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THE PRIMARY SURVEY OF THE VEGETATION OF THE MIDDLE KURILES

By

Misao Tatewaki

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FOREWORD

This report is an attempt to give a general description of the vegetation of the Middle Kuriles, based upon the writer's explorations undertaken during the years from 1927 to 1930. He limited the area of his investigations to the region from the Island of Urup to the Island of Matuwa, which, from the botanical point of view has been practically unknown, on account of the difficulties of communication. The materials have been collected for a flora of these botanically unexplored islands, in which special attention has been paid to the plant-associations and distribution.

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INTRODUCTION

GENERAL AREA. The present work deals with the description of the vegetation of an area including the Island of Urup, Shimushir, Ketoi, Ushishir, RASHUWA and MATUWA, which compose a distinct floral district. These islands extend in a regular chain located in the middle part of the Kuriles, extending a distance of about 220 miles, about 280 miles north-east off the main island of Hokkaido, and about 300 miles south-west off Kamtschatka, lying between the Okhotsk Sea and the Northern Pacific. The eastern coast facing the Pacific is washed by the cold Oyashio Current, and the western, the Okhotsk side, by a warm current which is an attenuated branch of the Tsushima Current. The islands are mountainous throughout and have many volcanoes, some of which are still active. As to the topography and geology, the Middle Kuriles are uniform on the whole. These features will be mentioned in detail later, when dealing with the topography of each island, from the sea-shore up to the mountains. On account of their barrenness, the cold insular climate, and precipitous unapproachable shores, the islands have been left undeveloped except for fox-farming. The vegetation on the whole shows the nature of the Kamtschatka region, indicating as it does a subarctic character, still there are found such southern elements as *Sasa*, which calls for special attention from the phytogeographical point of view.

CLIMATE. As to the meteorological data of these islands, we have no accurate observation bearing on the climate of the coast except the records in the fox-farming stations at Broughton Bay, Island of Shimushir and Minamijima, Island of Ushishir. According to the records of the keepers of the fox-farming establishments in the Middle Kuriles, the general climate of this district is as follows:

Fogs. The fogs around the Middle Kuriles are caused by the southerly or westerly winds passing over the cold sea-currents. These fogs, which have a bad reputation among the seamen, are sometimes so dense as to shut out the view completely even beyond a radius of a few meters. As a general rule they extend to a great altitude, but sometimes they occur in comparatively narrow belts. Their distribution varies considerably according to the direction of the wind. In April and May, there is a little fog, not very dense, about five days in a month. June has twelve to nineteen cloudy and foggy days. July is the worst month of the year as regards fogs, which occur on more than twenty days, and August has from fifteen to twenty days of foggy weather. In September, fogs suddenly decrease. From October to March, there is but little fog. The climate of the Middle Kuriles from the late spring to the late summer is, generally speaking, a moist one, on account of the prevalence of fogs, though the rainfall is comparatively scanty.

Snow and ice. The first snow fall comes in the middle of October, but on occasional mild days it may melt again. In November as the month advances, the weather is mostly overcast and snow falls on from about five to ten days a month. From December to February, snow falls are recorded on from twelve to twenty days a month, and sometimes more. In March snow falls are frequent, but generally not accompanied by storms. In the middle of May, the sun's rays melt the snow on the foot of hills, still it may snow till the end of May, rarely even as late as the beginning of June in the northern part. As a rule, the ground is well covered with snow from December to April. The lakes and ponds are frozen over and covered with ice from December to March. During the time above mentioned, the sea around these islands is locked up by the floating ice, so that navigation is quite impossible.

Wind. In the Middle Kuriles, it is usually calm and there are light winds during the summer, but strong winds prevail during the winter, especially in January and February. From October to April, westerly and northerly winds are frequent and the westerly are the strongest. From May to September, southerly winds predominate, the westerly and easterly winds holding subordinate rank. In May, variable winds, with gales, predominate from the north-easterly and westerly directions. In June, the wind, which becomes light, is variable, blowing, however, mostly from the southerly direction. In July, absolute calm or very light winds are recorded during the greater part of the month. In August, calm or light winds prevail. In September, the winds become

strong, blowing chiefly from the westerly direction.

Temperature. The temperatures range on the annual average from about 2.5°C to 4.5°C. From December to March it is winter, being cold and boisterous. At the end of April the spring arrives and from May to the middle of June is the vernal season of the Middle Kuriles. July and August are the summer time, recording the highest temperature through the year. A decided rise of temperature is shown compared with that of the foregoing months. September is the autumnal season from the botanical point of view, though the temperature during the first half of the month is in no way lower than that of July and August.

The record shows for January temperatures ranging from -1°C to -8°C, for February from -3°C to -8.5°C, and for March from -4°C to -8°C. The monthly mean temperature for April records from 1°C to 2°C, for May from 2.5°C to 4°C, and for June from 5°C to 10°C. But the minimum and maximum temperatures for April range from as low as -2°C to as high as 5°C, for May from -1.5°C to 6.5°C and for June from 1°C to 12°C (sometimes to about 15°C). July and August are the warmest months. Many flowers bloom then. The temperatures in July range on the average from about 11°C, and in August from 10°C, to 15°C. The minimum and maximum temperatures for July range from as low as 6.5°C to as high as 16°C, and for August from 8°C to 20°C. In September it is still warm, the record of average temperatures ranging from 9.5°C to 11°C. In October, the temperature gradually goes down, showing the monthly mean record from 2°C to 3°C, reaching sometimes as low as -2°C. As the month of December advances, the winter begins in earnest, with temperatures from around zero to -1.5°C.

THE AUTHOR'S JOURNEYS TO THE MIDDLE KURILES

The author's first botanical excursion offered the opportunity of investigation in the Middle Kuriles in August and September of 1927. During the first trip, the work was mainly confined to the middle part of the Island of Urup, especially in the neighbourhood of Tokotan on the western coast. In 1928, he paid a second visit to the Middle Kuriles. His researches in 1928 were concentrated on the Islands of Shimushir and Matuwa, and short visits were also made to the Islands of Ketoi, Ushishir and Rashuwa. During his second trip, the most interesting of the excursions were those to Lake Midori in the Island of Shimushir in the middle of August, and to Mt. Matuwa-fuji on the Island of Matuwa at the beginning of September. In 1929, after a short visit to the

western Aleutian Islands, he made his third botanical excursion in the Middle Kuriles, from the end of July to the end of September. He spent the first half of the month of August on the Island of Rashuwa, and about a month from the middle of August to the 8th of September on the Island of Ketoi, and also a week after that on the Island of Ushishir. In 1930 he had an opportunity of visiting the various parts of the Kuriles on board the patrol-ship "Urupmaru", for a study of the vernal aspect of the vegetation in the Middle Kuriles.

Route of the journeys to the Kurile Islands

Date	Place visited
1927	
August 22nd-23rd.	Shakotan, Isl. Shikotan.
August 24th-25th.	Toshimoye, Isl. Etorofu.
August 26th-27th.	Kobune, Isl. Urup.
August 28th-September 4th.	Tokotan, Isl. Urup.
September 5th-6th.	Pilikamoye, Isl. Urup.
September 7th-8th.	Tokotan, Isl. Urup.
September 9th-11th.	Onsenzaki, Isl. Urup.
September 12th-18th.	Tokotan, Isl. Urup.
1928	
August 1st.	Shakotan, Isl. Shikotan.
August 2nd-3rd.	Tokotan, Isl. Urup.
August 4th.	Mishima, Isl. Urup.
August 5th.	Broughton Bay, Isl. Shimushir.
August 6th.	Mikasa and Kitakado, Isl. Rashuwa.
August 7th.	Yamatowan, Isl. Matuwa.
August 8th-9th.	Nemo, Isl. Onnekotan.
August 9th.	Isl. Makanru.
August 10th.	Isl. Ekaruma.
August 11th.	Mikasa, Isl. Rashuwa; Isl. Raikokei; Isl. Ushishir.
August 12th.	Broughton Bay, Isl. Shimushir.
August 14th.	Kamoizaki, Isl. Shimushir.
August 15th.	Kamoiyama to Uratomine, Isl. Shimushir.
August 16th.	Yamagoshizaki, Isl. Shimushir.
August 17th.	Nakadomari, Isl. Shimushir.
August 18th.	Lake Midori, Isl. Shimushir.
August 19th.	Nakadomari, Isl. Shimushir.
August 20th-21st.	Sakanagawa, Isl. Shimushir.
August 22nd.	Wan-oku, Isl. Shimushir.
August 23rd-24th.	Broughton Bay, Isl. Shimushir.
August 25th.	Wan-oku, Isl. Shimushir.
August 26th-31st.	Broughton Bay, Isl. Shimushir.
September 1st.	Minami, Isl. Ketoi; Minamijima Isl. Ushishir.

September 2nd.	Mikasa, Isl. RASHUWA.
September 3rd-4th.	Yamatowan, Isl. Matuwa.
September 5th.	Mt. Matuwa-fuji, Isl. Matuwa.
September 6th.	Ainuwan, Isl. Matuwa.
September 7th.	Banjô, Isl. Matuwa.
September 8th-11th.	Yamatowan, Isl. Matuwa.
September 12th.	Isl. Ushishir; Broughton Bay, Isl. Shimushir.
September 13th.	Nakadomari and Shimushir, Isl. Shimushir.
September 14th.	Mishima and Tokotan, Isl. Urup.

1929

July 24th.	Mishima, Isl. Urup.
July 25th.	Shimushir and Nakadomari, Isl. Shimushir.
July 26th.	Broughton Bay, Isl. Shimushir.
July 27th.	Takinoshita, Isl. Shimushir.
July 30th.	Minamijima, Isl. Ushishir.
July 31st.	Kitajima, Isl. Ushishir.
August 1st-2nd.	Mikasa, Isl. RASHUWA.
August 3rd.	Nakadomari, Isl. RASHUWA.
August 4th.	Minamikado, Isl. RASHUWA.
August 5th.	Ohnuma, Isl. RASHUWA.
August 6th.	Higashiura, Isl. RASHUWA.
August 7th-9th.	Sonrakuwan, Isl. RASHUWA.
August 10th.	Chôtôzan, Isl. RASHUWA.
August 11th-13th.	Mikasa, Isl. RASHUWA.
August 14th.	Minami, Isl. KETOI.
August 15th.	Kodakigawa, Isl. KETOI.
August 16th.	Lake KETOI, Isl. KETOI.
August 17th.	Ishikuzurehama, Isl. KETOI.
August 18th.	Ashizaki, Isl. KETOI.
August 19th-23rd.	Minami, Isl. KETOI.
August 24th.	Isozaki, Isl. KETOI.
August 25th.	Minami, Isl. KETOI.
August 26th.	Kombuzaki, Isl. KETOI.
August 27th-31st.	Shimizugawa, Isl. KETOI.
September 1st-3rd.	Minami, Isl. KETOI.
September 4th.	Todozaki, Isl. KETOI.
September 5th-8th.	Minami, Isl. KETOI.
September 9th.	Minamijima, Isl. Ushishir.
September 10th.	Kuretawan, Isl. Ushishir.
September 11th.	Higashiwan, Nishiwan, Isl. Ushishir.
September 12th.	Nishiwan, Isl. Ushishir.
September 13th.	Nishiyama, Kuretayama, Isl. Ushishir.
September 14th.	Kitajima, Isl. Ushishir.
September 16th.	Broughton Bay, Isl. Shimushir.
September 17th.	Nakadomari, Shimushir, Isl. Shimushir.
September 18th.	Kobune, Isl. Urup.
September 19th.	Mishima and Tokotan, Isl. Urup.

1930

May 18th.	Kobune, Isl. Urup.
May 19th.	Tokotan, Isl. Urup.
May 20th.	Shimushir, Isl. Shimushir.
May 21st.	Higashiura, Isl. Shimushir.
May 22nd.	Broughton Bay and Nakadomari, Isl. Shimushir.
May 23rd.	Minamijima and Kitajima, Isl. Ushishir.
May 24th-25th.	Yamatowan, Isl. Matuwa.
May 26th.	Isl. Harumukotan.
May 27th.	Kakumabetsu, Isl. Paramushir.
May 28th.	Kitaura, Namikawa, Isl. Alaid.
May 29th.	Murakamiwan, Isl. Paramushir.
May 30th.	Kataokawan, Isl. Shumushu.
May 31st.	Kokutanzaki, Isl. Shumushu.
June 2nd.	Kakumabetsu, Isl. Paramushir.
June 3rd.	Nemo, Isl. Onnekotan.
June 4th.	Isl. Harumukotan.
June 5th.	Minamiura, Isl. Onnekotan.
June 6th.	Otomewan, Isl. Shashikotan.
June 7th.	Yamatowan, Isl. Matuwa.
June 8th.	Onsenwan, Isl. Ushishir.
June 9th.	Isl. Shimushir.
June 10th.	Mishima and Tokotan, Isl. Urup.
June 11th.	Shakotan, Isl. Shikotan.



The sea-shore at Kobune, Island of Urup,
taken on August 27, 1927.

The Plant-Communities of the Middle Kuriles

THE ISLAND OF URUP

TOPOGRAPHY

The Island of Urup lies about 215 miles north-east from the Port of Nemuro in Hokkaido, and about 380 miles south-west from Kamtschatka. It extends from $45^{\circ}34'$ to $46^{\circ}13'$ N.L. and from $149^{\circ}24'$ to $150^{\circ}34'$ E.L. It is oblong in outline, about 62 miles in length, averaging about 6 miles in width with an area of about 298 square miles. To the south-west is the largest island, Etorofu, separated from Urup by the Etorofu Strait, 45 miles wide, which forms one of the most important lines of the phytogeography of Northern Japan. It is separated from the Island of Shimushir to the north-east by the Urup Strait (Bussole Strait), which limits the line of the smaller botanical district, having a breadth of 60 miles. The island consists of three distinct portions:— the flat uplands of the northern and southern areas, characterized by arctic-alpine plants, and the central mountainous part where the principal peaks, ranging from south to north, are Mt. Iwaoto, Shiro-taye, Iwo, etc. The rivers are not large, running from the central region to the eastern and western sides. The only lake of any importance in the island is Lake Tokotan. The sea coast is generally bold and steep on the Okhotsk Sea side, where high cliffs stand out except near Tokotan. Sandy beaches are locally developed along the Pacific side.

THE PLANT-COMMUNITIES

The plant-communities are here treated under the following seven main categories:—

- | | |
|-------------------|-----------------|
| 1. Forest. | 2. Sea-shore. |
| 3. Heath. | 4. Grassy land. |
| 5. Meadow. | 6. Aquatics. |
| 7. Swamp and bog. | |

1. Forest

The general aspect of the woods in the lower altitudes is essentially different from that of Hokkaido, even that of the southern Kuriles. The arboreal flora is poor and the main woody species are composed of

northern elements. The predominant species are *Pinus pumila*, *Betula Ermani* and *Alnus fruticosa* and that of second importance is *Salix sachalinensis*. The most striking fact is the complete absence from this island of *Picea* and *Abies*, which are widely distributed over the main island of Hokkaido and also as far north as the Islands of Etorofu and Shikotan in the Southern Kuriles. *Prunus kurilensis* is known growing mainly on the western side as far north as to Mishima. Yet *Taxus cuspidata* occasionally grows in this island. The communities of the forest are divided into the following divisions:—

- i) *Pinus pumila*-consociation. ii) *Betula Ermani* consociation.
 iii) *Alnus fruticosa*-consociation. iv) *Salix sachalinensis*-consociation.

i) *Pinus pumila*-Consociation

The Pinetum, consisting of *Pinus pumila*, is strikingly uniform in appearance forming a pure impenetrable thicket. It extends generally all over the island from the altitude of about 200–300 m. upward, but sometimes it comes down in the heath on the hill-side or the marine terrace near the sea. The ascending main branches are commonly 1.5–2 m. high and reach occasionally a height of 3 m. *Sorbus sambucifolia* is found sparsely scattered in the lower thickets. The ground vegetation is sparse and sometimes completely absent. The following species are found in this consociation:—

<i>Lycopodium complanatum</i> L.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Empetrum nigrum</i> L.	<i>Cornus canadensis</i> L.
<i>Rhododendron chrysanthum</i> Pall.	<i>Vaccinium Vitis-idaea</i> L.
<i>Linnæa borealis</i> L.	<i>Lonicera coerulea</i> L.

ii) *Betula Ermani*-Consociation

The prominent feature of the forest of this island is the extensive and conspicuous forest of *Betula Ermani* with *Sasa kurilensis*. It is widely spread on the mountain side and often forms a pure stand. As one ascends the mountains, the trees become smaller and smaller until entirely substituted by *Pinus pumila*. The mixed trees are *Alnus fruticosa*, *Sorbus kamtschatcensis* and *Prunus kurilensis*. The undergrowth shows a paucity of shrubby species and is mostly characterized by the predominance of *Sasa kurilensis*. *Calamagrostis Langsdorffii* is sometimes exclusively found in the lower zones bordering on the Betuletum. The following plants occur in this consociation:

<i>Dryopteris dilatata</i> A. Gray	<i>Polystichum Braunii</i> Féc
<i>Athyrium Filix-femina</i> Roth	<i>Lycopodium chinense</i> H. Chr.
<i>Lycopodium annotinum</i> L.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Streptopus amplexifolius</i> DC.	<i>Platanthera Ditmariana</i> Kom.
<i>Listera nipponica</i> Makino	<i>Stellaria yezoensis</i> Maxim.
<i>Skimmia repens</i> Nakai	<i>Viola Selkirkii</i> Pursh
<i>Ilex rugosa</i> Fr. Schm.	<i>Cornus canadensis</i> L.
<i>Vaccinium praestans</i> Lamb.	<i>Vaccinium Vitis-idaea</i> L.
<i>Cacalia kamtschatica</i> Kudo	

iii) *Alnus fruticosa*-Consociation

This consociation is observed only on some places along the valley, where a pure stand is occasionally found. The trees attain a height of 5–8 m. The herbaceous constants are as follows:—

<i>Dryopteris Phegopteris</i> C. Chr.	<i>Polystichum Braunii</i> Féc
<i>Equisetum hyemale</i> L.	<i>Calamagrostis Langsdorffii</i> Trin.
<i>Sasa kurilensis</i> Makino et Shibata	<i>Allium Victorialis</i> L.
<i>Streptopus amplexifolius</i> DC.	<i>Urtica platyphylla</i> Wedd.
<i>Chrysosplenium kamtschaticum</i> Fisch.	<i>Aconitum kamtschaticum</i> Willd. et Reichb.
<i>Cacalia hastata</i> L.	<i>Filipendula kamtschatica</i> Maxim.
<i>Senecio palmatus</i> Pall.	

The plateau and hill-side are often covered by shrubby thickets dominated by *Alnus fruticosa*, *Betula Ermani* and *Sorbus sambucifolia*, showing an intermediate stage. On the lower mountain slopes also are sometimes found almost impenetrable thickets of this type.

iv) *Salix sachalinensis*-Consociation

Thickets of *Salix* are frequent on the margin of ponds, swamps or lakes occurring either singly or in groups and also frequently becoming prominent trees along the valley in the lower altitude. It is represented by a single species—*Salix sachalinensis*. In a piece of damp ground, *Salix* is sometimes found codominant with *Alnus fruticosa*. The following plants are commonly found in this consociation:—

<i>Calamagrostis Langsdorffii</i> Trin.	<i>Urtica platyphylla</i> Wedd.
<i>Chrysosplenium flagelliferum</i> Fr. Schm.	<i>Chrysosplenium kamtschaticum</i> Fisch.
<i>Filipendula kamtschatica</i> Maxim.	<i>Anthriscus sylvestris</i> Hoffm.
<i>Petasites japonicus</i> Miq. var.	

2. Sea-shore

The aspect of the marine belt may be divided into the following

three divisions; i) *Elymus mollis*-consociation. ii) *Elymus*-*Ammodenia*-*Senecio*-association. iii) The association of the sea cliff.

i) *Elymus mollis*-Consociation

The typical association of the sandy beach and dune, represented by the *Elymus mollis*-consociation was observed near Tokotan. The following list is an enumeration of the characteristic plants:—

<i>Elymus mollis</i> Trin.	<i>Carex macrocephala</i> Willd.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Arabis japonica</i> A. Gray
<i>Rosa rugosa</i> Thunb.	<i>Lathyrus maritimus</i> Bigel.
<i>Geranium yezoense</i> Fr. et Sav.	<i>Phellopterus littoralis</i> Benth.
<i>Mertensia maritima</i> G. Don	<i>Linaria japonica</i> Miq.
subsp. <i>asiatica</i> Takeda	<i>Artemisia Stelleriana</i> Bess.

It will be noticed at once how closely the plants in this list conform with the common sandy beach species of Hokkaido, northern Honshu and Saghalien.

The vegetation dominated by *Elymus mollis* tends to be uniform and *Carex macrocephala*, *Lathyrus maritimus*, *Artemisia Stelleriana* and *Lactuca repens* maintain a subordinate rank. *Rosa rugosa* grows about 0.5 m. in height on the sand dune.

ii) *Elymus*-*Ammodenia*-*Senecio*-Association

The beach near Tokotan is composed of pebbles ranging about 6–10 cm in diameter. The vegetation is sparse, consisting of a few flowering plants, such as *Elymus mollis*, *Ammodenia oblongifolia*, and *Senecio pseudo-Arnica*, and mixed with *Ligusticum scoticum*, and *Mertensia maritima*, subsp. *asiatica*.

iii) Sea-cliff-association

Some species belonging to this association grow only on the rocky-cliffs along the sea shore, while others are found also on rocks of the upland region. The vegetation is specially boreal in character and communities can be divided into two forms, viz., dry rocky shores and damp rocky shores, but these two are not always clearly separable. The following plants are commonly found:—

<i>Woodsia polystichoides</i> Eat.	<i>Selaginella helvetica</i> Link
<i>Tofieldia nutans</i> Willd.	<i>Stellaria ruscifolia</i> Willd.
* <i>Sagina Linnaei</i> Presl	* <i>Cochlearia oblongifolia</i> DC.
* <i>Draba borsalis</i> DC.	<i>Sedum Rhodiola</i> DC.

<i>Saxifraga rivularis</i> L.	* <i>Potentilla megalantha</i> Takeda
<i>Hedysarum obscurum</i> L.	<i>Empetrum nigrum</i> L.
<i>Rhododendron camtschaticum</i> Pall.	<i>Androsace Chamaejasme</i> Host.
* <i>Chrysanthemum arcticum</i> L.	* <i>Primula Fauriei</i> Franch.
<i>Artemisia sericea</i> Weber.	

(* Rocky elements of the marine belt).

3. Heath

The heath in this locality is found on flat lands and exposed hillsides, but is nowhere extensively developed. It seems to represent an intermediate stage destined to be suppressed by other plant communities such as the consociation of *Pinus pumila*, etc. *Empetrum nigrum* is the most remarkable element, and is there associated with the following characteristic Ericaceous plants:—

<i>Rhododendron chrysanthum</i> Pall.	<i>Rhododendron camtschaticum</i> Pall.
<i>Arctous alpina</i> Niedz.	<i>Vaccinium Vitis-idaea</i> L.
<i>Vaccinium uliginosum</i> L.	

Accompanied with them are found such plants as:—

<i>Polygonum viviparum</i> L.	<i>Anemone narcissiflora</i> L.
<i>Geum calthaefolium</i> Sm.	<i>Hedysarum obscurum</i> L.
<i>Cnidium ajanense</i> Drude	<i>Cornus suecica</i> L.
<i>Trientalis europaea</i> L.	<i>Lagotis glauca</i> Gaertn.
<i>Pedicularis euphrasioides</i> Steph.	<i>Artemisia arctica</i> Less.

4. Grassy land

The associations of grassy places were noticed on slopes of the hillsides and marine terraces. *Calamagrostis Langsdorffii* is the dominant species in addition to which are found the following plants:—

<i>Agrostis hyemalis</i> B.S.P.	<i>Festuca rubra</i> L.
<i>Sasa kwilensis</i> Makino et Shibata	<i>Cypripedium macranthum</i> Sw.
<i>Coeloglossum viride</i> Hartm.	<i>Microstylis monophyllos</i> Lindl.
<i>Cerastium boreale</i> Takeda	<i>Dianthus superbus</i> L.
<i>Thalictrum Thunbergii</i> A. P. DC.	<i>Sanguisorba tenuifolia</i> Fisch.
<i>Trifolium Lupinaster</i> L.	<i>Vicia unijuga</i> A. Br.
<i>Swertia tetrapetala</i> Pall.	<i>Halenia corniculata</i> Druce
<i>Euphrasia mollis</i> Wettst.	<i>Pedicularis resupinata</i> Schang.
<i>Galium verum</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Ligularia calthaefolia</i> Maxim.	

In places *Sorbus sambucifolia*, *Pinus pumila* and *Alnus fruticosa* form small patches. On the lower slopes they are replaced by meadow- or beach-association.

5. Meadow

The associations of this type are commonly developed in hollows of the low land, on flat tops of the marine terrace and on alluvial soils along water courses. They are divided into two divisions.

i) *Filipendula-Cacalia-Petasites*-Association

There are considerable tracts of this association on low lands. The tall herbs *Filipendula kamtschatica*, *Cacalia hastata* and *Petasites japonicus* var. *giganteus* are the codominant species. *Cirsium kamtschaticum* and *Senecio palmatus* maintain the subordinate rank. Besides them the following plants are commonly found:—

<i>Equisetum hyemale</i> L.	<i>Veratrum album</i> L.
<i>Gagea lutea</i> Ker-Gawl.	<i>Allium Victorialis</i> L.
<i>Lilium medeoloides</i> A. Gray	<i>Fritillaria camschatcensis</i> Ker-Gawl.
<i>Trillium kamtschaticum</i> Pall.	<i>Iris setosa</i> Pall.
<i>Urtica platyphylla</i> Wedd.	<i>Rumex Acetosa</i> L.
<i>Aconitum kamtschaticum</i> Willd. et Reichb.	<i>Corydalis ambigua</i> Cham. et Schl.
<i>Sanguisorba tenuifolia</i> Fisch.	<i>Geranium erianthum</i> DC.
<i>Coelopleurum Gmelinii</i> Ledeb.	<i>Heracleum lanatum</i> Michx.
<i>Pedicularis resupinata</i> Schang.	<i>Artemisia vulgaris</i> L.

The association is sometimes dominated by *Senecio palmatus* and *Cacalia hastata*, or locally only by *Petasites japonicus*, var. *giganteus*. They are developed on alluvial grounds along the stream.

ii) *Anemone-Geranium-Thalictrum*-Association

In this type of plant community, developed on the flat top of the marine terrace, the society of *Pinus pumila* is seen here and there. The dominant vegetation consists of *Anemone narcissiflora*, *Geranium erianthum* and *Thalictrum Thunbergii*, while *Sanguisorba tenuifolia*, *Trollius* sp., maintain subordinate rank. The following plants are commonly found in this association:—

<i>Carex vaginata</i> Tausch	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Polygonum viviparum</i> L.	<i>Geum calthaeifolium</i> Sm.
<i>Hedysarum obscurum</i> L.	<i>Geranium erianthum</i> DC.
<i>Cnidium ajanense</i> Drude	<i>Cornus suecica</i> L.
<i>Trientalis europaea</i> L.	<i>Gentiana auriculata</i> Pall.
<i>Swertia tetrapetala</i> Pall.	<i>Pedicularis Chamissonis</i> Stev.
<i>Anaphalis margaritacea</i> Benth. et Hook.	<i>Artemisia vulgaris</i> L.
	<i>Cirsium kamtschaticum</i> Ledeb.

6. Aquatics

As to the aquatic association, the observation is based on the visits to Lake Tokotan and to small ponds along the Yoroi River. The elements of this association are essentially of circumpolar nature. In Lake Tokotan the following species were found:—

Potamogeton alpinus Balbis. *Potamogeton perfoliatus* L.
Potamogeton Maackianus A. Benn. *Ranunculus trichophyllus* Chaix.
Myriophyllum spicatum L.

Only once has *Potamogeton natans* been noted as occurring in pools in the swamp along the Yoroi River.

7. Swamp and Bog

The swamp is occupied by the type of vegetation dominated by sedges with other swamp species, and the bog mostly by *Sphagnum* with dwarf shrubs. The communities of the swamp and bog are divided into the following four divisions:—

- i) *Calamagrostis-Filipendula*-association.
- ii) *Carex Lyngbyei*-consociation.
- iii) *Juncus-Carex*-association.
- iv) *Sphagnum-Andromeda-Oxycoccus*-association.

i) *Calamagrostis-Filipendula*-Association

This type of swamp association developed on more or less alluvial soils, is not of much importance. It is to be placed between the sedge-swamp and the meadow. *Calamagrostis Langsdorffii* and *Filipendula kamtschatica* are the codominant species and the characteristic plants are as follows:—

Equisetum palustre L. *Carex Lyngbyei* Hornem.
Lysichiton kamtschaticense Schott *Luzula parviflora* Desv.
Veratrum album L. *Iris setosa* Pall.
Ranunculus repens L. *Sanguisorba tenuifolia* Fisch.
Lathyrus palustris L. *Viola Langsdorffii* Fisch.
Angelica refracta Fr. Schm. *Aster Glehni* Fr. Schm.

ii) *Carex Lyngbyei*-Consociation

This type of swamp-association occurs around the ponds or lake and along the streams in the low land. The vegetation is generally

monotonous. The most important species is *Carex Lyngbyei*, but in certain places *Carex vesicaria* is dominant or codominant.

There are swampy areas of the Caricetum well developed near Tokotan and Hayakawa. Along Lake Tokotan it mainly forms a continuous stratum forming a border to the water community and near the Hayakawa it is the typical feature. The common herbaceous components are as follows:—

<i>Eleocharis palustris</i> L.	<i>Phalaris arundinacea</i> L.
<i>Lysichiton camtschaticense</i> Schott	<i>Rumex aquatica</i> L.
<i>Comarum palustre</i> L.	<i>Filipendula kamtschatica</i> Maxim.
<i>Sanguisorba tenuifolia</i> Fisch.	<i>Angelica refracta</i> Fr. Sehm.
<i>Naumburgia thyrsoiflora</i> Duby	

In the intermediate zone between the aquatic community and the Caricetum, *Eleocharis kamtschatica* and *Hippuris vulgaris* are found, and small patches of *Menyanthes trifoliata* sometimes occur in the pools.

iii) *Juncus-Carex*-Association

In the lower altitude, marsh areas dominated by *Juncus-Carex* occur. The codominant species are *Juncus kamtschaticensis* and *Carex Middendorffii*, but in certain places *Carex Oederi* or *Carex vesicaria*, var. is codominant, while such marsh plants as the following are common:—

<i>Equisetum palustre</i> L.	<i>Triglochin palustre</i> L.
<i>Juncus prominens</i> Miyabe et Kudo	<i>Parnassia palustris</i> L.
<i>Andromeda Polifolia</i> L.	<i>Menyanthes trifoliata</i> L.
<i>Lobelia sessilifolia</i> Lamb.	

Sometimes it is replaced by *Juncus-Scirpus*-association in more or less drier condition. *Juncus kamtschaticensis* and *Scirpus caespitosus* are codominant. The *Cladonia* societies are found here and there, associated with the elements of the *Sphagnum* bog.

iv) *Sphagnum-Andromeda-Oxycoccus*-Association

The *Sphagnum* bogs are well developed at the northern and southern parts of this island, but they are present only locally in the middle part of the island. There are several places on the marine terrace and on the flat places of the mountain side, where *Sphagnum* occurs in quantity, accompanied by dwarf shrubs, such as *Andromeda Polifolia* and *Oxycoccus vulgaris* and sedges. It is often surrounded by a border of *Pinus pumila*- or *Juncus-Scirpus*-association. The following is a list of vascular plants found in the *Sphagnum* bog:—

<i>Selaginella selaginoides</i> Link	<i>Eriophorum vaginatum</i> L.
<i>Scirpus caespitosus</i> L.	<i>Carex pauciflora</i> Lightf.
<i>Carex Middendorffii</i> Fr. Schm.	<i>Juncus kamschatcensis</i> Kudo
<i>Tofieldia nutans</i> Willd.	<i>Platanthera tipuloides</i> Lindl.
<i>Coptis trifolia</i> Salisb.	<i>Drosera rotundifolia</i> L.
<i>Parnassia palustris</i> L.	<i>Empetrum nigrum</i> L.
<i>Geum pentapetalum</i> Makino	<i>Ledum palustre</i> L.
<i>Oxycoccus microcarpus</i> Turcz.	<i>Vaccinium Vitis-idaea</i> L.
<i>Trientalis europaea</i> L.	<i>Gentiana Kawakamii</i> Makino

THE ISLAND OF SHIMUSHIR

TOPOGRAPHY

The Island of Shimushir lies about 332 miles north-east from the Port of Nemuro in Hokkaido and about 286 miles south-west from Kamtschatka. It extends from 46°46' to 47°10' N.L. and from 151°42' to 152°17' E.L. It is linear oblong in outline, lying from south-west to north-east, about 32 miles in length, about 4 miles in average width



Mt. Shimushir-fuji, from Nakadomari, the Island of Shimushir,
taken on May 22, 1930.

with an area of about 126 square miles. To the south-west is the Island of Urup, separated by the Urup Strait (Bussole Channel), 60 miles wide. It is separated from the Island of Ketoi on the north-east by the Shimushir Strait (Diana Strait), having a width of 10.5 miles

The island may be divided into three portions:—the south-western portion, which is dominated by the volcanic mountains, represented by Mt. Shimushir; the central, characterized by the flat upland plateaux, bounded on the north by Mt. Shimushir-fuji; and the north-eastern portion with several smaller mountains and the Broughton Bay, the only safe harbour in the Middle Kuriles. The principal peaks ranging from south to north, are Mt. Shimushir (1528 m), Mt. Kammuri (1324 m.), Mt. Yake (899 m.) and Mt. Shimushir-fuji (1360 m.). The rivers are small, running generally to the eastern and western sides. The lake of importance in this island is the Midori, which shows an interesting physiographical feature.

THE PLANT-COMMUNITIES

Owing to the low temperature and frequent dense fogs, the plant-physiognomy of the island is characterized by the subarctic aspect. The plant-communities are here treated under the following seven main categories:—

- | | |
|---------------------|-------------------|
| 1. Forest. | 2. Sea-shore. |
| 3. Heath. | 4. Grassy land. |
| 5. Meadow. | 6. Swamp and bog. |
| 7. Volcanic upland. | |

1. Forest

The resemblance between the aspect of the forest type of this island and that of Urup is striking, and both of them in this respect are essentially different from Yezo, even from the southern Kuriles. An interesting feature, which no doubt is of importance in connection with the vegetation, is that the woods are mostly of the shrubby type. The arboreal flora is poor in species and they are mostly composed of northern elements. The predominant species are *Pinus pumila* and *Alnus fruticosa* and that of the second importance is *Betula Ermani*. It is remarkable that *Prunus kurilensis*, which is distributed as far north as the Island of Urup, is completely absent from this island. *Taxus cuspidata* occasionally grows in this island. The communities of the forest are divided into the following three main divisions:—

- i) *Pinus pumila*-consociation.
- ii) *Alnus fruticosa*-consociation.
- iii) *Betula Ermani*-consociation.

i) *Pinus pumila*-Consociation

The Pinetum, consisting of *Pinus pumila* is monotonous in appearance, forming dense impenetrable thickets. It is well developed in the north-eastern part of the island from Mt. Shimushir-fuji northward, and often it comes down near the sea-shore. It is a striking fact that there is no Pinetum in the central part including Lake Midori. The locally developed consociation is found in the south-western end of this island. The ascending main branches are commonly 1.5–2 m. high. *Sorbus sambucifolia* and *Alnus fruticosa* are sparsely scattered in the lower region of the Pinetum. The ground vegetation is scanty and often completely absent. Owing to the impenetrability of the thicket, the collected data of the under layer were not sufficient to enable the author to make precise notes. The following species are found in this consociation:—

<i>Lycopodium complanatum</i> L.	<i>Lycopodium alpinum</i> L.
<i>Majanthemum dilatatum</i> Nels. et Macb.	<i>Empetrum nigrum</i> L.
<i>Cornus suecica</i> L.	<i>Rhododendron chrysanthum</i> Pall.
<i>Vaccinium Vitis-idaea</i> L.	<i>Linnaea borealis</i> L.

ii) *Betula Ermani*-Consociation

Thickets of *Betula Ermani* are frequent in the lower altitudes of the north-eastern part, forming rather a narrow zone around the base of the mountain, but not so well developed as those met with in the Island of Urup. The trees occur singly or in groups, and become especially prominent near the the fox-farming station of Broughton Bay. The dominant species of the under layer is *Sasa kurilensis*. Besides *Sasa*, the following plants are found in this consociation:—

<i>Dryopteris dilatata</i> A. Gray	<i>Polystichum Braunii</i> Fée
<i>Lycopodium Selago</i> L.	<i>Lycopodium annotinum</i> L.
<i>Allium Victorialis</i> L.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Trillium kamtschaticum</i> Pall.	<i>Stellaria yezoensis</i> Maxim.
<i>Oxalis Acetocella</i> L.	<i>Circaea alpina</i> L.

iii) *Alnus fruticosa*-Consociation

The prominent feature of the thickets in the central part of this island is the Alnetum, dominated by only one species, *Alnus fruticosa*. It clothes the ranges from the bottoms of the gullies to the ridges of

the mountains. This alder thicket seems to be the edaphic climax in the central part, although there is a suggestion in places of a pioneer phase. It is widely spread not only in the central part but also in the north-eastern and south-western. It occurs in large or small almost pure stands on the mountain-side, on the plateau or along the valley. The upper valleys are often densely covered with the prostrate alder. The height of the tree varies according to localities and was observed to range from 1-6 m. The under layer of the Alnetum seems to vary considerably in different places. In the lower region, it is dominated by *Sasa kurilensis*, which becomes sparse in the upper region and is sometimes completely absent. A general list of the vascular plants of the ground flora, from different localities, is given below.

<i>Dryopteris dilatata</i> A. Gray	<i>Botrychium robustum</i> Underw.
* <i>Polystichum Braunii</i> Fée	<i>Lycopodium chinense</i> H. Chr.
* <i>Equisetum hyemale</i> L.	<i>Allium Victorialis</i> L.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Streptopus amplexifolius</i> DC.
<i>Stellaria yezoensis</i> Maxim.	* <i>Filipendula kamtschatica</i> Maxim.
<i>Viola Selkirkii</i> Pursh	<i>Circaea alpina</i> L.
<i>Galium kamtschaticum</i> Stell.	<i>Peracarpa circaeoides</i> Feer
* <i>Cacalia kamtschatica</i> Kudo	

(* especially abundant in the under layer in the valley).

Notes on the main arboreal species.

Salix sachalinensis: This is not so frequently found as in the Island of Urup. It occurs in the southern part of Shimushir, growing either singly or in groups along the valley or very rarely in the hollows of the flat upland.

Salix arctica-group: The prostrate willows are almost represented by the *Salix arctica*-group, and rarely mixed with *Salix Reinii*. They are very common in the plateaux, being especially abundant in the central part. Also they grow in the heaths and bogs.

Sorbus sambucifolia: This is a common species in the island, occurring singly or in small patches locally. Sometimes it grows in the Alnetum and Betuletum and rarely also in the *Pinetum*.

Lonicera coerulea and *Lonicera Chamissoi*: They occur generally either in the alder or birch thickets. *Lonicera coerulea* is more common than *Lonicera Chamissoi*.

Diervilla Middendorffiana: This seems to be rather rare and is only found near Shimushir along the River Shimushir. It is distributed as far north as the Island of Matuwa.

2. Sea-shore

The plant communities of the marine belt may be divided into the following three divisions:—i) *Elymus mollis*-consociation. ii) *Elymus-Ammodenia-Senecio*-association. iii) The association of the sea cliff.

i) *Elymus mollis*-Consociation

The association of the sandy beach and dune was observed at the following five places:—near Sakanagawa, near Nakadomari, near Shimushir and Minamiura. The following list is an enumeration of the characteristic plants:—

<i>Elymus mollis</i> Trin.	<i>Atriplex patula</i> L.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Arabis japonica</i> A. Gray
<i>Rosa rugosa</i> Thunb.	<i>Lathyrus maritimus</i> Bigel.
<i>Thermopsis fabacea</i> DC.	<i>Ligusticum scoticum</i> L.
<i>Phellopterus littoralis</i> Benth.	<i>Mertensia maritima</i> G. Don subsp. <i>asiatica</i> Takeda
<i>Artemisia Stelleriana</i> Bess.	<i>Senecio pseudo-Arnica</i> Less.

It will be noticed at once how closely the plants in this list coincide with the common sandy beach species of Hokkaido, northern Honshu and Saghalien.

The sandy beach-association tends to be uniform, being mostly dominated by *Elymus mollis*; *Ammodenia oblongifolia* and *Lathyrus maritimus* maintaining the subordinate rank.

It is noticeable that there is a characteristic community near Shimushir and Minamiura caused by volcanic influences. A narrow zone along the beach supports a vegetation different from the typical sandy beach association. It is impossible to draw any line between the association under consideration and the volcanic gravelly and sandy association. Indeed the communities appear in equal quantities mixed with both elements, especially on the interior parts where the vegetation is generally scattered. The following plants have been gathered in these localities among which those marked with an asterisk are the constant elements of the volcanic gravelly and sandy association.

* <i>Calamagrostis purpurascens</i> R. Br.	* <i>Deschampsia flexuosa</i> Trin.
<i>Festuca rubra</i> L.	<i>Elymus mollis</i> Trin.
<i>Polygonum kurilense</i> Tatewaki	<i>Ammodenia oblongifolia</i> Rydb.
* <i>Stellaria ruscifolia</i> Willd.	* <i>Papaver nudicaule</i> L.
* <i>Arabis lyrata</i> L.	<i>Arabis japonica</i> A. Gray
* <i>Saxifraga Merckii</i> Fisch.	* <i>Oxytropis retusa</i> Matsum.

<i>Thermopsis fabacea</i> DC.	<i>Lathyrus maritimus</i> Bigel.
* <i>Hedysarum obscurum</i> L.	* <i>Lagotis glauca</i> Gaertn.
* <i>Campanula lasiocarpa</i> Cham.	<i>Artemisia Stelleriana</i> Bess.
<i>Senecio pseudo-Arnica</i> Less.	

Among the above mentioned, *Elymus mollis* is most abundant, *Thermopsis fabacea* forms patches here and there near the sea shore.

ii) *Elymus-Ammodenia-Senecio*-Association

The beach where this association occurs is composed of pebbles about 5–10 cm. in diameter. The vegetation is rather sparse, consisting of a few flowering plants, such as:—

<i>Elymus mollis</i> Trin.	<i>Ammodenia oblongifolia</i> Rydb.
<i>Ligusticum scoticum</i> L.	<i>Mertensia maritima</i> L.
<i>Senecio pseudo-Arnica</i> Less.	subsp. <i>asiatica</i> Takeda

iii) Sea-cliff-Association

There are many rocky cliffs along the coast, the vegetation of which is mostly boreal in character. The community can be divided into two forms, viz., the dry rocky shore and the damp rocky shore form, of which the former is more common in this island. However, these two are not always clearly separable. Some species belonging to this association grow only on rocky cliffs along the sea-shore, while the others are found also on rocky places of the upland region. The following plants are those commonly found in this kind of localities:—

<i>Festuca rubra</i> L.	* <i>Elymus mollis</i> Trin.
<i>Tofieldia nutans</i> Willd.	<i>Lloydia serotina</i> Reichb.
<i>Stellaria ruscifolia</i> Willd.	* <i>Sagina Linnaei</i> Presl
* <i>Cochlearia oblongifolia</i> DC.	* <i>Draba borealis</i> DC.
* <i>Sedum Rhodiola</i> DC.	* <i>Saxifrage rivularis</i> L.
* <i>Potentilla megalantha</i> Takeda	<i>Hedysarum obscurum</i> L.
<i>Empetrum nigrum</i> L.	* <i>Ligusticum scoticum</i> L.
<i>Rhododendron camtschaticum</i> Pall.	<i>Cassiope lycopodioides</i> Don.
* <i>Primula Fauriei</i> Franch.	<i>Primula cuneifolia</i> Ledeb.
* <i>Chrysanthemum arcticum</i> L.	<i>Taraxacum ceratophorum</i> DC.

(* Rocky elements of the marine belt).

Here the vegetation of the exposed slopes with disintegrating rocks is recorded as an additional note. It is characterized by the arctic-alpine plants, such as *Oxyria digyna*, *Stellaria ruscifolia*, *Papaver*

nudicaule, etc. Besides these are found *Plantago camtschatica* and *Chrysanthemum arcticum*, and sometimes *Pentstemon frutescens*, *Hedysarum obscurus*, etc.

3. Heath

In Shimushir, the heath represented by the dwarf shrubby one is developed on flat uplands, hill-tops, and terraces and sometimes on exposed hill-sides. Nowhere in this island do we find this association so well developed as in the northern Kuriles. It seems to represent a transitional phase to the Pinetum or Alnetum. *Empetrum nigrum* is the dominant species. The prostrated low shrubs such as *Salix kurilensis*, *Pinus pumila*, *Alnus fruticosa* and *Sorbus sambucifolia* are scattered in the heath. *Cladonia* are found here and there in small patches. In this association, the following plants are found:—

<i>Rhododendron chrysanthum</i> Pall.	<i>Rhododendron camtschaticum</i> Pall.
<i>Loiseleuria procumbens</i> Desv.	<i>Cassiope lycopodioides</i> G. Don
<i>Arcteria nana</i> Makino	<i>Arctous alpina</i> Niedz.
<i>Vaccinium Vitis-idaea</i> L.	<i>Vaccinium uliginosum</i> L.
<i>Bryanthus musciformis</i> Nakai	<i>Phyllodoce aleutica</i> A. Hell.

Accompanied with them are found such plants as:—

<i>Lycopodium alpinum</i> L.	<i>Lycopodium obscurum</i> L.
<i>Lycopodium sitchense</i> Rupr.	<i>Calamagrostis purpurascens</i> R. Br.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Tofieldia nutans</i> Willd.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Orchis aristata</i> Fisch.
<i>Polygonum viviparum</i> L.	<i>Geum calthaefolium</i> Sm.
<i>Hedysarum obscurum</i> L.	<i>Oxytropis retusa</i> Matsum.
<i>Cnidium ajanense</i> Drude	<i>Cornus succica</i> L.
<i>Trientalis europaea</i> L.	<i>Veronica Stelleri</i> Pall.
<i>Pedicularis euphrasioides</i> Steph.	<i>Artemisia arctica</i> Less.

4. Grassy land

The associations of the grassy land are well developed, especially in the vicinity of Broughton Bay. They are distributed on hill-sides and terraces and also on gentle slopes of the upland, showing a comparatively recent formation. The Graminetum is dominated by *Calamagrostis Langsdorffii* with *Festuca rubra* subdominant in places. Here besides these are found the following plants:—

<i>Botrychium lanceolatum</i> Angustr.	<i>Phleum alpinum</i> L.
<i>Agrostis hiemalis</i> B.S.P.	<i>Calamagrostis purpurascens</i> R. Br.
<i>Trisetum sibiricum</i> Rupr.	<i>Carex scita</i> Maxim.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Lilium medeoloides</i> A. Gray
<i>Cypripedium guttatum</i> Sw.	<i>Cypripedium macranthum</i> Sw.
<i>Rumex Acetosa</i> L.	<i>Polygonum kurilense</i> Tatewaki
<i>Parnassia palustris</i> L.	<i>Geranium erianthum</i> DC.
<i>Swertia tetrapetala</i> Pall.	<i>Halenia corniculata</i> Druce
<i>Euphrasia mollis</i> Wettst.	<i>Pedicularis resupinata</i> L.
<i>Solidago Virgaurea</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Achillea Ptarmica</i> L.	<i>Picris kamtschatica</i> Ledeb.

5. Meadow

The associations of the meadows are commonly developed on low lands, hill-sides and hill-tops, but especially in alluvial soils along the water courses. It is possible to divide the vegetation of this type into the following three divisions:—

i) *Filipendula-Cirsium-Senecio*-association; ii) *Petasites-Filipendula*-association; iii) Herbaceous associations of the upper hill-side and flat upland.

i) *Filipendula-Cirsium-Senecio*-Association

The *Filipendula-Cirsium-Senecio*-association is found in the low land. The tall herbs, *Filipendula kamtschatica*, *Cirsium kamtschaticum* and *Senecio palmatus* are the codominant species, the first named often forming a pure stand. Besides them the following plants are commonly found:—

<i>Lilium medeoloides</i> A. Gray	<i>Iris setosa</i> Pall.
<i>Urtica platyphylla</i> Wedd.	<i>Aconitum kamtschaticum</i> Willd.
<i>Corydalis ambigua</i> Cham. et Schl.	<i>Sanguisorba tenuifolia</i> Fisch.
<i>Geranium eriathum</i> DC.	<i>Heracleum lanatum</i> Michx.
<i>Cacalia kamtschatica</i> Kudo	

ii) *Petasites-Filipendula*-Association

The *Petasites-Filipendula*-association is usually found in a damp rich soil along the valley. *Petasites japonicus*, var. *giganteus* and *Filipendula kamtschatica* are the codominant plants. The former often forms locally a pure stand. In this island, it is developed especially in the vicinity of Nakadomari where there is a place called Fuki-no-sawa

(the valley of *Petasites*), on account of the abundance of *Petasites japonicus*, var. *giganteus*. The following plants are also commonly found:—

<i>Veratrum album</i> L.	<i>Lilium medeoloides</i> A. Gray
<i>Urtica platyphylla</i> Wedd.	<i>Aconitum kamtschaticum</i> Willd.
<i>Barbarea orthoceras</i> DC.	<i>Saxifraga punctata</i> L.
<i>Chrysosplenium kamtschaticum</i> Fisch.	<i>Epilobium Behringianum</i> Hausskn.
<i>Angelica refracta</i> Fr. Schm.	<i>Senecio palmatus</i> Pall.

iii) The herbaceous associations of the upper hill-side
and the flat upland

The plant-communities in these associations are a rather mixed assemblage, which do not always seem to have any definite relation to one another, having no peculiar dominants. Sometimes *Geranium erianthum* and *Trollius Riederianus* are the chief plants, especially on the marine terraces, while sometimes *Anemone narcissiflora* and *Geranium erianthum* are most abundant and striking, especially on the hill-side. The following plants are commonly recorded from several associations under consideration: —

<i>Festuca rubra</i> L.	<i>Carex vaginata</i> Tausch
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Allium Victorialis</i> L.
<i>Lilium medeoloides</i> A. Gray	<i>Fritillaria camtschatcensis</i> Ker-Gawl.
<i>Lloydia serotina</i> Reichb.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Iris setosa</i> Pall.	<i>Orchis aristata</i> Fisch.
<i>Coeloglossum viride</i> Hartm.	<i>Trollius Riederianus</i> Fisch.
<i>Anemone narcissiflora</i> L.	<i>Pulsatilla angustifolia</i> Turcz.
<i>Parnassia palustris</i> L.	<i>Geum calthaefolium</i> Sm.
<i>Sanguisorba tenuifolia</i> Fisch.	<i>Geranium erianthum</i> DC.
<i>Viola crassa</i> Makino	<i>Cnidium ajanense</i> Drude
<i>Cornus succica</i> L.	<i>Trientalis europaea</i> L.
<i>Swertia tetrapetala</i> Pall.	<i>Gentiana auriculata</i> Pall.
<i>Veronica Stelleri</i> Pall.	<i>Pedicularis Chamissonis</i> Stev.
<i>Pedicularis resupinata</i> L.	<i>Lagotis glauca</i> Gaertn.
<i>Solidago Virgaurea</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Achillea Ptarmica</i> L.	<i>Artemisia arctica</i> Less.
<i>Arnica unalascensis</i> Less.	<i>Saussurea Riederi</i> Herd.

Besides these plants are also found usually such dwarf shrubs as *Empetrum nigrum*, *Rhododendron chrysanthum*, *Rhododendron kamtschaticum*, *Arctous alpina*, *Vaccinium Vitis-idaea*, etc.

6. Swamp and Bog

These associations do not occupy any large area in the island. Little fringing bogs and swamps are developed in the north-eastern part. The communities of the swamp and bog are divided into the following:—

i) *Calamagrostis-Filipendula*-association; ii) *Carex Lyngbyei*-association; iii) *Potamogeton-Hippuris-Menyanthes*-association; iv) *Carex rariflora-Carex Middendorffii*-association; v) *Sphagnum-Andromeda-Oxy-coccus*-association.

a) Swamp

i) *Calamagrostis-Filipendula*-Association

This type of the swampy places, developed on an alluvial soil, is not of so much importance as in the Island of Urup. It is a transitional phase from the bog or swamp to the meadow. *Calamagrostis Langsdorffii* and *Filipendula kamtschatica* are the codominant species while other constant species are as follows:—

<i>Equisetum palustre</i> L.	<i>Carex Lyngbyei</i> Hornem.
<i>Lysichiton camtschaticense</i> Schott	<i>Luzula parviflora</i> Desv.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Veratrum album</i> L.
<i>Iris setosa</i> Pall.	<i>Platanthera hyperborea</i> Lindl.
<i>Trollius Riederianus</i> Fisch.	<i>Ranunculus repens</i> L.
<i>Sanguisorba tenuifolia</i> Fisch.	<i>Lathyrus palustris</i> L.
<i>Viola Langsdorffii</i> Fisch.	<i>Cornus suecica</i> L.

ii) *Carex Lyngbyei*-Consociation

The type of the swamp-association occurs around ponds, along streams and in damper places in the low land. The vegetation is uniform in appearance. The most important species is *Carex Lyngbyei*, but locally it is replaced by *Carex saxatilis*. The following additional plants are commonly found in this consociation:—

<i>Equisetum palustre</i> L.	<i>Eleocharis kamtschatica</i> Kom.
<i>Comarum palustre</i> L.	<i>Filipendula kamtschatica</i> Fisch.
<i>Sanguisorba tenuifolia</i> Fisch.	<i>Viola Langsdorffii</i> Fisch.

b) Bog

Bogs occur around the pond, on the terrace or along the water course. Around the pond, the following zones are recognized, viz.,

Potamogeton-Hippuris-Menyanthes-association; *Carex rariflora-Carex Middendorffii*-association; *Sphagnum-Andromeda-Oxycoccus*-association.

iii) *Potamogeton-Hippuris-Menyanthes*-Association

As to the aquatic plants, only one species, *Potamogeton natans* is found, occurring rather rarely through the island. The fenny plants are represented by three species, namely *Hippuris vulgaris*, *Eleocharis kamtschatica* and *Menyanthes trifoliata*. The former two species serve as the pioneers of the marsh and bog communities extending the belt to the aquatic area. The narrow zone of *Carex Lyngbyei* forms the continuous stratum following the fenny community.

Bogs, generally associated with ponds as described above, occur near Yamagoshizaki and the southern end of Broughton Bay, and support the following types of bog-communities.

iv) *Carex rariflora-Carex Middendorffii*-Association

On the terraces, bogs occur dominated by *Carex rariflora* (sometimes partly replaced by *Carex Middendorffii*). It is the most noteworthy community of the bog-association in the Middle Kuriles, though there is no extensive area in this island. The vegetation tends to be monotonous, including somewhat the same constants as the following association.

v) *Sphagnum-Andromeda-Oxycoccus*-Association

The bog association of this type seems to be present only locally in this island. *Sphagnum* occurs in quantity, accompanied by the dwarf shrubs and sedges. In one locality near Yamagoshizaki, the plants occurring are as in the following list which give some idea of this type of bog-association.

<i>Selaginella selaginoides</i> Link	<i>Triglochin palustre</i> L.
<i>Agrostis Trinii</i> Turcz.	<i>Eriophorum vaginatum</i> L.
<i>Scirpus caespitosa</i> L.	<i>Carex pauciflora</i> Lightf.
<i>Carex ciruinata</i> C. A. Mey.	<i>Carex hakkodensis</i> Franch.
<i>Carex Middendorffii</i> Fr. Schm.	<i>Carex limosa</i> L.
<i>Carex rariflora</i> Sm.	<i>Juncus kamtschaticensis</i> Kudo
<i>Juncus prominens</i> Miyabe et Kudo	<i>Iris setosa</i> Pall.
<i>Orchis aristata</i> Fisch.	<i>Platanthera tipuloides</i> Lindl.
<i>Polygonum viviparum</i> L.	<i>Coptis trifolia</i> Salisb.
<i>Drosera rotundifolia</i> L.	<i>Parnassia palustris</i> L.
<i>Rubus Chamaemorus</i> L.	<i>Geum calthaeifolium</i> Sm.
<i>Geum pentapetalum</i> Makino	<i>Sanguisorba tenuifolia</i> Fisch.

<i>Empetrum nigrum</i> L.	<i>Viola palustris</i> L.
<i>Rhododendron chrysanthum</i> Pall.	<i>Bryanthus musciformis</i> Nakai
<i>Andromeda Polifoia</i> L.	<i>Arctous alpina</i> Nieduz.
<i>Oxycoccus vulgaris</i> Hill	<i>Oxycoccus microcarpus</i> Turcz.
<i>Vaccinium uliginosum</i> L.	<i>Vaccinium Vitis-idaea</i> L.
<i>Trientalis europaea</i> L.	<i>Gentiana Kawakamii</i> Makino
<i>Pinguicula vulgaris</i> L.	

7. Volcanic Upland

The most prominent feature of the plant-community of this island is the volcanic upland association. They are especially developed in the central part between Shimushir Bay and Mt. Shimushir-fuji, including the complex volcano of Lake Midori.

Generally speaking, the vegetation is yet in an early stage, a complete association not yet having been formed. It is difficult to give any list which represents the association adequately, since it varies from place to place according to the instability and nature of the substratum.

In the most unstable places, *Papaver nudicaule*, var. is a prominent plant, together with *Stellaria ruscifolia* and *Pentstemon frutescens*.

Much of the ground of the plateau is covered with lapilli of various sizes, or consists of rocky outcrops. The vegetation is usually scattered. The following list gives some idea of the type of this community.

<i>Calamagrostis purprascens</i> R. Br.	<i>Deschampsia flexuosa</i> Trin.
<i>Carex flavocuspis</i> Fr. et Sav.	<i>Carex stenantha</i> Fr. et Sav.
<i>Oxyria diggyna</i> Hill.	<i>Polygonum viviparum</i> L.
<i>Stellaria ruscifolia</i> Willd.	<i>Papaver nudicaule</i> L.
<i>Saxifraga Merckii</i> Fisch.	<i>Potentilla Miyabei</i> Makino
<i>Hedysarum obscurum</i> L.	<i>Oxytropis retusa</i> Matsun.
<i>Viola crassa</i> Makino	<i>Primula cuneifolia</i> Ledeb.
<i>Pinguicula vulgaris</i> L.	<i>Pentstemon frutescens</i> Lambl.
<i>Lagotis glauca</i> Gaertn.	<i>Campanula dasyantha</i> Bieb.
<i>Campanula lasiocarpa</i> Cham.	<i>Achillea sibirica</i> Ledeb.
<i>Saussurea kurilensis</i> Tatewaki	

Among these, *Saxifraga Merckii* and *Pentstemon frutescens* are most prominent plants which appear in the early succession. *Saxifraga Merckii*, *Primula cuneifolia* and *Pinguicula vulgaris* occur in damper grounds. Among the shrubs, *Salix kurilensis* is characteristic while *Salix Reinii* is rarely found. In hollows or ditches in the upper valley, *Alnus fruticosa* is found, often distributed in isolated position or forming a pure stand.

One of the rocky slopes of the upland rich in the shrubby species

was examined at Nakayama in the vicinity of Nakadomari. The vegetation is of a stunted nature, including the following dwarf shrubs.

<i>Salix longipetiolata</i> Floderus	<i>Empetrum nigrum</i> L.
<i>Rhododendron chrysanthum</i> Pall.	<i>Rhododendron camtschaticum</i> Pall.
<i>Loiseleuria procumbens</i> Desv.	<i>Cassiope lycopodioides</i> Don.
<i>Arcteria nana</i> Makino	<i>Arctous alpina</i> Niednz.
<i>Vaccinium Vitis-idaea</i> L.	<i>Vaccinium uliginosum</i> L.
<i>Phyllocoe aleutica</i> A. Heller	<i>Diapensia lapponica</i> L.

Mixed with them are found such plants as:—

<i>Tofieldia nutans</i> Willd.	<i>Geum calthaeifolium</i> Sm.
<i>Oxytropis retusa</i> Matsum.	<i>Cnidium ajanense</i> Drude
<i>Cornus suecica</i> L.	

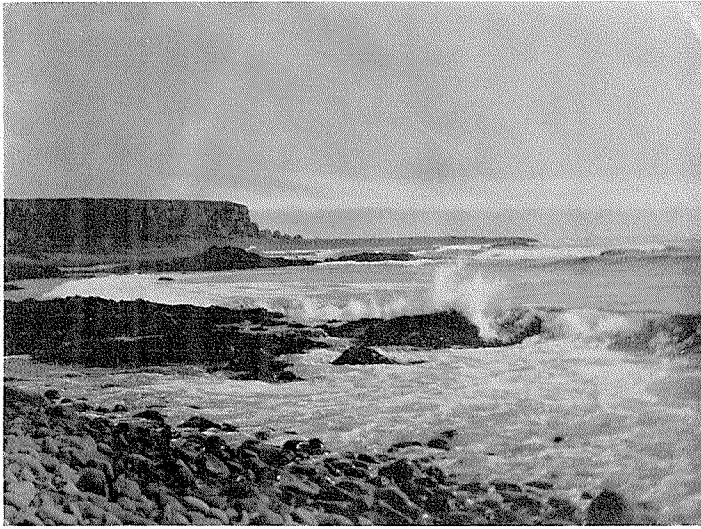
In the special locality in the vicinity of Lake Midori are found plants characteristically developed for miles over the lapilli places. The extraordinary abundance of *Hedysarum obscurum* is very striking, and the vegetation is very prominent in the atrio. *Pentstemon frutescens* maintains subordinate rank. The plants commonly found in this locality are given in the following list:—

<i>Carex flavocuspis</i> Fr. et Sav.	<i>Elymus mollis</i> Trin.
<i>Polygonum kurilense</i> Tatewaki	<i>Hedysarum obscurum</i> L.
<i>Potentilla Miyabei</i> Makino	<i>Lagotis glauca</i> Gaertn.
<i>Pentstemon frutescens</i> Lamb.	<i>Campanula lasiocarpa</i> Cham.
<i>Achillea sibirica</i> L.	

THE ISLAND OF KETOI

TOPOGRAPHY

This island lies about 362 miles north-east from the Port of Nemuro in Hokkaido and 268 miles south-west from Kamtschatka. It extends from 152°24' to 152°32' E. L. and from 47°18' to 47°23' N.L. It is almost orbicular in outline, about 5.5 miles in width, about 6 miles in length, with an area of about 35 square miles. It is separated from the Island of Shimushir on the south-west by the Shimushir Strait, which has width of 10.5 miles. To the north-east lie the small islands of Ushishir, separated by the Kotei Strait, 13.9 miles width. The island is mountainous. The mountains are all of valcanic formation, the upper region of several being naked. They are located in the middle and the northern part of the island. The highest mountain, called Mt. Ketoi, attains a height of 1172 m. Mt. Uyematsu (1136 m.), Mt. Kabuto



The sea-cliff, Ashizaki, Isl. Ketoi,
taken on August 28, 1929.

(873 m.) and Mt. Hakuyen (993 m.) are the main peaks among which Mt. Hakuyen is still active. The only lake of importance in the island is Lake Ketoi. It is a volcanic lake, situated between Mt. Ketoi and Mt. Hakuyen. There are several pools and ponds in boggy places on the plateaux of the southern part of the island. The rivers are rather short lying on the eastern, southern and northern sides. The Takinosawa river rising from Lake Ketoi and running toward the south-east is the largest. The sea-shore is mostly precipitous and unapproachable throughout the island.

THE PLANT-COMMUNITIES

The plant-communities are here treated under the following seven main categories:—

- | | |
|-------------------|-------------------|
| 1. Forest. | 2. Sea-shore. |
| 3. Heath. | 4. Grassy land. |
| 5. Meadow. | 6. Swamp and bog. |
| 7. Lapilli-slope. | |

1. Forest

The communities of the forest under consideration comprise three consociations, dominated respectively by the following three species:—

Pinus pumila, *Betula Ermani* and *Alnus fruticosa*. The stratification of the forest is not complex, but it is noteworthy for having a stratum of *Sasa kurilensis*. The forest is well developed on the southern side, where the vegetation seems to have escaped the damages of the recent volcanic eruptions.

i) *Pinus pumila*-Consociation

The forest vegetation is chiefly composed of the Pinetum pumilae. It is well developed from low lands up to the vegetation limit through the island, forming impenetrable thickets. The ascending main branches are commonly 1.5–2.5 m. high. In valleys or lower gentle mountain slopes, this consociation gives place to the Alnetum or Betuletum.

There is little or no development of the lower strata, for the dense thicket does not permit the development of such strata. The following species are found in the ground flora of this consociation:—

<i>Dryopteris dilatata</i> A. Gray	<i>Lycopodium Selago</i> L.
<i>Lycopodium sitchense</i> Rupr.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Ilex rugosa</i> Fr. Schm.	<i>Empetrum nigrum</i> L.
<i>Cornus succica</i> L.	<i>Rhododendron chrysanthum</i> Pall.
<i>Vaccinium Vitis-idaea</i> L.	<i>Vaccinium praestans</i> Lamb.
<i>Linnaca borealis</i> L.	

ii) *Betula Ermani*-Consociation

Betula Ermani is noteworthy for being the tallest trees in the island. It reaches an average height of from 3 m. to 6 m. The Betuletum is spread in the southern part of the island and often forms a pure stand. It is especially developed on the southern side of Mt. Hakuyen at the altitude from 100 m. to 300 m. from the sea-level. *Taxus cuspidata* grows rarely and *Sorbus sambucifolia* is locally prominent. Beneath these trees is formed a stratum of *Sasa kurilensis* of 1–1.5 m. height. The stratum of *Sasa* represents a characteristic feature of the forest in the Middle Kuriles, however, it is not found beyond this island northward. The Betuletum permits another development of the ground flora and the following main two forest types have been recognized:

a) *Betula-Sasa*-type; b) *Betula-Calamagrostis-Dryopteris*-type.

The former type, which is poor in species, is developed on mountainsides, while the latter, rich in species, occurs mostly along the valleys. In the under layer the following plants are found:—

<i>Dryopteris oreopteris</i> Maxon	<i>Dryopteris dilatata</i> A. Gray
<i>Polystichum Braunii</i> Fée	<i>Athyrium Filix-femina</i> Roth
<i>Lycopodium chinense</i> H. Chr.	<i>Calamagrostis Langsdorffii</i> Trin.
<i>Allium Victorialis</i> L.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Streptopus amplexifolius</i> DC.	<i>Trillium kamschaticum</i> Pall.
<i>Stellaria yezoensis</i> Maxim.	<i>Ilex rugosa</i> Fr. Schm.
<i>Viola Selkirkii</i> Pursh	<i>Trientalis europaea</i> L.
<i>Galium kamschaticum</i> Stell.	<i>Linnæa borealis</i> L.
<i>Peracarpa circacoides</i> Feer	

iii) *Alnus fruticosa*-Consociation

The alder thickets represented by the shrubby type, are distributed along valleys, on hill-sides or plateaux, often forming impenetrable thickets. On descending the valley slope, as the soil becomes more humid and richer, *Alnus* becomes more and more evident, while in the bottom of the valley, it is always found forming a narrow belt along the water course. But this consociation is not so important compared with the two other consociations above mentioned. Besides its pure stand, there occurs also the *Alnus-Calamagrostis-Dryopteris* type. It is almost identical in structure and composition with those of the lower stratum of the *Betula-Calamagrostic-Dryopteris* type and often associated with the constant of the *Filipendula-Petasites* association along the stream.

2. Sea-shore

The island is surrounded by high cliffs with bouldery shores at the base and scarcely any sandy beach is developed. The plant communities of the marine belt may be mostly divided into two associations, namely the *Elymus-Ammodenia-Senecio*- and the sea-cliff-association.

i) *Elymus-Ammodenia-Senecio*-Association

The beach association is mostly represented by that of the gravelly shore. The herbs and grasses are found scattered among boulders and gravels in this association and are represented by such constant species as:—

<i>Poa macrocalyx</i> Trautv. et Mey	<i>Elymus mollis</i> Trin.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Lathyrus maritimus</i> Bigel.
<i>Ligusticum scoticum</i> L.	<i>Mertensia maritima</i> L.
	subsp. <i>asiatica</i> Takeda
<i>Senecio pseudo-Arnica</i> Less.	<i>Chrysanthemum arcticum</i> L.

Among the above mentioned, *Lathyrus maritimus* occurs very rarely, and *Elymus mollis*, *Ammodenia oblongifolia* and *Senecio pseudo-Arnica*

become the dominant plants in the beach association. Besides them, the following species are found locally:—

<i>Juncus balticus</i> Willd.	<i>Oxyria digyna</i> Hill.
<i>Polygonum turilense</i> Tatewaki	<i>Stellaria calycantha</i> Bong.
<i>Stellaria ruscifolia</i> Willd.	<i>Cerastium boreale</i> Takeda
<i>Saxifraga rivularis</i> L.	<i>Epilobium Behringianum</i> Hausskn.
<i>Conioselinum kamschaticum</i> Rupr.	<i>Anaphalis margaritacea</i> Benth. et Hook.

In some places, especially near the mouths of the gullies, the plant-communities may be regarded as possessing a rather mixed feature of the coastal and mountain aspect, in which xeromorphy is pronounced. The following line transect is an example drawn near Tokkariwan, on Aug. 30, 1929:

m.	Name of the Plant.
0-0.10	<i>Anaphalis margaritacea</i> Benth. et Hook.
0.10-0.25	<i>Elymus mollis</i> Trin.
0.30-0.50	<i>Campanula lasiocarpa</i> Cham.
0.50-0.70	<i>Festuca rubra</i> L.
0.80-0.90	<i>Elymus mollis</i> Trin.
1.00-1.25	<i>Poa macrocalyx</i> Trautv. et Mey.
1.25-1.30	<i>Primula cuneifolia</i> Ledeb.
1.30-1.40	<i>Anaphalis margaritacea</i> Benth. et Hook.
1.45-1.50	<i>Elymus mollis</i> Trin.
1.60-2.90	<i>Alnus fruticosa</i> Rupr.
2.90-3.00	<i>Elymus mollis</i> Trin.
3.00-3.30	<i>Campanula lasiocarpa</i> Cham.
3.30-3.40	<i>Conioselinum kamschaticum</i> Rupr.
3.40-3.50	<i>Vaccinium uliginosum</i> L.
3.60-3.70	<i>Campanula lasiocarpa</i> Cham.
3.75	<i>Anaphalis margaritacea</i> Benth. et Hook.
3.90-4.10	<i>Campanula lasiocarpa</i> Cham.
4.10-4.20	<i>Elymus mollis</i> Trin.
4.40-4.60	<i>Anaphalis margaritacea</i> Benth. et Hook.
4.60-4.75	<i>Ligusticum scoticum</i> L.
4.80-4.90	<i>Anaphalis margaritacea</i> Benth. et Hook.
5.00-5.15	<i>Empetrum nigrum</i> L.
5.20-5.30	<i>Festuca rubra</i> L.
5.35-5.40	<i>Anaphalis margaritacea</i> Benth. et Hook.
5.45-5.50	<i>Campanula lasiocarpa</i> Cham.
5.60-5.90	<i>Elymus mollis</i> Trin.
6.10-6.20	<i>Campanula lasiocarpa</i> Cham.
6.25-6.30	<i>Festuca rubra</i> L.
6.40-6.50	<i>Vaccinium uliginosum</i> L.
6.60-6.70	<i>Elymus mollis</i> Trin.
6.80-6.90	<i>Campanula lasiocarpa</i> Cham.
6.95-7.00	<i>Festuca rubra</i> L.
7.00-7.15	<i>Campanula lasiocarpa</i> Cham.

7.20-7.25	<i>Anaphalis margaritacea</i> Benth. et Hook.
7.45-7.60	<i>Campanula lasiocarpa</i> Cham.
7.75-7.80	<i>Anaphalis margaritacea</i> Benth. et Hook.
7.90-8.20	<i>Cassiope lycopodioides</i> Don
8.25-8.30	<i>Anaphalis margaritacea</i> Benth. et Hook.
8.90-9.00	<i>Gaultheria Miqueliana</i> Takeda
9.10-9.20	<i>Festuca rubra</i> L.
9.30-9.40	<i>Festuca rubra</i> L.
9.40-9.60	<i>Campanula lasiocarpa</i> Cham.
9.70-9.80	<i>Campanula lasiocarpa</i> Cham.
9.90-10.0	<i>Elymus mollis</i> Trin.

ii) Sea-cliff-Association

The association of the rocky cliff on the sea-shore is well developed having an arctic-alpine aspect in which xeromorphy is prominent. The following species are found in this association:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Festuca rubra</i> L.
<i>Elymus mollis</i> Trin.	<i>Carex scita</i> Maxim.
<i>Stellaria ruscifolia</i> Willd.	<i>Sagina Linnæi</i> Presl
<i>Cochlearia oblongifolia</i> DC.	<i>Draba borealis</i> DC.
<i>Sedum Rhodiola</i> DC.	<i>Saxifraga rivularis</i> L.
<i>Saxifraga punctata</i> L.	<i>Potentilla megalantha</i> Takeda
<i>Empetrum nigrum</i> L.	<i>Epilobium Behringianum</i> Hausskn.
<i>Ligusticum scoticum</i> L.	<i>Rhododendron kamtschaticum</i> Pall.
<i>Cassiope lycopodioides</i> Don	<i>Vaccinium Vitis-idaea</i> L.
<i>Diapensia lapponica</i> L.	<i>Primula cuneifolia</i> Ledeb.
<i>Campanula dasyantha</i> Bieb.	<i>Campanula lasiocarpa</i> Cham.
<i>Chrysanthemum arcticum</i> L.	<i>Taraxacum ceratophorum</i> DC.

3. Heath

The heath is developed on flat uplands or marine terraces, expressing a transitional phase destined to be finally suppressed by the *Pinetum pumilae*. It is represented by the dry type and divided into the following two associations:—

- i) *Empetrum-Vaccinium-Salix*-Association.
- ii) *Empetrum-Loiseleuria-Salix*-Association.

The former is found on flat uplands, while the latter on more or less rocky and gravelly places, representing rather a primary sere.

In the former association, *Empetrum nigrum*, *Vaccinium uliginosum* and *Salix kurilensis* are codominant. *Bryanthus musciformis* is sometimes locally prominent. Besides them occur the following plants:—

<i>Lycopodium sitchense</i> Rupr.	<i>Lycopodium complanatum</i> L.
<i>Calamagrostis purpurascens</i> R. Br.	<i>Deschampsia flexuosa</i> Trin.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Cocloglossum viride</i> Hartm.
<i>Polygonum viviparum</i> L.	<i>Geum calthaeifolium</i> Sm.
<i>Hedysarum obscurum</i> L.	<i>Oxytropis retusa</i> Matsum.
<i>Cnidium ajanense</i> Drude	<i>Cornus suecica</i> L.
<i>Arctous alpina</i> Niedz.	<i>Rhododendron chrysanthum</i> Pall.
<i>Loiseleuria procumbens</i> Desv.	<i>Cassiope lycopodioides</i> Don
<i>Vaccinium Vitis-idaea</i> L.	<i>Diapensia lapponica</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Pedicularis euphrasioides</i> Steph.
<i>Linnæa borealis</i> L.	<i>Chrysanthemum arcticum</i> L.

In the latter association, *Empetrum nigrum*, *Loiseleuria procumbens* and *Salix longipetiolata* are codominant. *Bryanthes musciformis* and *Vaccinium uliginosum* maintain subordinate rank. Besides them the following plants are found:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Deschampsia flexuosa</i> Trin.
<i>Deschampsia caespitosa</i> P. Beauv.	<i>Carex flavocuspis</i> Fr. et Sav.
<i>Luzula sudetica</i> DC.	<i>Tofieldia nutans</i> Willd.
<i>Lloydia serotina</i> Reichb.	<i>Polygonum viviparum</i> L.
<i>Geum pentapetalum</i> Makino	<i>Oxytropis retusa</i> Matsum.
<i>Cnidium ajanense</i> Drude	<i>Cassiope lycopodioides</i> Don
<i>Vaccinium Vitis-idaea</i> L.	<i>Diapensia lapponica</i> L.
<i>Campanula dasyantha</i> Bieb.	<i>Campanula lasiocarpa</i> Cham.

4. Grassy land

The grassy land is mostly developed on hill-sides and terraces of the lower region. *Calamagrostis Langsdorffii* is the dominant species and sometimes *Festuca rubra* is locally abundant. In places, *Sorbus sambucifolia*, *Pinus pumila* and *Alnus fruticosa* form small patches. Besides them the following plants are found:—

<i>Phleum alpinum</i> L.	<i>Calamagrostis purpurascens</i> R.Br.
<i>Deschampsia flexuosa</i> Trin.	<i>Trisetum spicatum</i> Richt.
<i>Trisetum sibiricum</i> Rupr.	<i>Poa macrocalyx</i> Trautv. et Mey.
<i>Carex Gmelini</i> Hook. et Arn.	<i>Carex scita</i> Maxim.
<i>Luzula plumosa</i> E. Mey.	<i>Luzula Kjellmanniana</i> Miyabe et Kudo
<i>Lilium medeoloides</i> A. Gray	<i>Rumex Acetosa</i> L.
<i>Moehringia lateriflora</i> Fenzl	<i>Steilaria yezoensis</i> Maxim.
<i>Geranium erianthum</i> DC.	<i>Cornus suecica</i> L.
<i>Trientalis europaea</i> L.	<i>Swertia tetrapetala</i> Pall.
<i>Halenia corniculata</i> Druce	<i>Euphrasia mollis</i> Wettst.
<i>Achillea Ptarmica</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.

5. Meadow

The associations of this type are commonly found in hollows of the low land, on hill-sides and marine terraces. They are mainly divided into the following two associations:—

- i) *Filipendula-Petasites*-Association.
- ii) *Trollius-Geranium-Pedicularis*-Association.

i) *Filipendula-Petasites*-Association

The tall herbaceous community of this island dominated by *Filipendula kamtschatica* and *Petasites japonica*, var. *giganteus* is developed in rich moist soils in the lower region. *Filipendula kamtschatica* often becomes dominant on lower slopes of the hill-side, while *Petasites japonicus*, var. is abundant along the water courses. The following plants are found in this associations.

<i>Luzula parviflora</i> Desv.	<i>Allium Victorialis</i> L.
<i>Lilium medeoloides</i> A. Gray	<i>Iris setosa</i> Pall.
<i>Platanthera hyperborea</i> Lindl.	<i>Urtica platyphylla</i> Wedd.
<i>Rumex Acetosa</i> L.	<i>Aconitum kamtschaticum</i> Willd.
<i>Geranium erianthum</i> DC.	<i>Viola Langsdorfii</i> Fisch.
<i>Coelopleurum Gmelinii</i> Ledeb.	<i>Artemisia vulgaris</i> L.
<i>Senecio palmatus</i> Pall.	<i>Cirsium kamtschaticum</i> Ledeb.
<i>Cacalia kamtschatica</i> Kudo	

Along streams, the following plants are prominent:—

<i>Barbarea orthoceras</i> Ledeb.	<i>Cardamine Regeliana</i> Miq.
<i>Saxifraga punctata</i> L.	<i>Chrysosplenium kamtschaticum</i> Fisch.
<i>Epilobium Behringianum</i> Hausskn.	

ii) *Trollius-Geranium-Pedicularis*-Association

From the field observations, it is apparent that this association is in the main a complex community. It is developed on flat uplands or hill-sides. Near the south-western point of this island, called Toboyezaki where the elevation is about 100 m., the terraces are clothed with this mixed herbaceous association. *Trollius Riederianus*, *Geranium erianthum* and *Pedicularis Chamissonis*, var. are codominant and associated with the following plants:—

<i>Selaginella selaginoides</i> Link	<i>Agrostis Trinii</i> Turcz.
<i>Calamagrostis Langsdorfii</i> Trin.	<i>Calamagrostis purpurascens</i> R. Br.
<i>Carex hakkodensis</i> Franch.	<i>Carex vaginata</i> Tausch

<i>Luzula plumosa</i> E. Mey.	<i>Luzula Kjellmanniana</i> Miyabe et Kudo
<i>Lilium medeoloides</i> A. Gray	<i>Fritillaria camschatcensis</i> Ker-Gawl.
<i>Lloydia serotina</i> Reichb.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Iris setosa</i> Pall.	<i>Cypripedium guttatum</i> Sw.
<i>Cypripedium macranthum</i> Sw.	<i>Orchis aristata</i> Fisch.
<i>Coeloglossum viride</i> Hartm.	<i>Platanthera Chorissiana</i> Reichb. f.
<i>Platanthera hyperborca</i> Lindl.	<i>Listera cordata</i> R. Br.
<i>Polygonum viviparum</i> L.	<i>Mochringia lateriflora</i> Fenzl
<i>Anemone narcissiflora</i> L.	<i>Parnassia palustris</i> L.
<i>Aruncus sylvester</i> Kostel.	<i>Geum calthaeifolium</i> Sm.
<i>Hypericum kamschaticum</i> Ledeb.	<i>Viola crassa</i> Makino
<i>Primula cuneifolia</i> Ledeb.	<i>Trientalis europaea</i> L.
<i>Gentiana auriculata</i> Pall.	<i>Swertia tetrapetala</i> Pall.
<i>Halenia corniculata</i> Druce	<i>Veronica Stelleri</i> Pall.
<i>Lagotis glauca</i> Gaertn.	<i>Pedicularis Chamissonis</i> Stev.
<i>Pedicularis resupinata</i> L.	<i>Solidago Virgaurea</i> L.
<i>Achillea Ptarmica</i> L.	<i>Arnica unalascensis</i> Less.
<i>Cirsium kamschaticum</i> Ledeb.	<i>Saussurca Ricderi</i> Herd.
<i>Picris kamschatica</i> Ledeb.	

Among them, the following dwarf shrubs are scattered:—

<i>Salix kurilensis</i> Koidz.	<i>Rhododendron chrysanthum</i> Pall.
<i>Rhododendron kamschaticum</i> Pall.	<i>Vaccinium Vitis-idaea</i> L.
<i>Vaccinium uliginosum</i> L.	

6. Swamp and Bog

The swamp and bog extends on the flat upland in the southern part of this island at the altitude about 100–200 m. from the sea-level. The field observations were mainly made at the following three localities:—near Kodakigawa, near Isozaki and near Kamozaki. The communities of the swamp and bog are divided into the following four associations:—

- i) *Juncus-Iris-Carex*-association.
- ii) *Sparganium-Hippuris*-association.
- iii) *Carex*-association.
- iv) *Sphagnum-Carex-Andromeda-Oxycoccus*-association.

i) *Juncus-Iris-Carex*-Association

This association is developed at the foot of the hill-side of the island. It represents a transitional phase from the swamp community to the herbaceous one. *Juncus balticus*, *Iris setosa* and *Carex Lyngbyei* are codominant and the following additional plants are found in this association:—

<i>Deschampsia caespitosa</i> P. Beauv.	<i>Carex hakkodensis</i> Franch.
<i>Luzula parviflora</i> Desv.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Orchis aristata</i> Fisch.	<i>Polygonum viviparum</i> L.
<i>Coptis trifolia</i> Salisb.	<i>Cornus suecica</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Trientalis europaea</i> L.

ii) *Sparganium-Hippuris*-Association

The aquatic plants are represented by two species, namely, *Potamogeton Franchetii* and *Sparganium minimum*. The former is rarely found, while the latter occurs more commonly in pools. *Hippuris vulgaris* is often found serving as a pioneer of the marsh community. *Menyanthes trifoliata* and *Eleocharis palustris* forming a belt to the aquatic area are sometimes found in ponds where the depth of water is 0.5–1 m. *Carex limosa* follows them, sometimes mixed with *Comarum palustre*, and they are succeeded by *Carex Lyngbyei* or *Carex Middendorffii*.

iii) *Carex*-Associations

The *Carex*-association is mostly dominated by *Carex Middendorffii*, often associated with *Eriophorum angustifolium*. The characteristic plants found in this association are the same as those of the next association.

On terraces, the bogs of small area dominated by *Carex rariflora* occur. The characteristic plants are also somewhat the same as the following association.

iv) *Sphagnum-Carex-Andromeda-Oxycoccus*-Association

The *Sphagnum* bog is not very well developed in this island. Their representatives occur near Isozaki and Kodakigawa where *Sphagnum* grows in quantity, accompanied by the dwarf-shrubs and sedges. *Pinus pumila* and *Salix Reinii* occur scattered in the peripheral portion, and *Juniperus communis*, var. *montana* is rarely found. The following is a list of the vascular plants found in the bog.

<i>Lycopodium obscurum</i> L.	<i>Lycopodium annotinum</i> L.
<i>Selaginella selaginoides</i> Link	<i>Agrostis Trinii</i> Turcz.
<i>Calamagrostis neglecta</i> Gaertn.	<i>Eriophorum vaginatum</i> L.
<i>Scirpus caesitosus</i> L.	<i>Carex gynocrates</i> Wormsky.
<i>Carex hakkodensis</i> Franch.	<i>Carex pauciflora</i> Lightf.
<i>Carex pyrenaica</i> Wahlb.	<i>Carex Lyngbyei</i> Hornem.
<i>Carex Middendorffii</i> Fr. Schm.	<i>Carex rariflora</i> Sm.
<i>Carex Fujitae</i> Kudo	<i>Carex limosa</i> L.

<i>Juncus kamtschaticensis</i> Kudo	<i>Tofieldia nutans</i> Willd.
<i>Orchis aristata</i> Fisch.	<i>Platanthera tipuloides</i> Lindl.
<i>Coptis trifolia</i> Salisb.	<i>Drosera rotundifolia</i> L.
<i>Parnassia palustris</i> L.	<i>Geum calthaeifolium</i> Sm.
<i>Geum pentapetalum</i> Makino	<i>Empetrum nigrum</i> L.
<i>Cnidium ajanense</i> Drude	<i>Cornus succica</i> L.
<i>Loiselcuria procumbens</i> Desv.	<i>Bryanthus musciformis</i> Nakai
<i>Andromeda Polifolia</i> L.	<i>Oxycoccus vulgaris</i> Hill
<i>Oxycoccus microcarpus</i> Turcz.	<i>Vaccinium uliginosum</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Trientalis europaea</i> L.
<i>Gentiana Kawakamii</i> Makino	

7. Lapilli-slope

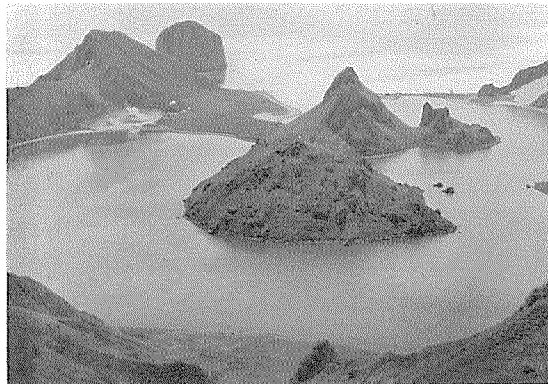
The ground of the lapilli-slope of the upper region is composed of lava fragments varying in size. The sparse vegetation is represented by the dry type showing colonies here and there. The data in the present paper, though not sufficient, are collected on the western slope of Mt. Hakuyen and enumerated as follows:—

<i>Deschampsia flexuosa</i> Trin.	<i>Carex flavocuspis</i> Fr. et Sav.
<i>Luzula Wahlenbergii</i> Rupr.	<i>Saxifraga Merckii</i> Fisch.
<i>Potentilla Miyabei</i> Makino	<i>Pentstemon frutescens</i> Lamb.
<i>Campanula lasiocarpa</i> Cham.	

THE ISLAND OF USHISHIR

TOPOGRAPHY

The Island of Ushishir is composed of the following two islets, namely Minamijima (the south islet) and Kitajima (the north islet).



Kuretawan, Minamijima, Isl. Ushishir, taken on July 15, 1929,
by Dr. Bergman.

lying about 400 miles north-east from the Port of Nemuro in Hokkaido and 255 miles south-west from Kamtschatka. The islets extend from $152^{\circ}47'$ to $152^{\circ}51'$ E.L. and $47^{\circ}30'$ to $47^{\circ}33'$ N.L. They are separated from the Island of Ketoi on the south-west by the Ketoi Strait, having a width of 13.9 miles. To the north-east lies the Island of Rasheda, separated by the Ushishir Strait, (Suredo Strait), 9.2 miles wide.

Minamijima is trapezoidal in outline, about 2.5 km. in width and length, and the area about 1 square mile. The mountains range in a circular form and the highest peak, called Mt. Mikasa, attains a height of 401 m. The southern part is deeply indented forming the inlet of the Kuretawan, on the eastern side of which there is a hot spring. The Kuretawan surrounded by the steep slope of the mountains seems to be an old crater.

Kitajima is smaller than Minamijima. It is narrow rhomboidal in outline, about 2.8 km. in width, and about 1.2 km. in length. The flatty terrace is stretched on the sea cliffs which surround the island at the height of about 100 m. above sea-level. The distance between these two islets is only about 430 m. where reefs appear at low tide.

THE PLANT COMMUNITIES

In vegetation, the Island of Ushishir shows a marked difference from the other islands of the Middle Kuriles, owing to the absence of the forest association. The difference between the vegetations of the south and the north islets is so remarkable that the former is characterized by the presence of the grassy lands while the latter by the heath. The plant-communities of the islets are divided into the following four categories:—

- | | |
|-----------------|---------------|
| 1) Grassy land. | 2) Meadow. |
| 3) Heath. | 4) Sea-shore. |

1. Grassy land

Attention has first been centered in the grassy land associations, as these are the prominent features both in Kitajima and Minamijima, especially in the latter islet which supports vegetation at a young stage. The grassy lands are developed on hill-sides, mountain-slopes and terraces, and their communities are divided into the following two associations and one association:—

- i) *Elymus mollis*-consociation.
- ii) *Calamagrostis Langsdorffii*-consociation.
- iii) *Poa-Festuca-Deschampsia*-association.

i) *Elymus mollis*-consociation

It is a characteristic feature in the Island of Ushishir, especially in Minamijima. This is caused by the recent formation of volcanic sands. It is developed from the sea-shore to the mountain except on Mt. Mikasa. *Elymus mollis* is the exclusive dominant species.

ii) *Calamagrostis*-consociation

The *Calamagrostis*-consociation dominated by *Calamagrostis Langsdorffii* is widely distributed on both islets. It is developed on mountain-slopes and hillsides. *Festuca rubra* is locally abundant. The following plants are commonly found:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Deschampsia flexuosa</i> Trin.
<i>Trisetum sibiricum</i> Rupr.	<i>Carex Gmelinii</i> Hook. et Arn.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Moheringia lateriflora</i> Fenzl	<i>Geranium erianthum</i> DC.
<i>Tridentalis europaea</i> L.	<i>Cornus suecica</i> L.

Vaccinium uliginosum and *Vaccinium Vitis-idaea* are found mixed with them.

iii) *Poa-Festuca-Deschampsia*-Association

This association is characteriste in the south islet. *Poa scabriflora*, *Festuca rubra* and *Deschampsia caspitosa* are codominant. This is a transitional phase from the bare land to some other community such as a Calamagrosetum. The following plants are commonly found:—

<i>Carex Gmelinii</i> Hook. et Arn.	<i>Luzula Kjellmanniana</i> Miyabe et Kudo
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Coelogrossum viride</i> Hartm.
<i>Polygonum viviparum</i> L.	<i>Potentilla megalantha</i> Takeda
<i>Hypericum kamtschaticum</i> Ledeb.	<i>Cornus suecica</i> L.
<i>Gentiana auriculata</i> Pall.	<i>Veronica Stelleri</i> Pall.
<i>Euphrasia mollis</i> Wettst.	<i>Pedicularis Chamissonis</i> Stev.
<i>Campanula lasiocarpa</i> Cham.	<i>Solidago Virgaurea</i> L.
<i>Chrysanthemum arcticum</i> L.	<i>Arnica unalascensis</i> Less.

2. Meadow

The meadow associations are not very well developed. They are found in hollows, along valleys or on mountain-sides. They are mainly divided into the following two associations:—

i) *Filipendula-Artemisia-Coelopleurum*-Association

This association is sparsely developed, and replaced partly by the *Artemisia-Cacalia*-community. The former is dominated by *Filipendula kamschatica*, *Artemisia vulgaris*, var. *kamschatica* and *Coelopleurum Gmelinii*, while the latter by *Artemisia vulgaris*, var. *kamschatica* and *Cacalia kamschatica*. *Petasites japonicus*, var. *giganteus* is very locally found only in the south islet. The following plants are commonly found in the association:—

<i>Fritillaria camschatcensis</i> Ker-Gawl.	<i>Urtica platyphylla</i> Wedd.
<i>Aconitum kamschaticum</i> Willd. et Reichb.	<i>Conioselinum kamschaticum</i> Rupr.
<i>Heracleum lanatum</i> Michx.	<i>Cirsium kamschaticum</i> Ledeb.
	<i>Senecio palmatus</i> Pall.

Under the tall herbs as above mentioned grow such plants as:—

<i>Dryopteris dilatata</i> A. Gray	<i>Chrysanthemum arcticum</i> L.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Luzula plumosa</i> E. Mey.
<i>Ranunculus acris</i> L.	<i>Cerastium boreale</i> Takeda
<i>Chrysoplenium kamschaticum</i> Fisch.	<i>Cardamine Regeliana</i> Miq.
<i>Conioselinum kamschaticum</i> Rupr.	<i>Potentilla megalantha</i> Takeda
<i>Anaphalis margaritacea</i> Benth. et Hook.	<i>Gentiana auriculata</i> Pall.
	<i>Achillea sibirica</i> Ledeb.

ii) *Geranium-Trollius*-Association

The association seems to be present very locally in these islets. It is developed on mountain-slopes, especially in Minamijima. *Geranium erianthum* and *Trollius Riederianus* are codominant and the following plants are found associated with them:—

<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Orchis aristata</i> Fisch.
<i>Cerastium boreale</i> Takeda	<i>Ranunculus acris</i> L.
<i>Cnidium ajanense</i> Drude	<i>Primula cuneifolia</i> Ledeb.
<i>Gentiana auriculata</i> Pall.	<i>Veronica Stelleri</i> Pall.
<i>Euphrasia mollis</i> Wettst.	<i>Pedicularis Chamissonis</i> Stev.
<i>Arnica unalascensis</i> Less.	<i>Achillea sibirica</i> Ledeb.

3. Heath

The heath is developed on the flat terrace in the north islet and rarely found on mountain-sides in the south islet. It is represented by the two associations:—

- i) *Empetrum-Vaccinium-Salix*-Association.
- ii) *Empetrum-Vaccinium-Rubus-Carex*-Association.

The former dominated by *Empetrum nigrum*, *Vaccinium uliginosum* and *Salix kurilensis* is distributed in drier places of both islets, while the latter dominated by *Empetrum nigrum*, *Vaccinium uliginosum*, *Carex rariflora* and *Rubus Chamaemorus*, occurs only in the north islet. The following plants are also found:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Agrostis Trinii</i> Turcz.
<i>Lloydia serotina</i> Reichb.	<i>Polygonum viviparum</i> L.
<i>Sorbus sambucifolia</i> Roem.	<i>Geum calthaeifolium</i> Sm.
<i>Cornus suecica</i> L.	<i>Rhododendron camtschaticum</i> Pall.
<i>Arctous alpina</i> Niedz.	<i>Cassiope lycopodioides</i> Don
<i>Vaccinium Vitis-idaea</i> L.	<i>Diapensia lapponica</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Linnaea borealis</i> L.
<i>Campanula lasiocarpa</i> Cham.	<i>Chrysanthemum arcticum</i> L.

4. Sea-shore

The islets are surrounded by high cliffs with boulder shores at the base and occasional sandy shores in Minamijima formed mainly by volcanic sand and ash. The plant communities of the marine belt may be divided into two associations, namely the beach and rocky shore association.

i) Beach Associations

The beach association is mostly represented by that of the gravelly shore in Kitajima. The following herbs and grasses are found among boulders and gravels.

<i>Elymus mollis</i> Trin.	<i>Poa macrocalyx</i> Trautv. et Mey.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Cochlearia oblongifolia</i> DC.
<i>Chrysanthemum arcticum</i> L.	<i>Senecio pseudo-Arnica</i> Less.
<i>Taraxacum ceratophorum</i> DC.	

Among them, *Elymus mollis* is very prominent, especially in Minamijima, often forming a pure stand. Along the coast line, the herbaceous

community is sometimes developed, following the *Elymus*-community. It is composed of such plants as:—

<i>Fritillaria camschatcensis</i>	
Ker-Gawl.	<i>Cochlearia oblongifolia</i> DC.
<i>Geranium erianthum</i> DC.	<i>Coelopleurum Gmelinii</i> Ledeb.
<i>Ligusticum scoticum</i> L.	<i>Heracleum lanatum</i> Michx.
<i>Anaphalis margaritacea</i> Benth.	<i>Artemisia vulgaris</i> L.
et Hook.	<i>Cacalia kamtschatica</i> Kudo

ii) Sea-cliff Association

The association of the rocky cliff on the sea-shore is well developed, especially in Kitajima where the association is composed of numerous species in comparison with those of Minamijima. The following plants are noticed in this association:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Elymus mollis</i> Trin.
<i>Sedum Rhodiola</i> DC.	<i>Cochlearia oblongifolia</i> DC.
<i>Draba borealis</i> DC.	<i>Draba hyperborea</i> Desv.
<i>Saxifraga rivularis</i> L.	<i>Saxifraga punctata</i> L.
<i>Potentilla megalantha</i> Takeda	<i>Coelopleurum Gmelinii</i> Ledeb.
<i>Ligusticum scoticum</i> L.	<i>Chrysanthemum arcticum</i> L.

THE ISLAND OF RASHUWA

TOPOGRAPHY

The Island of Rashuwa lies about 415 miles north-east from the Port of Nemuro in Hokkaido and 235 miles south-west from Kamtschatka. It extends from 47°41' to 47°48' N.L. and from 152°57' to 153°4' E.L. It is oblong in outline, about 8 miles in length, about 5.5 miles in width with an area of about 25 square miles. It is separated from the Island of Ushishir on the south-west by the Suredo Strait, having a width of 9.2 miles. To the north-east lies the Island of Matuwa, separated by the Rashuwa Strait (Nadiejeda Strait), 16 miles. The high mountains are located in the northern part of the island. The highest is a volcanic peak, attaining a height of 956 m. It is still active. The southern part, limited by Chôtôzan (503 m.), is a flat upland extending to the southern point. There are two small lakes, namely Onuma and Konuma, in addition to which there are several pools and ponds in the boggy places between Porochanupuri and Chôtôzan. The rivers are all small, the Onumagawa being the largest. It is about 3 miles in length. The sea-shore is bold and steep, and stands out in high cliffs.



Sonrakuwan in the Island of RASHUWA,
taken on August 6, 1928.

THE PLANT-COMMUNITIES

The plant-communities are here treated under the following six main categories:—

- | | |
|------------|-------------------|
| 1) Forest. | 2) Sea-shore. |
| 3) Heath. | 4) Grassy land. |
| 5) Meadow. | 6) Swamp and bog. |

1. Forest

The general aspect of the forest is mostly of the shrubby type, dominated by the following species:—*Pinus pumila*, *Betula Ermani* and *Alnus fruticosa*. It is a most striking fact in the feature of the under layer that there is complete absence of *Sasa kurilensis* which is widely distributed as far north as the Island of KETOI in the Middle Kuriles. The predominant species is *Pinus pumila* and the second in importance are *Alnus fruticosa* and *Betula Ermani*. The communities of the forest are divided into the following three divisions:—

- i) *Pinus pumila*-consociation.
- ii) *Betula Ermani*-consociation.
- iii) *Alnus fruticosa*-consociation.

i) *Pinus pumila*-Consociation

The Pinetum, composed of *Pinus pumila*, is well developed in this island. It extends from marine terraces to high mountains all over the island, often forming impenetrable thickets. The ascending main branches are commonly 1.5–2 m. in height and sometimes reach 2.5 m. *Sorbus sambucifolia* is scattered sparsely in the lower region and *Alnus fruticosa* occurs sometimes on the border of the Pinetum in the sub-alpine region. The ground vegetation is scanty and sometimes completely absent. The following species are found in this consociation.

<i>Lycopodium complanatum</i> L.	<i>Linnaea borealis</i> L.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Lycopodium alpinum</i> L.
<i>Cornus suecica</i> L.	<i>Empetrum nigrum</i> L.
<i>Loiseleuria procumbens</i> Desv.	<i>Rhododendron chrysanthum</i> Pall.
	<i>Vaccinium Vitis-idaea</i> L.

ii) *Betula Ermani*-Consociation

The forest of *Betula Ermani* is locally distributed in the island and often forms a pure stand, representing the northern-most limit of its distribution in the Kurile Archipelago. It is distributed on the mountain slopes as far up as about 250 m. above sea level. The largest stand is found at the foot of Mt. PoroChanupuri on the eastern side of the island. It forms impenetrable thickets on the mountainsides and somewhat scattered forest on the gentle mountain-slopes and in the alluvial valleys. The height of the trees varies according to the environment. The highest ones, in the valley, attain 6–10 m., having tall trunks. In the under-layer the following plants are found:—

<i>Dryopteris dilatata</i> A. Gray	<i>Lycopodium chinese</i> H. Chr.
<i>Lycopodium annotinum</i> L.	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Allium Victorialis</i> L.	<i>Streptopus amplexifolius</i> DC.
<i>Lilium medeoloides</i> A. Gray	<i>Trillium kamschaticum</i> Pall.
<i>Oxalis Acetosella</i> L.	<i>Viola Selkirkii</i> Pursh
<i>Circaea alpina</i> L.	<i>Torientalis europaea</i> L.
<i>Galium kamschaticum</i> Stell.	<i>Peracarpa circaeoides</i> Feer
<i>Cacalia kamschatica</i> Kudo	

iii) *Alnus fruticosa*-Consociation

The alder thickets are distributed along valleys, on hill-sides, plateaux and sometimes as far up as near the vegetation limit of the mountains, but this consociation is not so important as those above men-

tioned. The Alnetum is uniform in appearance especially forming dense thickets on the mountains-side. The height of the trees varies according to localities. In the upland heath the alder occurs as a dwarf shrub lying flat on the ground. The ground flora is similar to that of the Betuletum.

2. Sea-shore

The island is surrounded by high cliffs, with sandy beach very locally developed. The plant-communities of the marine belt may be generally divided into two associations, namely, the *Elymus-Ammodenia-Senecio*- and the sea-cliff-association.

i) *Elymus-Ammodenia-Senecio*-Association

The beach-association is mostly represented by that of the gravelly shore, consisting of a few plants such as the following:—

<i>Poa macrocalyx</i> Trautv. et Mey.	<i>Elymus mollis</i> Trin.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Lathyrus maritimus</i> Bigel.
<i>Ligusticum scoticum</i> L.	<i>Mertensia maritima</i> L.
<i>Senecio pseudo-Arnica</i> Less.	subsp. <i>asiatica</i> Takeda

Among above mentioned, *Ammodenia oblongifolia* is the pioneer, succeeded by *Senecio pseudo-Arnica*. *Elymus mollis* follows them and becomes the dominant species in the beach association.

ii) Sea-cliff-Association

The association of the rocky cliff on the sea-shore is well developed, showing a boreal aspect. The communities are divided into two forms, viz., those of dry and of damp rocky shores which are, however, not always clearly separable. The following species are found in this association.

* <i>Calamagrostis purpurascens</i> R. Br.	<i>Festuca rubra</i> L.
<i>Elymus mollis</i> Trin.	* <i>Tofieldia nutans</i> L.
* <i>Lloydia serotina</i> Reicheb.	* <i>Salix longipetiolata</i> Flod.
<i>Stellaria ruscifolia</i> Willd.	<i>Sagina Sagina Linnaei</i> Presl
* <i>Anemone narcissiflora</i> L.	<i>Cochlearia oblongifolia</i> DC.
<i>Draba borealis</i> DC.	<i>Sedum Rhodiola</i> DC.
<i>Saxifraga rivularis</i> L.	<i>Saxifraga punctata</i> L.
<i>Potentilla megalantha</i> Takeda	<i>Epilobium Behringianum</i> Hausskn.
<i>Ligusticum scoticum</i> L.	* <i>Rhododendron camtschaticum</i> Pall.
* <i>Loiseleuria procumbens</i> Desv.	* <i>Cassiope lycopodioides</i> Don
* <i>Vaccinium Vitis-idaea</i> L.	* <i>Diapensia lapponica</i> L.

Primula Fauriei Franch. **Primula cuncifolia* Ledeb.
 **Campanula dasyantha* Bieb. *Chrysanthemum arcticum* L.
Taraxacum ceratophorum DC.

(* Rocky elements of the upper part).

3. Heath

The heath is well developed on flat uplands and exposed mountain-sides. *Alnus fruticosa* forms creeping low thickets here and there, on the margin of which *Boschniakia glabra* is often found. The associations rich in kinds of the species are mostly represented by the dry type and may be divided into the following four associations:

- i) *Empetrum-Vaccinium*-association.
- ii) *Empetrum-Vaccinium-Rhododendron*-association.
- iii) *Empetrum-Vaccinium-Bryanthus*-association.
- iv) *Carex-Rubus-Empetrum-Vaccinium*-association.

i) *Empetrum-Vaccinium*-Association

This association is mostly developed in the lower region. *Sorbus sambucifolia*, *Salix kurilensis*, *Alnus fruticosa* and *Pinus pumila* are scattered in the heath. *Empetrum nigrum* and *Vaccinium uliginosum* are codominant and associated with such dwarf shrubs as:—

<i>Geum pentapetalum</i> Makino	<i>Rhododendron chrysanthum</i> Pall.
<i>Rhododendron camtschaticum</i> Pall.	<i>Loiseleuria procumbens</i> Desv.
<i>Phyllodoce aleutica</i> A. Heller	<i>Cassiope lycopodioides</i> Don
<i>Arctous alpina</i> Niedz.	<i>Vaccinium Vitis-idaea</i> L.
<i>Diapensia lapponica</i> L.	

Besides them the following plants are commonly found:—

<i>Lycopodium Selago</i> L.	<i>Lycopodium alpinum</i> L.
<i>Agrostis Trinii</i> Turcz.	<i>Calamagrostis purpurascens</i> R. Br.
<i>Deschampsia flexuosa</i> Trin.	<i>Luzula Kjellmanniana</i> Miyabe et Kudo
<i>Lloydia serotina</i> Reichb.	<i>Coeloglossum viride</i> Hartm.
<i>Polygonum viviparum</i> L.	<i>Anemone narcissiflora</i> L.
<i>Geum calthaefolium</i> Sm.	<i>Oxytropis retusa</i> Matsum.
<i>Cornus suecica</i> L.	<i>Trientalis europaea</i> L.
<i>Pedicularis euphrasioides</i> Steph.	

ii) *Empetrum-Vaccinium-Rhododendron*-Association

The association is often found on exposed mountain-sides of the upper region. *Empetrum nigrum*, *Vaccinium uliginosum* and *Rhododendron chrysanthum* are codominant, and *Rhododendron chrysanthum*

often forms the pure community. The association tends to be simple, associated with the following species such as:—*Loiseleuria procumbens* Desv., *Cassiope lycopodioides* Don, *Phyllodoce aleutica* A. Heller, *Vaccinium Vitis-idaea* L., *Diapensia lapponica* L. var., *Linnaea borealis* L., etc.

iii) *Empetrum-Vaccinium-Bryanthus*-Association

This is found on more or less rocky places on plateaux or mountainsides, and sometimes is locally replaced by the *Vaccinium-Loiseleuria-Arctous*-association or *Bryanthus-Loiseleuria-Salix*-association. *Empetrum nigrum*, *Vaccinium uliginosum* and *Bryanthus musciformis* are prominent. The characteristic species are *Salix longipetiolata*, *Loiseleuria procumbens*, *Arctous alpina* and *Diapensia lapponica*. Besides these there occur the following plants:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Tofieldia nutans</i> Willd.
<i>Carex stenantha</i> Fr. et Sav.	<i>Salix kurilensis</i> Koidz.
<i>Polygonum viviparum</i> L.	<i>Geum pentapetalum</i> Makino
<i>Oxytropis retusa</i> Matsum.	<i>Viola crassa</i> Makino
<i>Phyllodoce aleutica</i> A. Heller	<i>Rhododendron chrysanthum</i> Pall.
<i>Cassiope lycopodioides</i> Don	<i>Arcteria nana</i> Makino
<i>Vaccinium Vitis-idaea</i> L.	<i>Primula cuneifolia</i> Ledeb.
<i>Lagotis glauca</i> Gaetrn.	<i>Pinguicula vulgaris</i> L.
<i>Campanula dasyantha</i> Bieb.	

iv) *Carex-Rubus-Empetrum-Vaccinium*-Association

It is represented by the wet type of the heath, especially developing in the southern part of the island. *Carex rariflora*, *Rubus Chamaemorus*, *Empetrum nigrum* and *Vaccinium uliginosum* are prominent. The former two species are accompanied by *Carex Lyngbyei* when the heath gets wetter, while the latter two prevail abundantly when the substratum tends to become dry. The constant species found in this association are:—

<i>Carex rariflora</i> Smith	<i>Rubus Chamaemorus</i> L.
<i>Empetrum nigrum</i> L.	<i>Vaccinium uliginosum</i> L.
<i>Vaccinium Vitis-idea</i> L.	

Associated with them are found the following plants:—

<i>Calamagrostis Langsdorffii</i> Trin.	<i>Agrostis Trinii</i> Turcz.
<i>Deschampsia caespitosa</i> P. Beauv.	<i>Carex hakkodensis</i> Franch.
<i>Juncus balticus</i> Willd.	<i>Tofieldia nutans</i> Willd.
<i>Salix kurilensis</i> Koidz.	<i>Polygonum viviparum</i> L.
<i>Sorbus sambucifolia</i> Roem.	<i>Geum calthaeifolium</i> Sm.

Cnidium ajanense Drude *Cornus suecica* L.
Loiseleuria procumbens Desv. *Trientalis europaea* L.

4. Grassy land

The grassy land association is developed on lower gentle slopes of the mountain or hill-sides or sometimes on flat uplands. *Calamagrostis Langsdorffii* is the dominant species and sometimes *Festuca rubra* is locally abundant. It is noteworthy that there are found sparsely scattered *Lonicera coerulea* and *Sorbus sambucifolia*. Besides them are found the following species:—

<i>Phleum alpinum</i> L.	<i>Calamagrostis purpurascens</i> R. Br.
<i>Deschampsia flexuosa</i> Trin.	<i>Trisetum spicatum</i> Richt.
<i>Trisetum sibiricum</i> Rupr.	<i>Carex scita</i> Maxim.
<i>Carex Gmelinii</i> Hook. et Arn.	<i>Luzula plumosa</i> E. Mey.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Majanthemum dilatatum</i> Nels. et Macbr.
<i>Lilium medeoloides</i> A. Gray	<i>Cypripedium guttatum</i> Sw.
<i>Rumex Acetosa</i> L.	<i>Mochringia lateriflora</i> Fenzl
<i>Parnassia patustris</i> L.	<i>Geum calthaeifolium</i> Sm.
<i>Geranium erianthum</i> DC.	<i>Cornus suecica</i> L.
<i>Trientalis europaea</i> L.	<i>Swertia tetrapetala</i> Pall.
<i>Halenia corniculata</i> Druce	<i>Euphrasia mollis</i> Wettst.
<i>Pedicularis Chamissonis</i> Stev.	<i>Pedicularis resupinata</i> L.
<i>Solidago Virgaurea</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Achillea Ptarmica</i> L.	<i>Cirsium kamtschaticum</i> Ledeb.

5. Meadow

The associations of this type are commonly found in hollows of the low land, in moist rich soils, on hill-sides and on marine terraces. They are mainly divided into the following three associations:—

- i) *Filipendula-Petasites*-association.
- ii) *Trollius-Geranium-Anemone*-association.
- iii) *Primula-Geum-Coptis*-association.

i) *Filipendula-Petasites*-Association

The tall herbaceous community of this island, dominated by *Filipendula kamtschatica* and *Petasites japonicus*, var. *giganteus*, is well developed on rich moist soils in the lower region. Of the two species above mentioned *Filipendula kamtschatica* often becomes dominant. The following plants are commonly found in this association:—

<i>Allium Victorialis</i> L.	<i>Lilium medeoloides</i> A. Gray
<i>Iris setosa</i> Pall.	<i>Urtica platyphylla</i> Wedd.
<i>Rumex Acetosa</i> L.	<i>Aconitum kamtschaticum</i> Willd.
<i>Geranium erianthum</i> DC.	<i>Coelopleurum Gmelini</i> Ledeb.
<i>Heracleum lanatum</i> Michx.	<i>Artemisia vulgaris</i> L.
<i>Senecio palmatus</i> Pall.	<i>Cirsium kamtschaticum</i> Ledeb.
<i>Cacalia kamtschatica</i> Kudo	

Along streams or in wet places in the lower region *Petasites japonicus*, var. is locally prominent, associated with such plants as *Barbarea orthoceras* Ledeb., *Cardamine Regeliana* Miq., *Saxifraga punctata* L., *Chrysosplenium kamtschaticum* Fisch., *Epilobium Behringianum* Hausskn., etc.

In a special locality, *Artemisia-Rumex-Polygonum*-community is found near the shore in Sonrakuwan. *Artemisia vulgaris*, var., *Rumex Acetosa*, var. and *Polygonus kurilense* are codominant, and associated with such plants as *Urtica platyphylla* Wedd., *Geranium erianthum* DC., *Taraxacum ceratophorum* DC., etc.

ii) *Trollius-Geranium-Anemone*-Association

The *Trollius-Geranium-Anemone*-association composed of a large number of arctic-alpine plants, is well developed on flat uplands and gentle slopes of the mountain side. It is dominated by *Trollius Riederianus*, *Geranium erianthum* and *Anemone narcissiflora*, and it forms rather mixed associations accompanied by the following plants:—

<i>Calamagrostis purpurascens</i> R. Br.	<i>Festuca rubra</i> L.
<i>Carex hakkodensis</i> Franch.	<i>Carex vaginata</i> Tausch
<i>Carex scita</i> Maxim.	<i>Luzula plumosa</i> E. Mey.
<i>Luzula Kjellmanniana</i> Miyabe et Kudo	<i>Lilium medeoloides</i> A. Gray
<i>Fritillaria camschatcensis</i> Ker-Gawl.	<i>Lloydia serotina</i> Reichb.
<i>Majanthemum dilatatum</i> Nels. et Macbr.	<i>Iris setosa</i> Pall.
<i>Orchis aristata</i> Fisch.	<i>Coeloglossum viride</i> Hartm.
<i>Platanthera hyperborea</i> Lindl.	<i>Rumex Acetosa</i> L.
<i>Polygonum viviparum</i> L.	<i>Moeckringia lateriflora</i> Fenzl
<i>Parnassia palustris</i> L.	<i>Geum dilatatum</i> Sm.
<i>Geranium erianthum</i> DC.	<i>Viola crassa</i> Makino
<i>Cnidium ajanense</i> Drude	<i>Cornus suecica</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Trientalis europaea</i> L.
<i>Swertia tetrapetala</i> Pall.	<i>Gentiana auriculata</i> Pall.
<i>Veronica Stelleri</i> Pall.	<i>Pedicularia Chamissonis</i> Stev.
<i>Solidago Virgaurea</i> L.	<i>Anaphalis margaritacea</i> Benth. et Hook.

Achillea Ptarmica L. *Arnica unalascensis* Less.
Cirsium kamtschaticum Ledeb. *Saussurea Riederi* Herd.

Among them the following dwarf shrubs are found scattered:—

Salix kurilensis Koidz. *Rhododendron chrysanthum* Pall.
Rhododendron camtschaticum Pall. *Vaccinium uliginosum* L.
Vaccinium Vitis-idea L.

iii) *Primula-Geum-Coptis*-Association

The *Primula-Geum-Coptis*-association is developed along the upper valleys. Interesting to say, it represents the first transitional stage from the bare land to the heath or the herbaceous communities. *Primula cuneifolia*, *Geum pentapetalum* and *Coptis trifolia* are codominant and the following plants are found associated with them:—

Lycopodium Selago L. *Lycopodium sitchense* Rupr.
Selaginella selaginoides Link *Carex hakkodensis* Franch.
Carex pyrenaica Wahlb. *Orchis aristata* Fisch.
Veronica Stelleri Pall. *Pinguicula vulgaris* L.

Besides these the following dwarf shrubs are found, among which *Phyllodoce aleutica* is most remarkable.

Salix kurilensis Koidz. *Empetrum nigrum* L.
Phyllodoce alcutica A. Heller *Cassiope lycopodioides* Don
Cassiope Stelleriana DC. *Vaccinium uliginosum* L.
Vaccinium Vitis-idaea L.

6. Swamp and Bog.

The swamp and bog associations are well developed near Onuma and scattered locally on marine terraces throughout the island. They are dominated by the sedges associated with other bog plants. The communities of the bog and swamp are divided into the following divisions:—

- i) *Juncus-Iris-Carex*-association. ii) *Sparganium-Menyanthes-Hippuris*-association.
- iii) *Carex*-association.
- iv) *Sphagnum-Andromeda-Oxycoccus*-association.

i) *Juncus-Iris-Carex*-Association

The *Juncus-Iris-Carex*-association is developed in low lands, especially near Sonrakuwan. It represents a transitional phase from the boggy community to the herbaceous one. *Juncus balticus*, *Iris setosa*

and *Carex Lyngbyei* are codominant and the following additional plants are found in this association:—

<i>Deschampsia caespitosa</i> P. Beauv.	<i>Carex hakodensis</i> Franch.
<i>Luzula parviflora</i> Desv.	<i>Orchis aristata</i> Fisch.
<i>Sedum Rhodiola</i> DC.	<i>Polygonum viviparum</i> L.
<i>Parnassia palustris</i> L.	<i>Geranium erianthum</i> DC.
<i>Cnidium ajanense</i> Drude	<i>Cornus suecica</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Primula sibirica</i> Jacq.
<i>Lagotis glauca</i> Gaertn.	

Accompanied with them are found such shrubs as:—*Salix*, *Empetrum nigrum* L., *Vaccinium uliginosum* L., etc.

ii) *Sparganium-Menyanthes-Hippuris*-Association

The aquatic flora is represented by only two species *Potamogeton Franchetii* and *Sparganium minimum*. The former species is very locally found in this island, and the latter occurs in pools where the depth of water is about 1–1.5 m. *Menyanthes trifoliata* forming a pure stand is sometimes found in the ponds or lakes where the depth of the water is 0.5–1 m. *Hippuris vulgaris* often serves as a pioneer of the marsh plants extending the belt to the aquatic area. *Comarum palustre* or *Carex limosa* follow them and are succeeded by *Carex Lyngbyei* or *Carex Middendorffii*.

iii) *Carex*-Associations

The bog of this island is mostly represented by *Carex*-associations. It is developed in low lands and on terraces. In the low land *Carex Middendorffii* is dominant or replaced locally by *Carex Augustinowiczii* on the margin of the bog. In swampy places *Carex Lyngbyei* is abundant often forming a pure stand. The characteristic plants found in the associations are as follows:—

<i>Eriophorum angustifolium</i> Roth	<i>Scirpus caespitosus</i> L.
<i>Carex rotundata</i> Wahlb.	<i>Carex Michauxina</i> Boot.
<i>Carex pyrenaica</i> Wahlb.	<i>Iris setosa</i> Pall.
<i>Platanthera hyperborea</i> Lindl.	<i>Parnassia palustris</i> L.
<i>Rubus arcticus</i> L.	<i>Sanguisorba tenuifolia</i> Fisch.
<i>Viola Langsdorffi</i> Fisch.	<i>Galium trifidum</i> L.

On terraces, the bogs dominated by *Carex rariflora* occur. The vegetation tends to be monotonous, including somewhat the same characteristics of the following association. In this case, the heath invades this association, when the land tends to become dry.

iv) *Sphagnum-Andromeda-Oxycoccus*-Association

The *Sphagnum* bogs are not well developed in this island. It is found in the *Carex* bog or flat lands on the mountain side. The representative place of such an association occurs near Onuma. The following is a list of vascular plants found in the *Sphagnum* bog.

<i>Selaginella selaginoides</i> Link	<i>Scirpus caespitosus</i> L.
<i>Carex hakkodensis</i> Franch.	<i>Carex pyrenaica</i> Wahlb.
<i>Carex rariflora</i> Lightf.	<i>Carex Middendorffii</i> Fr. Schm.
<i>Platanthera tipuloides</i> Lindl.	<i>Coptis trifolia</i> Salisb.
<i>Drosera rotundifolia</i> L.	<i>Parnassia palustris</i> L.
<i>Geum pentapetalum</i> Makino	<i>Geum calthaefolium</i> Sm.
<i>Empetrum nigrum</i> L.	<i>Cnidium ajanense</i> Drude
<i>Loiseleuria procumbens</i> Desv.	<i>Bryanthus musciformis</i> Nakai
<i>Andromeda Polifolia</i> L.	<i>Oxycoccus vulgaris</i> Hill
<i>Vaccinium Vitis-idaea</i> L.	<i>Vaccinium uliginosum</i> L.
<i>Primula cuneifolia</i> Ledeb.	<i>Trientalis europaea</i> L.
<i>Gentiana Kawakamii</i> Makino	

THE ISLAND OF MATUWA

TOPOGRAPHY

The Island of Matuwa lies about 440 miles north-east from the Port of Nemuro in Hokkaido and about 215 miles from Kamschatka. It



Mt. Fuyo, (Matuwa-fuji), Isl. Matuwa,
taken on September 5, 1928.

extends from 153°10' to 153°17' E.L. and from 48°2' to 48°8' N.L. It is orbicular-oblong in outline, about 7 miles in width and the area about 20 square miles, including the Island of Banjô. It is separated from the Island of RASHUWA on the south-west by the RASHUWA Strait, having a width of 16 miles. To the north-east lies the small island of Raikokei. Matuwa is a volcanic island, in which the main peak, attaining a height of 1485 m., occupies about its central part. Mt. Fuyô (Sarytscheff Peak), the highest peak, broke out in a violent eruption in February 1928 and 1930. The rivers are small, often forming gullies. The coast is generally rocky and unapproachable, and the sandy beaches are but locally developed between Ainu-wan and Yamato-wan.

THE PLANT-COMMUNITIES

The physiognomy of the plant-communities of this island shows a comparatively recent formation. Although the vegetation of the lower slope is more or less well established, the higher altitudes over 800 m. are mostly barren. The plants growing in this island are comparatively poor in species. The communities may be characterised as follows:—

- i) The destitution of the Pinetum.
- ii) The destitution of the Betuletum.
- iii) The destitution of the undergrowth of *Sasa kurilensis*.
- iv) The well developed Calamagrostidetum, dominated by *Calamagrostis Langsdorffii*.

The plant-communities are here treated under the following seven main categories:—

- | | |
|-------------------|-------------------|
| 1. Forest. | 2. Sea-shore. |
| 3. Heath. | 4. Grassy land. |
| 5. Meadow. | 6. Swamp and bog. |
| 7. Lapilli-slope. | |

1. Forest

The vegetation of thickets consists almost entirely of *Alnus fruticosa*. It is worthy of notice that there is complete absence of *Betula Ermani*, *Pinus pumila* and *Sasa kurilensis*. The alder thickets are distributed as high up as 400 m. from the sea level, forming impenetrable simple bushes. The development of the alder bushes is better on the south-eastern and southern sides of the island. The height of the alder trees

varies according to the environment. They attain a height of 2.5 m. or sometimes more in the valley near Yamato-wan, but farther up on the exposed ridge, dwarf shrubby growth only is met with. Owing to the habitats, the undergrowth is not constant. In the lower places, *Lonicera coerulea* and *Sorbus sambucifolia* are occasionally found mixed here and there or forming pure patches. *Diervilla Middendorffiana* rarely occurs. As the under-layer the following plants are found.

<i>Dryopteris dilatata</i> A. Gray	<i>Polysticum Braunii</i> Fée
<i>Athyrium Filix-femina</i> Roth	<i>Calamagrostis Langsdorffii</i> Trin.
<i>Allium Victorialis</i> L.	<i>Streptopus amplexifolius</i> DC.
<i>Trillium kamtschaticum</i> Pall.	<i>Listera cordata</i> R. Br.
<i>Stellaria yezoensis</i> Maxim.	<i>Aconitum kamtschaticum</i> Willd. et Reichb.
<i>Moehringia lateriflora</i> Fenzl	<i>Chrysosplenium kamtschaticum</i> Fisch.
<i>Filipendula kamtschatica</i> Maxim.	<i>Peracarpa circaeoides</i> Feer
<i>Senecio palmatus</i> Pall.	

Among them, *Calamagrostis Langsdorffii* and *Filipendula kamtschatica* are mostly abundant except in places devoid of undergrowth.

2. Sea-shore

Sandy beaches are only slightly developed, and consequently the vegetation in this association is comparatively poor. The following species are found forming the sandy beach-associations of the island:—

<i>Poa macrocalyx</i> Trautv.	<i>Elymus mollis</i> Trin.
<i>Ammodenia oblongifolia</i> Rydb.	<i>Rosa rugosa</i> Thunb.
<i>Lathyrus maritimus</i> Bigel.	<i>Metensia maritima</i> G. Don subsp. <i>asiatica</i> Takeda
<i>Campanula lasiocarpa</i> Cham.	<i>Senecio pseudo-Arnica</i> Less.

A similar association extends to the stony shore, where besides the above mentioned plants such others as *Chrysanthemum arcticum* and *Taraxacum ceratophorum* are found. On rocky cliffs, the following plants occur:—

<i>Sagina Linnaei</i> Presl	<i>Cochlearia oblongifolia</i> DC.
<i>Sedum Rhodiola</i> DC.	<i>Saxifraga rivularis</i> L.

3. Heath

The heath-associations in this island are related to the drier type and are mostly represented by the *Empetretum*. It is one of the most distinctive types of the vegetation developed on the flat upland on this island. It seems to be poorer in number of the species than in the case

of the other islands in the Middle Kuriles. Shrubs such as *Salix kurilensis*, *Alnus fruticosa* and *Sorbus sambucifolia* occur in varying amount in the heath, but they are always subordinate to the dwarf-shrubs. *Empetrum nigrum* is the dominant species accompanied often by *Vaccinium Vitis-idaea* and there are associated the following Ericaceous plants:—

<i>Rhododendron chrysanthum</i> Pall.	<i>Arctous alpina</i> Niedz.
<i>Loiseleuria procumbens</i> Desv.	<i>Vaccinium uliginosum</i> L.

Accompanied with them are found such plants as:—

<i>Lycopodium annotinum</i> L.	<i>Lycopodium alpinum</i> L.
<i>Calamagrostis purpurascens</i> R. Br.	<i>Agrostis Trinii</i> Turcz.
<i>Lilium medeoloides</i> A. Gray	<i>Orchis aristata</i> Fisch.
<i>Polygonum viviparum</i> L.	<i>Geum calthaefolium</i> Sm.
<i>Astragalus secundus</i> DC.	<i>Oxytropis retusa</i> Matsum.
<i>Cornus suecica</i> L.	<i>Pyrola minor</i> L.
<i>Trientalis europaea</i> L.	

There is a wet type of the heath near AINU-wan. It seems to be an intermediate stage from the bog-association to the dry heath association. The characteristics are as follows:—

<i>Carex rariflora</i> Smith	<i>Rubus Chamaemorus</i> L.
<i>Empetrum nigrum</i> L.	<i>Vaccinium uliginosum</i> L.
<i>Arctous alpina</i> Niedz.	

Associated with them, the following plants are found:—

<i>Calamagrostis Langsdorffii</i> Trin.	<i>Agrostis Trinii</i> Turcz.
<i>Carex pyrenaica</i> Wahlenb.	<i>Carex hakkodensis</i> Franch.
<i>Tofieldia nutans</i> Willd.	<i>Polygonum viviparum</i> L.
<i>Geum calthaefolium</i> Sm.	<i>Cornus suecica</i> L.
<i>Loiseleuria procumbens</i> Desv.	<i>Trientalis europaea</i> L.

4. Grassy land

Most of the communities in the lower slopes are occupied by this type of vegetation. The master factor is the recent eruptions. The community is developed especially on gentle slopes or flat uplands, and the remarkable example is to be found near Miharashi-dai. *Calamagrostis Langsdorffii* is the dominant species, and here, besides it, are found the following plants:—

<i>Phleum alpinum</i> L.	<i>Festuca rubra</i> L.
<i>Trisetum sibiricum</i> Rupr.	<i>Luzula Kjellmanniana</i> Miyabe et Kudo
<i>Moehringia lateriflora</i> Fenzl	<i>Geranium erianthum</i> DC.
<i>Gentiana auriculata</i> Pall.	<i>Vaccinium Vitis-idaea</i> L.

<i>Swertia tetrapetala</i> Pall.	<i>Halenia corniculata</i> Druce
<i>Euphrasia mollis</i> Wettst.	<i>Achillea Ptarmica</i> L.
<i>Achillea sibirica</i> Ledeb.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Saussurea Riederi</i> Herd.	

Carex Gmelini and *Carex scita* are mixed with them near the beach.

5. Meadow

The associations of this type are commonly developed in hollows of the low land, on hill-sides and along streams. They are only represented by the tall herbaceous community—*Filipendula-Petasites*-association. They are found in more or less rich soils. *Filipendula kamtschatica* is the most prominent species, while *Petasites japonicus*, var. *giganteus* is the chief herb. *Senecio palmatus*, *Aconitum kamtschaticum* and *Cirsium kamtschaticum* maintain subordinate rank. Besides them are found the following plants:—

<i>Allium Victorialis</i> L.	<i>Lilium medeoloides</i> A. Gray.
<i>Urtica platyphylla</i> Wedd.	<i>Geranium erianthum</i> DC.
<i>Heracleum lanatum</i> Michx.	<i>Swertia tetrapetala</i> Pall.
<i>Saussurea Riederi</i> Herd.	<i>Anaphalis margaritacea</i> Benth. et Hook.
<i>Artemisia vulgaris</i> L.	

Along streams or in wet places, *Petasites japonicus* var. is dominant, associated with such plants as:—

<i>Cardamine Regeliana</i> Miq.	<i>Barbarea orthoceras</i> DC.
<i>Chrysosplenium kamtschaticum</i> Fisch	<i>Saxifraga punctata</i> L.
<i>Epilobium Behringianum</i> Hausskn.	

6. Swamp and Bog

The swamp and bog-associations are not so well developed in this island, occurring only at Ainu-wan and near Nakadomari. They are composed almost entirely of *Carex Lyngbyei* followed by the border of *Calamagrostis Langsdorffii*. *Carex rariflora* is locally prominent and the following plants have been found in the association:—

<i>Equisetum palusre</i> L.	<i>Deschampsia caespitosa</i> P. Beauv.
<i>Agrostis Trinii</i> Turcz.	<i>Carex hakkodensis</i> Franch.
<i>Iris setosa</i> Pall.	<i>Comarum palustre</i> L.
<i>Hippuris vulgaris</i> L.	

Besides these are sometimes noticed such plants as follows:—

<i>Carex pyrenaica</i> Wahlenb.	<i>Platanthera hyperborea</i> Lindl.
<i>Viola repens</i> Turcz.	<i>Viola Langsdorffii</i> Fisch.
<i>Galium trifidum</i> L.	

7. Lapilli slope

The ground of the lapilli slope is composed of lava fragments varying in size from large blocks to fine sands. The vegetation is generally of the dry type. The data collected were not sufficient to enable the writer to make a complete survey of the association, especially in its alpine region. The most characteristic species of the herbaceous plants are as follows:—

<i>Deschampsia flexuosa</i> Trin.	<i>Agrostis Trinii</i> Turcz.
<i>Carex flavocuspis</i> Fr. et Sav.	<i>Oxyria digyna</i> Hill.
<i>Stellaria ruscifolia</i> Willd.	<i>Papaver nudicaule</i> L.
<i>Saxifraga Merckii</i> Fisch.	<i>Oxytropis retusa</i> Matsum.
<i>Pentstemon frutescens</i> Lamb.	<i>Campanula lasiocarpa</i> Cham.

The pioneers of the association are *Papaver nudicaule*, *Stellaria ruscifolia*, *Saxifraga Merckii* and *Pentstemon frutescens*, and then *Oxytropis retusa* and *Campanula lasiocarpa*, and other species invade the region. In limited localities on the eastern side of Mt. Fuyô, are recorded such plants as *Pentstemon frutescens*, *Carex flavocuspis*, *Oxytropis retusa*, etc.

Among the shrubby species the following plants are found in these associations.

<i>Salix longipetiolata</i> Flod.	<i>Empetrum nigrum</i> L.
<i>Rhododendron camtschaticum</i> Pall.	<i>Rhododendron chrysanthum</i> Pall.
<i>Cassiope lycopodioides</i> Don	<i>Arcteria nana</i> Makino

GENERAL CONCLUSION

1. Forest. The forests can be divided into the following three consociations:—i) Pinetum, represented by *Pinus pumila*; ii) Alnetum, by *Alnus fruticosa*; iii) Betuletum, by *Betula Ermani*. The first and the second consociations are the climate climax, the former being developed on the exposed mountain regions and the latter in the lower regions, especially along the valleys. But sometimes the latter becomes the edaphic climax in the course of the succession after a volcanic eruption, such as is seen in the Island of Matuwa. The *Betula*-consociation accompanied by the undergrowth of *Sasa kurilensis* is the prominent feature that is remarkably different from the forest type predominating in the Northern Kuriles.

2. Sea-shore. The sea-shore-associations, except those of the sea-cliff, coincide with the sea-shore communities in northern Japan. Some

localities along the sea-shore support vegetation different from the typical one. This difference is mainly caused by volcanic influences. Several arctic-alpine elements, such as, *Papaver nudicaule*, *Saxifraga Merckii*, *Oxytropis retusa*, *Hedysarum obscurum*, *Lagotis glauca*, *Campanula lasiocarpa*, etc. are found. The sea-cliff association is mostly boreal in character, being rich in number of the arctic-alpine plants.

3. Heath. The heaths described show intermediate stages in the development to the climax. They arise in various ways, dominated by the dwarf shrubs. They are mainly represented by the *Empetrum-Vaccinium*-association in the lower region, and by the *Empetrum-Rhododendron-Vaccinium*-association in the higher altitude.

4. Grassy land. The Calamagrostidetum is most prominent. It is mostly a recent formation resulting from the volcanic soils.

5. Meadow. The tall herbaceous communities occur in rich soils of the low land, such as alluvial flats, river valleys and hill-sides. They are represented by the *Cacalia-Filipendula*- and *Filipendula-Petasites*-association. The other communities, developed on hill-tops or terraces, are rather of mixed assemblage. These show a considerable degree of stability, but ultimately pass into the forest-associations.

6. Swamp and Bog. These associations are mainly represented by the following three communities:—*Potamogeton-Hippuris-Menyanthes*-association, *Carex*-associations, *Sphagnum-Andromeda-Oxycoccus*-association. They are not very extensive in the Middle Kuriles except in the south-western end of the Island of Urup.

7. Volcanic upland. Having no opportunity to climb any mountains except Mt. Matuwa-fuji, and to go up to Lake Midori and Lake Kotoi, the collected data now under consideration are not sufficient to enable the author to discuss this problem. Generally speaking, however, the vegetation is still in an early stage, a complete association having not yet been formed.

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EXPLANATION OF PLATES

Plate I. Forest

- Fig. 1. The alder bush near Miharashidai on the Island of Matuwa, taken on Aug. 7, 1928.
- Fig. 2. *Pinus pumila* and *Betula Ermani* near Broughton Bay in the Island of Shimushir, taken on May 22, 1930.
- Fig. 3. A colonization of *Alnus fruticosa* to the gully near Lake Midori in the Island of Shimushir, taken on Aug. 18, 1928.

Plate II. Forest

- Fig. 4. The birch forest near Onuma on the Island of RASHUWA, taken on Aug. 5, 1929.
- Fig. 5. The birch forest near Wan-oku in the Island of Shimushir, taken on Aug. 22, 1928.
- Fig. 6. *Betula Ermani* and *Sasa kurilensis* near Kodakigawa on the Island of Ketoi, taken on Aug. 15, 1929.

Plate III. Sea-shore

- Fig. 7. A gravelly shore, (*Ammodenia oblongifolia*, var. *maxima*, *Senecio pseudo-Arnica*, *Elymus mollis*) near Yamatowan on the Island of Matuwa, taken on Aug. 7, 1928.
- Fig. 8. A sandy shore, (*Carex macrocephala*, *Linaria japonica*) near Tokotan in the Island of Urup, taken on Aug. 28, 1927.
- Fig. 9. *Chrysanthemum arcticum* on the sea-cliff at Yamatowan on the Island of Matuwa, taken on Aug. 7, 1928.
- Fig. 10. *Draba hyperborea* on the sea-cliff at Sonrakuwan on the Island of RASHUWA, taken on Aug. 8, 1929.

Plate IV. Characteristic Sea-shore

- Fig. 11. *Artemisia Stelleriana* and *Pentstemon frutescens*, near Shimushirwan in the Island of Shimushir, taken on Sept. 13, 1928.
- Fig. 12. *Campanula lasiocarpa* and *Ligusticum scoticum*, at Tokkariwan on the Island of Ketoi, taken on Aug. 29, 1929.
- Fig. 13. *Lagotis glauca* and *Elymus mollis*, near Shimushirwan in the Island of Shimushir, taken on Sept. 13, 1928.

Plate V. Heath

- Fig. 14. *Chrysanthemum arcticum*, at Minamiura on the Island of Ketoi, taken on Sept. 1, 1928.
- Fig. 15. *Rhododendron camtschaticum*, near Sonrakuwan on the Island of RASHUWA, taken on Sept. 8, 1929.

- Fig. 16. *Pinus pumila*, *Ledum palustre*, *Arctous alpina*, var. *Japonica*, *Rhododendron chrysanthum*, *Empetrum nigrum* and *Cladonia alpestris*, near Tokotan in the Island of Urup, taken on Sept. 13, 1927.
- Fig. 17. *Empetrum nigrum*, *Rubus Chamaemorus*, *Vaccinium uliginosum*, etc., near Ainuwan on the Island of Matuwa, taken on Sept. 6, 1928.

Plate VI. Grassy land

- Fig. 18. *Botrychium lanccolatum*, near Tozansaki in the Island of Shimushir, taken on Aug. 17, 1928.
- Fig. 19. *Cypripedium guttatum*, near Onuma on the Island of RASHUWA, taken on Aug. 5, 1929.
- Fig. 20. *Calamagrostis Langsdorffii*, in Kitajima in the Island of Ushishir, taken on Aug. 11, 1928.

Plate VII. Meadow

- Fig. 21. *Filipendula kamtschatica*, *Petasites japonicus*, var. *giganteus*, etc., near Yotsuiwahama on the Island of RASHUWA, taken on Aug. 6, 1928.
- Fig. 22. *Petasites japonicus*, var. *giganteus*, *Filipendula kamtschatica*, near Miharashidai on the Island of Matuwa, taken on Aug. 7, 1928.
- Fig. 23. *Arnica unalascensis*, *Geranium erianthum*, etc. near Sonrakuwan on the Island of RASHUWA, taken on Aug. 8, 1929.
- Fig. 24. *Lagotis glauca*, near Tokotan in the Island of Urup, taken on Sept. 1, 1927.

Plate VIII. Swamp and Bog

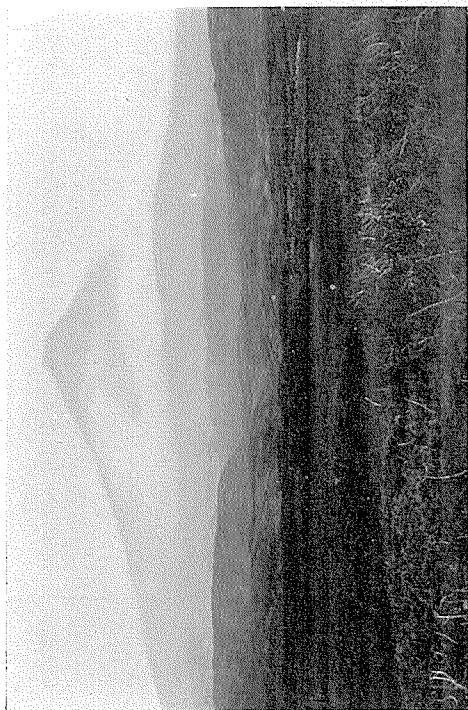
- Fig. 25. *Sparganium minimum*, *Eriophorum angustifolium*, etc., near Kodakigawa on the Island of Kctoi, taken on Aug. 15, 1929.
- Fig. 26. *Carex Lyngbyei*, near Onsenzaki in the Island of Urup, taken on Sept. 11, 1927.
- Fig. 27. *Menyanthes trifoliata*, near Onuma on the Island of RASHUWA, taken on Aug. 5, 1929.
- Fig. 28. *Hippuris vulgaris*, *Potamogeton natans*, *Lysichiton camtschaticense*, etc., near Wan-oku in the Island of Shimushir, taken on Aug. 26, 1928.

Plate IX. Volcanic Upland

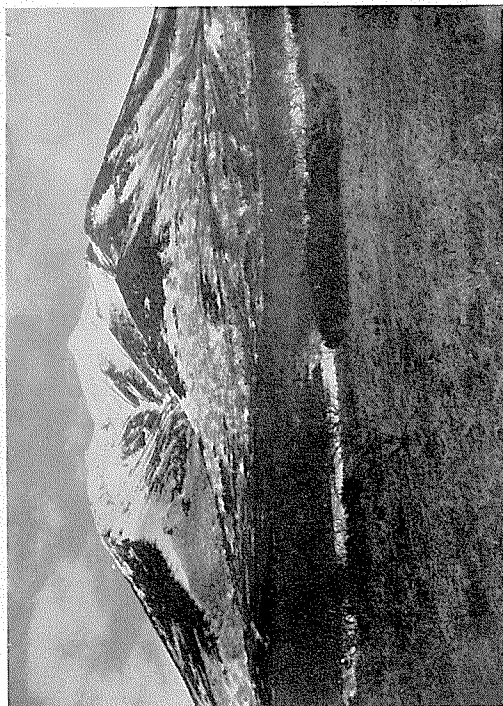
- Fig. 29. *Potentilla Miyabei*, near Shimushirwan in the Island of Shimushir, taken on Sept. 13, 1928.
- Fig. 30. *Pentstemon frutescens*, *Salix longipetiolata*, *Empetrum nigrum*, etc., near Nakadomari on the Island of Matuwa, taken on Aug. 7, 1928.
- Fig. 31. *Campanula lasiocarpa*, near Lake Midori, in the Island of Shimushir, taken on Aug. 18, 1928.
- Fig. 32. *Salix kurilensis*, near Shiroyama in the Island of Shimushir, taken on Aug. 18, 1928.

Plate X. Volcanic Upland

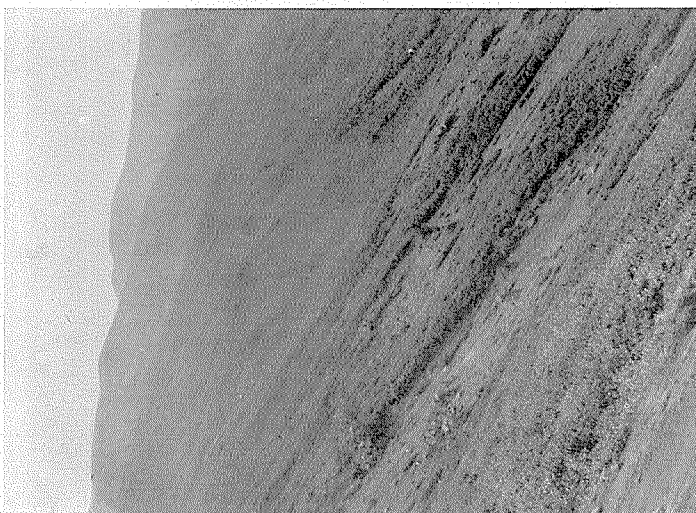
- Fig. 33. Lake Midori in the Island of Shimushir, taken on Aug. 18, 1928, by Yoshio Tokunaga.
- Fig. 34. *Pentstemon frutescens* and *Stellaria ruscifolia*, near Lake Midori in the Island of Shimushir, taken on Aug. 18, 1928.
- Fig. 35. *Saxifraga Merkkii*, near Nakadomari in the Island of Shimushir, taken on Aug. 18, 1928.



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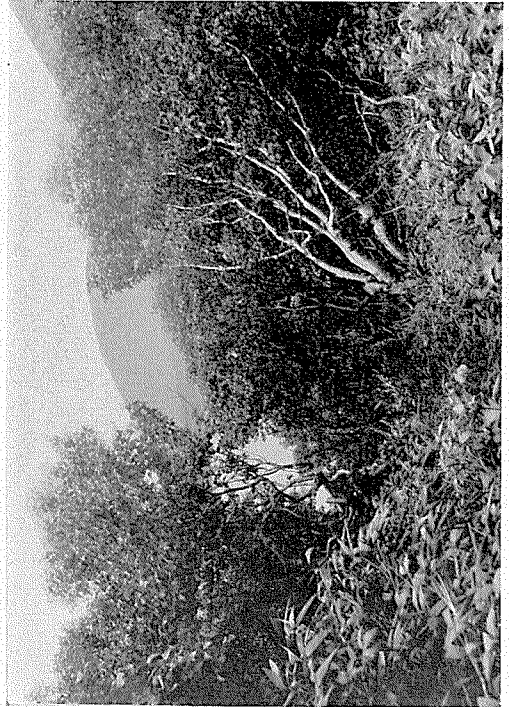
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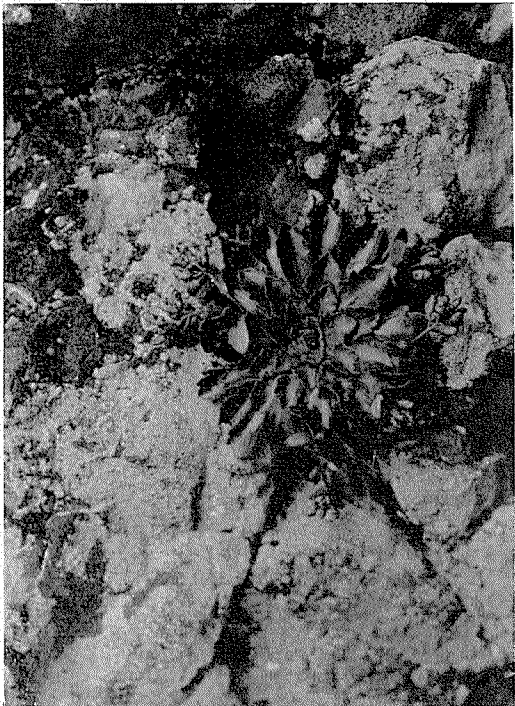
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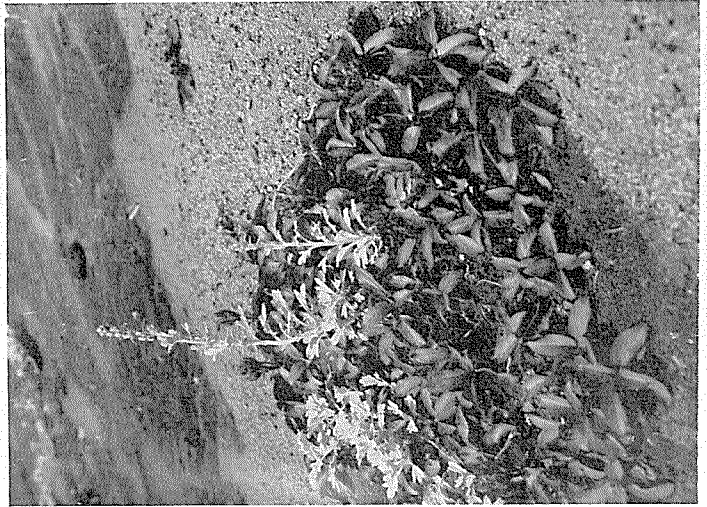
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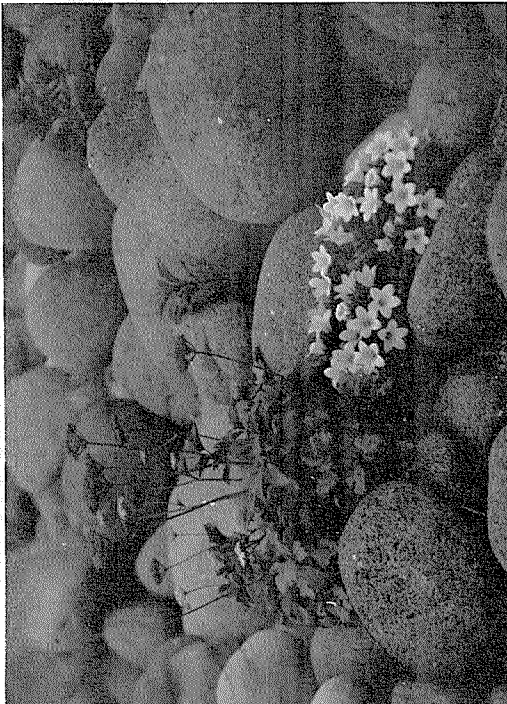
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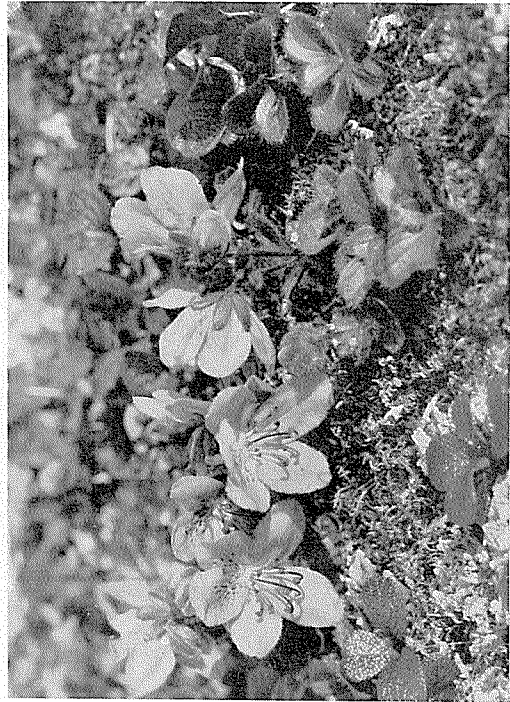
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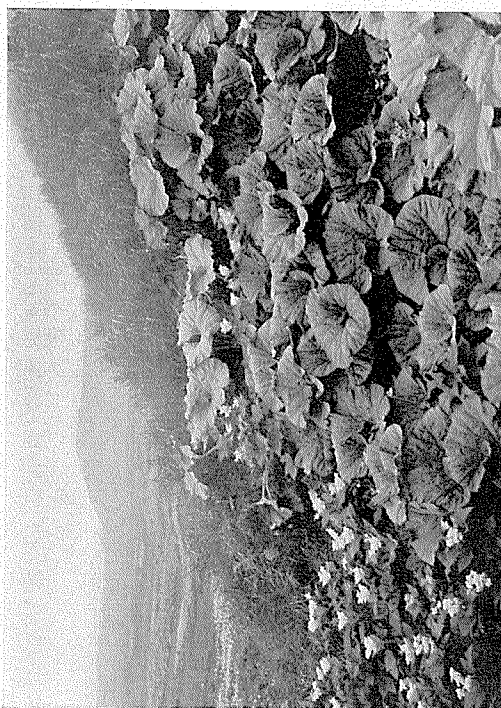
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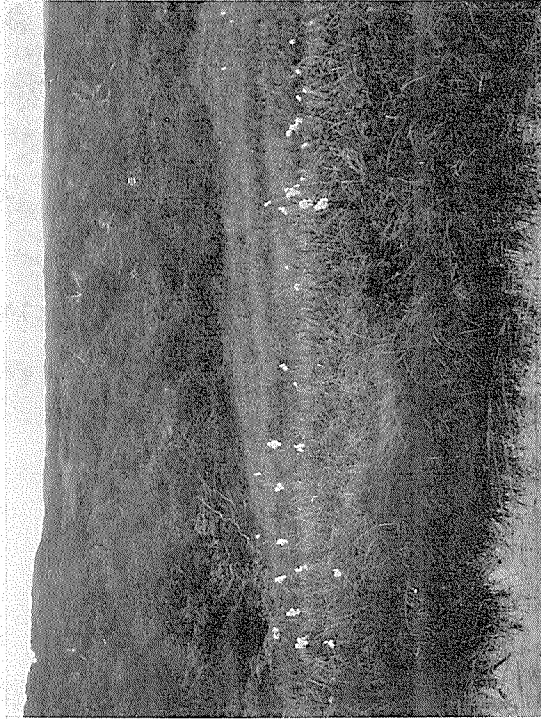
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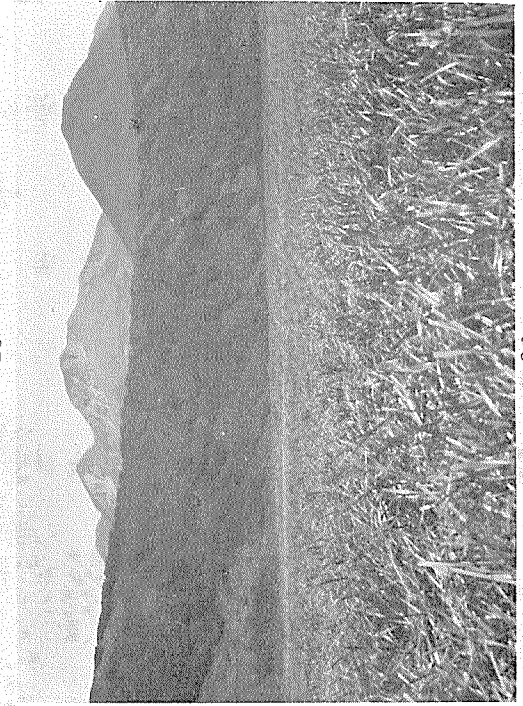
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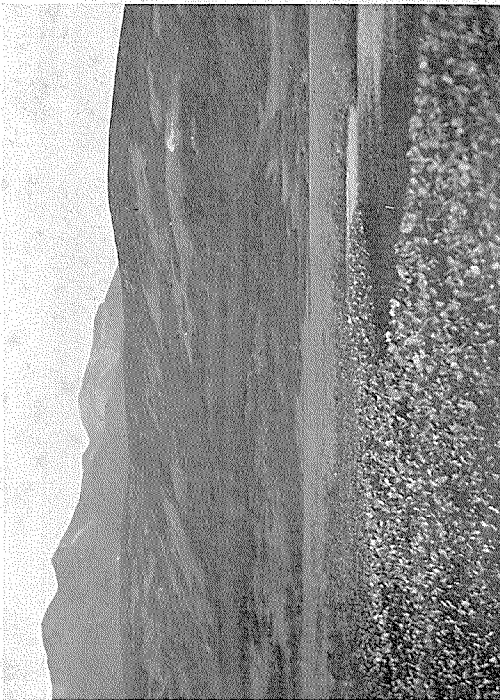
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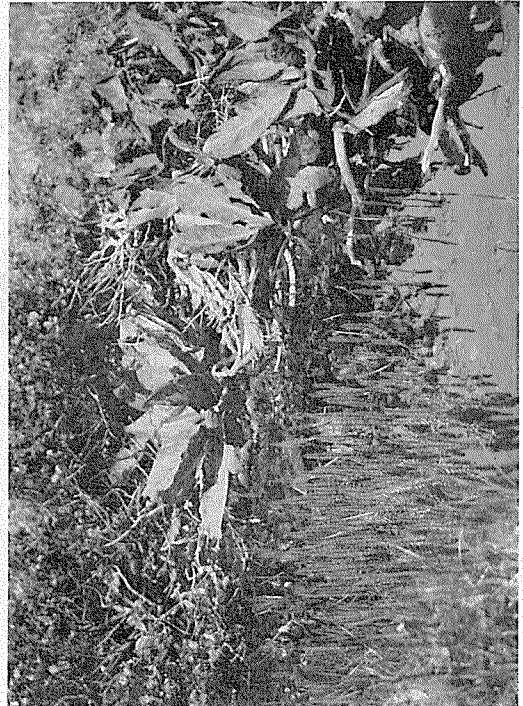
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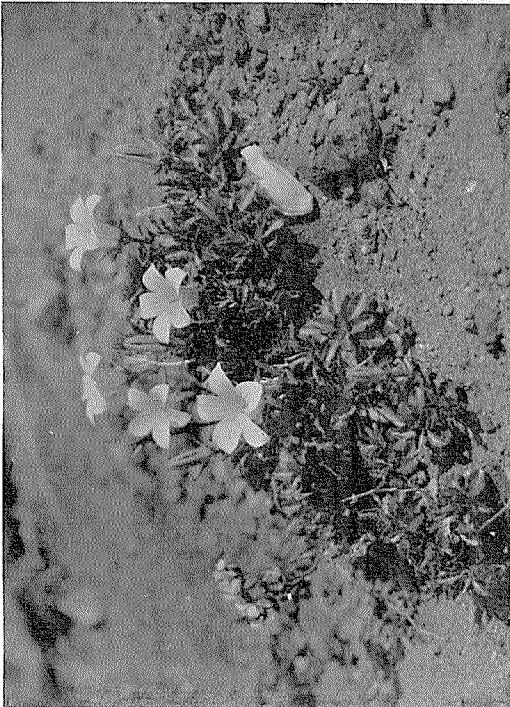
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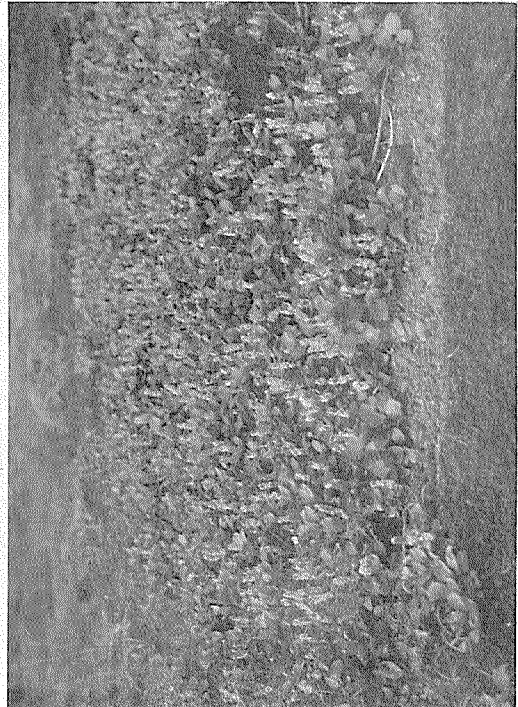
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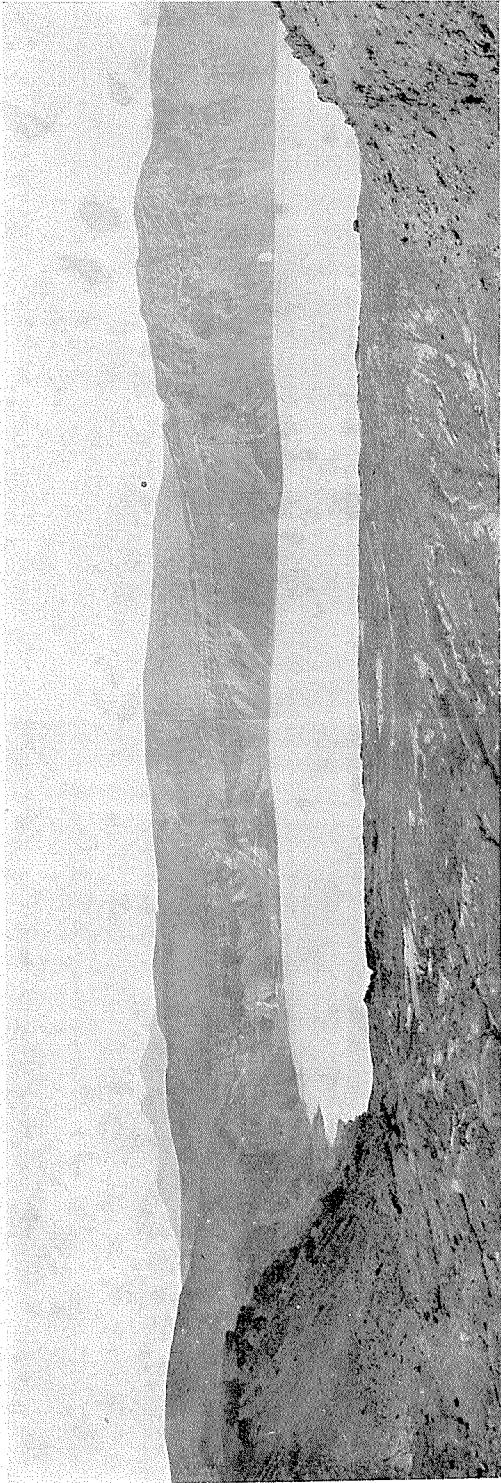
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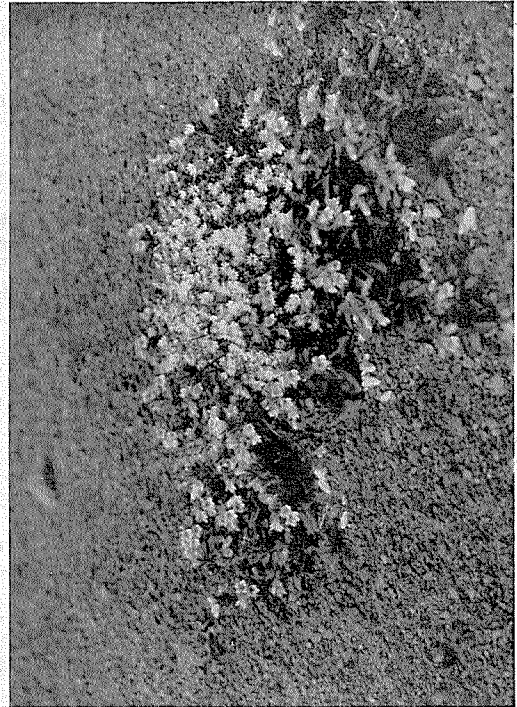
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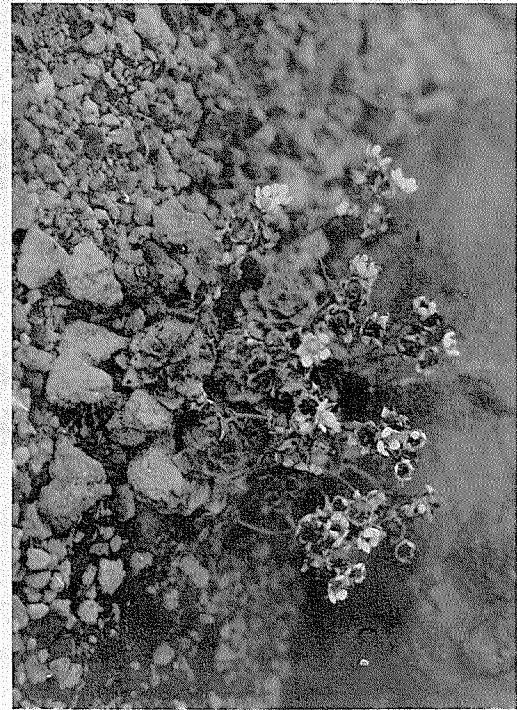
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