatus* subf. *angustus*, f. *ciliatus* subf. *latus*, f. *cervicornis* (*).

New combinations –

Chlorophyceae : – *Spongomorpha Mertensii* f. *tenuis* (*), *Codium dichotomum* var. *typicum* (SCHMIDT) (*),

Rhodophyceae : – *Halosaccion ramentaceum* f. *Tilesii* (KJELLMAN) (*).

5. The following 3 genera, 18 species, 2 varieties and 6 forms are reported by the writer himself or jointly with Mr. H. OHMI (1941) in the present paper (*) or in previous papers, to be new not only to Saghalien but also to the algal flora of Japan :

Genera new to Japan –

Phaeophyceae : – *Streblonema* (*).

Rhodophyceae : – *Polycoryne*, *Janczewskia*.

Species new to Japan –

Chlorophyceae : – *Hormiscia Wormskioldii* (*), *Monostroma undulatum* (*), *Prasiola crispa*.

Phaeophyceae : – *Sphacelaria plumigera*, *Halopteris scoparia*, *Leptonema fasciculatum*, *Stictyosiphon tortilis*, *Dictyosiphon hippurioides* (*), *Laminaria saccharina*.

Rhodophyceae : – *Rhododermis Georgii* (*), *Euthora fruticulosa*, *Rhodophyllis dichotoma*, *Gymnogongrus Griffithsiae*, *Antithamnion Corallina*, *Ceramium cimbricum*, *Phycodrys rubens*, *Odonthalia dentata*.

Cyanophyceae : – *Xenococcus pyriformis* (*).

Varieties and forms new to Japan –

Chlorophyceae : – *Ulothrix pseudoflacca* f. *major* & f. *minor* (*), *Monostroma undulatum* var. *Farlowii* (*).

Phaeophyceae : – *Leptonema fasciculatum* var. *subcylindricum*, *Laminaria saccharina* f. *linearis*, f. *bullata* & f. *membranacea*.

Rhodophyceae : – *Phycodrys rubens* f. *quercifolia*.

6. The localities where the materials of the present work were obtained are 67 in total number. The algae collected at Kaiba-tô and Shiranushi are 73 in number respectively, showing the largest number among these localities. Next come 64 of Nishinotoro, and then follow 56 of Nobori, 52 of both Chishiya and Kaihyô-tô, 48 of Airô, 47 of Tôbuchi-ko, 44 of Sakaehama, 43 of Yôman, 42 of Merei, and 41 of Sôni. At 29 localities among the rest, the number of the algae collected are less than 10 respectively.

7. The floristic relationships between southern Saghalien and other regions are considered by calculating the species common to each of 26 regions in the whole surface of the globe. The species common to Hokkaido are 141 in number or 77% of the entire flora, showing the largest number among those common to other regions. The species common to the Kuriles are 113 in number or 62% of the entire flora, showing the number next to Hokkaido. The marine floras of Saghalien, Hokkaido, and the Kuriles

are to be said, on the whole, as very similar to each other. The species common to other regions are generally likewise common to Hokkaido, the Kuriles, or Honsyû. The species peculiar to southern Saghalien are 9 in number or 4.9% of the entire flora, all of which are those described by the writer as new to science. One Genus, *Heterosaundersella*, is at present to be said as peculiar to our region. *Streblonema*, *Polycoryne* and *Janczewskia* have not yet been known from other regions in Japan outside Saghalien. Southern Saghalien is, after all, to be taken as a part of "the Japanese Region" of the Pacific Ocean from the viewpoint of the oceanic distribution of marine algae.

8. The species which have a boundary of their distribution at the Strait of Sôya are *Undaria pinnatifida*, *Coccophora Langsdorfii* and *Alaria* spp. The species which have the center of their distribution in the Kurile Islands or elsewhere and occur sporadically in southern Saghalien are *Arthrothamnus kurilensis*, *Laminaria longipes*, *L. dentigera*, *Alaria fistulosa* and *Kjellmaniella crassifolia*. The species of the temperate origin, which have the northernmost boundary of their distribution in southern Saghalien, especially at Kaiba-tô, are *Gelidium* spp., *Nemalion vermiculare*, *Branchioglossum nanum* and *Antithamnion nipponicum*.

9. Considering from the temperature data, the coast of southern Saghalien may be divided into the following five Sections : I. The western coast from Muitomari northward, including Kaiba-tô ; II. The Aniwa Bay coast ; III. The eastern coast as far north as Taraika Bay ; IV. The eastern coast from Kaihyô-tô and Cape Kitashiretoko northward ; V. The cold water region in the vicinity of Cape Nishinotoro. The Sections I & II are situated betweeen the isotheres of 15°C. and 20°C., III between 15°C. and 18°C., IV between 10°C. and 15°C., and V between 5°C. and 10°C. The Sections I, II, & III are then considered to belong to the North Temperate Zone according to the division of oceans by SETCHELL (1914), and are more or less rich in the species of temperate origin. The Section IV belongs to the Lower Boreal Zone, and is characterized by the disappearance or decrease of some temperate species such as *Acrothrix pacifica*, *Chorda Filum*, etc. and by the increase of some arctic species such as *Spongomorpha Mertensii*, *Callymenia reniformis*, *Antithamnion Corallina* etc. The Section V belongs to the Upper Boreal Zone, and is in sharp contrast with the others in the feature of the sublittoral vegetation, which consists principally of the most characteristic species of the Laminariaceae such as *Laminaria diabolica* f. *longipes*, *L. dentigera*, *Kjellmaniella crassifolia*, *Arthrothamnus kurilensis* and *Alaria fistulosa*.

10. The economic possibilities of the algae of southern Saghalien are described under the following topics : *"The 'Kombu' industry"*, *"The 'Kanten' industry"*, *"Algal slime or glue"*. *"The kelp industry"*, *"Algae as a source of bromine"*. *"Algae as medicine"*. *"Seaweed cultivation"*, and *"Algae used by the peoples of other countries."* The useful species found in our region, which are utilized for food or for other purposes among our countrymen, are 75 in number or 42.4% of the total number of the algal

species, of which 9 belong to Chlorophyceae, 33 to Phaeophyceae and 33 to Rhodophyceae. The edible species are 48 in number, which correspond to 27% of the entire flora and 63.1% of the number of the useful algal species. The following species were treated in Saghalien as the articles of commerce: *Heterochordaria abietina*, the species of the Laminariaceae excepting *Costaria costata* and *Agarum cribrosum*, *Porphyra* spp., *Gloiopeltis furcata*, *Gracilaria verrucosa*, *Ahnfeltia plicata*, *Chondrus* spp.. *Iridophycus* spp., *Rhodoglossum pulchrum*, and *Campylaephora hypnaeoides*. Of these species, those of the Laminariaceae (excl. *Alaria* spp.,) covered by the name "*kombu*" stand first in the annual production. Next comes "*kanten*" prepared from *Ahnfeltia plicata*, and then follow "*hoshinori*" (*Porphyra*), "*ginnansô*" (*Iridophycus* & *Rhodoglossum*), and "*funori*" (*Gloiopeltis*).

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Index of Latin Names

Pages where diagnoses or remarks appear are in boldface.

Acrosiphonia duriuscula 43, 45
Mertensii 45
Acrosorium 206, **214**
Yendoi **214**
Acrothamnion pulchellum 197
Acrothricaceae **83**, **96**
Acrothrix **96**
pacifica **96**
Aculeatae **99**
Aegagropila 35, **47**
clavuligera 48
Kannoi **47**
kurilensis 48
Lagerheimii 47, 48
Sauteri 48
Aegira virescens 89
Agarum 114, **121**
cribrosum **121**
Gmelini **121**
pertusum 121
Turneri 121
Ahnfeltia **175**
cretacea 203
paradoxa 28
plicata 40, **175**
f. *pumila* 177
f. *setosa* 176
f. *tenuior* 177
var. *tobuchiensis* 40, 75, 117, 175, **176** 178, 202, 213, 218
Alaria 114, **124**
corrugata 125
crispa 126
dolichorhachis 124, **126**
f. *longipes* **126**
f. *typica* **126**
elliptica 120
esculenta latifolia 125
esculenta pinnatifida **124**
fistulosa **124**
f. *stenophylla* 124
laticosta 125
macrophylla 125
macroptera 124, **125**
ochotensis 124, **125**
Amphiroa **160**
cretacea **160**
f. *rosariformis* 160
f. *typica* **160**
Anisocladus 76
Antithamnion 195, **196**
applicitum 197
Baylesiae 197
boreale 198
f. *baltica* 198
f. *corallina* 198
sparusum **196**
Corallina 196, **198**
corticatum **198**
cruciatum 197
defectum 196, 197
densiusculum 197
glanduliferum 196
Miharai 196
nippoincum 196, **197**
Plumula 196
var. *boreale* f. *corallina* 198
pulchellum 197
ramulosum 196
setaceum 197
Shimamuranum 198
sparsum **196**, 197
Aplanosporeae **74**, **127**
Arthrothamnus 114, **123**
kurilensis **123**
longipes 114
Asperococcaceae 100, **102**
Asperococcus Cystoseirae 109
sinuosus 106
Atomaria corymbifera 223
dentata 223
Kamtschatica 224
Bangia 142, **143**
Alsidii 141
atropurpurea 143
ceramicola 142
elegans 141
fusco-purpurea **143**
Bangiaceae **141**
Bangiales 140, **141**
Bangieae 141, 142, **143**
Bangioideae 140
Blastosporaceae 66
Blastosporeae 66

Branchioglossum 205, **206**
nanum **206**
Bryopsidaceae 70
Bryopsis **71**
hypnoides **71**
f. *adriatica* 71
Calliphyllis cristata 167, 169
incisa 167
Callithamnion Corallina 198
Callophyllis **166**
japonica 168
rhyncocarpa **167,** 168, 169
f. *acutiloba* 167 ,169
f. *crispata* 168, 169
f. *incisa* **168**
f. *obtusiloba* 167, **168,** 169
f. *subsimplex* 167
Sobolifera 190
Callymenia 166, **169**
ornata 69 ,188
reniformis **170**
var. *cuneata* **170**
var. *undulata* 170
Callymeniaceae 153, **165**
Callymenieae 165
Camphylaephora
crassa 204
f. *borealis* **204**
f. *cymosa* **204**
f. *elongata* **204**
f. *typica* **204**
hypnaeoides 196, 203, **205**
Castagnea virescens 89
Caulerpaceae **70**
Caulerpales 70
Cermaiaceae **195**
Cermaiales 151, **195**
Cermaieae 195
Ceramium 196, **201,** 203
boreale 204
cimbricum 201, **202**
confervoides 78
crassum **204**
cymosa 204
hamatum 205
hypnaeoides 205
japonicum 201, **203**
Kondoi 201, **202**
f. *ambiguam* 202, **203**
f. *trichotomum* 202, **203**
f. *typicum* **202**
rubrum 202
Chaetomorpha 35, **40**
aerea 40, **41**
f. *Linum* 40
cannabina 37
confervicola 36, 37
Linum **40,** 41, 83, 84, 103
f. *aerea* 41
melagonium 37
moniligera 39, 40, 41
tortuosa 36, 37
Wormskioldii 38
Chaetophorales 33
Chamaesiphonales **225**
Champiaceae **194**
Chelyosoma siboja 198
Chlorochytriaceae **68**
Chlorochytrium **68,** 69
gloeophilum 69
inclusum **69**
Lemnae 68
Moorei 68
Chlorococcales 32, **68**
Chlorophyceae **32**
Chlorophyta **32**
Chlorospermeae 32
Chondria 215, **217**
dasyphylla **218**
glandulifera 216
purpurascens 154
obtusa var. *paniculata* 216
tenuissima 218
Chondrieae **217**
Chondriopsis dasyphylla 218
Chondrus **177,** 181
armatus **178**
crispus 181, 182
mamillosus var. *ochotensis* 181, 182
var. *unalaschcensis* 182
var. *sitchensis* 182
ocheratus
f. *crispus* 182
pinnulatus **178,** 180, 203, 205
f. *cervicornis* 178, 181
f. *ciliatus*
subf. *angustus* 179, **180**
subf. *latus* 179, **180**
f. *conglobatus* 180
f. *flabellatus* 178, **179**
f. *longicornis* 178, **179**
f. *typicus* 178, **179,** 180
Chorda **112,** 141
Filum 41, 96, 97, **112,** 113
var. *β septigera* 113
Lomentaria 104

Chordaceae 83, **88**
Chordaria 88, **90**
abietina 93
Chordaria 90
Cladosiphon 90
firma 91, **92**
flagelliformis **91,** 92, 95, 110, 111, 112
f. *chordaeformis* 91, **92**
var. β *Hippurioides* 111
f. *typica* **91**
Nagaii 82, 91, **92**
sp. 92, 93
Chordariaceae **112**
Chordariales 74
Cladhymenia 217
Cladophora 35, **42,** 88, 141, 142
alaskana 45
arcta 45
clavuligera 48
diffusa 44
glaucescens **42,** 143
glomerata 35
Lagerheimii 48
Mertenssi 45
scopaeformis 45
Stimpsonii 42, **43**
viminea 46
Cladophoraceae 34, **35**
Cladophorales 34, **83**
Cladophorineae 33, **34**
Codiaceae 70, **71**
Codiales 70
Codieae 71
Codium **71,** 72
Brandegeei 73
dichotomum **71,** 72, 73
var. *typicum* **72**
subvar. *yezoense* **72,** 73
fragile 72
simulans 72, 73
tomentosum 71, 72
var. γ *typicum* 72
Coilodesmaceae **109**
Coilodesme 100, **109**
bulligera 109, **110**
f. *fucicola* 109, **110**
californica 110
Cystoseirae **101,** 110
fucicola 110
japonica 109, **110**
linearis 109
Colpomenia 103, **106**
sinuosa **106,**107
f. *deformans* 106, **107**
f. *typica* **106,** 109
Conferva aerea **41**
cannabina 37
carnea 142
cartilaginea 45
ceramicola 142
coalita 45
confervicola 37
duriuscula 43, 44
foeniculacea 111
fusco-purpurea 143
glaucescens 42
Linum 40
littoralis 77
Mertensii 45
penicilliformis 37
scoparia 76
tortuosa 36
urceolata 219
viminea 46
Wormskioldii 38
Constantinea **157**
Rosa-marina **157**
Sitchensis 157
subulifera 158
Corallineae 159
Corallina 88, 107, 159, **161**
cretacea 160
officinalis
f. *pilulifera* 161
pilulifera **161,** 192, 203
α *flabellata* 161
β. *sororia* 161
γ. *filiformis* 161
f. *filiformis* **161**
f. *intermedia* 161
f. *arbuscula* 161
f. *typica* 161
Corallinaceae 153, **159**
Corallineae 159, **160**
Corynephora umbellata 86
Corynophlaea 86
umbellata 86
Corynophloeaceae 86
Costaria 114, **122**
costata 122, **123**
f. *cuneata* **122**
f. *latifolia* 122
Turneri 122
var. *pertusa* 122, 123
quadrinervia 123

Cruoria verrucosa **82**
Cryptonemiales 151, 153
Cryptopleura-group 206
Cyanophyceae **225**
Cyanophyta **225**
Cyclosporeae **74**, **128**
Cystoclonium armatum 178
purpurascens 154
Cystophyllum 64, 131, 134
crassipes 106, 109, 132, **133**, 134
geminatum 87, 131, **132**, 133, 205
hakodatense 87, 132, **133**
Lepidium 132
Thunbergii 137
Cystoseira crassipes 132, 133
geminata 132, 133
hypocarpa 132
Lepidium 87, 132
Spicigera 132
Thunbergii 137
thyrsigera 132
β *Lepidium* 132
Dasycladaceae 70
Delesseria Baerii 208
crassifolia 206
crenata 209
var. *quercifolia* 210
var. *serratiloba* 211
fimbriata 212
glandulosa 166
kurilensis 213
Middendorffii 213
sinuosa 209, 212
f. *quercifolia* 210
Delesseriaceae 195, **205**
Delesserieae **206**
Desmarestia **97**
aculeata 97, **99**
Forma 98
var. *media* 98
latifrons 99
ligulata 97
media 97, **98**
var. *tenuis* 98
viridis 97, **98**
Desmarestiaceae **97**
Desmarestiales 94, **97**
Dicholria viridis 98
Dictyopteris **128**
divaricata **128**
Dictyosiphon **111**
Chordaria 95
foeniculaceus 111, **112**
f. *hippunoides* 111
hippurioides **111**
Dictyosiphonaceae 100, **111**
Dictyosiphonales 74, **100**
Dictyota **127**
dichotoma **127**
spathulata 128
Dictyotaceae **127**
Dictyotales 74, **127**
Dilsea edulis 156
integra 156
Diplastidia 150
Diploderma 144, **148**
amplissima **150**
variegatum 149
Dumontia **153**
contorta 154, 155
decapitata 191
filiformis 154, 155
fucicola 191, 192
furcata 163
hydrophora 191, 192
incrassata 153, **154**, 155
ramentacea 193
saccata 191
simplex 154, **155**
sobolifera 193
tubulosa 193
Dumontiaceae **153**
Dumontieae 153
Ectocarpaceae **77**
Ectocarpales 73, **76**, 77
Ectocarpus 77, **78**, 79
confervoides **78**, 79
f. *typicus* **74**
littoralis 78
fusiforme 79
siliculosus 79
Elachistaceae **83**
Encoelium sinuosum 106
Endarachne 108
binghamae 108
Endocladiaceae 153, **163**
Endosphaeraceae 68
Enelittosiphonia 115
Enteromorpha **49**
arctica 52
clathrata f. *uncinata* 52
var. *erecta* 53
coarctata 51
compressa 50
var. *intestinalis* 55
var. *minima* 50

f. *micrococca* 51
var. *prolifera* 54
erecta 53
intestinalis 50, 54, 55
β *micrococca* 51
var. *minima* 50
f. *prolifera* 54
Linza 49, **55,** 56, 65
micrococca 51
f. *subsalsa* 52
minima 50, 51
f. *rivularis* 52
nana **50**
var. *minima* 50, **51**
var. *subsalsa* 50, **52**
paradoxa 53
β *tenuissima* 53
pilifera 54
plumosa 49, **53**
prolifera 50, **53**
var. *arctica* 54
var. *trabeculata* 56
Erythrotrichia **142**
carnea **142**
ceramicola **142**
Erythrotrichieae **142**
Eudesme **88**
virescens 80, **88**
Euflorideae 150
Euhymenia Dubyi 171
reniformis 170
Euporphyra **144**
Euthora 147, 165, **166**
fruticulosa **166,** 199
Eu-ulotrichales 33
Farlowia **157**
irregularis 69, **157**
mollis 157
Florideae 140, 150
Fucaceae **129**
Fucales 74, **128**
Fucoideae 73
Fucus **129**
aculeatus 99
Agarum 121
aleuticus 224
Amansii 152
asplenioides 200
Babingtonii 130
barbatus 193
confervoides **174**
contortus 154, **155**
corymbiferus 223
costatus 122
crassipes 133
crenatus 209
cribrosus 121
crinitus 164
dasyphyllus 218
dentatus 223
dichotomus 173
dulcis 187
evanescens 77, 78, **129,** 130
f. *cornutus* 130
f. *fusiformis* 130
f. *intermedius* 130
f. *marginatus* 130
f. *pergrandis* 130
f. *pusillus* 130
f. *rudis* 130
f. *stellatus* 130
expansa palmama humanam referens 187
Fascia 107, 108
Eilum 113
flagelliformis 91
fuliginosum 81
fungiformis 81
Griffithsiae 175
heterophyllus 136
Horneri 135
kakiloides 133
Larix 221
Lepidium 132
ligulatus 99
longifolius 136
var. *tenuifolius* 136
pallidus 136
palmatus 187
pectinatus 199
plicatus 175
ramentaceus 193, 194
reniformis 170
rosa-marina 157
roseus 209
rubens 209
saccatus 191
saccharinus 115
sarniensis 187, 190, 191
serratifolius 136
sinuosus 209, 211
β *incrassata* 211
γ *quercifolius* 210,211
soboliferus 190, 191, 193
subtilis 111
spicigera 132

Thunbergii 137
tomentosus 71
tubulosus 193, 194
vesiculosus 129
viridis 98
Wrightii 130
Fuscaria Larix 222
Gastridium filiforme 154
var. *incrassata* 154
Gayella 67
Gelidiaceae **151**
Gelidiales **151**
Gelidieae 151
Gelidium **152,** 174
Amansii **152**
f. *typicum* **152**
cartilagineum 152
crinitum 164
vagum **152**
Gigartina 177, **181**
fastigiata 175
ochotensis **181,** 182
pacifica **181,** 182
plicata 175
sitchensis 181
unalaschcensis 181, 182
f. *grandifolia* 182
f. *typica* 182
f. *irregularis* 182
Gigartinaceae 171, 177
Gigarinales 151, **171**
Gigartineae **177**
Gloiodermate 177
Gloiopeltis **163**
coliformis 163
furcata **163**
var. *coliformis* 163
f. *coliformis* **163**
Gobia 95
baltica 95
saxicola 95
simplex 95
Goniotrichum **141**
Alsidii **141**
elegans 141
var. *Alsidii* 141
Gonodia **85,** 83
Sargassi **85,** 86
Gracilaria **173**
confervoides 174
verrucosa 174
Gracilariaceae 171, **173**
Grateloupia **162**
divaricata **162**
filicina 162
prolongata **162**
turuturu 162, **163**
Grateloupiaceae 153, **162**
Gymnogongrus **175**
Griffithsiae **175**
pinnulatus **178**
plicatus 175
Halidrys vesiculosa 129
Haliseris 128
divaricata 128
evanescens 128
Halochloa serratifolia 136
longifolia 136
serratifolia β longifolia 136
Halopteris 74, **76**
scoparia **76**
Halosaccion **191**
decapitatum 191
firmum 192
fucicola 191, 192
glandiforme 191, 192
Hydrophora 191
Hydrophorum 191
Lepechini 191
microsporum 192
var. *subsimplex* 192
ramentaceusm 191, 192, **193,** 194
f. *densum* **193**
f. *ramosum* **193,** 194
f. *robustum* **193**
f. *Tilesii* 193, **194**
subf. *proliferum* 194, **195**
saccatum **191,** 192
soboliferum 193
Tilesii 194
f. *prolifera* 194
tubulosum 193
Halothrix **83,84**
ambigua **84,** 85
lumbricalis 85
Halymenia Dubyi 171
filiformis 154
palmata **187**
ε Sarniensis **190**
purpurascens 154
Sobolifera 190
turuturu 163
Hapalosiphon filiformis 109
Haplostichales 83
Haplostichineae **73, 83**
Helminthocladiaceae **151**

Helminthocladiae 151
Herbaceae 99
Heterocarpeae 140
Heterochordaria 88, **93**
abietina **93,** 94, 95, 107
f. *simplex* **94**
Gunjii 94
Heteroderma **159**
zostericola **159**
Heterogeneratae 73, **83**
Heterosaundersella 88, **95**
Hattoriana **95**
Homoeostroma plantagineum 101
Hormiscia 34, 35, **37,** 40
doliifera 38
grandis 38, 40
penicilliformis **37,** 38, 40
sphaerulifera 40
tetraciliata 61
vancoquveeriianna 39
Wormskioldii **38,** 39, 40
Hyalosiphonia **158**
caespitosa 158
Hydroclathrus sinuosus 106
Hypoglossum-group 205
Hypophyllum 206
Middendorffii 75, 213
Ilea 103, **107**
Fascia 107, **108**
f. *caespitosa* 107, **108**
f. *typica* 107, **108**
Iridaea 69, 183
cornucopiae 183
laminarioides 183
var. *cornucopiae* 183
Mertensiana 172
pulchra 184
Iridophycus 177, **183**
Boryanum 183
cornucopiae 69, 156, **183**
subdichotomum 183, **184**
Isogeneratae 73, **74**
Isokontae 32
Janczewskia 215, **216,** 217
moriformis **217**
Morimotoi 216, **217**
Kallymenia Dubyi 171
rosa marina 157
Kjellmaniella 114, **120**
crassifolia **120**
Laingia 205, **206**
Hockeri 207
pacifica **206,** 207
Laminaria **114,** 116, 117, 118, 202, 219
caespitosa 108
cichorioides
var. *sachalinensis* 115, 116
costata 122
dentigera 114, **120**
diabolica 114, **118,** 119
f. *genuina* 118, **119**
f. *longipes* 118, **119**
Fascia 108
japonica 118
f. *angusta* 118
var. *ochotensis* 118
latifolia 115
longipedalis 119
var. *diabolica* 119
longipes **114,** 115, 117, 118
f. *angustifolia* 114
f. *typica* **114,** 115
ochotensis 114, **118**
Ruprechtiana 114
saccharina 114, **115**
β angustifolia 114
f. *bullata* 116, **117**
f. *linearis* 116, **117**
f. *membranacea* 116, **117,** 118
Laminariaceae 112, **113**
Laminariales 74,**112**
Laurencia **215,** 216, 217
glandulifera **216**
nipponica **216,** 217
paniculata 216
f. *patentiramea* 216
Laurencieae **215**
Leathesia **86**
difformis 86, **88**
globulifera **87**
sphaerocephala 86, **87**
umbellata 85, **86,** 87
Leathesiaceae 83,**86**
Leptonema 82, **84**
fasciculatum **83**
var. *subcylindricum* **83**
Lessonia repens 114
Linkia zosterae 89
Lithodermataceae 77, **81**
Lithophyllum zostericolum 159
Lomentaria **195**
hakodatensis **195**
sinensis 195
Lophura Larix 222
macracantha 222
Macrosiphon asperococcoidea 107

Mastocarpus 181
Mazzaella 183
Melanophyceae **73**
Melanospermeae **73**
Melobesia zostericola 159
Melobesieae **159**
Membranoptera 147, 205, **207**, 208
robbeniensis **208**
Membranoptera-group 205, **207**
Mesogloia simplex 95
virescens 85
zosterae 89
Microcoelia 169
chilensis 170
Microspongium Kuckuckianum 93
Monostroma **58**
angicava 59, **62**, 63
arcticum 59, **61**
crassidermum 59, **63**, 65
fuscum 59, **64**, 65
var. *Blyttii* 66
var. *splendens* 59, **65**, 66
f. *splendens* 65
var. *typicum* **64**, 65, 66
Grevillei γ *arctica* 62
var. *arctica* 64
var. *intestiniformis* 64
leptodermum 59
pulchrum 60
var. *asiaticum* 61
splendens 65
undulatum 60
var. *Farlowii* 59, **60**
zostericola 58, **59**
Monostromaceae 49, **58**
Myagropsis Thunbergii 137
Myelophycus **102**
intestinale **102**
f. *tenue* 102
Myriactis 85
pulvinata 85
Sargassi 85
Myriogramme 206, **213**
denticulata 214
Gunniana 214
pristoidea 214
yezoensis **213**
Myriogramme-group 206, **213**
Mytilus 82,197
Nemacystus decipiens 92, 96
Nemalion 115
elminthoides
var. *vermiculare* 151
helminthoides 151
vermiculare 151
Nemalionaceae 151
Nemalionales **151**
Nemastomaceae **171**
Nemastomeae 171
Neodilsea **156**
fruticulosa 166
integra 156
Yendoana 69, **156**
Nereidea fruticulosa 166
Neurocarpus 128
divaricata **128**
divaricatus 128
Neurocaulon rosa marina 157
Nitophylleae 205, **208**
Nitophyllum monanthos 214
Odonthalia 101, 147, 161, 173, 212, 215, **223**
aleutica 208, 223, **224**
corymbifera **223**
dentata **223**
floccosa 223
f. *macracantha* 222
Gmelini 223
Kamtschatica 47, 173, 223, **224**
Olpidium 44
Sphacelarum 76
Sphacelariariarum **76**
Orcasia Morrowii 219
Pacificae 181
Padina deusta 81
Palmaria expansa 187
var. *marginifera* 187
Palmatae 181
Pantoneura Baerii 208
Pecten yezoensis 198
Pelvetia 129, **130**
Babingtonii 130
japonica 130
Wrightii
f. *Babingtonii* 131
f. *japonica* 131
f. *typica* 131
Petalonia Fascia 107
var. *caespitosa* 108
Phaeophyceae **73**
Phaeophyta **73**
Phaeosporeae 73, **74**
Phasganon alatum
var. *longipes* 126
fistulosum 124
macropterum 125
Phloeospora pumila 103

tortilis 103
Phycodrys **204**
fimbriata 199, 209, 210, 211, **212**, 214
rubens 207, **209**, 210, 212, 214
f. *quercifolia* **210**, 211
f. *typica* 211
sinuosa 209, 211
Phycodrys-group **209**
Phyllitis caespitosa 108
Fascia 107
α fascia 108
β caespitosa 108
var. *caespitosa* 108
Phyllophoraceae 171, **174**
Phyllospadix 59, 62, 105, 204
iwatensis 85, 160
Phypophyllum 212
Middendorffii 212
Pithophora 48
Planosporaceae 68
Pleurocapsaceae **225**
Pleurocapsales 225
Plumaria asplenioides 200
californica 200
pectinata 199
Polycoryne 206, **214**
denticulata **214**
Polyostera gemmifera 220
Polysiphonia 215, **218**
bipinnata 220
japonica 218, 219
mollis 219
Morrowii 218, **219**
Savatieri 219
urcerolata 218, 219
violacea 219
Polysiphonieae **218**
Polystichales **100**
Polystichineae 74, **100**
Porphyra 142, **144**
abyssicola 150
amplissima 144, 150
f. *crassa* 150
f. *elliptica*
f. *elliptica* 150
f. *lanceolata* 150
hiemalis 145
lanciolata 150
laciniata 146
f. *laciniata* 146
f. *linearis* **145**, 146
f. *typica* 146
var. *umbilicalis* **145**
f. *vulgaris* 145, 146
linearis 145, 146, 147
miniata f. *abyssicola* 150
f. *amplissima* 150
occidentalis 149
ochotensis 144, 148
Onoi 150
perforata 148
pseudolinearis 144, 147, **148**
pulchra 150
purpurea 146
tenera 69
umbilicalis **144**, 145, 146, 148
f. *epiphytica* 146
f. *laciniata* **145**, 147
f. *linearis* 144, **145**, 147
f. *vulgaris* 144, **145**, 147
f. *sanguinea* 147
umbilicata 144
f. *laciniata* 144
var. *laciniata* 145
f. *perforata* 148
var. *vulgaris* 145, 146
variegata 144, **149**
vulgaris 145, 146
f. *linearis* 145
Porphyraceae **140**, 141
Porphyreae 141
Porphyridiaceae 140
Porphyridiales **140**
Potamilla myriops 197, 202
Prasiola **66**
crispa **66**, 67, 68
subsp. *eu-crispa* **67**
japonica 67
Prasiolaceae 66
Prasiolales 32, **66**
Prionitis crinita 164
Protococcales 68
Protoflorideae **140**
Pseudobyropsis 70
Pseudophycodrys 206, **208**
pacifica 207
Rainosukei **208**
Pseudophycodrys-group 206, 208
Pterosiphonia 215, **220**, 221
arctica 221
bipinnata **220**, 221
robusta 220, 221
Pterosiphonieae **220**
Pterota asplenioides 200
californica 200
Ptilota 147, 166, 173, 196, **199**, 200, 212

asplenioides 199, **200,** 201, 208
f. *alternans* 201
f. *latifolia* 201
f. *typica* 201
californica 200
pectinata 192, 199, 203, 208
plumosa α asplenioides 200
var. *serrata* 199
serrata 199
Pugetia 166, **169**
japonica 170
palmatifolia **169**
Punctaria **100,** 101
fissilis 101
plantaginea **100,** 101
Punctariaceae **100**
Pylaiella **77**
flexilis **78**
littoralis **77,** 78
Norlandica 78
ochotensis **77**
β Kamtschatica 78
lomentacea 78
siliquosa 78
olivacea **77**
pyrhrogo 78
saxatilis 78
Ralfsia **81**
Borneti 81, 82
deusta 81
fungiformis **81**
verrucosa **82**
Ralfsiaceae 81
Rhizoclonium 34, **35,** 141
implexum 36
tortuosum **35,** 36, 37, 75
f. *longiarticulatum* 37
Rhodocalis asplenioides 200
Rhododermis 158
Georgii **158,** 159
var. *fucicola* 159
Van Heurckii 158
Rhodoglossum 177, 184
pulchrum 69, 156, 183, 184
f. *divergens* 184
f. *luxurians* **185**
f. *typicum* 184, 185
Rhodomela 62, 101, 215, **221**
corymbifera 223
Larix 34, 36, 75, 106, 192, 204, 205, **221**
macracantha 221, **222**
subfusca 222
Thunbergii 137
Rhodomelaceae 195, **215**
Rhodomeleae **221**
Rhodomenia 186
Farbiciana 166
Rhodomeniaceae 186
Rhodophyceae **140**
Rhodophyllidaceae 171, **172**
Rhodophyllis 147, 166, **172**
capillaris **173**
dichotoma **173,**208
Rhodophysema Georgii 158
Rhodophyta **140**
Rhodospermeae 140
Rhodymenia **186**
palmata **187,** 192
f. *prolifera* 188, **189**
var. *sobolifera* **190,** 191
f. *sarniensis* 188, **190**
f. *typica* **187, 189**
subf. *marginifera* 188
pertusa **186**
sobolifera 188, 190
Rhodymeniaceae **186**
Rhodymeniales 151
Rivularia zosterae 89
Ruprechtiella-group **212**
Sarcophyllis edulis 156
Sargassaceae 129, **134**
Sargassum 106, 136, **134,** 137, 142
accinaria 136
confusum 86, 134, 136, 137, 205
f. *typica* 137
f. *validum* 134, **137**
Coreanum 135
corynocarpum 136
expansum 137
Fengeri 135
fuliginosum 136
Horneri **134,** 135
var. *spathulatum* 135
Kjellmanianum 85, 86, 134, **138,** 139
Miyabei 75, 85, 134, **139**
patens 135
polyodontum 135
Ringgoldianum 135,
serratifolium 134, **135,** 136
spathulatum **135**
Thunbergii **137,** 138
f. *latifolium* 134, **138**
f. *nipponicum* 134, **138**
validum 137

Saundersella 88, **94**, 95
simplex **95**, 96
Scaphospora 197
Schizogoniaceae 66
Schizogoniales 66
Schizymenia **171**
Dubyi **171**
edulis 156
Scytosiphon 103, 104
bullosus 107
erectus 53
Filum 113
foeniculaceus **111**
hippurioides 111
Lomentaria **104, 111**
f. *cylindricus* 105
subf. *major* 104, 105
subf. *nanus* 104, **105**
f. *tortilis* 104, **105**
f. *typicus* **104**, 105
var. *typicus* 104
ramentaceus 194
tortilis 103
Scytosiphonaceae 100, **103**
Siphonaceae 70
Siphonales 32, **70**
Siphoneae 70
Siphonocladiales 70
Sirophysalis crassipes 133
geminata 132
kakiloides 133
Solieriaceae 171, 172
Sphacelaria **74**
plumigera 74, **75**
scoparia 76
subfusca **75**
variabilis 75
Sphacelariaceae 174
Sphacelariales 73, 74
Sphacelarieae 74
Sphaerococcus cartilagineus
β setaceus 152
crinitus 164
palmatus 187
γ prolifera 189
sarniensis 190
Soboliferus 190
Sphaeropleaceae 35
Sphaerotrichia 88, **89**
divariacata 90
japonica **90**
Spongia dichotoma **71**
Spongocarpus Horneri 135
Spongomorpha 35, **43**
duriuscula **43**, 44, 46, 47, 48, 75
var. *cartilaginea* 43, **45**
var. *tenuis* 40
Hystrix 44
Mertensii 43, **45**, 46, 47
var. *tenuis* 43, **47**
ochotensis 46
f. *tenuis* 47
Sporochnus medius 98
Squamariaceae 153, **158**
Squamarieae **158**
Stictyosiphon **103**
tortilis **84, 103**
Stragulariaceae 81
Streblonema 77, **80**, 81
anomalum 80
Eudesmidis **80**
irregularis 80
Johnstonae 80
Striariaceae 100, **103**
Stypocaulon 76
scoparium 76
Tichocarpaceae 153, **164**
Tichocarpeae 164, 174
Tichocarpus 62, **164**
crinitus 75, 164, **165**
Tilopteridaceae 197
Tremella difformis 88
marina umbilicata 144
Turbinaria Thunbergii 138
Turnerella **172**
Mertensiana **172**
Tylocarpeae 174
Ulothricheae 33
Ulothrix **33**
flacca 38
pseudoflacca **33**, 38
f. *major* 33, **34**
f. *minor* 33, **34**
Ulotrichaceae **33**
Ulotrichales **32**
Ulotrichineae **33**
Ulva 49, **57**
crispa 67
dichotoma 127
enteromorpha
γ intestinalis
f. *micrococca* 51
var. *intestinalis* 55
filiformis 154
fusca 64
glandiformis 191

incrassiata 154
intestinalis 54, 51
ε nana 50
laciniata 145
Linza 50
plantaginesa 101
pertusa 57
prolifera 53
purpurascens 154
Purpurea 145, 146, 147
β elongata 145
sinuosa 106
sobolifera 193
splendens 65
umbilicalis 144, 145, 146
Ulvaceae 49, 58
Ulvales 32, **48**
Ulvaria 58
Urospora 37
penicilliformis 37
Wormiskioldii 38
Wildemania 148
bulbopes 146
laciniata 146
linearis 145
perforata 148
umbilicalis 144
variegata 149
Xenococcus **225**
Gildeyae 226
pyriformis **225**
Yendonia crassifolia 207, 213
japonica 213
Yendonia-group **212**
Zonaria deusta 81
Zostera 158, 219
caespitosa 85
marina 160

EXPLANATION OF PLATES

Plate I

Hormiscia Wormskioldii (Mert.) Fries

Fig. 1, habit of a typical filament with moniliform spherical segments in the upper portion, × 12. a, basal portion ; b, lower portion ; c, middle portion ; d, upper fertile portion. Fig. 2, habit of a thinner filament composed of long cylindrical segments, × 12. Fig. 3, parts of a thinner filament composed of very short segments toward the base and small moniliform spherical segments in the upper fertile portion, × 12. Fig. 4, basal portion of a filament showing rhizoids, × 35. Fig. 5, a basal segment issuing the rhizoid, showing the reticulate chromatophore, × 140. Fig. 6, a lower segment showing the fenestrate chromatophore, × 140. Fig. 7, portion of the chromatophore of a large segment measuring 1.2 mm. long and 0.87 mm. diam., × 300.

(See also Pl. XII, D).

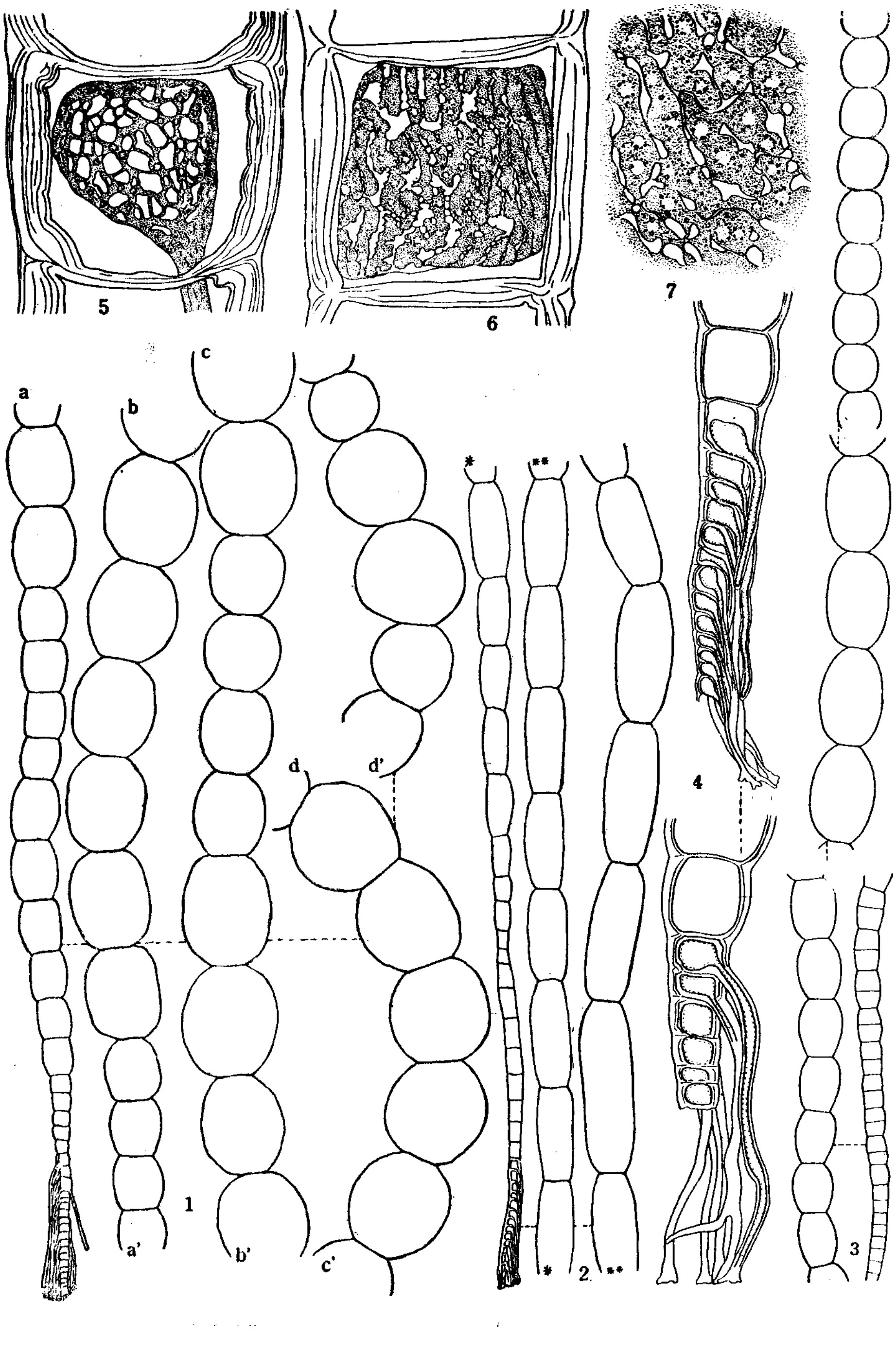
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Plate II

Figs. 1–4. *Cladohora Stimpsonii* Harv. : Fig. 1, lower portion of a filament showing the branching mode and seriate sporangia, all emptied, × 8. Fig. 2, middle and upper portions of a filament, showing the branching mode and pointed branch tips, × 8. Fig. 3, fertile apical segments terminating with a mucro, three at the left being provided with an opening and emptied, × 80. Fig. 4, a sterile apical segment, × 80.

Fig. 5. *Xenococcus pyriformis* Setch. et Gardn. A group of colonies growing on *Rhizoclonium tortuosum*. × 340. (See also Pl. V, Figs. 1–2, Pl. IX, Fig. 9).

Figs. 6–8. *Codium dichotomum* (Huds.) Setch. : Fig. 6, an utriculus with two gametangia, × 25. Fig. 7, two utriculi, × 30. Fig. 8, apical portion of utriculi in the middle portion of the thallus, showing the various shape of the apical wall, × 25.

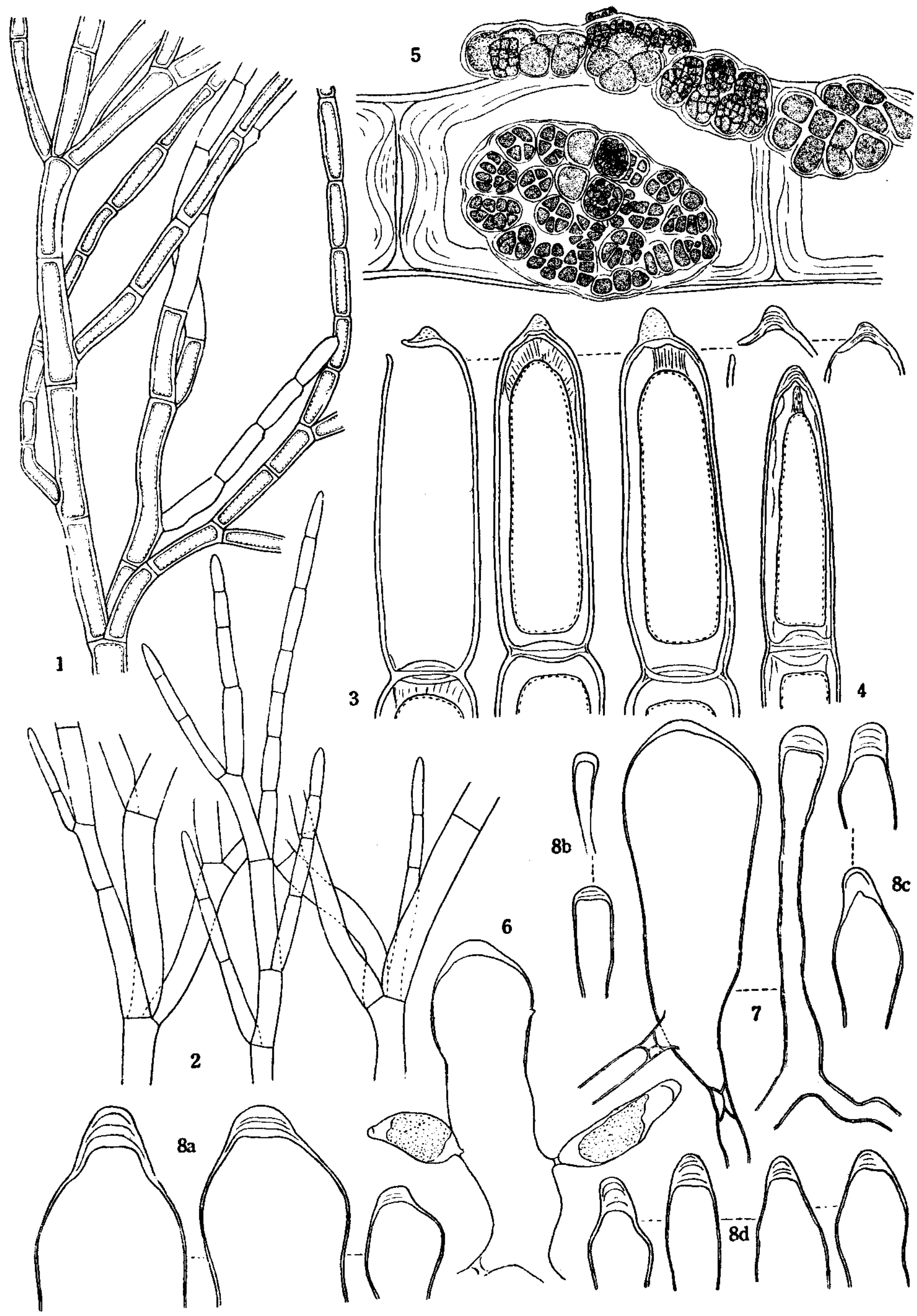
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Plate III

Figs. 1–4. *Aegagropila Kannoi* Tokida, n. sp.: Fig. 1, part of a filament showing a rhizoid, × 25. Fig. 2, part of a filament showing the branching mode, × 25. Fig. 3, bipolar portion of a filament, × 25. Fig. 4, parts of filaments showing terminal and intercalary inflated segments, × 25.

Figs. 5–6. *Monostroma fuscum* f. *splendens* (Rupr.) Rosenv.: Fig. 5, habit sketch of the basal portion of a plant showing the tubular stipe, × 3. Fig. 6, the same as fig. 5, with the base of the membrane turned open, × 3. (See also Pl. XI, B).

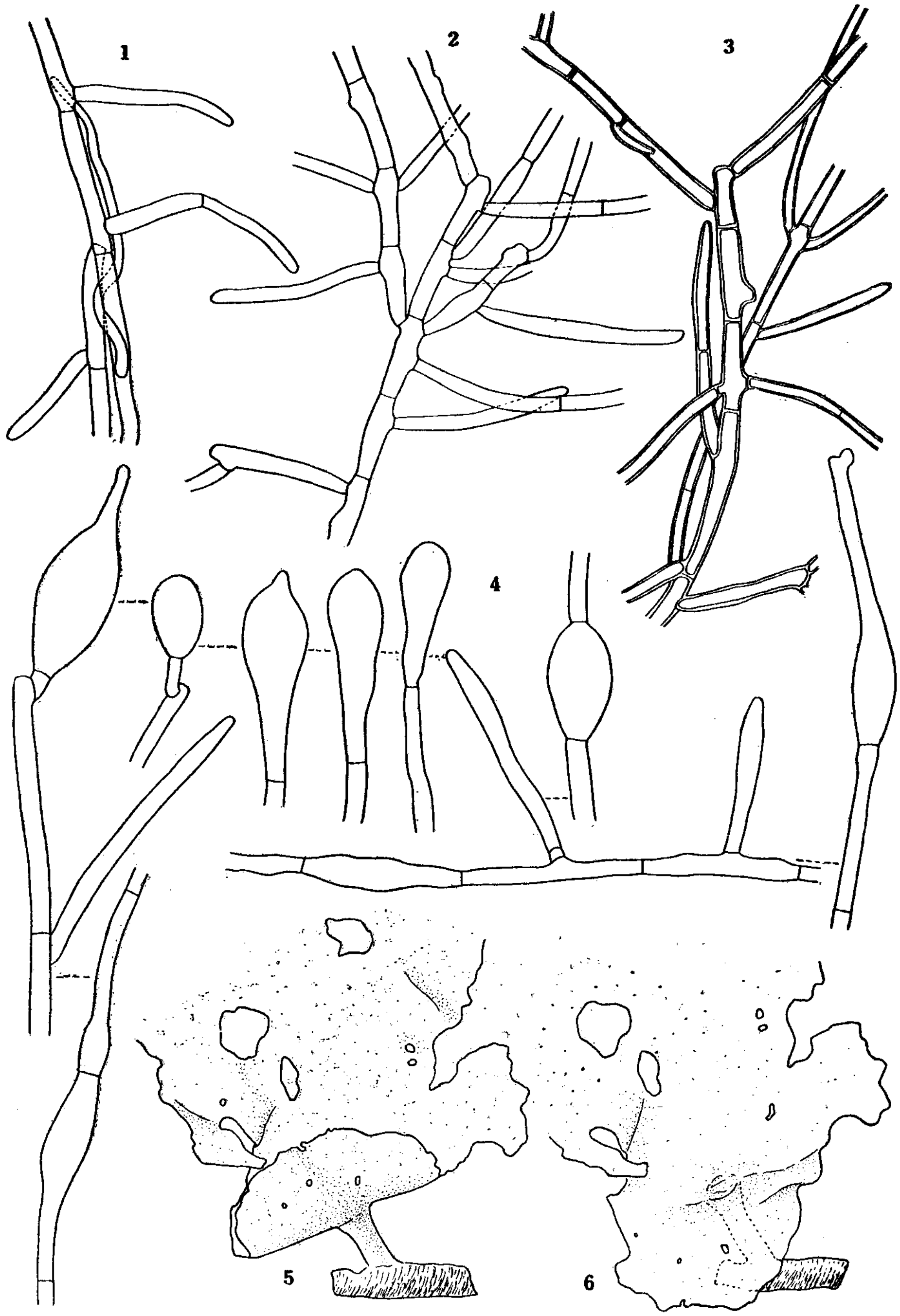
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Plate IV

Figs. 1–10. *Enteromorpha plumosa* Kütz. : Fig. 1, habit sketch of the lower portion of a frond, × 7. Fig. 2, portion of a branch showing a monosiphonous ramulus, × 107. Fig. 3, portion of a narrow branchlet with two monosiphonous ramuli, × 190. Figs. 4–5, cross sections through different parts of the frond, × 300. Fig. 6, part of the surface view of the lower portion of a frond showing the arrangement of the cells, × 300. Fig. 7, surface view of a fertile branch with large spores, × 190. Fig. 8, ditto, × 300. Fig. 9, surface view of a fertile branch with small spores, × 190. Fig. 10, ditto, × 300.

(Figs. 1–10, plants from Tôbuchi-ko, July 1935).

Figs. 11–16. *Enteromorpha prolifera* (Müll.) J. Ag. : Fig. 11, surface view of the vegetative part, × 300. Fig. 12, cross section in the vegetative part of a frond, × 300. Fig. 13, surface view of the fertile part of a frond, × 300. Fig. 14, surface view of the vegetative part of a frond, × 300. Fig. 15, cross section in the vegetative part, prepared from a dried specimen, × 300. Fig. 16, surface view of the fertile part, × 300.

(Figs. 11–13, plant from Rakuma, Aug. 1927 ; Figs. 14–16, plant from Tôbuchi-ko, July 1926).

Figs. 17–19. *Enteromorpha nana* (Sommerf.) Sjöst. Fig. 17, habit sketches of a portion of a frond showing scattered branchlets, × 19. Fig. 18, surface view of the vegetative part, × 300. Fig. 19, cross sections in the vegetative part, × 300.

(Figs. 17–19, plant from Maguntan, 1906).

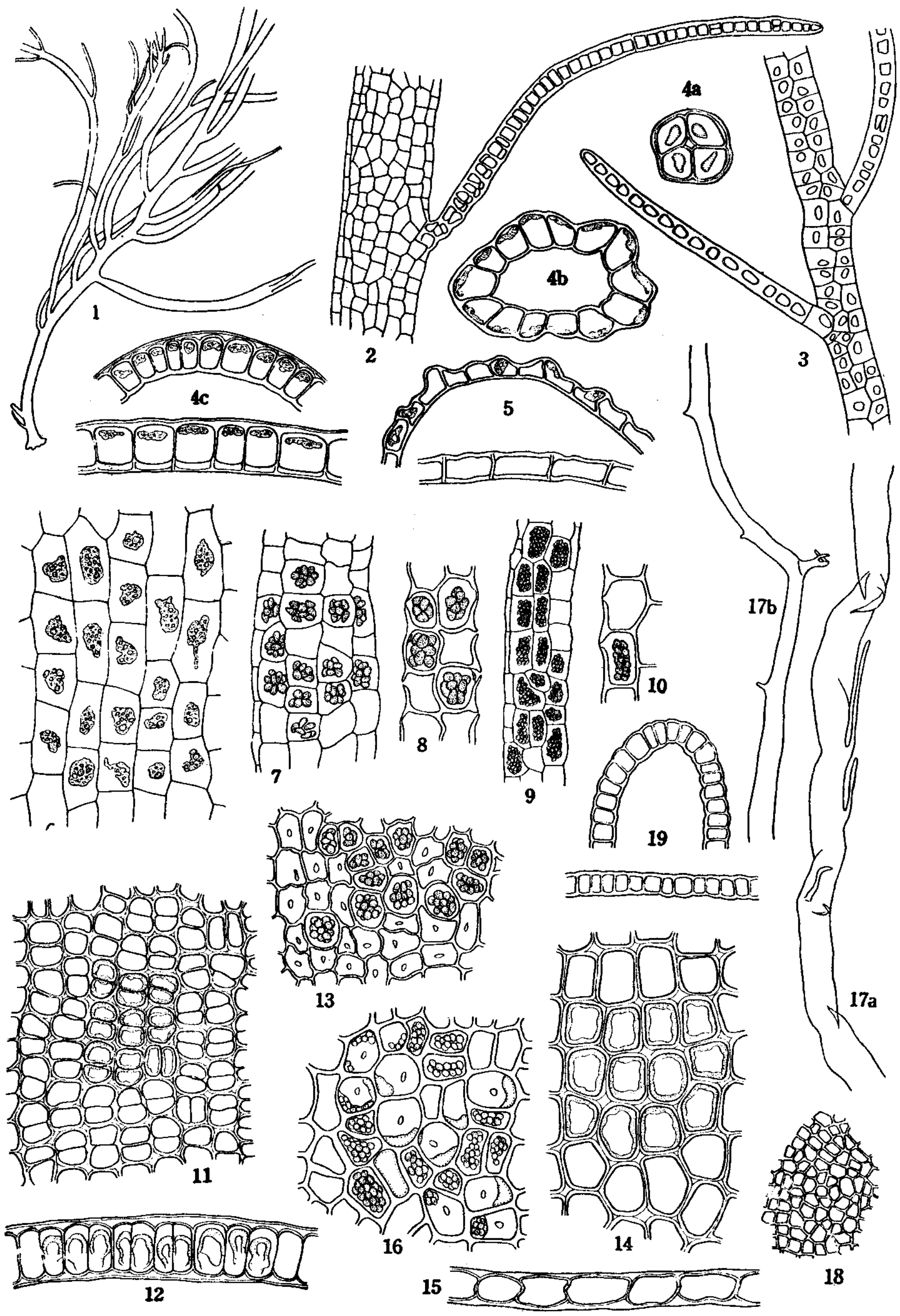
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Plate V

Figs. 1–2. *Xenococcus pyriformis* Setch. et Gardn. : Fig. 1, a group of colonies growing on *Rhizoclonium tortuosum*, × 340. Fig. 2, surface view of a colony, × 666. (See also Pl. II, Fig. 5, Pl. IX, Fig. 9).

Figs. 3–6. *Monostroma angicava* Kjellm. : Fig. 3, surface view of the upper vegetative part of a frond with the walls thickened at corners, × 190. Fig. 4, surface view of the stipe showing the pyrenoids, × 107. Fig. 5, surface view of the fertile part of a female gametophyte, × 190. Fig. 6, cross section showing the gametangia, × 190.

(Figs. 3–6, plant from Yôman, July 1935). (See also Pl. XI, C).

Figs. 7–13. *Monostroma crassidermum* Tokida, n. sp. : Fig. 7, surface view of the middle vegetative part of a frond, × 300. Fig. 8, surface view of the basal part of a frond, showing rhizoidal cells, × 300. Fig. 9, cross section near the base, stained with methylene blue, showing the thick lamellate walls, × 300. Fig. 10, cross section near the base showing the thick lamellate walls, × 300. Fig. 11, cross section of the middle part of a frond showing the thick lamellate walls × 300. Fig. 12, cross section through the boundary of the fertile part of a frond showing the irregular arrangement of the fertile gametangia, × 300. Fig. 13, surface view of the boundary of the fertile part of a frond, × 300.

(Figs. 7–10, plant from Nobori, July 1935 ; Figs. 11–13, plant from Robben Island, July 1932). (See also Pl. XI, D).

Figs. 14–17. *Monostroma arcticum* Wittr.: Fig. 14, vertical section through the basal part of a frond, × 190. Fig. 15, cross section through the basal part of a frond, × 190. Fig. 16, cross section through the rhizoid-bearing part of a frond, × 190. Fig. 17, vertical section through the rhizoid-bearing part of a frond, × 190. (See also Pl. VII, Figs, 1–7).

(Figs. 14–17, plant from Chishiya, April 1937).

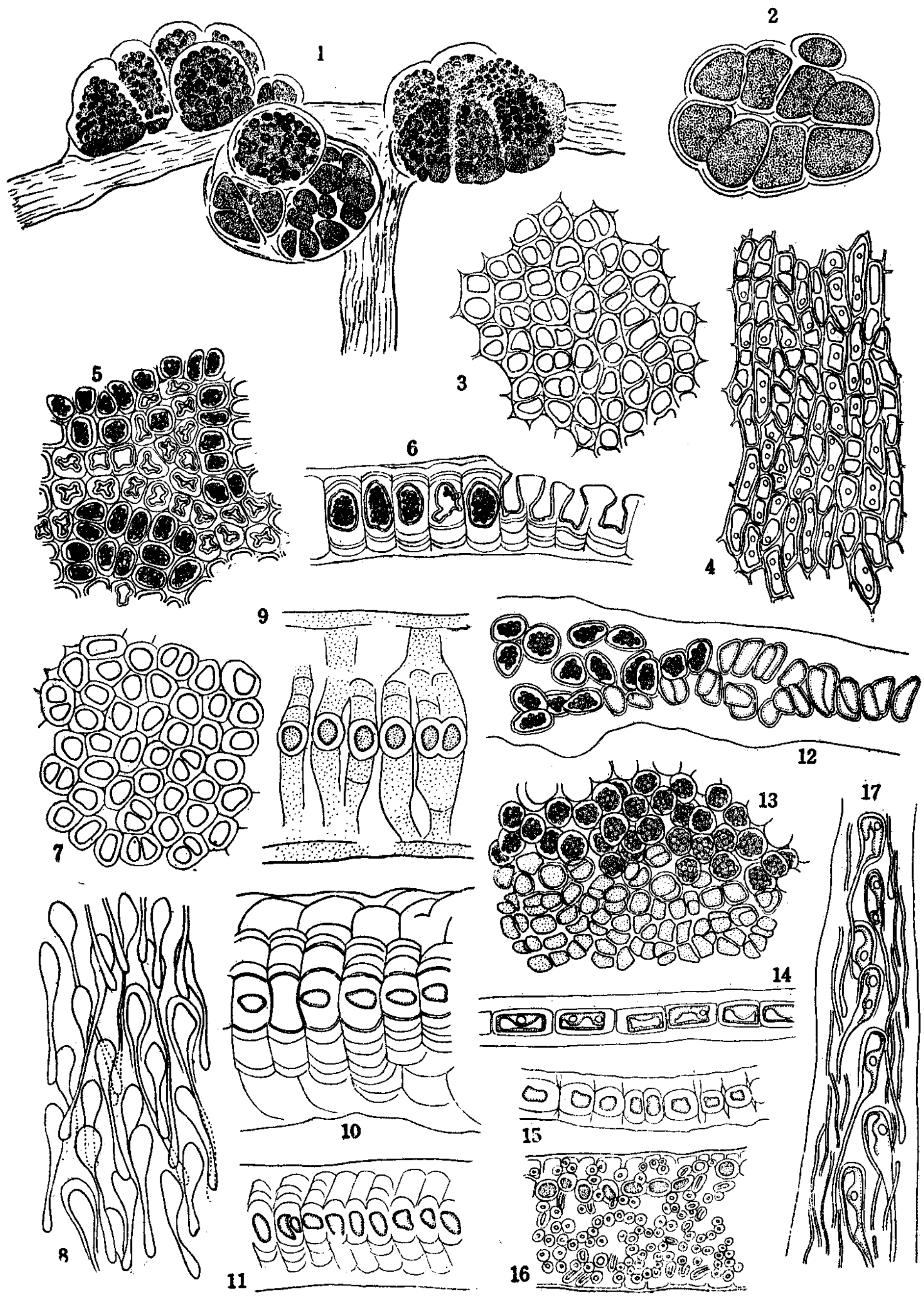
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Plate VI

Figs. 1–3. *Monostroma zostericola* Tilden: Fig. 1, surface view of the vegetative part of a frond, × 300. Fig. 2, surface view of the fertile part of a frond, × 300. Fig. 3, cross sections showing the sporangis, × 300.

(Figs. 1–3, plant from Yôman, Aug. 1935).

Figs. 4, 10–11. *Monostroma fuscum* f. *typicum* Rosenv.: Fig. 4, cross section of the sterile part of a frond, × 300. Fig. 10, habit sketch of the basal part of a frond measuring 4 cm. high and 8 mm. broad, showing the tubular stipe, × 7. Fig. 11, surface view of the basal rhizoid-bearing part of the blade, × 107. (See also Pl. XI, A).

(Figs. 4 & 10–11, plant from Sakaehama, Aug. 1929).

Figs. 5–9, 12–13. *Monostroma fuscum* f. *splendens* (Rupr.) Rosenv.: Fig. 5, cross section near the base of the blade, × 190. Fig. 6, cross section through the fertile part of a frond, × 300. Fig. 7, surface view of the fertile part of a frond with larger spores, × 300. Fig. 8, surface view of the fertile part of a frond with smaller spores, × 300. Fig. 9, surface view of the fertile part of a frond composed of larger cells with smaller spores, × 300. Fig. 12, cross section through the tubular stipe, × 44. Fig. 13, vertical section through the stipe, × 107.

(Figs. 5–8 & 12–13, plant from Kaiba-tô, July 1930; Fig. 9, plant from Tôbuchi-ko, July 1935).

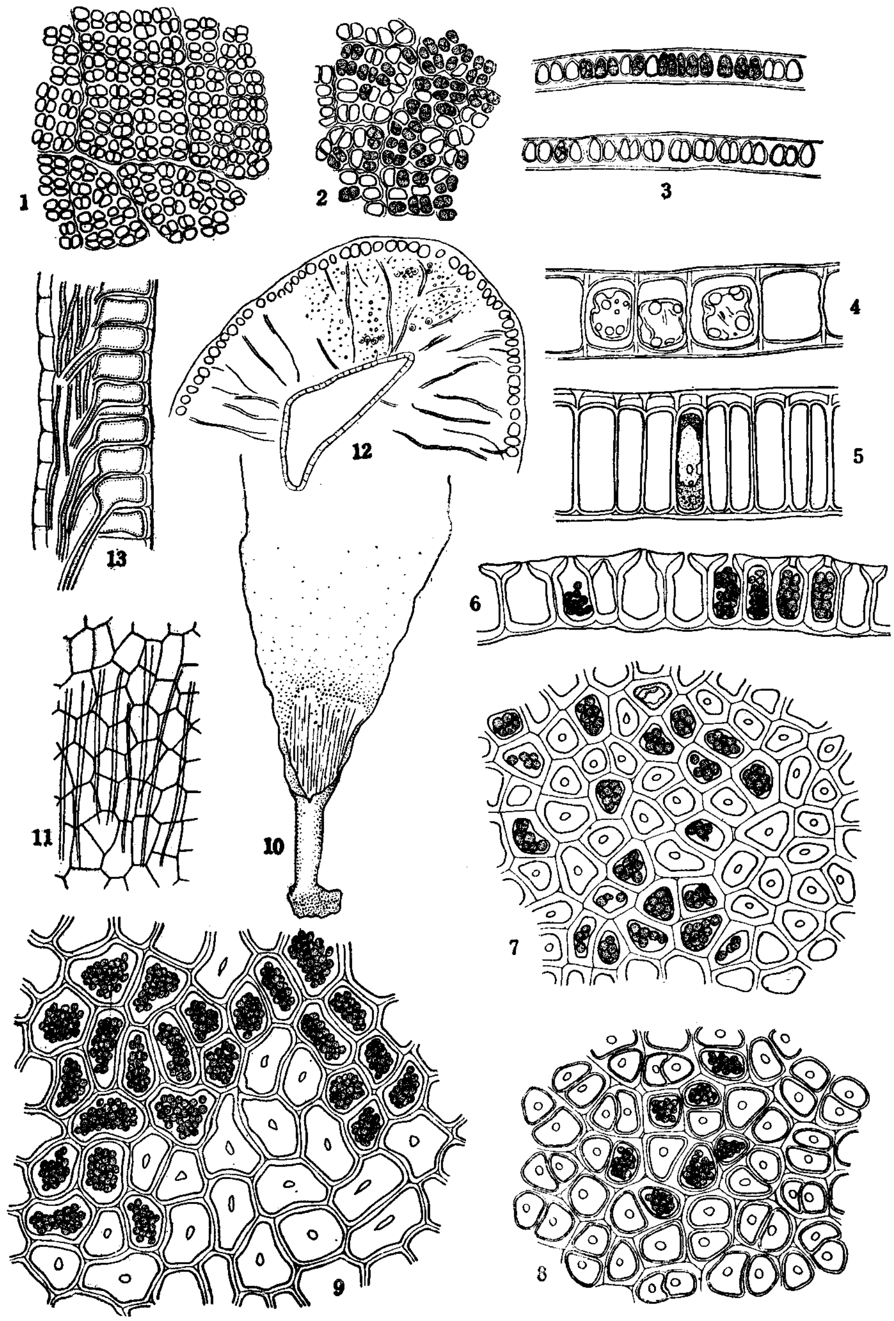
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Plate VII

Figs. 1–7. *Monostroma arcticum* Wittr.: Fig. 1, surface view of the lower part of a frond, × 190. Fig. 2, vertical section through the middle part of a frond, × 190. Fig. 3, surface view of the fertile part of a frond, × 300. Fig. 4, surface view of the fertile part of a frond, showing the gametangia partly emptied, × 300. Fig. 5, cross section showing the gametangia in various stages of division, × 190. Fig. 6, cross section showing the mature gametangia, × 190. Fig. 7, surface view of the marginal part of a fertile frond, × 190.

(Figs. 1–7, plant from Chishiya, April 1937). (See also Pl, V, Figs. 14–17).

Figs. 8–14. *Monostroma undulatum* var. *Farlowii* Fosl.: Fig. 8, surface view of the lower part of a frond showing the chloroplast, pyrenoid and nucleus, × 300. Fig. 9, optical section of the frond showing the content of the cells, × 300. Fig. 10, surface view of the fertile part of a frond showing the gonidangia partly emptied and the gonidia passing through the intercellular spaces, × 300. Fig. 11, surface view of the marginal part of a fertile frond showing an oscillating mass of the swarmers formed at the frond margin, × 300. Fig. 12, typical swarmers killed by osmium vapour, × 500. Fig. 13, apparent conjugation (?) of the swarmers, one of which is evidently biciliate, × 500. Fig. 14, typical swarmers treated by iodine-tincture, × 500. (See also Pl. XII, A-C).

(Figs. 8–14, plant from Oshoro, Hokkaido).

Figs. 15–16. *Chlorochytrium inclusum* Kjellm.: Fig. 15, cross sections through the host, showing the endophyte immersed in the cortical tissue, × 190. Fig. 16, a cell with the lobed base, × 190.

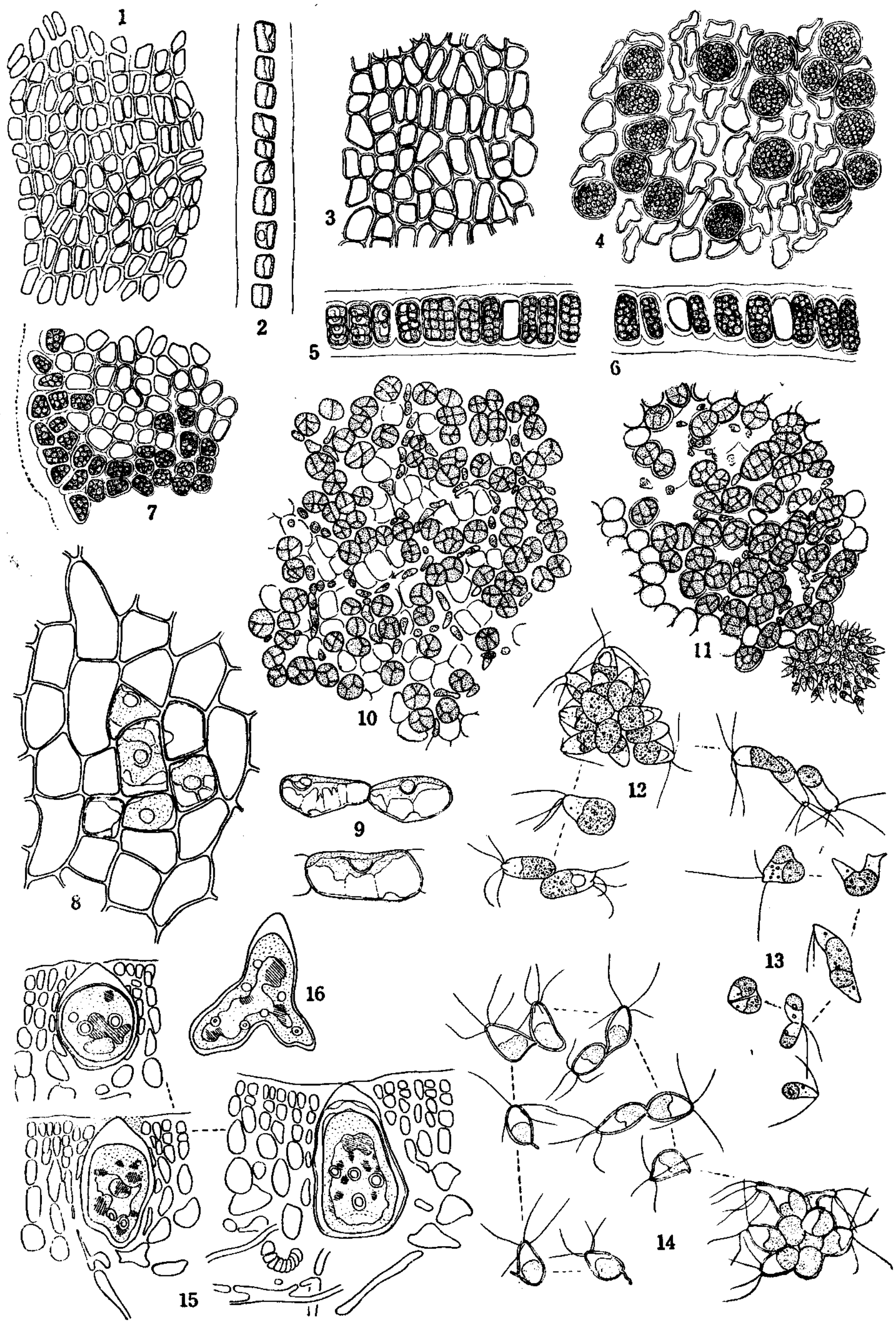
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Plate VIII

Figs. 1–4. *Ulothrix pseudoflacca* Wille: Fig. 1, habit sketch of the filament, × 65. Fig. 2, vegetative part of the filament, 15 μ thick, × 300. Fig. 3, fertile part of the filament, 21 μ thick, × 300. Fig. 4, two sporangia, × 300.

Figs. 5–7. *Ectocarpus confervoides* f. *typicus* Kjellm.: Fig. 5, lower part of the frond, showing the rhizoidal filaments, × 80. Fig. 6, showing plurilocular sporangia and a branch apex, × 80. Fig. 7, part of a fertile branch, bearing plurilocular sporangia, showing band-shaped plastids, × 190.

Figs. 8–9. *Streblonema Eudesmide* Tokida, n. sp.: Fig. 8. portion of a frond showing the branching mode, plurilocular sporangia and hairs, ×190. Fig. 9, part of the filament showing the narrow band-shaped plastids, × 344.

Figs. 10–12. *Ralfsia fungiformis* (Gunn.) Setch. et Gardn. Fig. 10, portion of a section perpendicular to the surface of the frond showing two young plurilocular sporangia, × 300. Fig. 11, section showing a unilocular sporangium × 300. Fig. 12, section showing plurilocular sporangia in a sorus of the unilocular sporangia. ×300. (See also Pl. XIII. A-C).

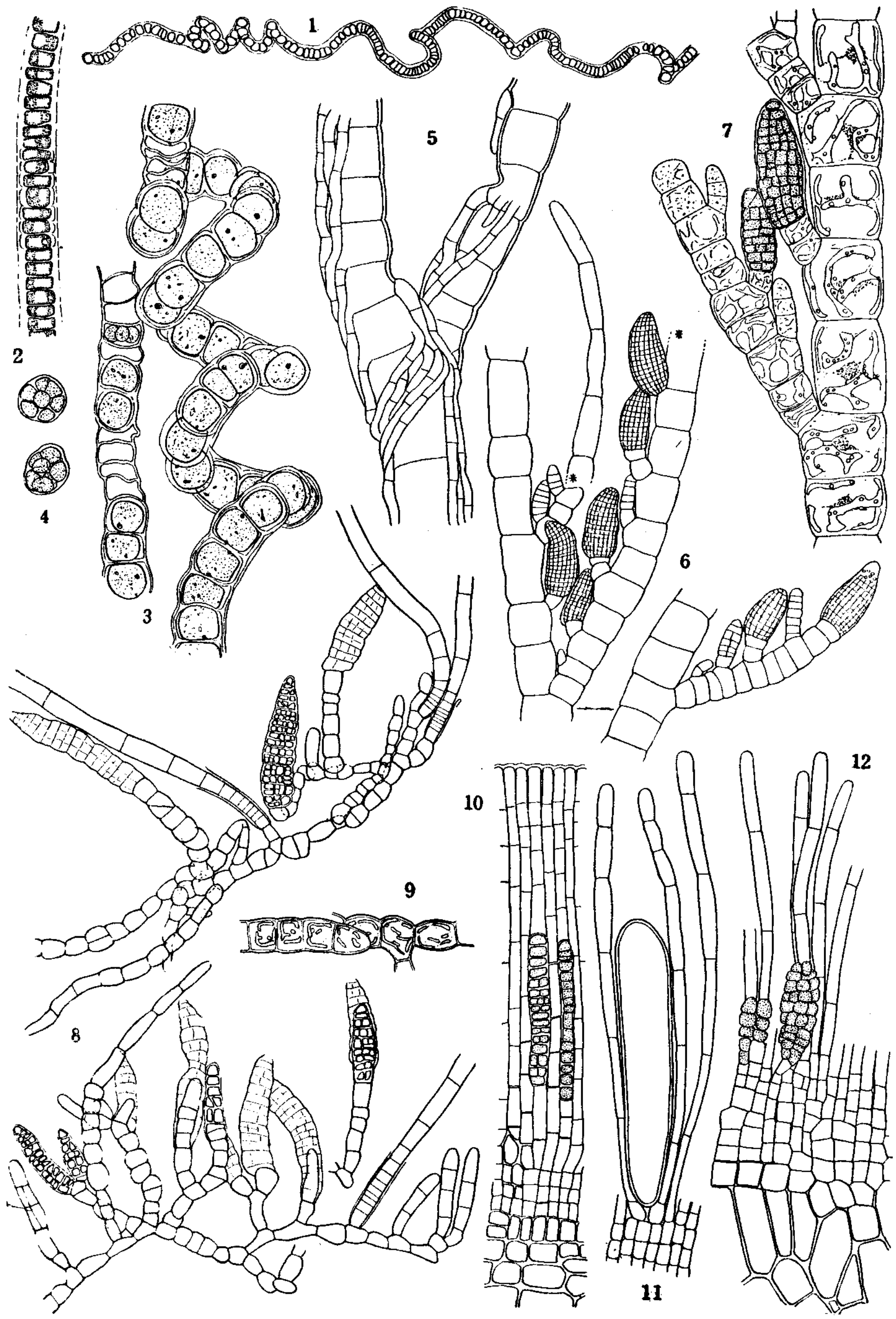
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Plate IX

Figs. 1–2. *Leathesia umbellata* (Ag.) Menegh. : Fig. 1, cross sections through the vesicle of a host plant infected by the present epiphyte as well as by *Gonodia Sargassi* (g). a, × 25, b, × 30. Fig. 2, portions of the thallus showing assimilating filaments, plurilocular and unilocular sporangia and hairs, × 120.

Fig. 3. *Gonodia Sargassi* (Yendo) Setch. et Gardn. Portions of the thallus showing assimilating filaments, plurilocular and unilocular sporangia and hairs, × 120.

Figs. 4–7. *Eudesme virescens* (Carm.) J. Ag. : Fig. 4, apical portion of an axial filament, × 190. Fig. 5, part of a cross section of the thallus, × 107. Fig. 6, ditto, × 190. Fig. 7, ditto, showing branched assimilating filaments, × 190. (See also Pl. XIII, E).

(Fig. 4, plant from Chiriye, Aug. 1935; Figs. 6–7, plant from Tôbuchi-ko, Aug. 1935).

Fig. 8. *Sphaerotrichia japonica* Kylin. Branch apices showing the projecting central filament ending with one to several spherical cells, × 120.

Fig. 9. *Xenococcus pyriformis* Setch. et Gardn. Side view of a colony growing on the host, × 666. (See also Pl. II, Fig. 5, Pl. V, Figs. 1–2).

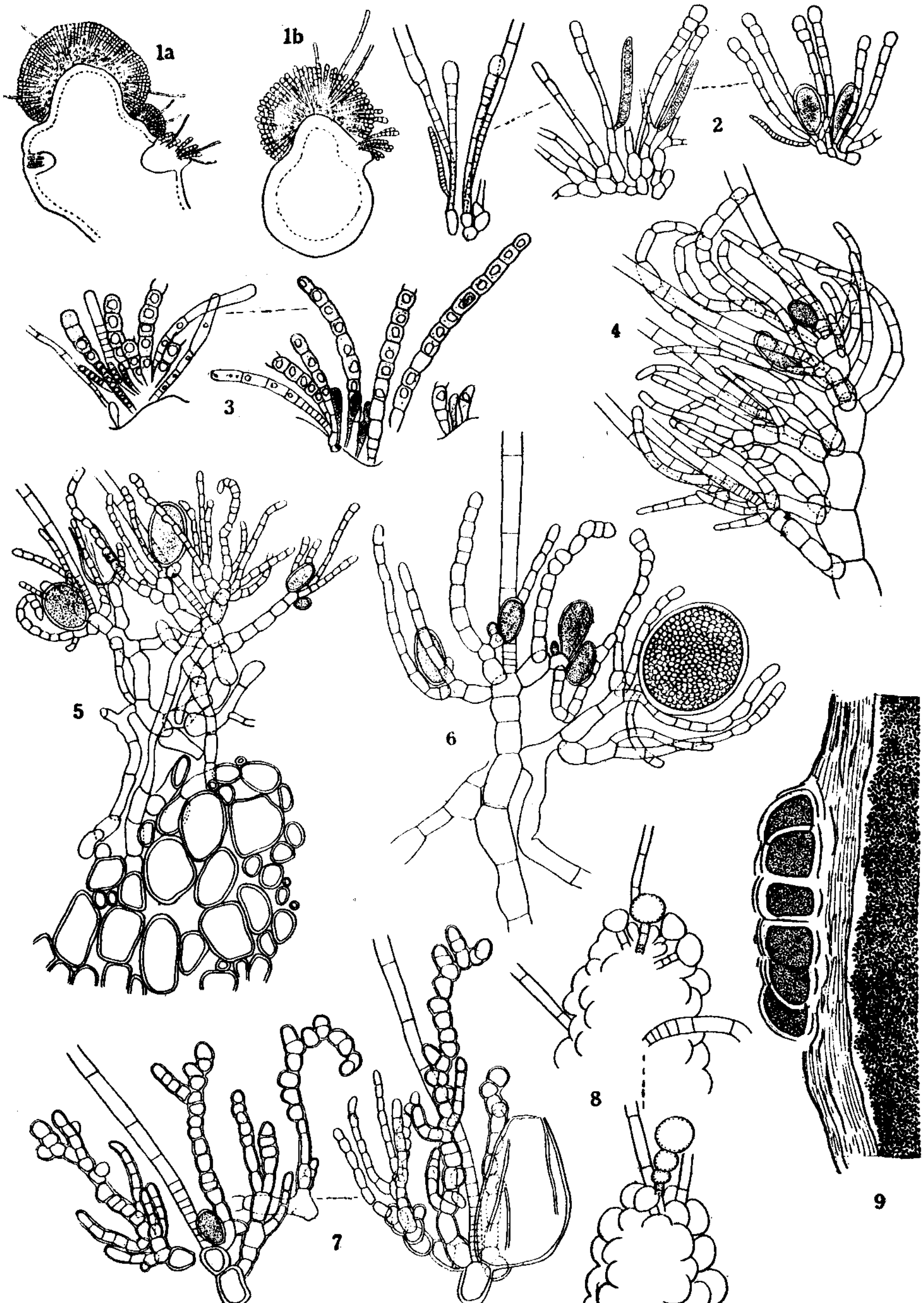
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Plate X

Figs. 1–2. *Punctaria plantaginea* (Roth) Grew.: Sections of a fruiting frond, showing unilocular sporangia, and hairs, × 190. (Plant from Noto, Aug. 1935). (See also Pl. XII, E).

Figs. 3–7. *Laminaria saccharina* (L.) Lam.: Figs. 3–4, parts of the under (3) and upper (4) surfaces of a sterile blade, showing the typical shape of the bullations, diagrammatic. Fig. 5, cross section of a blade, *u* denotes the upper side. Diagrammatic. Figs. 6–7, parts of the under (6) und upper (7) surfaces of a fruiting blade, showing the typical shape of the zoosporangial sori. Diagrammatic.

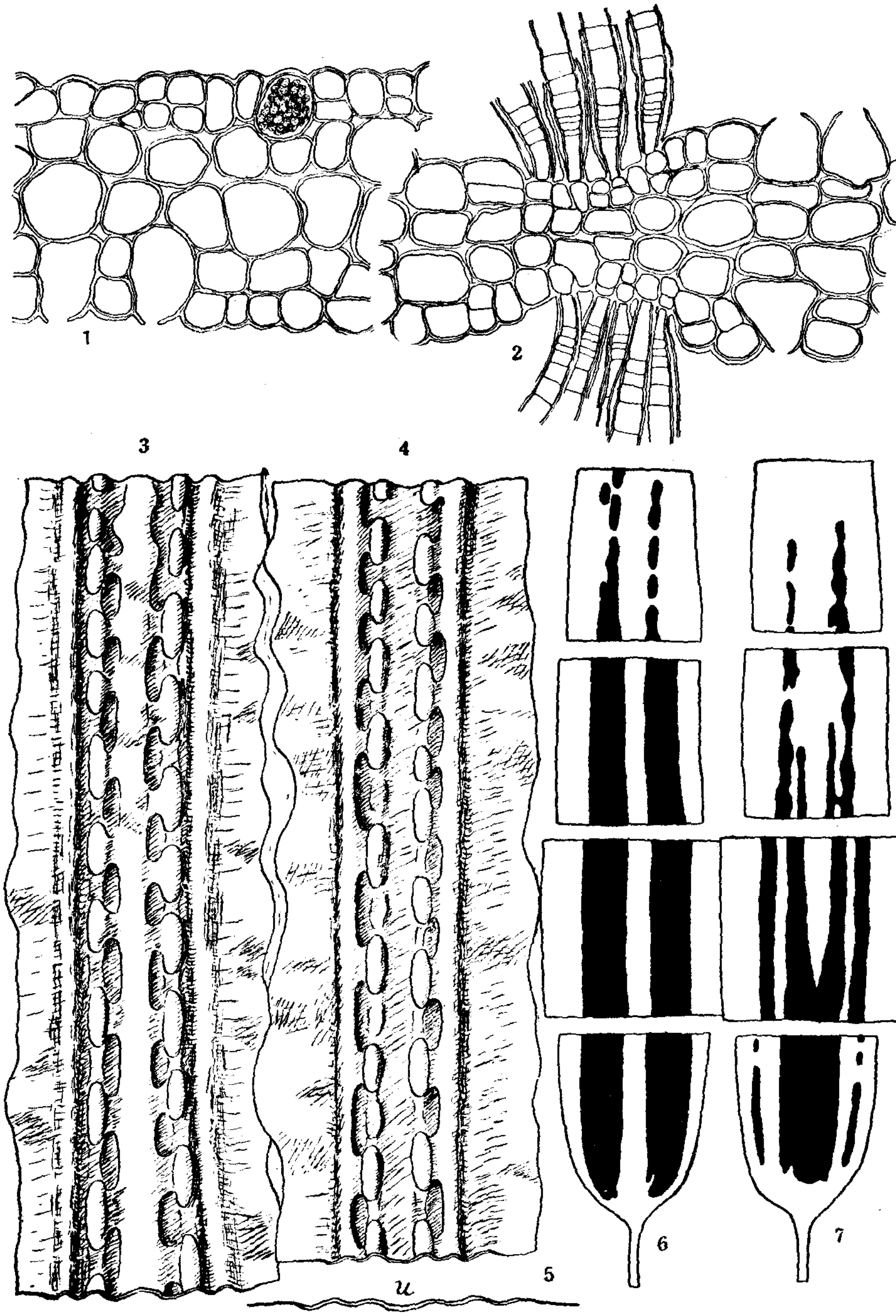

1
2
3
4
5
u
6
7

Plate XI

Monostroma fuscum f. *typicum* Rosenv.

A. A group of plants in position on the host, *Chordaria flagelliformis*, from Sakaehama.

Monostroma fuscum f. *splendens* (Rupr.) Rosenv.

B. A plant from Tôbuchi-ko., × 2/5.

Monostroma angicava Kjellm.

C. A group of plants in position on the host, *Odonthalia aleutica*, from Yôman.

Monostroma crssidermum Tokida, n. sp.

D. A plant from Robben Island. × 2/5.

A

B

C

D

Plate XII.

Monostroma undulatum var. *Farlowii* Collins

A. Microphotograph of a part of the surface, showing the areolate arrangement of the fertile cells. × 85.

B. Microphotograph of a part of the surface, showing the network formed by the swarmers ouzed out into the intercellular spaces. × 375.

C. Microphotograph of the grouping masses of the free swimming swarmers. × 375.

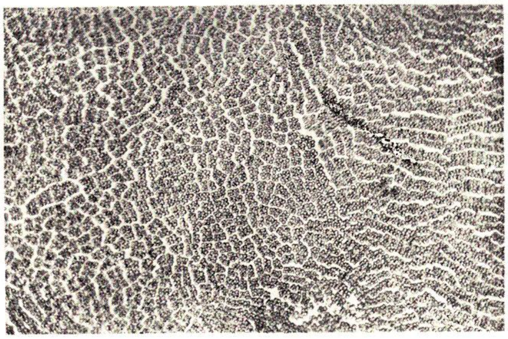
Hormiscia Wormskioldii (Mert.) Fries

D. A group of filaments from Nishinotoro.

Punctaria plantaginea (Roth) Grev.

E. A group of plants from Chishiya. 3/5.

Pl. XII



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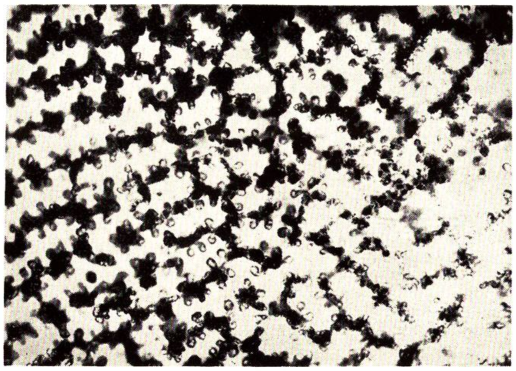

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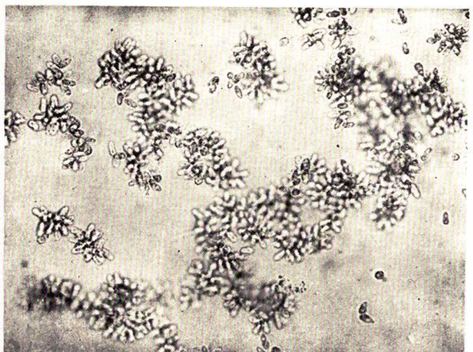

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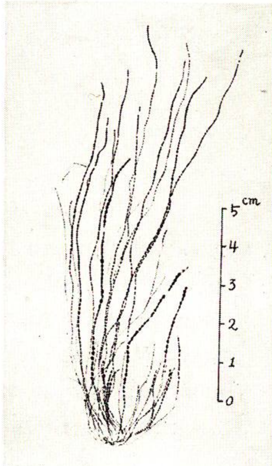


D

E

Plate XIII

Ralfsia fungiformis (Gunn.) Setch. et Gardn.

A. A colony of plants from Shiranushi, slightly reduced.

B. Microphotograph of a section through an unilocular sporangial sorus. Plant from Nishinotoro. × 85.

C. Microphotograph of a section through a plurilocular sporangial sorus. Plant from Shiranushi. × 85.

(See also Pl. VIII, Figs. 10–12).

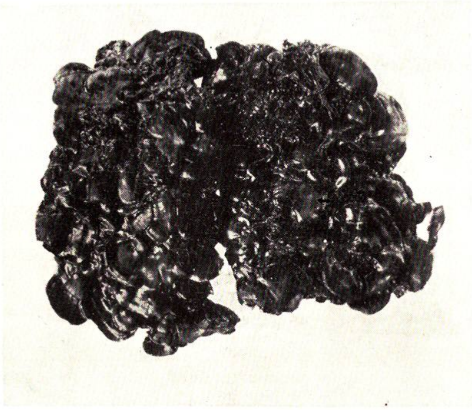
Heterosaundersella Hattoriana Tokida

D. From a photograph of a group of plants in position on the hosts, *Heterochordaria abietina*, from Yôman.

Eudesme virescens (Carm.) J. Ag.

E. From a photograph of a plant from Chiriye.

(See also Pl. IX, Figs. 4–7).



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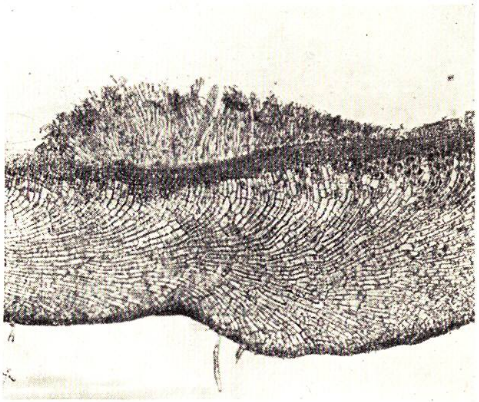

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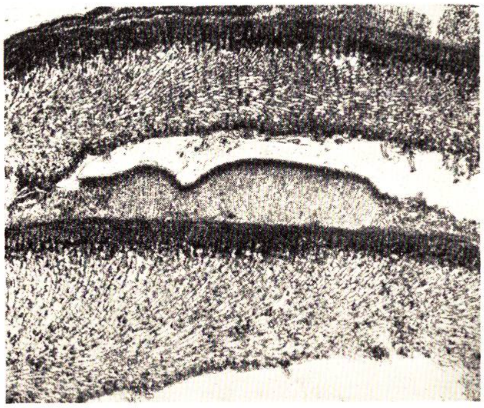

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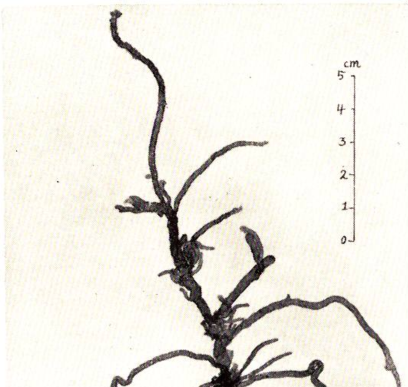


E

D

Plate XIV

Chondrus pinnulatus f. *ciliatus* subf. *angustus* Tokida

A. Plant from Minabetsu.

Chondrus pinnulatus f. *ciliatus* subf. *latus* Tokida

B. Plant from Hota.

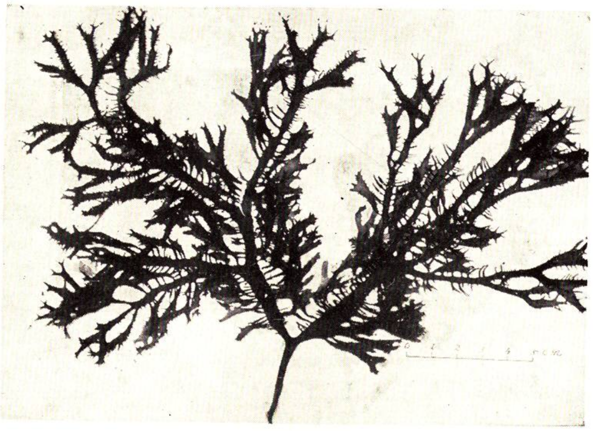
Chondrus pinnulatus f. *typicus* Nagai

C. A part of a plant from Hota.

D. A part of a plant from Nishinotoro.

Chondrus pinnulatus f. *flabellatus* Tokida

E. A part of a plant from Dorokawa.



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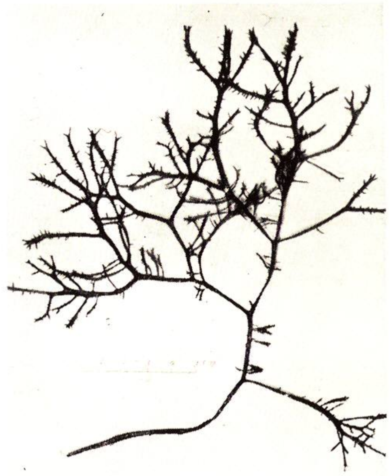

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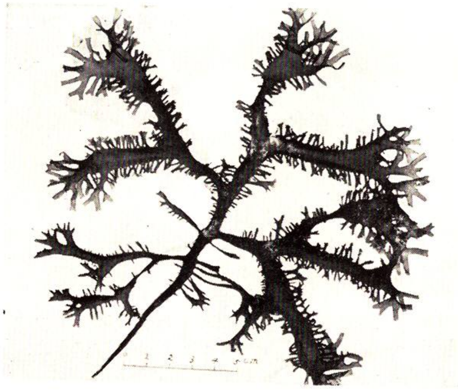

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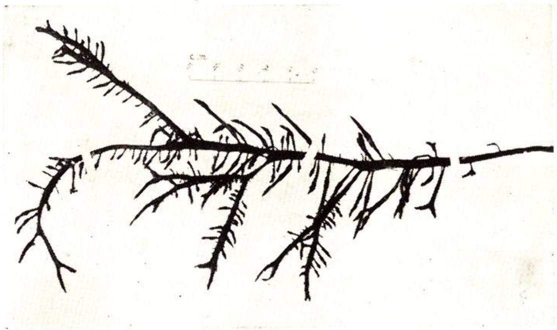


D

E

Plate XV

Chondrus pinnulatus f. *longicornis* Tokida, f. nov.

A. Plant from Merei.

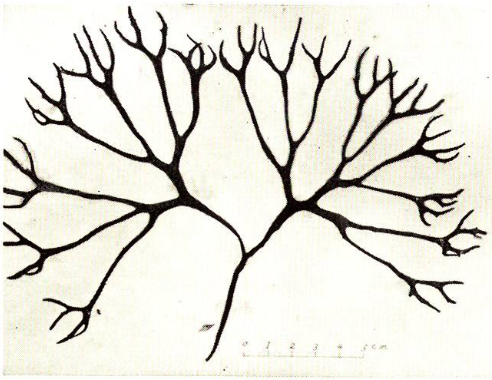
B. Plant from Unetonnai.

Chondrus pinnulatus f. *cervicornis* Tokida, f. nov.

C. Plant from Yôman.

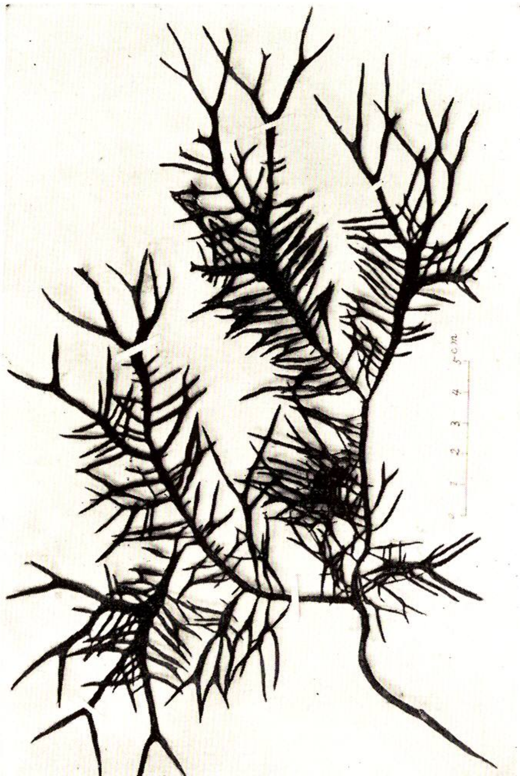
D. Cystocarpiferous plant from Kitashiretoko.

E. Plant from Robben Island.



A

C



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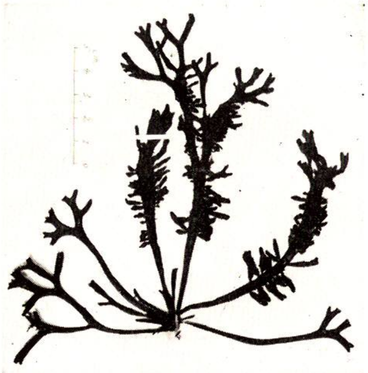

D

E