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TECHNICAL PROGRESS REPORT
OF
BIOLOGICAL RESEARCH ON
THE VOLCANIC ISLAND SURTSEY AND ENVIRONMENT
FOR THE YEAR 1971

Submitted to
Division of Biology and Medicine
U.S. Atomic Energy Commission
Washington 25, D.C.

CONTRACT NO: AT(11-1)-3521

The study involves the terrestrial biological research on the volcanic island, Surtsey, off the coast of Iceland, according to Contract No. AT(11-1)-3521.

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According to the Research Proposal for the year 1971, the project involves a study of dispersal, colonization and ecological succession of terrestrial plants and animals on the volcanic island of Surtsey off the shore of Iceland and its environs.

As indicated in previous reports, a general research program was organized by the Surtsey Research Society covering various fields of geology and biology.

The research dealing with the terrestrial biota on Surtsey and its environs has been financed by the U.S. Atomic Energy Commission.

The research work carried out during the summer of 1971 proceeded along the same general lines as that of previous summers with regular observations during the summer months. Two guards stayed permanently on the island during the summer and took care of the meteorological recordings. Several students of biology made frequent trips to Surtsey and recorded biological events and collected samples. In addition, expeditions to Surtsey and the environs as well as to the nunataks were made for special studies.

The results are annually published in the "Surtsey Research Progress Report" of which five volumes have been issued. The latest report, Volume VI, is being published and is sent along with this progressreport. In addition, a number of special articles have appeared in various journals or are in preparation.

In general the research in 1971 was carried out as follows:

MICROBIOLOGY

The following scientists have been connected with various fields of the microbiological study on Surtsey:

Prof. Tomas D. Brock, Department of Microbiology
Indiana University, Bloomington, Indiana, U.S.A.

Prof. Dr. W. Schwartz, Institut für Molekular
Biologie, Biochemie und Biophysik, 3301 Stockheim,
Germany, who has been most interested in autotrophic
bacteria of the soil.

Dr. G. H. Schwabe, Max-Planck Institut für
Limnologie, 232 Plön, Germany, who has studied the micro-
flora of the two main craters on Surtsey.

MOSES AND LICHEN

Mosses have been studied by Mr. Bergthor Johannsson,
M.Sc., of the Icelandic Institute of Natural History,
Reykjavik, Iceland.

The distribution of moss on Surtsey was recorded
by students of biology as well as some of the visitors.
A report on the moss for the year 1971 is given in
Appendix III. The lichen have been studied by Hördur Krist-
insson, Akureyri, Iceland.

VASCULAR PLANTS

The studies of vascular flora were performed by
Sturla Fridriksson, Ph.D., Agricultural Research Institute,
Reykjavik, as well as by the biology students working
as assistants.

Records were kept of seeds and other plant parts that drifted to Surtsey. (Appendix II).

All higher plants that started growing during the summer of 1971 were counted and staked out. They numbered 77 and most were of the species Minuartia peploides, (Syn. Honckenya peploides), Cochlearia officinalis and a few were of Elymus arenarius and Stellaria media. (Appendix I).

The vegetations of selected areas on the adjacent mainland have been investigated to compare their climax communities and various successions in habitats which are similar to those found on Surtsey. Thus studies were carried out on the cliffs at Vík in Mýrdalur on the southern shore of Iceland. A list of plants in the various communities is given in Appendix III.

ENTOMOLOGY

The recording of insects found on Surtsey was continued during the summer 1971 by the guards stationed on the island. The entomological work was directed by Professor Carl H. Lindroth, Zoological Institute, University of Lund, Lund, Sweden. A list of collembola from this study is given in Appendix IV.

VERTEBRATES

The ornithological studies were directed by Dr. Finnur Gudmundsson, Head of the Zoological Department, the Icelandic Institute of Natural History, Reykjavik.

The migration of birds was recorded in the autumn of 1971. Two bird collectors were stationed on the island in September. They collected stray birds and birds migrating from Iceland back to Europe. (Appendix VI).

The opportunity was used for investigating the role played by birds in the dispersal of living diaspores. From the gizzard of two barnacle geese which were caught in Surtsey a collection of seed was obtained. These seed are being identified and tested for germination ability.

METEOROLOGY

The meteorological study was supervised by Hlynur Sigtryggsson, Director of the Icelandic Bureau of Meteorology, Reykjavik. Daily observations were carried out by the guards at the field station.

SOIL

Further investigation on the substrate were carried out. Such as the consolidation and palagonitization of the tephra which was studied by Sveinn Jakobsson.(Appendix V).

CONFERENCES

A symposium on the terrestrial life of Surtsey was held at the University of Lund, Sweden during 24th to 28th of September 1971. The participants were the Swedish entomologists, with professor Carl H. Lindroth as a director, Dr. G.H. Schwabe from Plön, Germany, Dr. Hörður Kristinsson, lichenologist from Akureyri and the principal investigator, Dr. Sturla Fridriksson. (Appendix VIII)

During March 28th to 31st Sturla Fridriksson attended an International Geobotanical Congress at Rinteln Germany. He reported on the Surtsey study and showed a color movie on Surtsey.

APPENDIX I.

Vegetation Studies on Surtsey in 1971.

by

Bjartmar Sveinbjörnsson, Skúli Magnússon
and Sturla Fridriksson.

Introduction:

The study of moss and vascular plants on Surtsey commenced on 8th June. During the first trip it was only possible to investigate the few plants that had over-wintered.

The second trip to Surtsey commenced on 22nd June and lasted five days. The time was employed to look for plants that had started growth during the summer of 1971, and these were marked with a stake. A total of 40 plants were discovered, of which two were new. Individuals of Cakile maritima and Cochlearia officinalis were flowering.

The third trip lasted from 15th to 23rd July. Plants were again looked for and marked, the number reaching 57. Some^{of} these were Cochlearia officinalis plants growing by the water container. On this trip a liverwort was found on the island for the first time, in a cave in the lava to the south. The Cakile maritima was already bearing pods, and the Cochlearia officinalis had begun to dehisce. A further individual of Elymus arenarius was discovered.

The fourth trip was from 5th to 12th August. Seven new vascular plants were found, 5 of these growing on the shoreline behind the boulders on the north-western part of the island. Two of these were

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

CHLARIA OFFICINALIS

- **STOPTERIS FRAGILIS**
- **ELYMUS ARENARIUS**
- **HONCKENYA PELOIDES**
- **STELLARIA MEDIA**
- **UNIDENTIFIED SPECIES**
- **BRYOPHYTA**

A
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SURTSEY
1971

Surtsey August 1971

Photo: Skuli Magnusson

grasses, probably Elymus. All 5 plants were destroyed later in violent surf that occurred on August 8th. The sea flooded over the reef northwest of Bólfell, coming from the northwest. The northern part of the island was isolated, and a large lagoon formed on the airstrip running from northeast to southwest. More samples of moss were taken, probably new species. Between 18th August and 3rd September one of us, (Magnusson), remained on the island. In a detailed search for mosses in the lava he found still more individuals of vascular plants, including Stellaria media and Elymus plants as well as a fern, very probably Cystopteris fragilis, which was growing in the roof of a cave. At least one new moss species L Encalypta sp. was found with capsules.

The Vegetation

An unusually large percentage of vascular plants survived the winter of 1970 to 1971, or 40 of 75, compared with 18 of 63 in the previous summer. There are doubtless many reasons for this. One is that in the summer of 1970 no plants grew in the northernmost part of the island (in quadrats A, B and C), which is flooded by the sea in winter. Moreover, the winter and spring were unusually mild, much milder than the previous year.

Altogether 85 individual vascular plants were found, definitely of 5 species and perhaps 7: 52 Honckenya peploides (syn: Minuartia peploides), 21 Cochlearia officinalis, 3 Elymus arenarius, 3 Cystopteris fragilis (probably), 2 Stellaria media, possibly two Elymus arenarius and four unidentified individuals (see plant list).

OCT 1971

Honckenya peploides, Surtsey 1971

Pl. 17. '71

OCT 1971

Honckenya peploides with fruits
on Surtsey in 1971.

OCT 1971

Chochlearia officinalis, Surtsey 1971

OCT 1971

Elymus arenarius, Surtsey 1971.

The distribution of the plants was considerably greater than in the previous year (see map). In the summer of 1969 plants grew in 17 quadrats, in 1970 in 22 quadrats, and now in 36 quadrats. The biggest increase, however, was in individual plants scattered throughout the lava, the main growing areas being the same as before, i.e., the hollows between Bólfell and Vestri Bunki, in Svartagil and between the lava and Eystri bunki.

Honckenya (Minuartia) peploides. Over 60% of the plants were of this species, or similar to last summer. Of 52 Honckenya plants, 31 are from the previous year and 14 from 1969 or earlier. Those that flowered were mostly from this group, or 4 of 5. Pods formed on some of the, but seeds did not ripen except on one plant (No.17). The accompanying graph shows the change in the number of leaves per plant per day. The continuous line shows the average growth of 10 plants in the summer, but the final observation has been omitted because many plants were then buried in sand, either completely or partially. The dotted line represents the average of all plants at a given time, so that there are considerably more plants in late summer than in early summer, and many of them are thus growing when others have ceased to grow. It can be seen from both lines, however, that the growth is greatest after the first week in July and ceases in the beginning of August.

Cochlearia officinalis. As already mentioned, 21 specimens of Cochlearia officinalis were found on Surtsey this summer, but 30 the summer before. There were 9 plants near the water container this summer, and 24 last year. The plants near the water-container had obviously been dispersed by birds that had been attracted by the drinking water. These plants were

Number of leaves of the average Honckenya peploides on Surtsey 1971.

Schematic drawing of the cave with Cystopteris fragilis growing down from its roof.

therefore removed at the same time as the containers.

The Cochlearia officinalis that are found growing in Surtsey have probably all been dispersed by birds. In some cases the plants have grown up out of bird droppings or bird carcasses, though in other cases no definite assertion can be made. Cochlearia is widely distributed over the island, much more so than Honckenya, which tends to support the above-mentioned theory of the dispersal route.

The Cochlearia flowers early, and the pods had formed already early in June, while many plants dehisced this summer. The plants varied greatly in size, forming hummocks from 1.5 to 30 cm. in diameter. The biggest was plant No. 38 in quadrat S.14 (No. 74, 1970). Observations made late in August revealed 8 seedlings that had grown up from its seeds, and more seeds were germinating.

Elymus arenarius. At least 3 plants of this species were now found on the island, possibly 5. Only one was from the previous year, No. 39 in Plot M.11 southwest of the eastern crater. There had been some doubt as to the species to which it belonged, but this was now clearly identified as Elymus and this helped to classify other plants of the same species.

There were 8 leaves on the largest plant, the greatest length per leaf being 11 cm. Each of the three Elymus plants which were definitely identified grew in separate quadrats outside the main habitat. The other two, which may have belonged to this species, grew on the old shore-line behind the boulders and were destroyed as already described. The Elymus seems to grow up from seeds dispersed by the sea, many such seeds were found drifting ashore during the summer 1971.

Cystopteris fragilis. During a detailed search for mosses in the lava three ferns were found growing down from a cave roof, and one was taken for closer investigation. This would seem to be the species Cystopteris fragilis. The plants were 2 to 3 cm long and about 0.5cm broad. They grow in sand and in the cave roof (cf. illustration).

Stellaria media. In the summer of 1970 Stellaria media was found on Surtsey for the first time. That same summer it bore seed. Two plants now grew up from this seed. During the final observation this summer they were still only seedlings and had not developed much. In addition to these two specimens, a plant was found at the bottom of a narrow cleft, which proved inaccessible for further investigation. This plant could well be a new species for the island, as it is not certain whether it belongs to the species Stellaria media or not.

Unidentified Plants. In addition to the plants that have been mentioned, a grass species was found that was not at once identified. It seems clear, however, that this is Elymus arenarius, but the grass was withered when it was found. The plant was No.76 and was found in quadrat M.15.

In extensive areas of lava, the tuff is drifting in from the tephra mounds. At first this drifting was mainly in the old lava to the west, and consisted largely of tephra from Jólnir. After the new lava flowed to the east, there has been much drifting of tuff from the mounds to the north of the lava and sandstorms are frequent, with the result that there is now sand and dust all over the lava, at any rate in its hollows. However, this is the first summer when it may be safely said that all the lava is covered with a loose substrate and this explains to some extent the increased distribution of the plants.

Plant no	Species	First route				Second route				Third route				Fourth route				Fifth route				Location
		No. of plants	No. of leaves	No. of flowers	No. of seeds	No. of plants	No. of leaves	No. of flowers	No. of seeds	No. of plants	No. of leaves	No. of flowers	No. of seeds	No. of plants	No. of leaves	No. of flowers	No. of seeds	No. of plants	No. of leaves	No. of flowers	No. of seeds	
1	Minuartia peploides	36	2	16	0	5	37	2 1/2	5	37	3 1/2	5	72	4	5	68	5	F-13				
2	Minuartia peploides	29	1	17	0	4	20	2 1/2	4	36	6 1/2	3	68	10	2	62	9	G-13				
3	Minuartia peploides	60	1	4	0	1	12	2 1/2	3	28	5 1/2	3	28	15	3	34	55	F-13				
4	Minuartia peploides	2	1	1	0	1	10	2 1/2	10	28	4 1/2	18	306	200	19	270	190	F-13				
5	Minuartia peploides	27	2	0	0	0	22	2 1/2	9	78	3 1/2	4	107	5	9	44	10	D-12				
6	Minuartia peploides	43	1	1	0	1	8	2 1/2	1	10	1	1	15	13	1	14	14	E-11				
7	Minuartia peploides	21	1	1	0	1	3	2 1/2	1	10	0.7	1	17	1.5	1	14	1	E-11				
8	Minuartia peploides	43	1	2	0	1	3	2 1/2	1	14	1.6	1	17	2.5	1	14	1	E-12				
9	Minuartia peploides	53	1	6	0	1	12	1 1/2	1	16	1.8	1	20	3	1	14	2.5	E-12				
10	Minuartia peploides	35	1	0	0	1	5	2 1/2	6	28	1.5	6	48	2.5	1	14	1	E-12				
11	Minuartia peploides	92	2	18	0	2	22	3 1/2	5	38	2.5	2	44	2.5	10	127	100	F-13				
12	Minuartia peploides	12	10	0	0	10	206	6	10	266	100	10	249	200	10	127	100	F-13				
13	Minuartia peploides	24	2	0	0	2	26	3	4	48	3.2	2	52	5	2	50	150	J-18				
14	Minuartia peploides	21	2	0	0	2	32	2 1/2	2	42	2.8	2	65	5	2	36	300	J-18				
15	Minuartia peploides	21	15	0	0	15	375	15	15	495	200	14	426	200	24	311	180	J-18				
16	Minuartia peploides	27	3	0	0	1	11	5	3	13	10.5	2	12	1	1	10	15	E-12				
17	Minuartia peploides	23	2	0	0	1	11	2	2	32	4	3	32	5 1/2	2	24	5	J-17				
18	Minuartia peploides	15	1	0	0	1	24	2	3	36	2.5	3	46	2 1/2	3	38	100	J-17				
19	Minuartia peploides	25	7	0	0	7	94	10	7	118	6.5	7	176	6.5	7	120	20	J-18				
20	Minuartia peploides	23	2	0	0	2	52	4	2	60	5.5	4	94	7 1/2	5	48	9.5	J-18				
21	Minuartia peploides	21	8	0	0	5	116	5	5	118	10.5	5	184	11	7	82	11.5	J-18				
22	Minuartia peploides	9	1	0	0	1	8	1 1/2	1	10	1.2	1	12	1	1	10	0.5	J-18				
23	Minuartia peploides	23	1	0	0	1	18	3	1	26	3.4	1	28	4.0	1	28	5	J-18				
24	Minuartia peploides	20	3	0	0	3	38	3	3	46	3.8	3	56	3	3			J-18				
25	Minuartia peploides	4	4	0	0	4	102	4	6	150	10.5	6	132	10.5	6	140	8.5	J-18				
26	Minuartia peploides	20	1	0	0	1	6	1 1/2	1	10	1.3	1	16	2.5	1	5	1.5	J-18				
27	Cochlearia officinalis	13	0	7	0	13	458	20	13	151	8	37	20.5	13	34	128		K-18				
28	Cochlearia officinalis	14	12	27	0	14	76	4	13	17	6.3	5	46	3	1	10	15	K-17				
29	Cochlearia officinalis	10	0	27	0	10	14	4	13	16	1.6	11	10	1	1			L-17				
30	Cochlearia officinalis	19	0	19	0	19	220	4	13	232	5	13	278	15.5	12	110	105	J-17				
31	Cochlearia officinalis	14	0	14	0	14	10	2.5	13	10	2.5	13	17	3.5	12	23	32.5	O-6				
32	Cochlearia officinalis	23	0	23	0	23	76	4	1	2	6.5	33	4	36.2	2	19	28	S-14				
33	Cochlearia officinalis	22	4	3	0	22	6	10	28	3	10	7	11	1	13	11		S-14				
34	Cochlearia officinalis	24	0	24	0	24	8.3	0.3	1	6	0.7	1	6	0.7	1	6	0.7	M-11				
35	Cochlearia officinalis	11	0	11	0	11	4.5	0.5	1	7	4.5	7	18	1.4	1	12	1.4	K-18				
36	Minuartia peploides	1	1	1	0	1	9	0.5	4	12	1.4	2	18	1	1	12	1	J-18				
37	Minuartia peploides	1	1	1	0	1	4	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
38	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
39	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
40	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
41	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
42	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
43	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
44	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
45	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
46	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
47	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
48	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
49	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
50	Minuartia peploides	1	1	1	0	1	5	0.5	1	14	1.5	2	30	5	1	5	13	F-13				
51	Cochlearia officinalis	10	0	10	0	10	112	4	10	112	4	10	112	4	10	112	4	D-11				
52	Cochlearia officinalis	12	0	12	0	12	112	4	12	112	4	12	112	4	12	112	4	F-13				
53	Cochlearia officinalis	4	0	4	0	4	112	4	4	112	4	4	112	4	4	112	4	S-14				
54	Cochlearia officinalis	8	0	8	0	8	112	4	8	112	4	8	112	4	8	112	4	S-14				
55	Cochlearia officinalis	3	0	3	0	3	112	4	3	112	4	3	112	4	3	112	4	S-14				
56	Cochlearia officinalis	7	0	7	0	7	112	4	7	112	4	7	112	4	7	112	4	S-14				
57	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
58	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
59	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
60	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
61	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
62	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
63	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
64	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
65	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
66	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
67	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
68	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
69	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
70	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
71	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
72	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
73	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
74	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
75	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
76	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
77	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
78	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
79	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
80	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
81	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
82	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
83	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
84	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
85	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
86	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
87	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
88	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
89	Cochlearia officinalis	1	0	1	0	1	112	4	1	112	4	1	112	4	1	112	4	S-14				
90	Cochlearia officinalis	1	0	1	0</																	

RECORDS OF PLANT PARTS FOUND DISPERSING TO SURTSEY
IN 1971 BY STURLA FRIDRIKSSON.

OCEAN DISPERSAL

The shores of Surtsey were searched rather regularly throughout the summer from June 21st to August 11th 1971 and the plant parts which were discovered were recorded but not collected.

In table 1 the results of these observations are given by listing the species, plant parts and the amount of debris and dates of discovery. The plant parts mostly drift ashore during heavy storms and high tide. In the summer 1971 there was very little debris on the shores of Surtsey, and in early August no new material drifted ashore for several days. The drift was greatest during 23-25th of June. Of the total discoveries leaves of Festuca rubra were the most common plant parts. But in late July a number of seed of Cochlearia officinalis had also drifted ashore. Parts of Tripleurospermum maritimum and Poa pratensis and Elymus arenarius were observed occasionally. All these plants are common on the neighbouring islands and skerries from where they may have drifted. Other species listed in the table were only rare dispersers.

AIR DISPERSAL

On two occasions airborne seed were discovered on Surtsey in the summer 1971.

On June 21st one seed of a Taraxacum species was found in quadrat C-15 and on August 5th nine nuts of Eriophorum species, apparently both E. Angustifolium and

E. Scheuchzeri, were found blowing along the surface of the island. These must have at least been carried from the mainland of Iceland as *Eriophorum* did not produce seed on Heimaey in 1971, and the species is not found on the smaller islands.

PLANT PARTS DIRFTED ASHORE ON SURTSEY IN 1971

SPECIES	21.6	23.6	24.6	25.6	19.7	20.7	21.7	5-8.8	23.7	11.8
<i>Elymus arenarius</i>	35 F 1 I				I (1)					L (1)
<i>Festuca rubra</i>	1 I	L (many)	L(130) I(1)	(100)L I(8)	L(60) L(1)	L(4) I(2)	L(33) I(4)		L(17) I(5)	
<i>Cochlearia officinalis</i>	2 L	2 L	L(8) I(6)	L(15) I(1)	L(6) I(4) 2 pods		L(2) I(2)		L(5),I(1) Se(40) I(1),Se(12)	L(6) I(1)
<i>Poa pratensis</i>	1 S	L(many)			L(7)	L(8)	L(4)			L(80)
<i>Calluna vulgaris</i>	1S									
<i>Achillea millefolium</i>	1 S			S(4)	S(2)					
<i>Cladonia sp.</i>										
<i>Tripleurospermum maritimum</i>			L(8)		S(1)				I(8), SE(0)	L(13)
<i>Stellaria media</i>				I(2) S(1)	I(1) Se(3)					
<i>Taraxacum sp.</i>							Se(1)			
<i>Agrostis tenuis</i> (probably)							I(1)			
<i>Cakile maritima</i>									L(1)	
<i>Armeria maritima</i>									I(1) Se(5)	

S
F
I
N
D
I
N
G
S

N
E
W

N
O

B:Branch; I:Inflorescence; L:Leaves; R:Roots; S:Stems; Se:Seeds; F:Flowers.

THE MOSSES OF SURTSEY 1971

by

Skúli Magnússon and Sturla Fridriksson

Introduction.

The moss flora of Surtsey increased greatly in number of species from the year 1969 to 1970 (Bjarnason 1972, Fridriksson 1972). The area covered with moss is gradually becoming more extensive and some of the first colonizing plants are becoming so mature that they can be easily identified. The discovery of a new moss species one year thus does not exclude the possibility that the moss had already colonized somewhat earlier, but that the species may have been overlooked as it was yet inconspicuous or that the place of growth had not been sampled.

In the summer of 1971 an extensive survey of the moss vegetation was organized throughout the island. This was done to get a clear picture of the number of species which had dispersed to the island and at the same time the distribution of each species could be marked and the areas mapped. In drawing the distribution maps it was decided to use the quadrat mesh already used for other activities on the island. The distribution of a species within a quadrat was thus a unit in the total survey.

As moss was growing vividly in some areas of the island the opportunity was also used to make some cover estimates and to study further the selective habitats of the various species.

Method of Research.

The main study during the summer 1971 was to survey the moss vegetation in each quadrat throughout the island and to take samples regularly. The procedure was such that each of the 100x100 m quadrats was searched thoroughly once during the summer, and records made of the species discovered. Samples were then taken of various moss colonies for later identification. Then the cover of the most common mosses in each quadrat was estimated and records made of the kind of habitat the colonies were occupying. The cover was measured within plots of 25x25 cm. This relatively small measuring area gives higher cover figures than expected, as the moss is yet found only in small colonies at each location and although the total distribution covers a wide area. The cover figures are therefore not a true estimate of the total cover but show the relative density in colonies of the various species.

The identification of species from the 130 samples collected was carried out during the winter 1972 and the identified species recorded for each quadrat. The species found in each quadrat were then divided into three categories according to their frequency and the respective insignia marked on the distribution map. The categories were marked and classified as follows:

- Legend: 1) - the species is common in the quadrat
2) - a few individuals of the species occur in the quadrat
3) - the species is only found once in the quadrat.

The classification method for the three categories:

- 1) The species is grouped in category 1 when it is easily observed in the quadrat although it is not necessarily abundant in any place.
- 2) The species is grouped in this category when it is relatively rare. It means that the species grows at two or a few locations in the quadrat.
- 3) Should the species be found only once in a quadrat it is grouped in category 3. This could either mean a) that the species has only been found on one occasion or b) that the distribution of the species is not clearly known because of difficulties in the identification of species in the field. Some species that otherwise have a relatively extensive distribution may fall into this class, such as Leptobryum puriforme, Cerotodon purpureus, Pohlia whalenbergii, Dichodontium pellucidum.

The total distribution of moss was marked on an aerial photograph in such a way that the contours of the moss vegetation were drawn connecting the outermost locations of the colonies. On 8 locations there were isolated colonies, which were not joined with the main distribution area.

Results.

I. The Total Distribution:

The total distribution of moss on Surtsey has increased markedly since the summer of 1970. This may be noted by comparison of the main distribution map (Map 1) for the years 1971 and that of 1970. (Fridriksson, S. et al., 1972).

The spread of growth has mainly been towards west but is hindered on the northern side by the tephra hills. The greatest increase has been on the slopes south of Surtur II, i.e., in the quadrats J6 and 8-9, K6-10, L6-9 and M6-9. In these areas the lava is rough and heavily covered with tephra or 50-90% (Fridriksson et al, 1970) and the growing conditions for moss may be considered rather poor, there are no hollows or caverns which are favourable habitats for the many moss species.

Racomitrium canescens is the dominating species. It, however, does not form a heavy cover but only small tufts here and there.

Moss was found growing in isolated colonies in quadrats J5, P6, R7, K14 and L14 far from the main moss area. These new centers are shown as islands on the map. The moss areas in J13, K12 and K13 are also kept separately as they are found in a rather special habitat of lava isolated by tephra. No moss was found in quadrat H13 where it had been discovered in 1970.

In the older areas of growth there has been a gradual increase in the spread of moss. The two Racomitrium species have especially become more conspicuous than in 1970, mainly in the rough part of the lava such as in quadrats N0, P10-15.

At the small crater in quadrats J13 and K12 there was a pronounced increase of moss growth. There the lava is still quite warm and is constantly moistened by the steam emission. The same holds for the western edge of the crater Surtur I in H8. These were one of the first "green spots" on Surtsey. In H8 there is an even cover of 15% in a large area.

In K12 the cover was, in parts, up to 60% where the steam emission was most noticeable. There the dominating species were mostly Bryum argenteum and Funaria hygrometrica at an early state of maturity.

II. Distribution of the Various Species:

A distribution map was also drawn for every species found on the island in 1971, according to the method previously described. The maps which are presented on page 25 to 44 show the number of moss species found on Surtsey in 1971 and illustrate their distribution and frequencies.

Comparison of the total moss
distribution and the lava area.
Lava in E,F 13-14 and G,H 13
omitted.

Total distribution of mosses 1971.

Species: Bryum sp.

FREQUENT SPECIES:
=====

Distribution of moss species 1971.

Species: Bryum stenotrichum

Distribution of moss species 1971.

Species: *Geratodon purpureus* (Hedw.) Brid.

Distribution of moss species 1971.

Species: *Euraria hygrometrica* Hedw.

Distribution of moss species 1971.

Species: *Racomitrium canescens* (Hedw.) Brid.

Distribution of moss species 1971.

Species: *Racomitrium lanuginosum* (Hedw.) Brid.

Distribution of moss species 1971.

Species: *Bryum argenteum* Hedw.

Distribution of moss species 1971.

RATHER FREQUENT -
=====

RATHER RARE SPECIES:
=====

Species: *Dichodontium pellucidum* (Hedw) Schimp

Distribution of moss species 1971.

Species: *Dicranella crista* (Hedw.) Schimp

Distribution of moss species 1971.

Species: *Leptobryum pyriforme* (Hedw.) Wils.

Distribution of moss species 1971.

Species: *Philonotis* sp. -----

Distribution of moss species 1971.

Species: *Pohlia cruda* (Hedw.) Lindb. -----

Distribution of moss species 1971.

Species: *Pohlia wahlenbergii* (Web. & Mohr) Andr.

Distribution of moss species 1971:

Species: *Atrichum undulatum* (Hedw) Beauv.

RARE SPECIES:
=====

Distribution of moss species 1971.

Species: *Barbula recurvirostra* (Hedw.) Dix.

Distribution of moss species 1971.

Species: *Bartramia ithyphylla* Brid.

Distribution of moss species 1971.

Species: *Bryum pallens* Sw. ---

Distribution of moss species 1971.

Species: *Campylium polygamum* (RSG) C. Jens.

Distribution of moss species 1971.

Species: *Desmoulinia uncinata* (Hedw.) Urb. et.

Distribution of moss species 1971.

Species: *Grimmia apocarpa* Hedw.

Distribution of moss species 1971.

Species: *Pogonatum urnigerum* (Hedw.) Beauv.

Distribution of moss species 1971.

Species: *Rhytidiadelphus squarrosus* (Hedw.) Warnst.

Distribution of moss species 1971.

Species: *Anomobryum filiforme* (Dicks) Husn.

VERY RARE SPECIES:

Distribution of moss species 1971.

Species: *Bryum angustirete* Kindb.

Distribution of moss species 1971.

Species: *Calliergon stramineum* ---

Distribution of moss species 1971.

Species: *Dicranella schreberiana* (Hedw.) Schimp

Distribution of moss species 1971.

Species: *Dicranella varia* (Hedw.) Schimp.

Distribution of moss species 1971.

Species: *Distichium capillaceum* (Hedw.) BSG.

Distribution of moss species 1971.

Species: *Encalypta ciliata* Hedw. ---

Distribution of moss species 1971.

Species: *Fissidens adianthoides* Hedw.

Distribution of moss species 1971.

Species: *Grimmia maritima* Turn.

Distribution of moss species 1971.

Species: *Grimmia stricta* Turn. ---

Distribution of moss species 1971.

Species: *Marchantia polyzorca* L.

Distribution of moss species 1971.

Species: *Mnium hornum* Hedw.

Distribution of moss species 1971.

Species: *Ombrophorus virens* (Hedw.) Brid.

Distribution of moss species 1971.

Species: *Pohlia annotina* (Hedw.) Loeske

Distribution of moss species 1971.

Species: *Polytrichum alpinum* Hedw.

Distribution of moss species 1971.

Species: *Polytrichum longisetum* — — —

Distribution of moss species 1971.

III. List of Species:

The total number of moss species which so far have been found growing on Surtsey are recorded in the following list. The species are grouped in four classes according to their frequency.

<u>Common Species:</u>	Number of years since discovered:	With capsules:
Bryum spp.	3	
Bryum stenotrichum	#	+
Ceratodon purpureus Hedw.	3	+
Funaria hygrometrica Hedw.	4	+
Racomitrium canescens (Hedw.)Brid.	2	+
Racomitrium lanuginosum (Hedw.)Brid.	1	
<u>Relatively Common - Rare Species:</u>		
Bryum argenteum Hedw.	4	
Dichodontium pellucidum (Hedw.) Schimp.	1	
Dicranella crispa (Hedw.)Schimp.	2	+
Leptobryum pyriforme (Hedw.)Wils.	2	+
Philonotis sp.	1	
Pohlia cruda (Hedw.)Lindb.	3	
Pohlia wahlenbergii (Web.&Mohr.)Andr.	1	
<u>Rare Species:</u>		
Atrichum undulatum (Hedw.)Beauv.	1	
Barbula recurvirostra (Hedw.)Dix	#	
Bartramia ithyphylla Brid.	#	
Bryum pallens Sw.	1	
Campylium polygamum(B.S.G.)C.Jens.	#	
Drepanocladus uncinatus (Hedw.)Warnst.	1	
Grimmia apocarpa Hedw.	#	
Pogonatum urnigerum (Hedw.)Beauv.	2	
Rhytidiadelphus squarrosus (Hedw.)Warnst.	#	

Number of years With
since discovered: capsules:

Very Rare Species:

Anomobryum filiforme (Dicks.)Husn	#	
Bryum anquistirete Kindb.	#	
Calliargon stramineum (Brid.)Kindb.	#	+
Dicranella schreberiana (Hedw.)Schirnp	#	
Distichium capillaceum Hedw.B.S.G.	#	
Encalypta ciliata Hedw.	#	+
Fissidens adianthoides Hedw.	#	
Grimmia maritima Turn.	#	
Grimmia stricta Turn.	#	
Marchantia polymorpha L.	#	
Mnium hornum Hedw.	#	
Onchophorus virens (Hedw.)Brid.	#	
Pohlia annotina Hedw.Loeske	#	
Polytrichum alpinum Hedw.	#	
Polytrichum longisetum Brid.	#	

Classification into the four groups is based on the following criteria:

Common Species: In this group are species which are found in many quadrats, i.e., 25 or more. An exception to this is Bryum stenotrichum, which is included in this class although it is only shown to be found in four quadrats on the map. It is, however, rather certain that it is widely spread over quadrats N-S. But it is difficult to prove as the species can not be identified clearly unless it has capsules. These have only been developed on the moss in the four quadrats. A few Bryum species are classified in this group but the distribution of Bryum which is shown on the map includes probably two to four species one of which is B. stenotrichum.

Relatively Common - Rare Species: In this group are species found in 5 to 25 quadrats and which have, in one of these quadrats, reached the frequency of being classified with the quadrat mark no. 2. An exception is Bryum argenteum which was given the quadrat mark no.2 in two quadrats. Species in this group were all found before 1971.

Rare Species: In this group are species found in 2 to 5 quadrats and only once in each. In this group are both new and old species.

Very Rare Species: In this group are species which have only been found at one location. These were also new to the island in 1971.

In the list for 1971, all new species are marked with an asterik but for the older species it is noted how many years have passed since it was first discovered on the island. A comparison of the lists of moss species found on Surtsey in the years 1970 and 1971 reveals the great increase in species during this last year as the total number has increased from 16 to 33. (Bryum ssp. and Philonotis are not included). In the summer of 1971 twenty new species were discovered but three older species were not re-discovered. These were Bryum pallens sw., Brachythecium salebrosum (Web.&Mohr) B.S.G. and Anogstroemia longipes (Sommerf.) B.S.G. It is, however, likely that Bryum pallens is present in some of the samples which could not be identified as it lacked capsules.

The moss which is colonizing Surtsey is gradually developing in the new habitat and reaching maturity. Thus more and more species are bearing capsules.

In 1970 capsules were observed on only three species, i.e., Funaria hygrometrica, Ceratodon purpureus and Dicranella crispa. In 1971 immature capsules were also found on the following species: Racomitrium canescens, Bryum stenotrichum, B. angustifolium, Leptobryum pyriforme and Encalypta ciliata.

The first liverwort to be discovered on Surtsey was found during the summer 1971. It was the species Marchantia polymorpha and it had developed gemmae.

By comparing the various species according to their frequency and the number of years since they were first discovered it is possible to get some indication of the growth conditions and the dispersing ability of the species. As an example one year has passed since R. lanuginosum was first discovered and it has already obtained such a wide distribution that it is now considered common the island. The species may thus be considered to have favourable growth conditions and good ability for spreading. The species Bryum argenteum has relatively limited distribution and slow dispersal rate considering the fact that it was first discovered 4 years ago. The species is restricted to a rather specific habitat as it grows only on tephra moistened by the hot vapour which in places is ejected from the lava. The species Pogonatum urnigerum was first found 2 years ago but has been discovered at only four locations. Its rate of spreading may thus be considered rather slow.

IV. Cover: It was rather difficult to estimate the cover of single species. This was, however, attempted in regard to Racomitrium and Funaria hygrometrica which have the most extensive coverage.

The maximum cover for these species in various quadrats are presented below:

Racomitrium spp.:

Quadrat	H-9	P-16	L-12	M-12	L-16	N-16	O-16	O-15
Cover %	8-10	10	30	50-60	10	50-60	15	15

Quadrat	P-15	Q-16	Q-14	R-15	O-11	N-13	N-9	N-8
Cover %	30	10	35-40	35	50	10-15	50-60	25

Funaria hygrometrica:

Quadrat	N-7	N-15	Q-10	R-10	S-10	S-12	S-8	T-10	T11
Cover %	5	10	90-95	50	50	30	25	2	5

The cover of Bryum species, and other species less abundant, was not recorded separately. The cover of these, including also Funaria hygrometrica, is presented as follows:

Funaria hygrometrica; Bryum spp. and other species:

Quadrat	I-10	K-12	L-12	M-7	N-6	O-6	O-7	O-16
Cover%	10-20	60	60-70	5	10	1	5	10-15

Quadrat	P-8	P-10	P-15	P-16	Q-8	Q-15	Q-16	R-9
Cover %	15	70-80	40	10	10	35	2-4	10

Cover	R-11	R-13	S-11	S-13	T-11	T-12
Cover %	85-90	3-5	85-90	6-7	30	1

V. Habitats:

The various habitats were described previously by Bjarnason et al. (1969). Some of the moss species are restricted to selective habitats, others have a wider distribution and are found on various substrates. This may, to some extent, be observed by comparing the various distribution maps with maps of substrates and thermal areas.

The tendency of species to inhabit special substrates and to colonize with other moss species or lichens in associations has been investigated and will be continued in the following years.

VI. Acknowledgements:

The authors are indebted to Bergthor Johannsson of the Institute of Natural Science in Iceland for reviewing all doubtful identifications and for all his valuable guidance in this study.

References:

Bjarnason, A.H. and Fridriksson, S. : 1972

Moss on Surtsey, Summer 1969

Surtsey Research Progress Report VI:9-10

Fridriksson, S., Sveinbjörnsson, B., and Magnússon, S.:1972

Vegetation on Surtsey - Summer 1970.

Surtsey Research Progress Report VI: 54-59

Fridriksson, S., Sveinbjörnsson, B., and Magnússon, S.:1972

Substrate Map of Surtsey 1970.

Surtsey Research Progress Report VI:60-63.

THE COLLEMBOLA OF SURTSEY

from a report by Högni Bødvarsson, University
of Stockholm, Sweden

In the following tables Dr. Högni Bødvarsson reports on the collembola discovered on Surtsey as well as its distribution on the various islands of the Vestmannaeyjar group, and four areas in southern part of Iceland. The areas are shown on the accompanying map.

Table / . The collembola of South Iceland, showing the distribution of the species over the four sub-areas shown on the map on p.25. The table shows the number of samples in which the species have been found and the number of specimens found totally. "Mass" means that the species has been found in very great numbers (thousands) in a sample.

	No. of sampl.	No. of spec.	Vestmálastadur - Skúlavegur	Varmahlíð - Skógasandur	Sólheimur - Dyrnólaey	Reyniskirkja - Höfðabrekkuheiði
<i>Lepidocyrtus lanuginosus</i>	64	737	x	x	x	x
<i>Isotoma viridis</i>	63	213	x	x	x	x
<i>Onych. arm. pseudovand.</i>	61	345	x	x	x	x
<i>Folsomia quadrioculata</i>	38	566	x	x	x	x
<i>Deuterosm. bilineatus</i>	31	812	x	x	x	x
<i>Sminthurus aureus</i>	27	93	x	x	x	x
<i>Hypogastrura denticulata</i>	24	167	x	x	x	x
<i>Onych. arm. armatus</i>	22	187	x	x	x	x
<i>Isotoma notabilis</i>	21	95	x	x	x	x
<i>Onych. arm. campatus</i>	18	101	x	x	x	x
<i>Pseudisotoma sensibilis</i>	14	206	x	x	x	x
<i>Lepidocyrtus cyaneus</i>	12	17	x	x	x	x
<i>Keanura muscorum</i>	11	Mass	x	x	x	x
<i>Tullbergia krausbaueri</i>	9	55	x	x	x	x
<i>Folsomia fimetaria</i>	8	44	x	x	x	x
<i>Bourletiella hortensis</i>	7	14	x	x	x	x
<i>Bourletiella clavigera</i>	6	315	x	x	x	x
<i>icyrtoma minuta</i>	8	16	x	x		x
<i>Friesia mirabilis</i>	7	14	x	x		x
<i>Isotoma olivacea</i>	7	67	x	x		x
<i>Isotomiella minor</i>	6	26	x	x		x
<i>Sminthurides schötti</i>	5	13	x	x		x
<i>Sminthurides numilis</i>	5	10	x			x

<i>Tetracanthella arctica</i>	2	45	x			x
<i>Entomobrya nivalis</i>	46	468	x	x	x	
<i>Sminthurides malmgreni</i>	2	25		x		x
<i>Hypogastrura purpurea</i>	5	25		x	x	
<i>Archisotoma bezzelsi</i>	5	470		x	x	
<i>Odontella armata</i>	3	13			x	x
<i>Folsomia litsteri</i>	2	4	x	x		
<i>Folsomia brevicauda</i>	2	174		x	x	
<i>Micranurida pygmaea</i>	1	13	x			
<i>Onych. arm. tricampatus</i>	1	4	x			
<i>Tullbergia affinis</i>	1	4	x			
<i>Onych. arm. bicampatus</i>	1	2	x			
<i>Pseudanuroph. binoculatus</i>	1	2	x			
<i>Isotoma violacea</i>	1	1	x			
<i>Orchesella cincta</i>	3	7		x		
<i>Onych. arm. procamp.</i>	2	4		x		
<i>Hypogastrura ripperi</i>	1	77		x		
<i>Anurida germanica</i>	1	60		x		
<i>Folsomia bisetosa</i>	1	3		x		
<i>Willemia anophthalma</i>	1	1		x		
<i>Sminthurides aquaticus</i>	1	1		x		
<i>Dicyrtoma fusca</i>	2	2			x	
<i>Tomocerus minor</i>	5	14				x
<i>Hypogastrura viatica</i>	1	25				x
<i>Isotomodes productus</i>	1	1				x

Table //

Occurrence of the different forms of collembola on South Iceland, Heimaey, Ellidaey, Djarnarey, Sudurey, Alfsey, Brandur, Hellisey, Sólmasker, Geirfuglasker, and Surtsey. The forms are arranged so, that those having reached Surtsey come first, then those having reached Geirfuglasker, Sólmasker etc., and lastly those found only on the mainland of South Iceland.

Arranged in the order which they reached Surtsey:

	S-Iceland	Heimaey	Ellidaey	Djarnarey	Sudurey	Alfsey	Brandur	Hellisey	Sólmasker	Geirfuglasker	Surtsey
Total number of forms per area	49	45	8	15	18	12	8	3	6	5	3
5 <i>Onychiurus duplopunctatus</i>	x									x	x
1 <i>Archisotoma bessalae</i>	x	x									x
2 <i>Isotoma maritima</i>		x			x					x	x
3 <i>Hypogastrura assimilis</i>		x									x
4 <i>Vertagopus arborea</i>				x							x
6 <i>Onych. arm. pseudovanderdr.</i>	x	x	x	x	x	x				x	
7 <i>Folsomia fimetaria</i>	x	x								x	
4 <i>Anurida inessiana</i>		x	x		x					x	
<i>Isotoma viridis</i>	x	x	x	x	x	x	x	x	x		
<i>Hypogastrura purpureescens</i>	x	x		x	x	x	x	x	x		
<i>Folsomia quadrioculata</i>	x	x		x	x	x	x		x		
<i>Onych. arm. macfadyeni</i>		x							x		
<i>Xenylla humicola</i>					x	x	x		x		
<i>Friesia clavipes</i>									x		
<i>Lepidocyrtus lanuginosus</i>	x	x		x	x	x	x	x			
<i>Hypogastrura denticulata</i>	x	x	x	x	x	x	x				
<i>Sminthurinus aureus</i>	x	x		x	x		x				
<i>Sminthurides pumilis</i>	x	x					x				
<i>Tetracanthella arctica</i>	x	x	x		x	x					
<i>Isotomiella minor</i>	x	x	x	x		x					
<i>Onych. arm. campatus</i>	x	x		x	x	x					
<i>Onych. arm. bicampatus</i>	x	x			x	x					
<i>Lepidocyrtus cyaneus</i>	x	x				x					
<i>Friesia mirabilis</i>	x	x		x	x						
<i>Isotoma notabilis</i>	x	x		x	x						
<i>Onych. arm. armatus</i>	x	x			x						

<i>Pseudisotoma sensibilis</i>	x	x			x
<i>Entomobrya nivalis</i>	x	x			x
<i>Isotoma violacea</i>	x	x	x	x	
<i>Tullbergia kraushaneri</i>	x	x		x	
<i>Bourletiella hortensis</i>	x	x		x	
<i>Micranurida pygmaea</i>	x		x		
<i>Hypogastrura ripperi</i>	x	x			
<i>Willemia anophthalma</i>	x	x			
<i>Xenyllodes armatus</i>	x	x			
<i>Neanura muscorum</i>	x	x			
<i>Onych.arm.precampatus</i>	x	x			
<i>Tullbergia affinis</i>	x	x			
<i>Pseudanurephorus binoculatus</i>	x	x			
<i>Folsomia brevicauda</i>	x	x			
<i>Isotomodes productus</i>	x	x			
<i>Isotoma olivacea</i>	x	x			
<i>Sminthurides schötti</i>	x	x			
<i>Bourletiella bilineata</i>	x	x			
<i>Dicyrtoma minuta</i>	x	x			
<i>Onych.arm.cancellatus</i>		x			
<i>Tullbergia quadrispina</i>		x			
<i>Isotonima bipunctata</i>		x			
<i>Isotomurus palustris</i>		x			
<i>Megalothorax minimus</i>		x			
<i>Hypogastrura viatica</i>	x				
<i>Anurida germanica</i>	x				
<i>Onych.arm.tricampatus</i>	x				
<i>Folsomia bisetosa</i>	x				
<i>Folsomia litsteri</i>	x				
<i>Orchesella cincta</i>	x				
<i>Tomocerus minor</i>	x				
<i>Sminthurides aquaticus</i>	x				
<i>Sminthurides malmgreni</i>	x				
<i>Bourletiella clavigera</i>	x				
<i>Dicyrtoma fusca</i>	x				

APPENDIX V.

"The consolidation and palagonitization of the tephra of
the Surtsey volcanic island, Iceland."

A preliminary report

by

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I. Introduction

About one third of the exposed part of Surtsey is made up of tephra, pyroclastics of alkali olivine-basaltic composition, formed in the phreatic eruptions in Surtsey during Nov. 14, 1963 - April 4, 1964. Since the formation of the tephra, samples have been taken ^{from it} on various localities every year (except 1965 and 1968) in order to find out when and how the expected process of consolidation and palagonitization of the tephra would start.

A thorough study of the petrology of the tephra-formation in Surtsey might give important answers to some of the problems of the chaotic subglacial "palagonite formation" of Iceland and to the question of formation of palagonite from basaltic glass in general.

The first signs of consolidation in the tephra were seen in 1966, and in 1969 a marked consolidation and palagonitization process had begun, clearly connected to local heating of the tephra. It seems possible to define exactly under what conditions these processes work.

II. General properties of the tephra.

The tephra ~~formed~~ ^{fell} when the approx. 1150°-1160°C or hotter magma (Sigurgeirsson 1966) was quenched ~~at the~~ ^{at the} contact with the seawater. The tephra ~~was~~ ^{fell} still ~~not~~ ^{hot} when ^{to the touch} it fell in the immediate surroundings of the crater, but it was probably only a matter of ^{as} relatively short time, possibly only a few hours, before it had cooled down to air temperature. The quenching resulted in ^{phreatic} explosions, and horseshoe-craters with a diameter of about 400 m and a height of 150-170 m above sealevel were formed. The tephra was deposited in finely-bedded layers (Fig. 1 and 2), each layer representing one shower. The crater and

- Fig. 1 -

the tephra of the first phreatic phase (Nov. 14, 1963 - April 4, 1964) is for convenience called ^{Surtsey I} (S I) and that of the second phreatic phase (Febr. 1 - April 4, 1964) ^{Surtsey II} (S II). For further details of the eruption history the reader

is referred to the detailed descriptions of Thorarinnsson et al. (1964) and Thorarinnsson (1965, 1968).

Microscopic investigations on the tephra shortly after deposition (summer 1964) showed that 82-88 vol. was made up of unaltered and unpalagonitized basaltic glass (sideromelane), the rest being fragments of autogenic hyalobasalt and phenocrysts of olivine, plagioclase and Cr-spinel. The sideromelane is light-brown with a refractive index of $n=1.505 \pm 0.002$. Dispersed in the tephra are grains of opaque glass (tachylite); in contrast to the sideromelane, the tachylite is magnetic. It is difficult to measure the density of the glass because of the great number of vesicles, but values around 2.70 g/cm^3 were repeatedly obtained. The tachylite grains have similar density.

In most than 90% The grain size in five analysed samples varies, between 0.05 - 5 mm. The grain size curves have in most cases three maxima and are quite distinct from the curves of samples of tephra deposited in the seawater e.g. just north of Surtey, which are rather well-sorted and have only one maximum. The content of olivine-phenocrysts varies greatly because of eolian differentiation, and in the case of Jólnir (an island formed in 1966, which broke down the same year) the olivine content was found to decrease by 50% between two sites at a distance of 350 m ^{and} to 1100 m from the crater in contemporaneously formed tephra-layers.

III. Consolidation of the tephra.

The first signs of consolidation were seen in August 1966 in a few places, f.ex. at the top of the eastern mound. It was then possible to take a coherent sample, but it disintegrated when transported. Only the outermost 10-15 cm of the exposed tephra layers were consolidated. No abnormal heat was observed in the layers. The exposures face SE, which is the main direction for precipitation and since this is also the sunny side, it is

possible that the consolidation depends on the frequent oscillations in temperature and moisture on the surface. Microscopic examination of samples from one of the locali-

(- Fig. 2 -)

ties did not reveal any palagonitization, and it was not possible to ^{detect} ~~unveil~~ (at 1000x) any cementing substance in the sample. These localities ^{have been} ~~are~~ since 1968 part of the thermal field which will be described below.

In Sept. 1969 ~~it was discovered that~~ a considerable area in the walls of the S I - tephra crater was ^{already} ~~consolidated~~, ^{probably as a result of} ~~connected to~~ the heating up of the tephra. In April 1968 Prof. Sigurdur Thorarinnsson had discovered that a considerable part of the older tephra crater (S I) was warm. In Sept. 1969 the present author visited the island and the thermal field was ~~charted~~ ^{surveyed}; temperatures between 40°-84°C were measured at approximately 5 cm depth in the hottest areas. The tephra in the thermal field was usually slightly wet and in some places steam ^{escaped} ~~was emitted~~ through the surface. In August 1970 the thermal field was ^{mapped} ~~measured~~ in detail, see Fig.

(- Fig. 3 -)

3, and it now seemed slightly ^{larger} ~~greater~~ than in 1967. At 20 cm depth the temperature was usually between 40°-60°C within the thermal field, but 10°C or lower outside the field. It was attempted to measure the temperature gradient ~~with depth~~ by hammering an iron bar down (Fig. 4). Usually it was not possible to get farther down than about 40-60 cm within the thermal field as the tephra gradually became harder. As ^{is} ~~is~~ evident from Fig. 4, the

(- Fig. 4 -)

temperature gradient is very steep in the uppermost 40 cm of tephra, but as the temperature reaches 100°C the curve seems to flatten out. This could mean that 100°C is maximum temperature, at least near ^{the} surface. A small area in the northern part of the field was kept under observation for a few weeks in Aug.-Sept. 1970. At 20 cm depth the temperature was found to vary as much as 35°C at the same locality when measurements were repeated within a few days. Temperatures above 100°C were never

obtained. From the above it could be suggested that the tephra is heated up by vapour at 100°C. It is very important to get this clear in order to ascertain at what temperatures the consolidation and palagonitization takes place at depth.

As is evident from Fig. 3 the thermal field surrounds the lava craters and it is therefore probable that the heating up is connected with heat flow through the feeder dykes of the lava craters. The lava crater S II (the westernmost one) was last in action in May 1965, whereas the craters S I ceased lava-effusion in June 1967. Heat flow through the craters continued however, in July 1968 temperatures around 500°C were measured in discharged gases in the S II lava crater, and as late as in 1970 temperatures as high as 300-400°C were obtained. The temperatures of gases from the S I craters were somewhat lower.

As mentioned above it seems clear that the tephra, at least near the surface, is heated up by steam at 100°C. This steam can either be vapourized meteoric water which after precipitation seeps down to the 100°C level and then is vapourized, or it can be vapourized seawater which must be present in the porous underground of Surtsey. In the small area which was kept under observation during Aug. - Sept. 1970 the temperature varied considerably, even from one day to the next. The volume of steam which escaped in this area seemed to increase with increasing temperature. It was not possible to see any connection between the precipitation as measured in this time interval at the weather station near the hut and the variations in the emanation of steam from the area. It could therefore be suggested that the steam is mainly seawater which becomes vapourized at sea level and then emanates through the tephra to become mixed with meteoric water near surface. This would mean that the palagonitization and the consolidation proceeds at 100°C below about 1/2 m depth with a more or less constant flow of water vapour at this

temperature, and probably near atmospheric pressure. This could be ascertained with a shallow, say 50-100 m, bore-hole.

In Fig. 3 is shown how ~~great~~^{large} the consolidated area ~~was~~^{is} at surface in August 1970. A considerable area is "semi"-consolidated, ~~where~~^{where} it is possible to take good coherent samples by hammer, and about 7000 m² are made up of quite hard rock where a good hammer is needed when samples are taken. Elsewhere within the thermal field the tephra seemed hard and consolidated at 40-80 cm depth.

IV. Palagonitization.

Within the consolidated area which was ~~discovered~~^{observed} in Sept. 1969 a few small rust-brown patches were found in the tephra, especially where the vapour emanation was ~~activated~~^{observed}. The glass grains were distinctly coloured, but usually only on the under side of the grains which turned towards the vapour stream. Under the microscope the outermost 0.05-0.10 mm of the sideromelane grains were found to be altered to red-brown "gelpalagonite" (Peacock 1926, Noe-Nygaard 1940), i.e. isotropic and apparently homogenous palagonite. In many cases the palagonite is concentrically banded. The refractive index is $n=1.665 \pm 0.002$, i.e. considerably higher than before alteration,

(- Fig. 5 -)

in contrast to the palagonite in the tuffs of the older Vestman Islands, ~~where~~^{where} refractive index is lower, usually about 1.56-1.58. Samples from the same area taken in Nov. 1969 and in Aug. 1970 showed ~~a~~^a similar degree of alteration (Fig. 4). In these red-brown patches in the tephra, approx. 1-3% vol. of the rock was palagonized. It does not appear that the palagonite is the actual cementing substance. It was possible to take consolidated samples before any palagonitization was ~~seen~~^{observed} in the microscope. ~~Probably electron microscopy can solve the problem.~~ *The cementing substance, if any, can possibly be identified by electron microscopy.*

The sideromelane and its first alteration product, the red-brown gelpalagonite, were analysed in one grain

from the sample taken in Sept. 1969 (TABLE 1, I and II); both analyses are the average of 3-4 single analyses respectively. The analyses were made on the ARL electron microprobe, using as standard a basaltic glass from Hawaii, kindly provided by R. L. Hay. The palagonite analyses were difficult to make and should only be considered as semiquantitative. The sum of the analysis is only 84.5% which is suspiciously low; it is, however, not impossible that water amounts to 35%. The sideromelane, which represents the average composition of the magma minus phenocrysts, proved to be very homogeneous, whereas the palagonite rim was rather heterogeneous. The process of palagonitization appears to be isovolumetric.

As seen from these preliminary analyses all components ^{are depleted} fall in concentration in terms of weight %, except Fe and Ti and water. Fig. 6 ^{shows} visualizes how e.g. Ca and Na are lost ^{with} at palagonitization in a single sideromelane grain. Microlites are unaffected. It would here be interesting to calculate the change in concentration per volume, but as the specific gravity of the palagonite is not yet known this is not possible.

(- Fig. 6)

Approximate values of the ^{relative} amounts of leached components can, however, be obtained by assuming that the amount of total iron is constant during palagonitization, following the procedure of Hoppe (1940, p. 487). Probably all the iron in the palagonite is found as Fe^{3+} which is heavily insoluble, cf. the experiments of Hoppe (op. cit.). With this assumption the values of the sideromelane analysis in Table 1 ^{was} multiplied with 3.153 as the iron content of the palagonite is higher by that factor. From the values obtained in this way (IV) are then subtracted the values of the waterfree palagonite analysis (III) and the difference gives the relative amount of each component ^{which} has been leached out.

It then appears (Table 1, VI) that the following components are lost in order of relative amounts: Na_2O , K_2O , CaO , Al_2O_3 , SiO_2 , MgO and TiO_2 . Instead, water enters the palagonite, and as mentioned before, probably

wt %

TABLE 1

	I	II	III	IV	V	VI
SiO ₂	46.5	23.6	36.6	146.6	110.0	75.0
TiO ₂	2.5	4.2	6.5	7.9	1.4	17.7
Al ₂ O ₃	16.0	5.2	8.1	50.4	42.3	83.9
*Fe ₂ O ₃	12.4	25.2	39.1	39.1	0	0
MgO	4.8	3.9	6.0	15.1	9.1	60.3
CaO	10.8	2.3	3.6	34.1	30.5	89.4
Na ₂ O	3.3	0.05	0.08	10.4	10.32	99.2
K ₂ O	0.6	0.02	0.03	1.9	1.87	98.4
	96.9	64.5	100.0	305.5	206.5	

* total Fe as Fe₂O₃

I: Electron - microprobe analysis of sideromelane in the grain shown in Fig. 6. II: Do - of palagonite rim. III: Palagonite analysis calculated waterfree. IV: Sideromelane values multiplied with 3.153. V: Difference between IV and III, loss of leached components. VI: Loss in % of original amount.

all the iron becomes oxidized to give the palagonite a rust-brown colour. The above mentioned elements are the same as Hoppe (op. cit.) found by experiments to be leached out of sideromelane in varying amounts at various pH conditions. pH has yet to be measured in the condensate of the steam which flows through the tephra in Surtsey. Microprobe analyses by Hay & Iijima (1968) of sideromelane and palagonite from Hawaii showed that three quarters or more of the K_2O , Na_2O and CaO , half of the Al_2O_3 and about one third of the SiO_2 were lost in the process of palagonitization.

In palagonite tuffs of the older Vestman Islands, e.g. in Saffjall, Ellidaey and Bjarnarey which are 5000-6000 years old (Jakobsson 1968), zeolites and calcite have been precipitated as the result of palagonitization. Of the zeolites, analcime, phillipsite, chabazite and natrolite have been identified. In Surtsey opal along with traces of thenardite (?) was discovered on the surface already in Nov. 1969 in areas with strong emanation of steam. The last-named mineral is possibly formed because of a high content of precipitated seasalts in the tephra. Sigvaldason (1965) has reported encrustations of halite and aphthitalite on lava and tephra in Surtsey. In Aug. 1970 opal was clearly much more abundant. At the time of writing (May 1971) the first zeolite has just been discovered in a sample taken in Surtsey on 28th April 1971; the zeolite is probably chabazite.

Outside the thermal field no consolidation or palagonitization has yet been discovered. This of course does not mean that it is ruled out that these processes can proceed under these circumstances, only that they are slowed down because of lower (atmospheric) temperatures and less moisture.

The ions which are found in solution on the surface of the glass grains as a result of palagonitization will be available to organisms which eventually colonize on the surface of the tephra. In this connection it is of interest to consider that the rock constituents of Icelandic soil are in most parts of the country by 80-95% made up of volcanic glass, mainly of basaltic composition (Jóhannes-

son 1960, Sigbjarnarson 1969), the main part of the remainder being ~~crystals included in the~~ ^{hyalitic} glass. Provisional analyses of Icelandic soil indicate that the rock constituents (i.e. the glass) undergo easily chemical weathering (Jóhannesson 1960, p. 10). It seems probable that palagonitization of basaltic glass is ~~the most important~~ ^{an important chemical} process leading to the formation of soil in Iceland. If so, it is of interest to note that the process works at appreciable speed at temperatures as low as approx. 0°-15°C which are common mean monthly temperatures near ^{the} surface in *Icelandic* soil in Iceland (Helgason 1961). Average temperatures in tephra, at 5 cm depth on the northern coast of Surtsey varied ^{during} in April-August, 1968, between 5-17°C (Sigtryggsson 1970)

Discussion.

In the case of Surtsey it is possible to follow closely the processes of consolidation and palagonitization of basaltic tephra and describe how they ~~run~~ ^{take place} under the local physical conditions. So far the story reads as follows:

Nov. 14, 1963 - April 4, 1964: The tephra forms in phreatic eruptions and is composed of fresh basaltic glass (sideromelane) with dispersed fragments of hyalobasalt.

August 1966: Consolidation has started in surface layers ~~at~~ ⁱⁿ a few places but proceeds slowly.

April 1968: Heating of tephra with emanations of steam discovered in the eastern mound close to the newest lava craters.

Sept. 1969: A part of the tephra is found to be consolidated to tuff within the thermal field at surface temperatures of approx. 60°-100°C. Palagonitization has commenced ~~at~~ ⁱⁿ a few places. Dispersed opal precipitations.

August 1970: The area of consolidated tephra is now about 12.000 m², whereas the extension of the thermal field is similar as in 1969. Precipitations of opal common.

April 1971: Consolidation proceeds to give a more dense rock; the first zeolite (chabazite) is discovered in the tuff.

As mentioned above the author did not have the opportunity to visit Surtsey in 1968 but it is probable that consolidation and possibly palagonitization had already started by that time, i.e. only one half to one year after heating up of the tephra.

From the above it then follows that the product of submarine, basaltic, phreatic eruptions near sealevel is finegrained tephra made up of sideromelane glass. This glass is subject to palagonitization, which is a post-eruptional process taking place at relatively low temperatures, cf. Noe-Nygaard (1940) and Hay & Iijima (1968). It is provisionally suggested that palagonitization in the tephra-pile above sea-level in Surtsey proceeds at 100°C in the presence of abundant water, and that the temperature falls gradually in the uppermost 1/2 - 1 m of the layers. At temperatures of approx. 60-100°C it is only a matter of 3-4 years before dense palagonite tuff (Icel. móberg) is formed with precipitations of opal and chabazite.

Some workers (e.g. Nuyudo-1964, Bonatti 1965) have suggested that palagonite is formed at the time of eruption as the result of reaction between the hot melt and water. Both in the case of the Surtsey eruption and the subglacial 1934 Grímsvötn eruption (Noe-Nygaard 1951) it is established that the glass content of the erupted tephra was sideromelane with no traces of palagonite.

The mechanism of the heat transfer of the thermal field has not been established. As mentioned before, the heating is obviously connected to the lava craters. It is possible that cooling-feeder dykes and small intrusions at high level are the main sources of the heat. Sigvaldason (1968) has suggested that pillow lavas buried beneath the tephra pile serve as the main heat source for the process of palagonitization of pyroclastic material in subaquatic volcanoes of specific structure. The presence of pillow lavas in Surtsey has not been proved. If pillow lava is found at the base of Surtsey it will have →

been formed in the first days of eruption, i.e. in Nov. 1963. The thermal field was, however, not discovered before 1968, and it is therefore not probable that the hypothetical pillow lava is the heat source.

Research on the formation of palagonite rocks in Surtsey will be continued during the next several years. All investigations have so far been limited to the surface of the tephra formation. The value of this research could be greatly enlarged by drilling a hole into the tephra in order to find out how palagonite is formed at depth both above and below sea-level.

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References

- Bonatti, E. 1965: Palagonite, hyaloclastites, and alteration of volcanic glass in the ocean.
Bull. Volc. 28; 3-15.
- Hay, R. L. & Iijima, A. 1968: Nature and origin of palagonite tuffs of the Honolulu group on Oahu, Hawaii.
Geol. Soc. Am. Mem. 116; 331-376.
- Helgason, B. 1961: Athuganir á hitastigi jarðvegs á Íslandi.
Nátt.fr. 31; 97-113.
- Hoppe, H. J. 1940: Untersuchungen an Palagonittuffen und ihre Bildungsbedingungen.
Chemie d. Erde 13; 484-514.
- Jakobson, S. 1968: The geology and petrography of the Vestman Islands. A preliminary report.
Surtsey Progr. Rep. IV; 113-129.
- Jóhannesson, B. 1960: The soils of Iceland.
Univ. Res. Inst. Reykjavik
- Noe-Nygaard, A. 1940: Sub-glacial volcanic activity in ancient and recent times.
Fol. Geogr. Dan. Tom 1, no. 2.
- Noe-Nygaard, A. 1951: Materials from the eruption in Grimsvötn, Vatnajökull, in 1934.
Fol. Geogr. Dan. Tom 1, no. 4.
- Norrman, J. O. 1970: Trends in postvolcanic development of Surtsey Island.
Surts. Res. Progr. Rep. V; 95-112.
- Peacock, M. A. 1926: The petrology of Iceland. Part I. The basic tuffs.
Trans. Roy. Soc. Edinb. 55; 51-76.
- Sigbjarnarson, G. 1969: Áfok og uppblástur.
Nátt.fr. 39; 88-118.
- Sigtryggsson, H. 1970: Preliminary report of the results of meteorological observations on Surtsey 1968.
Surts. Res. Progr. Rep. V; 119-120.
- Sigurgeirsson, Th. 1966: Geophysical measurements in Surtsey carried out during the year of 1965.
Surtsey Res. Progr. Rep. II; 181-185.
- Sigvaldason, G. E. 1968: Um rannsókn á gosefnum frá Surtsey.
Nátt.fr. 35; 181-188.
- Sigvaldason, G. E. 1968: Structure and products of sub-aquatic volcanoes in Iceland.
Contr. Min. Petr. 18; 1-16.
- Thorarinsson, S. 1965: The Surtsey eruption: Course of events and the development of Surtsey and other new islands.
Surtsey Res. Progr. Rep. II; 117-124.
- Thorarinsson, S. 1968: Síðustu þættir Eyjaelda (The last phases of the Surtsey eruption).
Nátt.fr. 38; 113-135.
- Thorarinsson, S., Einarsson, Th., Sigvaldason, G. E. & Elisson, G. 1964: The M submarine eruption off the Vestman Islands 1963-64.
Bull. Volc. 27; 1-11.

Bird Observations on Surtsey in 1971.

by
Erling Ólafsson.

In 1971 Surtsey was manned the 13.6 to 24.8 by Mr. Erling Ólafsson and the 9.10 to 28.10 by Mr. Hálfván Björnsson. During this time altogether 51 species of birds were observed.

In the summer of 1970 two bird nests were found, one of fulmar (*Fulmarus fulmarus*) and one of black Guillemot (*Cepphus grylle*). In 1971 the colonization of birds proceeded. Ten to eleven nests of fulmar and six nests of the black guillemot were found. Five of the fulmar nests were successful, but all the black guillemot nests were ruined by a heavy seasurf the 8th of August.

All of the fulmar-nests were situated in the cliffs of the west-coast, and most of them in the cliff, where the first fulmar nest was found in 1970, and one of them on the same spot, most likely the same pair of birds (that nest was again successful).

The black guillemot nests were equally dispersed along the cliffs of the south and west-coast. One of the nests was situated at the same place as the first nest found in 1970, though not the same hole, as the cliff had changed a lot during the winter.

What happened this summer shows that colonization of birds that breed in cliffs can be rather difficult. Heavy surf for one day during the summer seems to be enough to spoil most of the nests. The cliffs where the fulmars breed is the only one quite stable the surf that spoiled the nests this

summer occurred at hightide, and that helped quite a lot. Colonization of landbirds is also difficult because of unstable or lacking foodsources. Not more than 100 individual vascular plants were found this summer, insects were most often present, but seldom numerous, so this food source of both primary and secondary production can hardly support any population of landbirds.

In spite of this there should be possibilities for some species to breed on the island, such as birds that get their food from the open sea like razorbills whose breeding habits are quite similar to those of the black guillemot. There are also possibilities for birds that feed on carcasses, for example, gulls and birds that can feed on small Crustacea and other things that commonly drift ashore (ringed plower, arctic tern ...).

Fulmarus fulmarus on its nest, which was also inhabited in 1970.

Fulmarus fulmarus with its single young.
One of 10 nests found in Surtsey 1971.

Photo: Erling Ólafsson.

Preliminary Studies of the Vegetation
on the Southern Coast of Iceland.

II Reynisfjall.

By

Sturla Fridriksson, Skuli Magnusson and
Bjartmar Sveinbjörnsson.

Introduction:

The palagonite tuff mountains on the southern coast of Iceland south of the glaciers Mýrdals- and Eyjafjallajökull are in many respects similar in formation to the Westman Islands of which Surtsey is the newest member.

Some of these mountains have cliffs that descend straight into the sea, other descend towards a sandy beach which lies between them and the ocean. These cliffs are often inhabited by birds that roost and nest on the numerous shelves. These birds live on fish and fertilize the soil of the cliffs profusely with their droppings. The soil is therefore very fertile and carries a lush vegetation. Investigations have previously been carried out on the south coast of Iceland in order to establish better knowledge of the vegetation with regard to dispersal of plants and plant colonization on Surtsey. The sociological work carried out during the summer 1971 at Vík in Mýrdal, the southernmost tip of Iceland, was a part in this general study.

Method of Sociological Measurements:

As a special emphasis was laid on sociological measurement of higher plants, the distribution and coverage of each species were recorded at each site.

The distribution was calculated as frequencies in percentage according to the occurrence of individual plants in a quadrat of 1 m^2 laid out 5 times at each locality. The coverage of the species was estimated in each quadrat. The average cover was then calculated by adding the coverage estimates of all quadrats and dividing by number of observations. These estimates fall into six cover classes: †

<u>Cover class</u>	<u>Coverage</u>	<u>Average Coverage</u>
5	1/2	24/32
4	1/2-1/4	12/32
3	1/4-1/8	6/32
2	1/8-1/16	3/32
1	-1/16	1/32
+	1-2 specimen	

†According to Hult, Sernander, Du-Rietz.

The species are listed in the following tables showing the various measurements made per societies and how these are grouped into communities. The distribution of the various species is given as frequency in percentage followed by the class number of the average density. There are altogether nine communities, in addition to the cultivated fields, the distribution of which is drawn on the map of Reynisfjall.

At the end of this paper is a list of plants found on Reynisfjall in 1971.

A List of Plants Found on Reynisfjall
in the Summer 1971:

Achillea millefolium	Luzula multiflora
Agrostis canina	" spicata
Agrostis stolonifera	Mertensia maritima
Agrostis tenuis	Minuartia peploides
Alchemilla alpina	Myostatis arvensis
Alchemilla sp.	Oxyria dygyna
Angelica archangelica	Parnassia palustris
Anthoxanthum odoratum	Phleum alpinum
Armeria maritima	Pinguicula vulgaris
Bartsia alpina	Plantago lanceolata
Botrichium lunaria	" maritima
Bromus inermis	Poa alpina
Cakile maritima	Poa annua
Capsella bursa pastoris	Poa nemoralis
Cardamine hirsuta	Poa pretensis
Cardaminopsis petrea	Polygonum viviparum
Cerastium alpinum	Polypodium vulgare
Cerastium fontanum	Potentilla anserina
Cochlearia officinalis	Prunella vulgaris
Cystopteris fragilis	Ranunculus acris
Dactylorhiza maculata *	Rhinanthus minor ssp. groenlandicus *
Draba incana	" " ssp. minor *
Elymus arenarius	Rumex acetosella
Epilobum collinum	" acetosa
Equisetum arvense	" domesticus
" pratense	Sagina nodosa
Erigeron boreale	Salix herbacea
Eriophila verna	Saxifraga caespitosa
Euphrasia frigida	" hirculus
Festuca rubra	" hypnoides
" vivipara	" nivalis
Filipendula ulmaria	" oppositifolia
Galeopsis tetrahyt	Sedum acre
Galium pumillum	" rosearum
" verum	Selaginella selaginoides
Grantiana aurea	Senecio vulgaris
Geranium silvaticum	Silene acaulis
Hieracium sp. (2-3 kinds)	Silene maritima
Kobresia myosuroides	Spergula arvensis
Koenigia islandica	Stellaria media
Lathyrus maritimus	Taraxacum sp.
" pratensis	Thymus drucei
Leontodon autumnalis	Trifolium repens
Ligusticum scoticum	Tripleurospermum maritimum *
Limnorchis hyperborea *	Trisetum triflorum
	Viccia cracca

* Nomenclature from: Löve, Aspell (1970)
Íslenzk flórablaði, Reykjavík, 1970.

Mosa. pembra. Heath vegetation. (J)

Thymus drucei - Festuca rubra ssp. sociata

	9	14
<u>Agrostis canina</u>		40-1
<u>Achillea alpina</u>	X	40-1
<u>Achillea sp.</u>	X	
<u>Angelica archangelica</u>	40-+	
<u>Anthoxanthum odoratum</u>	100-2	
<u>Botrychium lunaria</u>	60-+	
<u>Cerastium fontanum</u>	60-+	80-1
<u>Oxylophora maculata</u>	X	
<u>Draba incana</u>	40-+	
<u>Elymus arenarius</u>	20-+	
<u>Epilobium collinum</u>	X	
<u>Equisetum arvense</u>	20-+	
<u>Equisetum pratense</u>		100-1
<u>Erigeron borealis</u>	X	
<u>Euphrasia frigida</u>		X
<u>Festuca rubra</u>	100-1	100-2
<u>Festuca vivipara</u>		100-3
<u>Galium pumilum</u>	80-1	100-1
<u>Galium verum</u>	20-1	
<u>Habenaria hyperborea</u>	X	
<u>Hieracium sp.</u>	100-1	
<u>Koeleria myosuroides</u>		100-2
<u>Luizula multiflora</u>	20-1	60-1
<u>Luizula spicata</u>	100-1	20-+
<u>Myosotis arvensis</u>	X	
<u>Pinguicula vulgaris</u>		X
<u>Plantago lanceolata</u>	80-1	
<u>Plantago maritima</u>	20-1	X
<u>Poa pratensis</u>	80-1	
<u>Polygonum viviparum</u>	X	100-1
<u>Potentilla anserina</u>	60-+	
<u>Ranunculus acris</u>	100-2	
<u>Rhinanthus minor ssp. minor</u>	X	
<u>Rumex acetosa</u>	100-2	
<u>Rumex acetosella</u>	20-1	
<u>Salix herbacea</u>	X	80-2
<u>Salix repens</u>		40-1
<u>Salix maritima</u>	20-1	
<u>Thymus drucei</u>	100-2	100-4
<u>Trifolium repens</u>	X	

Maling nr 9, loka í áinokur
hlíð fjallanna en 14 ofan á
fjallinu. Nr 9: Jarðvegur
matarborins skríða og halli
43°. Nr 14: Jarðvegur
ændinn og halli lítil.

Malingar þessar eru rökkuð
ísamræðar sem sjá má
og spurning hvort það er
á helga þessu sama sam-
fella. Nr. 14 er í sam-
inni frekar Thymus drucei
Festuca vivipara samfella.
Þessi flokkur hér er frekar
lítil þagunda en á þessu
gröfun á "homogeneity" sam-
fellaanna er ekki fyrir
hendi.

(G2)

Festuca rubra - Agrostis sylvatica - Anthoxanthum odoratum soc.

	7
<u>Agrostis sylvatica</u>	100-2
<u>Achillea</u> sp.	X
<u>Anthoxanthum odoratum</u>	100-2
<u>Angelica archangelica</u>	X
<u>Poltrichium lunaria</u>	X
<u>Cardamine hirsuta</u>	X
<u>Cardaminopsis peltica</u>	X
<u>Crastium fontanum</u>	100-1
<u>Araba oncans</u>	60-+
<u>Festuca rubra</u>	100-4
<u>Galium verum</u>	40-1
<u>Luzula multiflora</u>	20-+
<u>Myosotis arvensis</u>	80-1
<u>Plantago lanceolata</u>	80-1
<u>Poa pratensis</u>	100-1
<u>Ranunculus acris</u>	100-1
<u>Rhinanthus minor</u> var. <u>minor</u>	X
<u>Rumex acetosa</u>	100-+
<u>Sedum acre</u>	X
<u>Sedum rosea</u>	X
<u>Silene maritima</u>	20-1
<u>Stellaria media</u>	X
<u>Taraxacum</u> sp.	100-1
<u>Thymus drucei</u>	X

Malingin lekinn i austurhlíð fjallanna i grósigróvinni skóðu.
Jardvegur sambland af mól og mól. Hallinn 25-70°

(G3)

Agrostis canina - Festuca vivipara - Anthoxanthum odoratum soc.

	17
<u>Achillea millefolium</u>	X
<u>Agrostis canina</u>	100-2
<u>Agrostis tenuis</u>	60-1
<u>Achillea</u> sp.	60-1
<u>Anthoxanthum odoratum</u>	100-2
<u>Poltrichium lunaria</u>	40-+
<u>Carex flacca</u>	20-1
<u>Cerastium fontanum</u>	100-1
<u>Equisetum arvense</u>	100-1
<u>Equisetum pratense</u>	100-1
<u>Festuca rubra</u>	100-1
<u>Festuca vivipara</u>	100-2
<u>Galium verum</u>	100-1
<u>Hieracium</u> sp.	20-1
<u>Luzula multiflora</u>	100-1
<u>Plantago lanceolata</u>	20-1
<u>Poa pratensis</u>	100-2
<u>Ranunculus acris</u>	40-+
<u>Rumex acetosa</u>	20-1
<u>Taraxacum</u> sp.	100-2
<u>Trifolium repens</u>	80-2

Maling lekinn við veiginn upp
fjallit að austurhlíð.
Jardvegurinn er þurr og mól-
jardvegur. Mikill mólur er
í samplaginu þó hann sé
ekki sýnilegur þegar er
annarslektur. Graslendi-
móspunktur hefur annars
alltaf mól og liquiditær.
Drepanocladus uncinatus og
Rhynchospora alba sem
einnast (dominandi) leggjast.

Blómabrekktur: Herb slope (H)

Anthoxanthum odoratum - Galium verum society (H)

	2
<u>Angelica archangelica</u>	X
<u>Anthoxanthum odoratum</u>	100-5
<u>Armeria maritima</u>	X
<u>Cerastium fontanum</u>	100-1
<u>Draba incana</u>	X
<u>Equisetum arvense</u>	X
<u>Festuca rubra</u>	100-1
<u>Galium pumilum</u>	X
<u>Galium verum</u>	100-3
<u>Hieracium spp.</u>	X
<u>Leontodon autumnalis</u>	X
<u>Luzula multiflora</u>	20-1
<u>Myosotis arvensis</u>	100-1
<u>Plantago lanceolata</u>	100-2
<u>Plantago maritima</u>	X
<u>Poa pratensis</u>	100-1
<u>Primula acaulis</u>	X
<u>Ranunculus acris</u>	100-2
<u>Rhinanthus minor ssp. groenl.</u>	X
<u>Rhinanthus minor ssp. minor</u>	X
<u>Rumex acetosa</u>	100-1
<u>Silene maritima</u>	20-1
<u>Taraxacum sp.</u>	100-2
<u>Thymus drucei</u>	X

Jardagur er sandin sludabjardu.
Malingin lakin í austurhlíð
fjallanna og hallinn er 40° til
austurs.

Undirlegundir í samfelaginu
eru Dryas octopetala uncinata
og Rhytidadelphus squarrosus

Vanskapað Silypsi (Plantago lanceo-
lata) fannst þar sem malingin
var gerð. Blómshjúpin var
þjót skipt í andann og klippir
míðar. &

Geranium silvaticum - Agrostis tenuis - Alchemilla sp. society (H2)

	10
<u>Agrostis tenuis</u>	100-3
<u>Alchemilla sp.</u>	100-3
<u>Angelica archangelica</u>	X
<u>Anthoxanthum odoratum</u>	100-1
<u>Cerastium fontanum</u>	20-1
<u>Equisetum arvense</u>	100-1
<u>Equisetum pratense</u>	100-1
<u>Filipendula ulmaria</u>	X
<u>Galium pumilum</u>	20-1
<u>Galium verum</u>	100-1
<u>Geranium silvaticum</u>	100-4
<u>Hieracium sp.</u>	20-1
<u>Lathyrus pratensis</u>	X
<u>Luzula multiflora</u>	20-1
<u>Myosotis arvensis</u>	20-1
<u>Plantago lanceolata</u>	100-2
<u>Plantago maritima</u>	20-1
<u>Poa pratensis</u>	20-1
<u>Polygonum viviparum</u>	20-1
<u>Ranunculus acris</u>	100-2
<u>Rumex acetosa</u>	100-1
<u>Taraxacum sp.</u>	20-1
<u>Trifolium repens</u>	100-2

Maling þessi gerð í austurhlíð
fjallanna. Jardagur er grænnur
moldarjardvegur. Hallinn 40°

Lundabyggð ávaran í Reynisfelli.
 Grunnur moldergarðvegur á stórum björgum.
 Halli minnumandi í allar áttir.

Puffin ground vegetation: (L)

Festuca rubra - Stellaria media sociaty:

	1
<u>Angelica archangelica</u>	X
<u>Athoranthus odoratum</u>	X
<u>Armeria maritima</u>	X
<u>Cerastium fontanum</u>	X
<u>Cochlearia officinalis</u>	X
<u>Euphrasia frigida</u>	X
<u>Festuca rubra</u>	100 - 4
<u>Leontodon autumnalis</u>	X
<u>Oxyria digyna</u>	X
<u>Plantago maritima</u>	X
<u>Poa pratensis</u>	100 - 2
<u>Plantilla anserina</u>	X
<u>Ranunculus acris</u>	20 - +
<u>Rumex acetosa</u>	100 - 2
<u>Sagina nodosa</u>	X
<u>Sedum roseum</u>	X
<u>Silene maritima</u>	20 - 2
<u>Stellaria media</u>	100 - 4
<u>Taraxacum sp.</u>	20 - 1
<u>Triplurospermum maritimum</u>	40 - 3

Maling þessi lúka í
 stórgríðri sem skridu
 við fjallsrætur.
 Ekki tekur fleiri maling
 en í lundabyggðum þar
 sem viðast er málun af
 að að komast að þeim.

Poa annua

vex í þéttum hópum sumarsíðar.

Lundabyggðin er með allsunnarlega, undir ávarshlíð fjalls-
 ins í Kletthóli moldergarðsins, og klettarir að megin þakur
 grunnur molder-
 garðsins. Utan á kletturnum vex klettagrös, s.d.
Sedum, Oxyria og Cochlearia en meðfylljandi maling
 er tekið afan á stórum kletti með þessum samfélagi.
 Hvarfslóð er töluvert sýnileg í þessum lundabyggðasinnar
 í hvorum milli klettanna eru áhrif. Lundans minnst og
 þar komu helaf fyrir þar plöntur sem ekki eru þessu
 fyrir lundabyggðina.

Graslandisgröður:

Trifolium repens - Festuca rubra societas: (G1)

	11	12	18
<u>Agrostis tenuis</u>		100-2	100-4
<u>Achillea</u> sp.	100-3		100-2
<u>Rhoxanthum odoratum</u>	100-3	40-1	
<u>Podium lunaria</u>	X		20-+
<u>Geranium fontanum</u>	80-+	20-1	100-1
<u>Equisetum arvense</u>		100-1	100-1
<u>Festuca rubra</u>	100-2	100-4	100-3
<u>Festuca ovina</u>		100-2	
<u>Galium pumilum</u>		40-+	
<u>Galium verum</u>	100-1		60-1
<u>Gentiana aurea</u>		X	
<u>Hieracium</u> sp.	80-1		20-1
<u>Leontodon autumnalis</u>		100-1	
<u>Luzula multiflora</u>	100-1	80-1	60-1
<u>Myosotis arvensis</u>	40-+		
<u>Parnassia palustris</u>			20-+
<u>Plantago lanceolata</u>	100-2	20-+	20-1
<u>Plantago maritima</u>	20-1	40-1	
<u>Poa pratensis</u>	80-1	100-2	
<u>Polypodium</u>			
<u>Polygonum maritimum</u>		40-1	20-+
<u>Polinilla anserina</u>	60-+		20-+
<u>Prunella vulgaris</u>			40-+
<u>Ranunculus acris</u>	100-2	60-1	60-1
<u>Rumex acetosa</u>	80-1	80-1	100-1
<u>Vicia cracca</u>	X		
<u>Jasacium</u> sp.		60-1	
<u>Thymus drucei</u>		20-1	60-1
<u>Trifolium repens</u>	100-5	80-4	100-3
<u>Rhinanthus minor</u>	20-+		

Malingar 11 og 18 teknar í grasbrækkum utan í fjallinu, en nr 12 ofan á þri þremur. Nr. 11 í austurhléinu en nr. 18 í vesturhléinu. Jarðvegur er þykkur moldarjarðvegur í brækkunum en þurr og sandinn moldarjarðvegur í nr 12.

Vesturhlé fjallins er nokk þetta heilar og þri mjög afköll sem vika að greina graslegundirnar.

Sam sjá má af malingunum er álitandi hvort helga skuli þessat malingar til sama samfélagins. Þetta er að líta á marga F. rubra og Trifolium repens sem einkeimistegundir frekar en að um dominerandi tegundir sé þar að ræða.

Melagrisus Grawel vegetation (D)

Agrostis stolonifera - Festuca rubra society.

	8	13
<u>Angelica archangelica</u>	40-1	
<u>Agrostis stolonifera</u>	100-1	100-1
<u>Armoracia maritima</u>		20-2
<u>Cardaminopsis petraea</u>		80-1
<u>Cerastium alpinum</u>		100-1
<u>Cerastium fontanum</u>	100-1	
<u>Epilobium collinum</u>	20-+	
<u>Equisetum arvense</u>		60-+
<u>Euphrasia frigida</u>	100-1	80-1
<u>Festuca rubra</u>	100-2	100-1
<u>Galium pumillum</u>		X
<u>Hieracium sp.</u>	80-1	
<u>Leontodon autumnalis</u>	20-1	
<u>Luzula spicata</u>		80-1
<u>Myosotis arvensis</u>	80-1	
<u>Oxyria digyna</u>	20-1	
<u>Plantago lanceolata</u>	40-1	
<u>Plantago maritima</u>		20-+
<u>Polygonum viviparum</u>		X
<u>Poa pratensis</u>	20-1	
<u>Ranunculus acris</u>	100-2	X
<u>Rumex acetosa</u>	100-1	40-+
<u>Rumex acetosella</u>		X
<u>Salix herbacea</u>		X
<u>Saxifraga caespitosa</u>		X
<u>Sedum rosea</u>	40-1	
<u>Silene acaulis</u>		X
<u>Silene maritima</u>	20-1	80-1
<u>Stellaria media</u>	40-+	100-1
<u>Thymus drucei</u>		20-1
<u>Triplurospermum maritimum</u>		60-1

Maling nr 8 er ís hálfrö-
inni skridu í þátri lunda-
laggðar. Allt frá lunda-
num sjálf á vestri ley.
eins og Angelica archan-
gelica og Stellaria media.
Maling nr. 13 tekur upp
á fjallinu og þar nær
mælingum eftir nokkurn
stórt svæði. Jarðvegur er
sundinn og grófur. Halli
5° til suðurs. Því er um
að ræða uppjök sem er
farir að gróa upp aftur.

Flag. (F)

Koenigia islandica - Equisetum arvense society.

	15
<u>Agrostis stolonifera</u>	250-1
<u>Cardaminopsis petraea</u>	50-1
<u>Cerastium alpinum</u>	50-1
<u>Cerastium fontanum</u>	25-1
<u>Epilobium collinum</u>	25-+
<u>Equisetum arvense</u>	100-1
<u>Eriophila verna</u>	25-1
<u>Festuca rubra</u>	50-1
<u>Galium pumillum</u>	25-1
<u>Koenigia islandica</u>	100-1
<u>Rumex acetosa</u>	25-1
<u>Spergula arvensis</u>	25-1
<u>Stellaria media</u>	25-1
<u>Thymus drucei</u>	X

Mold og mætur uppi á fjallinu.
Eftir mjög gamalt uppjök sem er
að byrja að gróa upp. Halli ca 5°
til austurs

Hvannstöð Angelica decodes. (A)

	6	6B
<u>Agrastis canina</u>		100-4
<u>Richardella sp.</u>	40-1	40-2
<u>Angelica archangelica</u>	100-5	100-4
<u>Anthoxanthum odoratum</u>		100-1
<u>Ceratium fontanum</u>		30-1
<u>Equisetum arvense</u>	60-1	100-2
<u>Galium verum</u>		100-1
<u>Geranium silvaticum</u>		X
<u>Hieracium sp.</u>		20-+
<u>Ligusticum scoticum</u>	X	
<u>Plantago lanceolata</u>		100-1
<u>Poa pratensis</u>	60-2	80-1
<u>Polandilla arvensis</u>		60-1
<u>Ranunculus acris</u>	100-1	100-2
<u>Rumex acetosa</u>	20-2	100-2
<u>Rumex acetosella</u>		X
<u>Silene maritima</u>	100-1	20-+
<u>Taraxacum sp.</u>		20-+

Malinguð leikin í grjólli
steridu með Ca. 40% halla,
upp undir klabbabelli í
auðveldis fjallinu.
Fyrri malinguð, nr 6 er latín
í mjög þéllu hvannstöði, og
þar er undirgröðurinn lítil
Summi malinguð er leikin
í skjótri sama hvannstöð
þar sem hvannstær vara
ekki jafn þétt. Hér er þar
sem stæva ofstigið að ræða
sama gróðurinn að ræða
nema hvað undirgröðurinn
nær meiri vexti vegna
meiri þéttu. Geranium silvaticum
er myndast sumis slæðs
Hvannstöðin klabbabelli með
mikilli þéttu í jafri hvann
stöðinni.

Hvannstöðin er mjög algengt gróðurlandi í Reykjafjallinu austur
an megin. Einkunn er það undir klabbabellum og í sylfum
í klabbunum, allt upp undir ofstu krönnu. Ástæðan fyrir
þessu þessu hvannstær er líklegast sú að jarðvegurinn
er sakari undir kjörgrunum og kjörsemari vegna áburðar
kjörgrunna. Hvannstöðin er þéttast næst klabbabellunum,
en gefur niður oflu þéttunum. Þó gefur það vísir all þétt
í hvorum milli stönda allt niður að fjallarótunum.

Cliff vegetation. (C)

Mikil klabbabelli eru í auðveldis fjallinu, ~~með~~ með
eru þverhnyggir harnar ofar í altri fjallshlédinni. Sumastæðar
eru kjörgrin alveg í sjó fram og kindra grógu með klabbunum
krönnu fjallis. Mikil er af fugli í kjörgrum þessum og
margur áburður fyrir gróður þar af leiddi, þar sem harnar
þrífst, en þar er einkunn í kjörgrum sylfum sem eru í
kjörgrum. Eins og áður er sagt er Angelica archangelica
vísir í þéttum stöðum á klabbabellum og Sedum rosea er
vísir einnig mikil á sylfum, í þéttum krönnu.

Hér fara á eftir hris legundaliðar og í klabbunum, ~~með~~ með
í þverhnyggju kjörgru í auðveldis hlédinni, en sú seinni í klabbunum
vísir vegun upp fjallis. Þar var mikið jarðvegur í klabbunum
og haldi ekki eins mikill og á fyrri stöðunum.

Cardaminopsis pilosa
Ceratium fontanum
Cystopteris fragilis
Draba incana
Festuca rubra
Luzula multiflora
Luzula spicata
Poa nemoralis

Polypodium vulgare
Sagina nodosa
Saxifraga caespitosa
Sedum acre
Sedum rosea
Silene maritima

Agrostis stolonifera
Blechumella alpina
Blechumella sp.
Angelica archangelica
Cardamine arvensis
Cerastium alpinum
Cerastium fontanum
Cystopteris fragilis
Draba incana
Epidendrum collinum
Eriogon boreale
Euphrasia frigida
Festuca rubra
Galium pumilum
Geranium silvaticum
Hieracium sp.
Luzula spicata
Myosotis arvensis
Oxyria digyna
Parnassia palustris
Phleum alpinum

Ranunculus vulgaris
Plantago maritima
Poa alpina
Poa pratensis
Polygonum viviparum
Ranunculus acris
Rumex acetosa
Rumex acetosella
Sagina nodosa
Sanifraga caespitosa
Sanifraga nivalis
Sanifraga oppositifolia
Sedum acre
Sedum rosea
Sedum album
Selaginella selaginoides
Silene acaulis
Taraxacum sp.
Thymus drucei

Angelica archangelica og Geranium silvaticum eru saman
sums stadar á hlekkasýðum þar sem þessi liði var tekið.

Strandgróður Beach vegetation (B)

Þegga vegna fjallsins þ.e. austan og vestan er
sandströnd fyrir opnu hafi Grödurlaus strönd er á
lengdu helldu þegga vegna (BE) en síðan telur við Belld
af strandgróði. Á vestanverðu eru þetta gróðurlandi sett saman
af Sagittaria Elymus arenarius, Calla maritima, Mertensia
maritima og Minuartia peploides. Þar er gróðurinn frekar
dröfður gagnstætt þar sem er austan megin fjallsins.
Á austanverðum eru melkólar og Elymus arenarius þar
einkennisdeqund. Einnig er mjó sama er síðan melkóla, en
nær sjónum sem maxin er Cacile maritima, Minuartia peplo-
ides og Mertensia maritima einöngu, og þar er gróðurinn
dröfður lítil og vestan megin.
Melkólanir eru allveg að roðum fjallsins og þar sem
þar mæla fjallshlidinni hefur meirast síðast gróðurlandi
sem mjög erfitt er að afmarka á korti þetta er jafar
(Ecotone) milli gróðurlandanna í fjallinu og melkóla, fyrir
síðan. Þetta gróðurlandi er mest áberandi frá því að sjónum
mæli fjallinu og nokkud norður með fjallroðnum (200m)
(2-300m) Tegundastíðinn sem hit þar á eftir, er tekið í þessu
gróðurlandi. Þessar þessara tegunda finnast íðjmelkóla og á
þangli ein og ein planta. Í jafnunum eru þar hino vegar
fléstar ~~melkóla~~ áberandi.

Í jafnunum er Rumex acetosella í tölu
melli melkóla, og gróðurlandið hefur
sig á gróðurlandinu fjallsins á sandinn
Equisetum arvense er einnig algeng og Potentilla
anserina alar sumstæðar gróður á
gróðurlandið, einkum nær fjallshlidinni.

Agrostis pectinifera
Angelica archangelica
Anthoxanthum odoratum
Calula maritima
Caprella hirsuta pastores
Ceratium foetidum
Elymus arenarius
Equisetum arvense
Euphrasia frigida
Festuca rubra
Mertensia maritima
Mimulus reptans
Plantago lanceolata
Plantago maritima
Poa pratensis

Potentilla anserina
Ranunculus acris
Rumex acetosella
Rumex acetosa
Rumex domesticus
Silene acaulis
Silene maritima
Taraxacum sp.
Triplurospermum maritimum
Thymus drucei

References.

1. Fridriksson, Skúla, Björnsson, P. H., and Sveinbjörnsson, B. (1971).
 "On the Vegetation of Heimaey"
 Survey Research Progress Report VI.
2. Hylander, Nils, (1955)
 "Förteckning över Nordens växter, 1. Karlväxter"
 (List of plants of NW Europe, 1 Vascular plants),
 Lund, Sweden.
3. Love, Askell, (1970) "Íslenska ferðaflóra"
 Almenna Bókafélagið Reykjavík

SURTSEY CONFERENCE

held at the Zoological Institute, Lund, Sweden
September 24th to 25th, 1971.

P r o c e e d i n g s

Program, see Appendix I.

Participants, see Appendix II.

The content of the papers presented are either already published or will be so in a near future, mainly in the Surtsey Research Progress Reports, Reykjavík. They are therefore not accounted for here.

The plans for future investigations discussed at the end of the second day resulted in the following recommendations, which were unanimously agreed upon.

(1) Protected areas. A number of such areas, of appr. 5 x 5 or 10 x 10 meters, should be selected and fenced in the most vegetated parts of the craters. One such, marked in 1970, had got its vegetation destroyed by overheating. The selection of suitable areas was postponed to July, 1972 (see below).

(2) The plastic tubs erected by Dr. B. Maguire, Jr. The Board of the Surtsey Society had already decided that these experiments should discontinue. Sturla Fridriksson agreed to see to it that the equipment be destroyed.

(3) Measures against the contamination by man. One copy of the leaflet printed by the Surtsey Society and containing instructions for visitors, should be sent to each of the participants of the conference for possible amendments. Sturla Fridriksson agreed to arrange this.

(4) Publications on Surtsey. The Surtsey Society was recommended to compile an annual list of all publications on research on Surtsey, appearing outside the Progress Report, and to distribute this among all scientists involved.

(5) Specialists on Bacteria and Terrestrial Fungi. The need to find and encourage suitable specialists in these fields was urged.

(6) All participants at the conference agreed to make plans for meeting on Surtsey in the first week of July, 1972.

Lund, 8.X. 1971.

Carl H. Lindroth

Högni Bödvarsson

Meteorological Observations in Surtsey 1971

The observations were carried out during the period 14 June to 4 September in a similar manner as in previous years. Climatological observations were made at the site above the field station, and continuous registration of temperature and humidity were made at the same place. Wind registrations, measurements of soil temperature and air temperature near the ground were made on the sandflat east of the field station.

It is planned to make a summary of observations made at Surtsey, including treatment of the observations made in 1970 and 1971, some time in 1972 or 1973.

26. 6. 1972.

THE BIOMASS OF MOSS ON SURTSEY IN 1971

by

Sturla Fridriksson

The organic matter produced on the island of Surtsey has been negligible up to the present. It has mostly been in the form of plant material produced by the few individuals of vascular plants, mosses, lichens and the microorganisms which are mainly confined to the moist areas at the craters. Consumers are still very few. Of all the organisms in the community the mosses are becoming the most abundant. And, in some parts the colonies were so dense and productive that the areas have been called "the green spots on Surtsey." It is of interest to follow the production of organic matter of these colonies from an early stage in its development.

Quantitative measurements of moss from different areas were undertaken in September 1971. Samples of moss were collected from three areas which had the densest moss growth. The collection was performed in such a way, that samples were taken from an area of 0.25m^2 at three sites in quadrats J-8, K-18 and M-11. The samples were dried at 100°C - 105°C for a few hours; weighed and burned at ca. 550°C .

The calculated biomass from each area was as follows:

Biomass of moss from Surtsey in 1971 in g/m²

Quadrat	Sample	g/m ²	Average
J-8	1	0.318	0.338
	2	0.372	
	3	0.323	
K-18	1	0.185	0.196
	2	0.230	
	3	0.173	
M-11	1	2.299	1.020
	2	0.235	
	3	0.528	
Total Average			0.518

The areas on Surtsey with this maximum of 1g/m² are yet very small. Other areas of moss have a much lower biomass, but most of the dry land on surtsey has no measurable biomass at all.