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NÁTTÚRUGRIPASAFNIÐ Í REYKJAVÍK

Contributions to the Plant-Geography and Flora of Iceland

IV

THE VEGETATION OF ÍSAFJARÐARDJÚP, NORTH-WEST ICELAND

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WITH 2 FIGURES IN THE TEXT

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INTRODUCTION

The Vestfirðir-peninsula has in many respects been subjected to less investigation by naturalists than other parts of Iceland. This is chiefly due to the fact that it lies outside the main routes on land and is very difficult to traverse. The study of its vegetation in particular has been very desultory. During the summer 1938 I travelled over wide areas around Ísafjarðardjúp (often shortened to Djúp), especially north of the fjord, for the purpose of studying the vegetation in these parts. My intention was to continue these researches, but various circumstances have prevented my being able to do so, and I do not expect to be able to resume this work for some time to come. I sent a flora list from this region to the periodical "Botanisk Tidskrift" where it was due to appear in 1940.

This paper is intended to give an account of the chief plant formations examined by me to any extent. But it must be born in mind that no attempt is made at giving an exhaustive description of the vegetation of the investigated area, only types of the principal formations being dealth with. Yet I think they give some idea of the kind of vegetation to be found around Ísafjarðardjúp, and I think it probable that the vegetation is of a similar nature elsewhere in Vestfirðir.

My centres of investigation and starting points were these: *Ögur, Laugaból at Ísafjörður, Melgraseyri, Sandeyri,* and *Æðey.* I also made a trip to *Jökulfirðir.*

I have written a special paper on the vegetation of Æðey. Consequently it will be left out of consideration in the following.

The examination of the formations was made by C. Raunkiær's circling method. The calculations of the biological spectra give both H. Mölholm Hansen's species-groups and Raunkiær's life-forms. In the tables, however, I have omitted the sub-divisions of the species-

groups, only the northern species A and the southern species E being represented.

There is no need to go into the geography or geology of the investigated area beyond what must inevitably be included in the description of the formations. Yet mention may be made of the fact that basalt is the only type of rock met with over the whole of this area. Judging by the vegetation I think it probable that the soil here has on the whole a higher degree of acidity than is otherwise usual in Iceland. This I infer chiefly from the fact that Sphagnum is probably more widespread here than in other parts of the country, through which I have travelled.

Neither do I intend to discuss the climate specially, having already treated it in some detail in my paper on Æðey.

PLANT-FORMATIONS

PRELIMINARY

The plant-formations present a remarkably uniform appearance. Around the upper part of Ísafjarðardjúp chamaephyte-formations, either heath or copse, are in preponderance. Marsh-formations are rare and valllendi (grass land) formation still more so, with the exception of the home fields. There does not seem to be any pronounced difference between the vegetation north of the Djúp and that south of it. The mountains here are on the whole rather low and flat-topped. At the upper levels of the mountain sides screes frequently occur, mostly devoid of vegetation, the soil on the whole being shallow and stony. Up on the lower mountains there are stretches with considerable vegetation, for instance on the ridge between Ísafjörður and Langidalur. Here masses of débris alternate with gravelly flats and (narrow) strips of marsh. Considerable stretches of Grimmia heath also occur. At Kaldalón the physiognomy of the vegetation changes completely. The coast to the north-west of Kaldalón, the Snæfjallaströnd, is much damper than the Langadalsströnd and the mountain slopes farther up the Djúp. Her it snows heavily and rather large snow drifts are common in the upper parts of the mountain sides, from which constant moisture penetrates

down to the lower parts. Although the Snæfjallaströnd enjoys much sun and is sheltered against winds from the north, it is much more exposed to winds from the sea than the inner part of the Djúp region. Consequently the climate is of a more oceanic character. On the Snæfjallaströnd the chamaephyte formations are much less in prominence than farther up the Djúp, the principal formation at the lower levels of the mountains sides being fairly dry marshes and a kind of valllendi-vegetation covering slopes and small hollows. In depressions highly developed fern thickets occur everywhere. The upper regions of the mountains of Snæfjallaströnd are practically bare of vegetation. Here we have rocky boulders, which are almost impassable with only solitary plants scattered here and there.

A peculiar feature of the vegetation around the Djúp is seen in the fact that the formations are never sharply marked off from one another. Ingimar Óskarsson noticed this peculiarity on the peninsula between Ísafjörður and Mjóifjörður, describing the landscape as "featureless in floristic respect" (I. Ó. p. 404). I have nowhere found this so conspicuous in other parts of the country. The causes of this cannot be gone into here, and besides it would be difficult without a more intimate knowledge of life-conditions generally, than I possess. As a consequense the descriptions in the following are rarely of clearly delimited formations, although I have done my best to select for investigation the most suitable areas. In most formations there occur species which properly belong to other formations. Yet this becomes still more apparent in connection with individual associations, many of which are properly speaking intermediate forms, or fragments of associations.

I have made no attempt to demonstrate any marked developmental continuity between the formations, which in most cases would be very difficult. Similarly, I have preferred to discuss at some length the individual analyses rather than the formations as a whole, because on one hand it is difficult to give a comprehensive description of them, because of their variability, while on the other hand the analyses are too few to render possible an exhaustive account of the vegetation of a whole district.

A. WET-SOIL FORMATIONS

a. MÝRI

As mentioned above wet-soil formations are rare throughout the greater part of the area examined. Upon the whole they occur mostly in small patches at the lower levels of the mountains, on ledges and on small ridges. The wet-soil series in Iceland are these: *flói* (swamp), *flæðimýri* (inundation marsh), *mýri* (marsh), and *dý* (moss pools). The flói- formation proper is not widespread around Ísafjarðardjúp, the flæðimýri-formation occurs at Kaldalón and elsewhere at the heads of fjords along the mouths of rivers, the dý-formation is frequent, covering here as elsewhere only very small stretches. By far the most common type of formation is the *mýri* (marsh) or what Mölholm Hansen terms halla-mýri (well mýri), and in this all my analyses were made. Some of the associations, however, may be said to be transitional forms between mýri and flói, yet always more reminiscent of the mýri. I shall now proceed to describe the individual associations.

TABLE I A

Localities: 1 Ögur 7.-7., 2, 5 Melgraseyri 19.-7., 3, 8—9 Sandeyri 23.-7., 4, 6—7 Laugaból 11.-7., 1—4 Eriophorum polystachium - Scirpus cæspitosus Ass., 5 Eriophorum polystachium, - Betula nana - Empetrum nigrum Ass., 6—7 Carex rigida - Gramineae Ass., 8—9 Carex Lyngbyei Ass. ($10 \times 1/10$ m^2).

			1	2	3	4	5	6	7	8	9
Eriophorum polystachium	G	E4	100	100	100	90	100	70	—	10	40
Scirpus caespitosus	H	E4	100	90	100	70	—	—	—	30	—
Vaccinium uliginosum	Ch	E4	40	30	30	10	80	—	—	100	—
Carex rigida	G	A3	10	40	50	60	—	100	100	80	—
Empetrum nigrum	Ch	E4	—	20	—	—	100	—	—	80	—
Carex Lyngbyei	G	E3	—	—	—	—	—	—	—	80	100
— rariflora	G	A2	—	40	60	30	—	—	—	100	—
Polygonum viviparum	G	A3	90	60	40	60	—	60	100	20	70
Betula nana	Ch	A2	—	20	—	—	100	—	—	—	—
Poa alpina	H	A2	—	—	—	—	—	100	50	—	—
Scirpus palustris	H	E3	60	—	—	—	—	—	—	—	—
Festuca ovina	H	E4	20	—	10	—	—	60	—	10	—
Carex Goodenoughii	G	E3	—	40	—	50	—	—	—	—	—
Thalictrum alpinum	H	A2	—	50	—	20	—	50	80	—	—

		1	2	3	4	5	6	7	8	9
Luzula multiflora	H E3	—	—	10	20	—	80	20	10	—
Calamagrostis neglecta	H E4	—	—	30	20	40	30	—	—	60
Equisetum arvense	G E4	—	—	40	20	—	30	100	—	40
Juncus filiformis	G E3	—	—	10	—	—	—	—	—	50
Festuca rubra	H E4	—	—	—	30	30	—	100	—	—
Salix herbacea	Ch A3	—	—	—	20	—	—	70	40	60
Comarum palustre	HHE4	—	—	—	—	—	10	—	—	60
Ranunculus acer	H E4	—	—	—	—	—	—	—	—	80
Leontodon autumnalis	H E3	—	—	—	—	—	—	—	—	60
Agrostis alba	H E3	—	—	—	—	—	—	—	10	10
Botrychium lunaria	G E4	—	—	—	—	—	—	10	—	—
Carex alpina	H A2	—	—	—	10	—	—	—	—	—
— capillaris	H A3	10	10	—	—	—	—	—	—	—
— dioica	G E4	—	10	—	30	—	—	—	—	—
— microglochin	G A2	40	—	—	—	—	—	—	—	—
— panicea	G E3	—	—	30	—	—	—	—	—	—
— saxatilis	G A3	—	20	—	10	—	—	—	—	—
— sparsiflora	G A1	—	—	—	30	30	—	—	—	—
Cerastium caespitosum	Ch E3	—	—	—	—	—	—	20	—	10
— trigynum	Ch A2	—	—	—	—	—	—	10	—	10
Eriophorum Scheuchzeri	HH A3	—	—	—	—	—	—	—	—	20
Luzula spicata	H A2	—	—	—	—	—	—	10	—	—
Nardus stricta	H E3	—	—	30	—	—	—	—	—	—
Pinguicula vulgaris	H E4	10	10	10	—	—	—	—	40	—
Potentilla verna	H A2	—	—	—	—	—	—	40	—	—
Rhinanthus crista-galli	Th E2	10	20	—	—	—	—	—	—	—
Rumex acetosa	H E3	—	—	—	—	—	—	10	—	—
Salix glauca	Ch A3	—	—	—	10	—	—	—	—	—
— glauca × Sal. herbacea	Ch A3	—	—	—	—	—	—	10	—	—
Taraxacum croceum	H A2	—	—	—	—	—	—	10	—	—
Tofieldia palustris	H A2	10	10	20	—	—	—	—	—	—

TABLE I B.

Biological Spectra of the Mýri-vegetation.

	1	2	3	4	5	6	7	8	9
Points sum	500	570	570	590	480	590	740	610	670
Number of Species	12	16	15	18	7	10	16	13	14
Density of species	5,0	5,7	5,7	5,9	4,8	5,9	7,4	6,1	6,7
A	32,0	43,9	29,8	32,3	27,1	52,5	64,8	39,3	23,9
E	68,0	56,1	70,2	67,7	72,9	47,5	35,2	60,7	76,1
Ch	8,0	12,3	5,3	6,8	58,4	—	14,9	36,1	11,9
H	42,0	29,8	36,8	28,8	14,5	54,2	43,2	16,4	31,3
G	48,0	54,4	59,9	64,4	27,1	44,1	41,9	47,5	44,8
HH	—	—	—	—	—	1,7	—	—	11,9
Th	2,0	3,5	—	—	—	—	—	—	—

1. ***Eriophorum polystachium-Scirpus caespitosus Ass.*** (Table I, A—B, 1—4).

This is the most widely distributed marsh-association. Yet it rarely covers large areas, but usually only small patches or narrow strips of land. This is a rather dry type of marsh. The ground is usually a little inclined and the surface is either level or studded with small knolls. The situation of the marsh-stretches indicates a rather deep covering of snow in winter. *Eriophorum polystachium* and *Scirpus caespitosus* are the dominants everywhere, both in physiognomy and density. It cannot be said with any certainty which predominates. Other species which are rather conspicuous are, *Carex rariflora, C. rigida* and *Polygonum viviparum* of which, however, only scattered specimens are found.

Then *Carex Goodenoughii* and *Scirpus pauciflorus* are often conspicuous. Sometimes *Carex saxatilis* is prominent in these marsh-patches, although it is not included in the analyses in question. From this it will be seen how species intermingle, which belong to the wettest marsh-formation as C. rariflora and Eriophorum polystachium on one hand, and dry-ground species as C. rigida on the other.

The biological spectrum (Table I.B.) shows that the southern species on the whole predominate, although the A% is rather high. The proportion of the life-forms varies a good deal, although the geophytes are everywhere predominant in this association, but the varying ratio of the individual life-forms is due to the variability of the plants accompanying the dominant species. The hemicryptophyte percentage is remarkably high for a marsh-formation. It is noteworthy that no hydro-helophytes are found here, which is, indeed, unusual in a marsh-formation, but it is the best proof that the localities in question are rather dry.

Concerning the individual analyses I want to remark:

No. 1. is from Ögurdal, on a level stretch. The soil is moderately moist. Where there are shallow depressions Eriophorum dominates, whereas Scirpus is predominant on the low elevations.

No. 2 is from the mouth of Skjaldfannardalur by the river Selá. Here the marsh is rather wet with small knolls, a formation approaching that of flói (swamp). Sphagnum frequently occurs on the knolls as is usually the case with marshes in this part of the country.

No. 3 is from Sandeyri some way up the slope where the ground is considerably inclined. The soil is moderately damp, but on the other

hand snow seems to lie rather long. Scirpus dominates physiognomically.

No. 4 is made on a ledge of the ridge above Laugaból at an altitude of c. 100 m. above sea-level, but all the other analyses are made at lower levels. The ground is rather dry and consequently we find here the greatest number of species. Carices and Scirpus dominate in physiognomy.

2. ***Eriophorum polystachium - Betula nana - Empetrum nigrum Ass.*** **(Table I, A—B, 5).**

From this association there is only one analysis, made at the mouth of Skjaldfannardalur in the vicinity of No. 2. The surface of the ground here is level, knolly and rather wet. Chamaephytes are the physiognomic dominants, this being the only marsh association, where Ch are the dominating life-form. This association is rather rare.

3. ***Carex rigida Ass., rich in Gramineae*** **(Table I, A—B, 6—7).**

In this association Carex rigida predominates together with the Gramineae, *Festuca rubra, F. ovina* and *Poa alpina.* Then *Equisetum arvense* and *Salix herbacea* are very sonspicuous, although physiognomically unimportant.

No. 6 is made in a depression of the ridge above Laugaból. Here we have a slightly inclined surface with large knolls. *Eriophorum polystachium* plays a rather prominent part in the physiognomy of the vegetation. This association is widespread in marsh-formations all over the ridge between Laugaból and Langidalur, where the ground is comparatively dry. Where the ground becomes wetter, it is replaced by the Eriophorum-associations.

No. 7 is made up the western valley side of Langidalur at an altitude of c. 180 m. Here the ground slopes steeply and the soil is rather dry. C. rigida dominates entirely in physiognomy, but there is a good deal of moss. This association seems to be widely distributed over the slopes here, and it is by far the most widespread association over a large area. A very similar type of vegetation is found up the southern slope of Kaldalón. C. rigida seems to be the main marsh formation species in the upper parts of the slopes.

4. *Carex Lyngbyei Ass.* (Table I, A—B, 8—9).

This association has nowhere been examined by me, except near the sea at Sandeyri, and I do not think it is widespread. It is very unlike the usual C. Lyngbyei-marsh, especially in respect of the number of species, because usually the C. Lyngbyei-marsh contains a very restricted number of species and rarely other life-forms than geophytes. But it has this in common with the C. Lyngbyei-marsh that the soil is saturated with water.

In *No. 8 C. rigida* and *C. rariflora* are so prominent that it is doubtful, which of these three species covers most ground, although *C. Lyngbyei* dominates entirely in physiognomy. Although the Ch% is high, they are physiognomically inconspicuous, because they are shorter than the sedges. But on account of the high Ch% I think we have here to do with a formation in the transitional stage, i. e. a heath-formation, which has been permeated by water, and is changing into marsh.

In *No. 9* C. Lyngbyei is more prominent than in the previous locality, and the Ch% is considerably lower, on the other hand Philonotis is very conspicuous, there being numerous springs at the foot of the mountain slope.

As previously indicated there is a rather wide stretch of flæðimýri (inundation marsh) at Kaldalón, where Carex Lyngbyei is the dominating species, and also in several places at the heads of fjords. I have no circling results for these localities, but at Kaldalón the marsh seemed to possess all the usual characteristics peculiar to the flæðimýri, i. e. wet, level and very poor in species, so that in many places scarcely other species than C. Lyngbyei occurred, but this species was on the whole of low growth and less developed than is usual under similar conditions.

To the marsh-formation as a whole the following applies: It is not widespread, the flói-formation is almost entirely absent, but the wettest parts are forms intermediate between flói (swamp) and marsh. The driest parts on the other hand are so rich in dry-ground species that they approach the so-called jaðar-vegetation (intermediate between marsh and heath). The Equisetum palustre-marsh hardly occurs. On the other hand *Scirpus caespitosus* is one of the main dominants of the marsh-vegetation. I have nowhere else seen it so widespread in this country, except in the most northern districts of Eyjafjörður, where growth conditions are in many respects similar, i. e.

considerable snow covering in winter and exposure to winds from the sea, from which it might perhaps be inferred that the Scirpus caespitosus-marsh is a specially marine association.

B. FORMATIONS ON DRY SOIL

a. MÓLENDI (Heath)

Wherever I travelled about the Ísafjarðardjúp the mó (heath) was the most widespread formation of those with a continuous vegetation, especially around the head of the Djúp. West of Kaldalón it diminishes appreciably, and is succeeded by a formation intermediate between mýri and valllendi at the lowest levels of the slopes, while the heath holds its ground at the upper levels. The original heath-associations are:

TABLE II A.

The Mólendi (Heath) Vegetation.

Localities: 1,4,8 Laugaból 12.-7., 2,7 Melgraseyri 17.-7, 3 Ögur 7.-7., 5 Ármúli 14.7., 6,9,10 Sandeyri 23.-7. 1—2 Empetrum nigrum - Betula nana Ass., 3—7 Empetrum nigrum - Betula nana - Vaccinium uliginosum Ass., 8 Juncus trifidus - Elyna Bellardi Ass., 9 Juncus trifidus Ass., 10. Agrostis tenuis - Anthoxanthum odoratum - Carex-rigida Ass. ($10\times1/10$ m^2).

		1	2	3	4	5	6	7	8	9	10
Empetrum nigrum	Ch E4	90	90	100	90	100	100	70	60	—	—
Betula nana	Ch A2	90	50	100	100	90	40	80	—	—	—
Vaccinium uliginosum	Ch E4	—	—	70	80	100	100	100	70	—	—
Carex rigida	G A3	50	100	60	30	50	100	90	60	100	100
Juncus trifidus	H A2	50	—	—	—	20	—	—	100	100	20
Festuca rubra	H E4	90	80	—	60	—	50	60	40	40	40
— ovina	H E4	80	—	10	—	—	10	60	70	20	—
Polygonum viviparum	G A3	80	80	100	40	40	10	100	70	—	—
Thalictrum alpinum	H A2	100	80	—	60	10	—	50	90	—	—
Salix herbacea	Ch A3	—	60	40	—	—	—	60	10	—	—
Elyna Bellardi	H A3	10	—	—	—	—	—	—	100	—	—
Luzula multiflora	H E3	50	10	—	10	10	—	—	50	30	40
Equisetum arvense	G E4	—	30	—	—	—	80	—	10	10	30
Poa alpina	A A2	—	20	—	—	—	80	—	—	20	—
Anthoxanthum odoratum ..	H E3	—	—	—	—	—	—	—	—	60	70
Galium silvestre	H E1	20	—	—	10	—	—	10	50	—	20

		1	2	3	4	5	6	7	8	9	10
Carex sparsiflora	G A1	50	—	—	30	—	—	70	—	—	—
Salix glauca	Ch A3	—	50	—	—	—	10	—	—	—	—
Scirpus caespitosus	H E4	—	—	—	—	—	—	60	—	—	—
Carex capillaris	H A3	—	—	—	—	—	—	80	30	—	—
Pinguicula vulgaris	H E4	—	—	—	—	—	—	50	10	—	—
Viola palustris	H E3	—	—	—	—	—	—	—	—	50	30
Thymus serpyllum	Ch E4	—	—	—	—	—	—	—	80	—	—
Agrostis tenuis	H E2	—	—	—	—	—	—	—	—	50	100
— canina	H E3	30	—	—	—	—	—	20	30	20	10
Armeria vulgaris	Ch A3	—	10	—	—	—	—	10	—	—	—
Arctostaphylus uva ursi ..	Ch E2	10	—	—	—	—	—	—	—	—	—
Bartschia alpina	H A2	—	10	—	—	—	—	—	—	—	—
Betula pubescens	Ph E3	—	—	—	—	—	40	—	—	—	—
Carex alpina	H A2	—	—	—	—	—	—	10	—	—	—
— atrata	H A1	—	—	—	—	—	—	—	10	—	—
— microglochin	G A2	—	—	—	—	—	—	30	—	—	—
— panicea	G E3	20	—	—	—	—	—	—	—	—	—
— saxatilis	G A3	—	—	—	—	—	—	10	—	—	—
Cerastium alpinum	Ch A3	—	20	—	—	—	—	—	10	—	—
— caespitosum	Ch E3	—	—	—	—	—	—	—	—	30	—
Deschampsia flexuosa	H E3	—	—	—	30	—	—	—	—	—	—
Equisetum pratense	G E2	—	—	—	10	—	10	—	20	—	—
— variegatum	H A3	10	40	—	—	—	—	—	—	—	—
Euphrasia latifolia	Th A2	—	—	—	—	—	—	10	—	—	—
Galium verum	H E1	—	—	—	—	—	—	—	30	—	—
Gentiana nivalis	Th A2	—	—	—	—	—	—	10	—	—	—
Juncus biglumis	H A3	—	—	—	—	—	—	20	—	—	—
Luzula spicata	H A2	—	—	30	—	10	—	—	30	20	—
Pedicularis flammea	H A3	—	10	—	—	—	—	—	—	—	—
Phleum alpinum	H A2	—	—	—	—	—	—	—	—	—	20
Poa glauca	H A3	—	20	—	—	—	—	—	10	—	—
Rumex acetosa	H E3	—	—	—	—	—	—	—	—	10	20
Salix lanata	Ch A1	—	30	—	—	—	—	—	—	—	—
Selaginella selaginoides ..	Ch A1	20	—	—	—	—	—	10	30	—	20
Silene acaulis	Ch A3	—	30	20	—	10	—	10	30	—	—
Taraxacum croceum	H A2	—	—	—	10	—	—	—	—	—	—
Tofieldia palustris	H A2	—	—	—	—	—	—	10	—	—	—
Trisetum spicatum	H A3	—	—	—	—	—	—	—	—	20	—

TABLE II B

Biological Spectra of the Heath-Vegetation.

	1	2	3	4	5	6	7	8	9	10
Points sum	850	820	530	560	440	630	1090	1100	580	520
Number of species	17	19	9	13	10	12	25	25	15	13
Density of species	8,5	8,2	5,3	5,6	4,4	6,3	10,9	11,0	5,8	5,2

A	54,0	74,4	66,0	48,3	52,2	38,0	60,6	52,6	44,8	30,7
E	46,0	25,6	34,0	51,7	47,8	62,0	39,4	47,4	55,2	69,3
Ch	24,7	41,5	62,3	48,2	68,2	39,7	31,2	26,4	5,2	3,8
H	51,8	32,9	7,5	32,1	11,3	22,2	39,5	60,0	77,7	71,2
G	23,5	25,6	30,2	19,7	20,5	31,7	27,5	13,6	19,1	25,0
Ph	—	—	—	—	—	6,4	—	—	—	—
Th	—	—	—	—	—	—	1,8	—	—	—

1. ***Empetrum nigrum - Betula nana Ass.*** **(Table II, A—B, 1—2).**

In this association, which is very widespread in the heath, the characteristic species *Empetrum nigrum* and *Betula nana* dominate entirely, both in physiognomy and density. Yet the amount of Betula nana varies considerably, and it seems especially to disappear at the higher levels of the slopes. The other most common species are *Carex rigida* and *Juncus trifidus*.

No. 1 is made in the valley east of Laugaból on a flat stretch of heath with knolls of average size. There is some difference between the vegetation of the knolls and that of the hollows between. Juncus trifidus anda Betula nana are found almost exclusively on the knolls, Betula nana being nearly always on the south side. The other species of the association occur chiefly in the hollows. Moreover, *Grimmia* and *Cladonia* are rather conspicuous on the knolls.

No. 2 is made up on the Melgraseyrarháls at an altitude of c. 250 m. Local conditions are very like those of No. 1, and the physiognomy is much the same. *Betula nana,* however, is less prominent and *Juncus trifidus* is absent, whereas *Salix herbacea* is more frequent. Vegetation is scanty in the depressions. The A and Ch percentage are here strikingly higher than in the lowland analysis.

2. ***Empetrum nigrum - Betula nana - Vaccinium uliginosum Ass.*** **(Table II, A—B, 3—7).**

The main difference between this association and the previous one is the addition of Vaccinium uliginosum as a dominant species. Yet it is not quite clear, whether this is caused by any difference in conditions, except perhaps that this association is found where it is more sheltered and the soil perhaps damper than where associations 1. occurs. This is the most widely distributed association of the whole

of the heath-vegetation, both at the higher and lower levels of the mountain slopes. Yet it partly gives place to the Juncus trifidus - Elyna Bellardi association at the lower levels. There is some difference in the composition of the vegetation in the individual analyses, as is commonly the case with most formations in these parts. Consequently the percentage of the life-forms and species-groups varies somewhat. Yet on the whole it may be said that A is predominant, although E is somewhat higher here than in the previous association. In spite of this these two associations will be designated as associations of the northern species. Ch is the dominant life-form, although the H percentage is higher than the Ch percentage in one analysis.

No. 3 is made at Ögurdalur at c. 250 m. above sea-level. Empetrum is the physiognomical dominant, but Lichens play a prominent part, especially various species of Cladonia. I have hardly anywhere seen a formation more like the Scandinavian Lichen heath. The soil is shallow, dry and stony.

No. 4 is made at Laugaból. In this locality this association is predominant everywhere at 100—200 m. above the sea, increasing towards the 200 m. limit. *Betula nana* is physiognomically more dominating than *Empetrum*. Lichens are here less conspicuous than at Ögurdalur. The soil is deeper and shelter is better than at Ögurdalur. It is probable that it is not very long since the area, where this analysis is made, was covered with wood.

No. 5 is made on a flat ledge of Ármúli at an altitude of c. 275 m. (Nos. 3 and 4 are from a considerably sloping surface). The physiognomy and local conditions are in most respects similar to those at Ögurdalur, but the soil is somewhat damper, there being springs at the top of the ledge.

No. 6 is made in the mountain slope at Sandeyri at 250 m. above sea-level. Here we have a kind of transitional form between copse and heath, scattered specimens of procumbent dwarf-birches occurring here and there. I have, it is true, referred the birch to Ph in the biological spectrum, but actually it is chamaephytic. *Vaccinium* and *Empetrum* are equally conspicuous physiognomically, whereas *Betula nana* is much less abundant than in the foregoing analyses. At Sandeyri this association is very widespread at 150—200 m. above sea-level, alternating with very low-growing, stunted shrubs. Small patches of heath-vegetation occur among rubble heaps and screes up to an altitude of 350 m. The snow is rather deep and lies long all over

this slope and therefore it is rather damp. Lichens play no great part in the composition of the vegetation.

No. 7 represents a flat stretch near the sea at a short distance from Melgraseyri.The soil here is damper than is otherwise usual in the heath-formation, and the knolls likewise are smaller. In fact it is questionable whether this association should be referred to the heath-formation, because it is really an intermediate form between marsh and heath, or nearest to the jaðar-formation. On the other hand the jaðar proper is found only on the borderline between marsh and heath or as small patches in vast marshy stretches, but here we have to do with a continuous vegetation, and this was the deciding factor together with the physiognomy being the same as that of the heath-formation, although pure marsh-formation species such as Scirpus caespitosus are met with here.

3. ***Juncus trifidus - Elyna Bellardi Ass.*** **(Table II, A—B, 8).**

At the lower levels of the slopes up to 50 m above sea-level this association is very widespread. The characteristic species *Juncus trifidus* and *Elyna Bellardi* are dominant in physiognomy and cover by far the most ground of all species. It is worthy of note how rich in species this association is. The Ch% is low, the chamaephytes playing an unimportant part in its composition. Where this association occurs the ground is considerably inclined with small knolls. Lichens are inconspicuous. The only analysis of this association is made at Laugaból, where it is more widely distributed than in the other localities examined.

4. ***Juncus trifidus Ass.*** **(Table II, A—B, 9).**

This is properly speaking a variety of the previous association, deviating from the latter in that *Elyna Bellardi* is totally lacking. Moreover, the chamaephytes have for the most part disappeared. The analysis is made at Sandeyri, but in this part of the Snæfjallaströnd this association replaces entirely the *Juncus-Elyna* association. This must be attributed to differences in life conditions, the soil being damper and deeper, and the snow-covering deeper and more persistent than around the head of the Djúp, where the Juncus-Elyna association is most widespread. This association may partly be considered as a transitional form between the Juncus-Elyna association and the *valllendismó* or Agrostis tenuis - etc- association.

5. ***Agrostis tenuis - Anthoxanthum odoratum - Carex rigida Ass.*** **(Table II, A—B, 10).**

This association I shall term differently *valllendismó*. Here *Gramineae* together with *Carex rigida* are predominant. By far the most important species is *Agrostis tenuis,* but *Anthoxantum* is also rather conspicuous. Local conditions resemble very much those in the *Juncus*-association, but the *valllendismó,* however, is probably somewhat damper and its snow-covering deeper. Apart from this, these two associations are very intermixed , forming a mosaic pattern at the lower levels of the Snæfjallaströnd. It is questionable whether it would not be justifiable in spite of all, to look upon both as a single formation, because the difference in vegetation appears almost solely on the knolls, while in the hollows the vegetation is almost identical in both, and the knolls are generally of a considerable size.

Finally some concluding remarks on the heath-formation as a whole. At the head of Ísafjarðardjúp where there is less snow and the soil drier than on Snæfjallaströnd, the chamaephyte-associations are predominant above the 50 m. level, but are also met with below, although the Juncus trifidus - Elyna association dominates in that zone. On the Snæfjallaströnd the *Juncus* - and *Gramineae* - associations replace the *Juncus* - *Elyna* associations at the lower levels, extending considerably higher up than the Juncus - Elyna association. The chamaephyte-associations are not so continuous here as in the districts farther up the Djúp. A greater amount of moisture in the soil and a deeper snow-covering are probably the main causes, although winds from the sea may also play some part.

b. COPSE

Everywhere around Ísafjarðardjúp birch copse is widespread. It is very unequally developed and nowhere in the regions visited by me could it be called a forest except at Laugaból. Laugaból-forest attains frequently a height of 2—4 m., but the trees are stunted and many-stemmed. Mountain ashes occur sporadically among the birches. But the greater part of the copsewood does not exceed 1 m. It is, however, quite common among the low copse to come across rather tall bushes in grooves and gullies. All of the copse is stunted and frequently prostrate, ruined by grazing and pressed down and broken by the weight of the snow. The copse on Snæfjallaströnd in particular has suffered heavily from the latter. The copse is in many places

so dense that the undergrowth becomes scattered and the number of species restricted as will be described in greater detail in connection with the individual analyses. Although the copse is still widespread, there is no doubt that it used to be still more widely distributed. As a proof of this may be instanced the right of Vatnsfjörður church in 1473 to wood-cutting between Arngerðareyri and Laugaból (Dipl. Isl. V. p. 714—715), which is now entirely denuded of wood.

The birch of this copse seems mostly or entirely to be *Betula pubescens var. tortuosa Ledeb.*, which some botanists count as an independent species. In two places, at Ögur and at Sandeyri, I found a type of birch, greatly deviating from the ordinary one. Its leaves were more elongated and narrower than those of the Icelandic birch, the base gradually tapering towards the leaf-stalk, instead of being truncate or cordate.

The Forest-ground Vegetation.

Localities: 1—4 Laugaból 10.—14.-7., 5 Sandeyri 23.- 7. (10 $\times 1/10$ m^2).

		1	2	3	4	5
Vaccinium uliginosum	Ch E4	90	80	30	100	100
— Myrtillus	Ch E2	40	10	80	40	40
Empetrum nigrum	Ch E4	50	10	10	80	80
Deschampsia flexuosa	H E3	70	80	90	60	90
Carex rigida	G A3	80	—	30	20	90
Betula pubescens	Ph E3	—	—	—	—	100
Agrostis canina	H E3	60	—	10	60	—
Rubus saxatilis	H E3	50	60	10	—	—
Leontodon autumnalis	H E3	60	50	—	10	—
Geranium silvaticum	H E3	50	50	10	—	—
Festuca rubra	H E4	30	60	—	70	—
Thalictrum alpinum	H A2	40	70	50	50	—
Pyrola minor	H E4	10	30	100	—	—
Carex sparsiflora	G A1	—	70	20	40	—
Ranunculus acer	H E4	50	30	30	—	—
Anthoxanthum odoratum	H E3	—	50	10	—	—
Poa pratensis	G E4	—	20	60	—	—
Dryopteris pulchella	G E3	—	—	50	—	—
Melampyrum silvaticum	Th E2	—	—	50	—	—
Pyrola secunda	Ch E4	—	—	60	—	—
Agrostis tenuis	H E2	—	40	—	—	—
Alchemilla alpina	Ch A2	—	—	40	—	—

Betula nana	Ch A2	—	10	—	—	—
Equisetum pratense	G E2	10	20	—	10	10
Festuca ovina	H E4	—	—	—	10	—
Galium silvestre	H E1	10	10	—	10	—
— verum	H E1	30	—	—	20	—
Geum rivale	H E2	—	30	—	—	—
Juncus trifidus	H A2	20	—	—	30	—
Luzula multiflora	H E3	40	20	20	20	—
— spicata	H A2	10	—	—	—	—
Poa alpina	H A2	—	—	—	—	10
— nemoralis	H E3	—	—	30	10	—
Polygonum viviparum	G A3	20	20	—	40	—
Potentilla verna	H A2	—	10	—	—	—
Rumex acetosa	H E3	—	20	30	—	—
Salix lanata	Ch A1	—	—	—	—	40
— phylicifolia	Ch A1	—	10	10	—	—
Taraxacum croceum	H A2	—	40	20	—	—

TABLE III B.

Biological Spectra of the Forest-ground Vegetation.

	1	2	3	4	5
Points sum	830	900	810	720	560
Number of species	21	25	22	19	9
Density of species	8,3	9,0	8,1	7,2	5,6
A	21,6	25,5	16,0	30,6	25,1
E	78,4	74,5	84,0	69,4	74,9
Ch	22,9	13,3	23,5	36,1	46,4
H	63,9	72,2	50,6	48,6	17,9
G	13,2	14,4	19,8	15,3	17,9
Ph	—	—	—	—	17,9
Th	—	—	6,1	—	—

The table shows the type of undergrowth peculiar to this copse. The most common species are *Vaccinium uliginosum* and *V. Myrtillus*, particularly the former. *Empetrum nigrum, Deschampsia flexuosa,* and *Carex rigida* are conspicuous, although in varying quantities. On the other hand there are occasional species, met with in individual associations as dominants, which will be dealt with in their respective places.

The biological spectrum (Table III. B) shows high E and H percentages. This is on the whole characteristic of forest vegetation all

over the country. It is noticeable how much the life-form spectra of the forest-ground vegetation resemble those of some of the snow-patches, cf. what will be said in the following.

Nos. 1—4 are all from Laugaból-forest. Nos. 1—2 from the lower parts of the slope, but 3—4 higher up near the upper limit of the forest. Altitude c. 200 m. above sea-level.

No. 1 represents a thinly dispersed copse, with open glades everywhere between the bushes. The copse is about 2 m. high. In the glades *Empetrum nigrum* dominated, but *Vaccinium* in the copse itself. *Deschampsia flexuosa* and *Carex rigida* were very conspicuous. Flowering plants, *Geranium silvaticum, Rubus saxatilis, Leontodon autumnalis,* and *Ranunculus acer,* were very prominent.

No. 2 was made in a copse of 2—3 m. height, and a great deal denser than in No. 1. The dominant species are mostly the same as in No. 1, except that *Vacc. Myrtillus* and *Empetrum* have for the most part disappeared. This is seen in the reduced Ch percentage. The Gramineae are very dominant in physiognomy and the H% appreciably higher than in no. 1. The vegetation carpet has a rather scattered growth and a great deal of moss.

No. 3 represents a dense copse of nearly 1 m. height. The biological spectrum is much the same as in No. 1, except that Th is found here which is due to the fact that *Melampyrum silvaticum* is here among the typical species, this species being of a rather common occurrence in the forests at the head of the Djúp. Its western limit is Rauðamýri on Langadalsströnd. In addition we have here three characteristic species, *Pyrola minor, P. secunda,* and *Dryopteris pulchella.* P. secunda occurs sporadically in the copses in these parts, but the other two are quite common, although D. pulchella is not represented in the other analyses.

No. 4 is made in the vicinity of No. 3 in a copse of a similar height, but considerably more dispersed. The Ch % and A % are much higher, attaining here a maximum in the copse growth, whereas the H % is at its lowest. Therefore it seems justifiable to conclude that the higher and closer the copse is, the higher the E % and H% will be, both on the other hand decreasing, while the A % and Ch % increase, where the copse is of low growth and scattered.

No. 5 is made at Sandeyri at an altitude of c. 200 m. above sea-level. The table shows clearly the bottom vegetation in the decumbent copse in this locality. The soil is rather damp. The copse is low, nowhere

exceeding 40—50 cm., and frequently even less. All the shoots are prostrate, often becoming rather long, 1 m. or even more. The birch is very slender with small leaves, and all of the *var. tortuosa* type. Occasionally, however, the hybrid *Betula nana* x *B. pubescens* is met with.

The copse is so law that any actual undergrowth is out of the question. As the table shows I have included the birch in the circling results, which is inevitable, because it stands here in the same relation to the surrounding vegetation as *Betula nana* in the heath-vegetation. On the other hand it is doubtful, whether the birch should be regarded as phanerophytic, although I have done so. It comes here much nearer to being chamaephytic, and therefore this formation should properly be referred to the heath-vegetation. I have, however, decided rather to refer it to the copse, both because it is customary in Iceland to do so, and because here we have most of the typical species of the copse vegetation, but it is conspicuous, how much fewer the species are than is otherwise the rule for copse vegetation, and the H % lower. The biological spectrum corresponds most nearly to the heath-vegetation spectra. It remains to be said that this analysis is a sample of the most low-growing birch-vegetation to be found on mountain slopes with a deep and constant snow-covering in the most out-lying parts of Iceland.

Finally, mention must be made of the fact, that in the analyses I have made, one of the characteristic species of the Vestfirðir-copse has not appeared, this being *Lycopodium annotinum* which is very conspicuous in some places.

c. SNOWPATCHES

Wherever snow lies abnormally long on the ground, being likewise deep, it gives rise to a special vegetation. In many parts of the country, however, this does no appear until we reach a considerable height above sea-level. On the other hand I have seen an unmistakable snow-patch vegetation just above sea-level on Melrakkaslétta and the same applies to Ísafjarðardjúp. Mölholm Hansen describes this type of formation in his work Studies etc., terming it *geiri*. I have also described it in some detail in my paper on Melrakkaslétta. In the snow-patches around Ísafjarðardjúp I investigated four associations.

TABLE IV A.

The Snow-patch Vegetation.

Localities: 1,4 Laugaból 10.-7., 2, 3, 7 Melgraseyri 17.-7., 5—6 Sandeyri 23.-7. 1—2 Vaccinium-Empetrum nigrum Ass., 3 Alchemilla alpina Ass. 4—5 Nardus stricta-Anthoxanthum Ass., 6—7 Salix herbacea- Gnaphalium supinum Ass. ($10\times1/10$ m^2).

		1	2	3	4	5	6	7
Vaccinium uliginosum	Ch E4	100	100	50	10	—	—	—
— Myrtillus	Ch E2	90	—	40	10	—	—	—
Deschampsia flexuosa	H E3	100	—	—	—	80	—	—
Empetrum nigrum	Ch E4	80	100	50	—	—	—	—
Nardus stricta	H E3	—	—	10	100	100	—	—
Anthoxanthum odoratum	H E3	30	—	—	100	50	—	10
Alchemilla alpina	Ch A2	40	—	100	30	—	—	—
Salix herbacea	Ch A3	60	50	40	—	10	100	100
Gnaphalium supinum	Ch A2	—	—	—	—	—	90	100
Carex rigida	G A3	50	100	40	70	90	70	40
Thalictrum alpinum	H A2	70	70	30	20	—	—	20
Polygonum viviparum	G A3	40	100	20	30	10	—	30
Festuca rubra	H E4	40	90	90	—	—	20	60
Taraxacum croceum	H A2	40	20	10	90	—	20	50
Agrostis canina	H E3	60	10	20	20	—	—	10
Sibbaldia procumbens	Ch A2	—	—	—	—	—	60	70
Equisetum pratense	G E2	50	—	—	—	—	—	—
Luzula multiflora	H E3	10	—	—	30	60	—	—
Leontodon autumnalis	H E3	10	—	—	60	—	—	—
Galium silvestre	H E1	10	—	60	—	—	—	—
— verum	H E2	—	—	50	—	—	—	—
Carex sparsiflora	G A1	10	50	—	40	—	—	—
Eriophorum polystachium	G E4	—	—	—	50	20	—	—
Agrostis tenuis	H E2	—	—	—	—	20	—	—
Alchemilla minor	H E4	—	—	20	30	—	20	10
Betula nana	Ch A2	—	—	10	—	—	—	—
Carex alpina	H A2	—	—	20	—	—	—	—
— lagopina	H A2	—	—	—	—	—	20	10
Cassiope hypnoides	Ch A2	—	—	—	—	—	—	10
Cerastium alpinum	Ch A3	—	—	20	—	—	—	—
Deschampsia alpina	H A2	—	—	—	—	—	40	—
Draba incana	H A2	—	—	30	—	—	—	—
Elyna Bellardi	H A3	10	—	10	—	—	—	—
Epilobium anagallidifolium	H A2	—	—	—	—	—	10	40
Equisetum palustre	G E2	—	—	—	—	20	—	—
Geranium silvaticum	H E3	—	—	10	—	—	—	—

			1	2	3	4	5	6	7
Juncus filiformis	G	E3	—	—	—	—	—	10	—
— trifidus	H	A2	30	—	30	—	—	—	—
Listera cordata	G	A1	—	—	—	—	10	—	—
Lycopodium selago	Ch	E4	—	—	—	—	—	—	20
Luzula spicata	H	A2	—	—	10	—	—	—	—
Phleum alpinum	H	A2	—	—	—	—	—	20	—
Poa alpina	H	A2	—	—	30	—	—	30	20
Potentilla verna	H	A2	—	—	20	—	—	—	10
Pyrola minor	H	E4	—	—	—	—	—	—	20
Ranunculus acer	H	E4	—	—	10	—	—	—	—
Salix glauca	Ch	A3	—	20	—	—	—	—	—
Silene acaulis	Ch	A3	—	—	20	—	—	—	—
Veronica alpina	H	A2	—	—	—	—	—	40	10
— fruticans	Ch	A2	—	—	70	—	—	—	—
Viola palustris	H	E3	20	—	—	10	—	—	—

TABLE IV B.

Biological Spectra of the Snow-patch Vegetation.

	1	2	3	4	5	6	7
Points sum	950	710	920	700	470	550	640
Number of Species	21	11	28	16	11	14	19
Density of Species	9,5	7,1	9,2	7,0	4,7	5,5	6,4
A	36,8	57,7	55,4	40,0	25,5	90,9	79,7
E	63,2	42,3	44,6	60,0	74,5	9,1	20,3
Ch	38,9	38,0	43,5	7,2	2,1	45,5	46,9
H	45,3	26,8	50,0	65,7	66,0	40,0	42,2
G	15,8	35,2	6,4	27,1	31,9	14,5	10,9

1. *Vaccinium - Empetrum nigrum Ass.* **(Table IV, A—B, 1—2).**

The dominant species here are *Vaccinium uliginosum, Empetrum nigrum,* and in some places *Vaccinium Myrtillus.* This association is widespread in snow-patches at the lower levels of the slopes, especially up the Djúp, and it is also met with at a considerable height. *Deschamsia flexuosa* is often prominent in this association, usually in company with *Vaccinium Myrtillus.* It is remarkable in regard to both composition of species and biological spectra, how much this association resembles the undergrowth of the copse, the long-lasting snow-covering appearing to afford similar conditions as the copse.

Tis association is always found in the steepest part of the snow-patch slope, but above and below it is replaced by other associations.

Thus it is never met with where the snow is of greatest depth or longest duration, cf. fig 1.

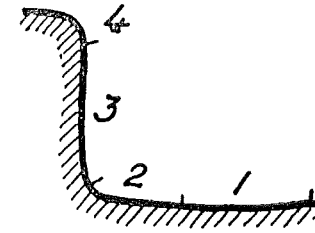

Fig. 1. — 1—2 bottom and 3—4 side of a snow-patch. 1 Alchemilla alpina Ass. (Table IV 3), 2 Mixed Associations, 3 Vaccinium - Empetrum Ass. (Table IV 2), 4 Betula pubescens copse.

No. 1 is from Laugaból. The snow-patch slope has a south western exposure. Above the Vaccinium association there is an *Alch. alpina association,* abutting, in turn, on a gravelly flat.

No. 2 is from Melgraseyrarháls at a height of c. 200 m. Here Vaccinium Myrtillus and Deschampsia flexuosa are absent, these species being very rare here at such an altitude.

2. Alchemilla alpina Ass. (Table IV, A—B, 3).

In this association Alch. alpina is the dominant species. The only analysis representing it is from Melgraseyrarháls, and fig. 1 shows the relative distribution of the associations in the snow-patch. The snow-patch, in which the analysis is made, has been formed by a low ledge above, caused by solifluction, the bottom being practically level. Along the upper edge of the slope is a low birch-copse, cut of above on a level with the ledge. On the side of the snow-patch, which is very steep, we find the *Vaccinium - Empetrum association,* and here analysis IV. 2 is made, but the Alchemilla association covers the bottom. In zone 2 there is a mixed vegetation of both associations, with scattered specimens of Nardus, without a pure *Nardus-association* being developed. Here, as elsewhere, it is seen that the Alchemilla-association develops only in that part of the snow-patch where the layer of snow begins to get thinner. But this snow-patch is all so shallow, that snow can hardly lie very long here. The relative distribution of these two associations is in very good agreement with that of the same associations on Melrakkaslétta.

3. Nardus stricta - Anthoxanthum odoratum Ass. (Table IV, A—B, 4—5).

This association is found on the bottom of the snow-patches in the lower parts of the slopes, being particularly of common occurrence

on the Snæfjallaströnd. The soil is always damp, and this association often passes over into marsh-vegetation beneath the snow-patch. *Nardus stricta* dominates entirely in physiognomy, occupying most ground of all the species. Anthoxanthum also shows great frequensy, but it always covers less ground. Then the frequency of the Deschampsia flexuosa is often rather great. The diagram, fig. 2, represents the relation of this association to the other associations in the snowpatch where analysis 4 is made. This snow-patch is in a groove, formed by a brook, with a southern exposure. Next to the bed of the

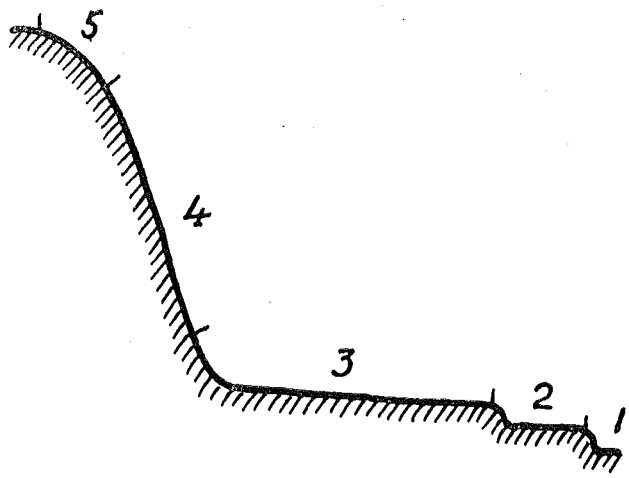

Fig. 2 — 1 Bed of a brook, 2 Eriophorum - Scirpus. Ass., 3 Nardus - Anthoxanthum Ass. (Table IV 4), 4 Vaccinium - Empetrum Ass., 5 Betula nana Ass.

brook (1) is a narrow strip of marsh where *Eriophorum polystachium* and *Scirpus caespitosus* are the dominant species, adjoined by the Nardus association, but higher up the slope the Vaccinium - Empetrum association is found as usual.

No. 5 is from Sandeyri. The arrangement here is similar, except that the shrubby growth at the upper margin of the slope is absent. It is noticeable how high the E % of this association is.

4. Salix herbacea — Gnaphalium supinum Ass. **(Table IV. A—B, 6—7).**

When we come higher up the mountain slopes and the snow lies till late in spring, this association becomes predominant in the snow-patches. Then there is often little vegetation round the snow

patches. The main species is *Salix herbacea,* although *Gnaphalium supinum* is likewise rather prominent. Other species are scattered, although of rather great frequency. Next after these two species we usually have *Sibbaldia procumbens,* which is sometimes quite prominent physiognomically. The biological spectrum shows a very high A %, but the Ch % also attains here a maximum in the snow-patches.

No. 6 is from Sandeyri at an altitude of c. 120 m. The snow evidently lies long here. The analysis is made on the side of the snow-patch, but the bottom is wet, approximating most nearly to the dý-vegetation with cushions of *Philonotis* and very dispersed phanerogams.

No. 7 is from Melgraseyrarháls c. 270 m. above sea-level. It is noticeable how much farther down the slopes the snow-patch extends on the Snæfjallströnd than farther up the Djúp, which must solely be due to a deeper and more persistent snow-covering.

About the snow-patch vegetation as a whole this may be said. At the lower levels of the mountain slopes the Vaccinium - Empetrum and Alch. alpina associations are most widespread where the ground is dry, but in the damper snow-patches the Nardus association is often met with at the bottom. In the upper marginal zone Betula shrubs are often found. At the higher levels, where the snow is deep and lies long the Salix herbacea association dominates almost exclusively, with this modification, however, that where the snow lies longest, the phanerogam vegetation disappears mostly or completely, being replaced by an *Anthelia*-crust.

Peculiar to the snow-patches on the Snæfjallaströnd are the fern-thickets, *Athyrium alpestre* being almost the sole type. *Blechnum spicant* is not infrequent here and *Dryopteris filix mas* and *D. austriaca* are also found. Athyrium either covers the whole of the bottom or forms a circular belt around the snow-patch where sides and bottom meet.

d. MELUR (Gravelly Flat) AND MOSAPEMBA (Grimmia Heath)

Before we leave the dry-ground vegetation I want to say a few words about the gravelly flats and Grimmia heath, although there are no circling results at hand, to be compared with other formations. Of the gravelly-flat formation proper there are no extensive tracts

at the lower levels, but up on the mountains the formations consist almost exclusively of gravelly flats or débris-covered tracts. Near the mountain edges in particular large formations of rocky boulders, caused by solifluction, are very prominent, with a very scanty vegetation, except in sheltered places, and then mainly of the snow-patch type. On loose gravelly flats in the lowland *Papaver radicatum* is the typical species and frequently almost the only species met with. But where the soil is more firm, most of the same species as those of the heath vegetation are found. The following occur: *Empetrum nigrum, Salix herbacea, Carex rigida, Armeria vulgaris, Thymus serpyllum, Festuca ovina, Poa alpina, Cerastium alpinum, etc.* All these are hardy species and most of them belong to the northern species-group. Many of these same species grow in the Grimmia heath, wherever it occurs, but apart from these it is mainly the *Grimmia hypnoides* that determine its physiognomy. The Grimmia heath is not common and most frequently only in small patches. It occurs chiefly on the lower ridges. On the rock débris up on the mountains there are frequently large quantities of lichens, which I have not had determined. Thus it is, for instance, up on the Ármúli mountain.

The following plant list is from the mountain above Sandeyri at an altitude of 480—550 m. It is covered by masses of débris, appearing bare of vegetation at a distance.

Arabis alpina, Carex rigida, Cassiope hypnoides, Cerastium alpinum, Dryas octopetala, Deschampsia alpina, Equisetum arvense, Empetrum nigrum, Festuca ovina, Gnaphalium supinum, Juncus trifidus, Luzula arcuata, Luzula spicata, Oxyria digyna, Papaver radicatum, Poa alpina, P. glauca, Polygonum viviparum, Salix glauca, S. herbacea, Saxifraga groenlandica, S. nivalis, Sibbaldia procumbens, Silene acaulis, Taraxacum sp., Thymus serpyllum, Veronica alpina, Rhodiola rosea.

C. SEA SHORE VEGETATION

Running along the shore there is usually a level, flat strip of land, originally ancient, overgrown gravel-banks. The layer of soil is thin and dry and no doubt exposed to sea-spray when the wind blows from the sea. Viewed from a distance this strip of land has the appear-

ance of valllendi (grassland) vegetation, grass-like plants being dominant here, and shrubby plants rarely occurring, with the exception of *Salix herbacea,* which, however, is so dwarfish, that nowhere does is affect the physiognomy. A very similar type of vegetation has been described by me in my paper on Melrakkaslétta, where this formation is termed "Strandvoldenes Vegetation".

TABLE V A.

The Sea shore Vegetation.

Localities: 1 Ögur 7.-7., 2-3,6 Laugaból 12.-7., 4,7 Melgraseyri 18.-7., 5 Sandeyri 23.-7. ($10 \times 1/10$ m^2).

		1	2	3	4	5	6	7
Festuca rubra	H E4	60	100	50	70	—	10	100
— ovina	H E4	70	—	80	80	70	—	—
Carex rigida	G A3	40	50	80	90	—	—	—
Polygonum viviparum	G A3	—	100	100	100	—	—	—
Plantago maritima	H E4	—	70	30	10	—	100	10
Leontodon autumnalis	H E3	—	100	90	—	—	—	—
Salix herbacea	Ch A3	—	10	40	100	—	—	—
Elyna Bellardi	H A3	—	—	100	10	—	—	—
Thalictrum alpinum	H A2	—	—	100	—	—	—	—
Thymus serpyllum	Ch E4	—	—	10	—	100	—	—
Juncus trifidus	H A2	—	—	—	—	100	—	—
Puccinellia maritima	H E3	—	—	—	—	—	100	—
Poa alpina	H A2	90	—	—	—	—	—	—
Cerastium alpinum	Ch A3	70	—	—	—	—	—	—
Potentilla anserina	H E4	50	—	—	—	—	—	60
— verna	H A2	—	—	70	—	—	—	—
Juncus balticus	G A1	—	—	—	90	—	—	—
Parnassia palustris	H E2	—	—	—	90	—	—	—
Armeria vulgaris	Ch A3	30	—	20	10	—	60	10
Luzula spicata	H A2	20	—	—	—	60	—	—
Galium silvestre	H E1	10	—	10	—	60	—	—
Poa pratensis	G E4	—	—	—	50	—	—	—
Carex glareosa	H A3	—	—	—	50	—	—	—
Agrostis alba	H E3	—	40	30	—	10	—	—
— canina	H E3	—	—	10	—	—	—	—
Betula nana	Ch A2	—	—	—	30	—	—	—
Botrychium lunaria	G E4	10	—	—	—	—	—	—
Calamagrostis neglecta	H E4	—	—	—	40	—	—	—
Carex incurva	G A3	40	—	—	30	—	—	—
— sparsiflora	G A1	40	—	—	30	—	—	—
Cerastium caespitosum	Ch E3	10	—	—	—	10	—	—

			1	2	3	4	5	6	7
Draba incana	H	A2	10	—	—	—	—	—	—
Elymus arenarius	G	E4	—	—	—	—	—	—	10
Equisetum arvense	G	E4	—	20	—	10	30	—	—
— variegatum	H	A3	—	—	20	40	—	—	—
Euphrasia latifolia	Th	A2	—	40	30	30	—	—	—
Luzula multiflora	H	E3	10	—	—	20	—	—	—
Pinguicula vulgaris	H	E4	—	20	—	10	—	—	—
Poa glauca	H	A3	—	—	—	—	30	—	—
Rhinanthus crista-galli	Th	E2	—	20	20	10	—	—	—
Rumex acetosa	H	E3	—	—	—	—	10	—	—
Saxifraga groenlandica	Ch	A3	—	—	—	—	10	—	—
Silene acaulis	Ch	A3	—	—	—	—	10	—	—
Stellaria crassifolia	H	A1	—	—	—	—	—	10	—
Taraxacum croceum	H	A2	—	10	—	—	—	—	—
Trisetum spicatum	H	A3	—	—	—	—	10	—	—
Vaccinium uliginosum	Ch	E4	—	—	—	10	—	—	—
Viola palustris	H	E3	—	30	—	—	—	—	—
Viscaria alpina	H	A2	—	—	—	—	10	—	—

TABLE V B.

Biological Spectra of the Sea shore Vegetation.

	1	2	3	4	5	6	7
Points sum	560	610	890	1010	520	280	190
Number of species	15	13	18	23	14	5	5
Density of species	5,6	6,1	8,9	10,1	5,2	2,8	1,9
A	60,7	34,4	63,0	59,5	44,2	25,0	5,3
E	39,3	65,6	37,0	40,5	55,8	75,0	94,7
Ch	19,6	1,6	7,8	13,9	25,0	21,4	5,3
H	57,2	60,7	66,3	42,6	69,2	78,6	94,7
G	23,2	27,9	20,3	39,6	5.8	—	—
Th	—	9,8	5,6	3,9	—	—	—

Table V. A—B 1—5 shows the composition of the vegetation on this coastal strip. No. 1 is from Ögur, 2—3 from Laugaból, 4 from Melgraseyri, and 5 from Sandeyri.

As the table clearly indicates, the composition of the species is somewhat variable, so that I have not found it possible to speak here about distinct associations. The biological spectrum is likewise rather variable, although it is difficult to demonstrate any essential difference in life conditions. A somewhat exceptional position, however, is occupied by Nos. 2—3, which are situated close together and require a more detailed description. The difference in local condi-

tions is this that 2 is made on a flat stretch, while 3 is from a low elevation close by. The greatest difference with regard to species appears in the circumstance that in 3 *Festuca ovina, Elyna Bellardi, Thalictrum alpinum,* and *Potentilla verna* are all among the dominants, whereas they are totally absent in 2. On the other hand *Festuca rubra* and *Plantago maritima* are much more common in 2 than in 3. In the biological spectrum the most remarkable thing is that the A % and Ch % are much higher in 3 than in 2. I think that this difference is due to the fact that locality 3 is much more exposed than 2, the plants therefore being less protected from wind and cold.

No. 6 is from a shallow depression down by the sea, which is flooded by sea-water. Here we have a type of formation, which is termed *fit* in Icelandic and „Strandeng" in Danish. The analysis is made at Laugaból. The main species is *Puccinellia maritima,* but *Plantago maritima* shows equal frequency, although covering less of the surface. This type of vegetation is met with here and there, but always in small patches just above the high-water mark. I have also described it in some detail in my paper on Æðey.

Finally sand-beach vegetation is described in *no. 7.* This analysis is made on a level stretch of sand just above the true beach at Melgraseyri. There is some drift-sand here and the vegetation is not continuous, although it mostly gives the appearance of continuity at a distance. The main species is *Festuca rubra var. arenaria.* The beach-vegetation proper I did not investigate except in Æðey, and shall therefore refer the reader to my paper on Æðey. But, apart from this, there is little beach-vegetation round the head of the Djúp.

In the preceding sections an account has been given of the main types of formation to be found at Ísafjarðardjúp. As has already been stated this is not a general description but only a description of types, which, however, I hope will contribute something to our knowledge and understanding of the vegetation of this country as a whole, showing primarily, how difficult it is from the investigation of particular districts to draw conclusions about the vegetation of the country in general.

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