Vegetational development in the Faroes from 10.000 BP to the present

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In this paper three pollen diagrams from the Faroe Islands are presented; one from Saksunarvatn and two from Hovi. They cover the time from 10.000 BP to the present. The first vegetation was a fell field vegetation. In the middle of the Preboreal, Betula nana immigrated, had a short maximum and subsequent decline due to climatic changes. From the end of the Preboreal and to the present, grasses and sedges are by far the most dominant pollen taxa. From Boreal and up to man's arrival, Juniperus and Salix phylicifolia covered large areas of the lowland. During the Atlantic and the Subboreal, Calluna became important. Besides, a tall herb vegetation persisted until the land occupation by man. One of the diagrams from Hovi shows the development from 1350 BC to the present.

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In this paper three pollen diagrams from the Faroe Islands are presented and the vegetational development from 10.000 BP is described. Late Weichselian deposits have not been found. The localities are Lake Saksunarvatn and Hovi A and B (fig. 1).

Methods and pollen identification

The material was obtained by coring and by taking samples from an open profile. This is described more closely later, where the three pollen diagrams are discussed.

The preparation technique has been the same for all samples. They have been treated by the method described in Fægri and Iversen's Textbook of Pollen Analysis (1966): KOH, HF, HC1, acetolysis, ethanol, benzene and, finally, silicone oil. An Ortholux microscope was used, and normally about 600 pollen and spores were counted pr. sample.

Pollen identifications. *Betula.* At Hoydalar it was found, by size measurements of *Betula* pollen diameter, that the local *Betula* population was *Betula*

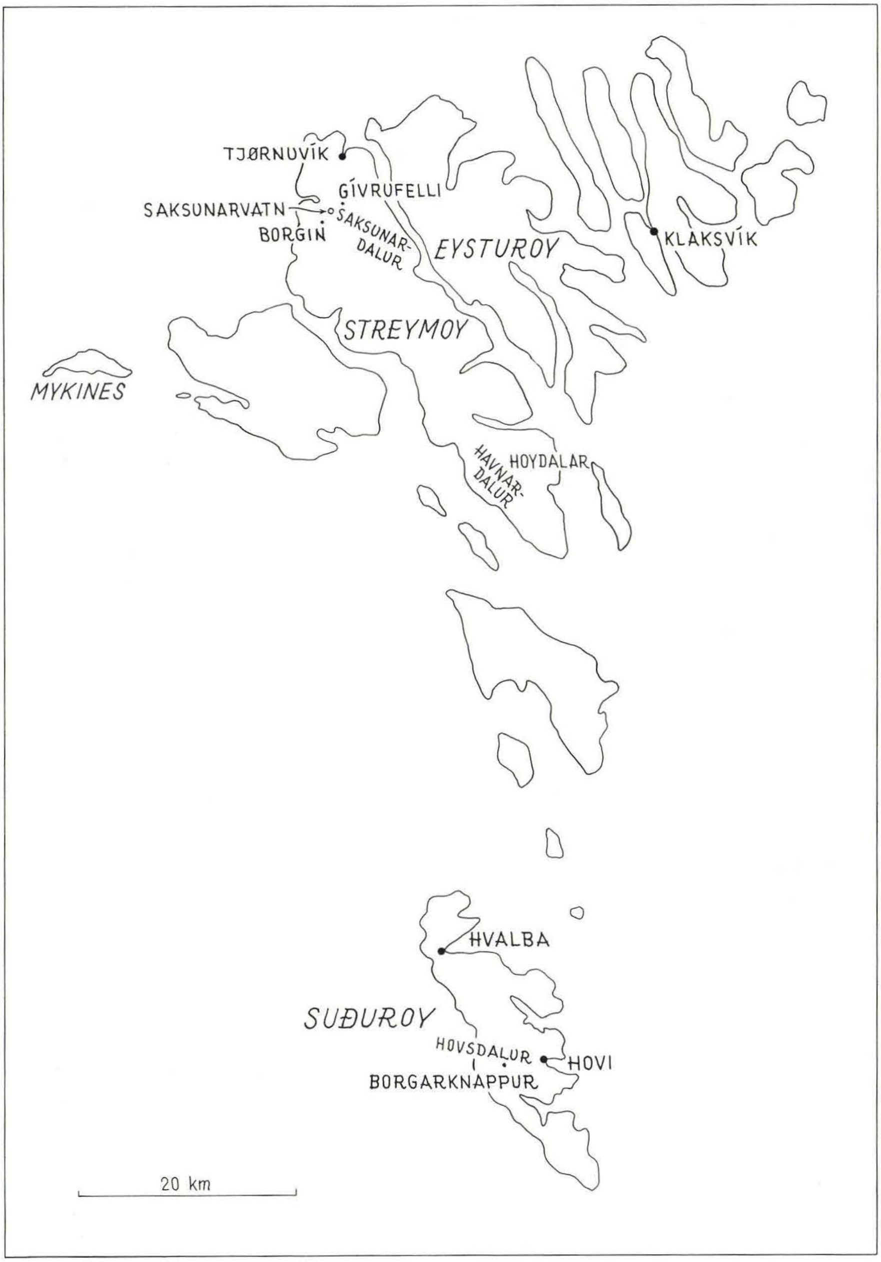

Fig. 1. Faroe Islands with the localities mentioned in the text.

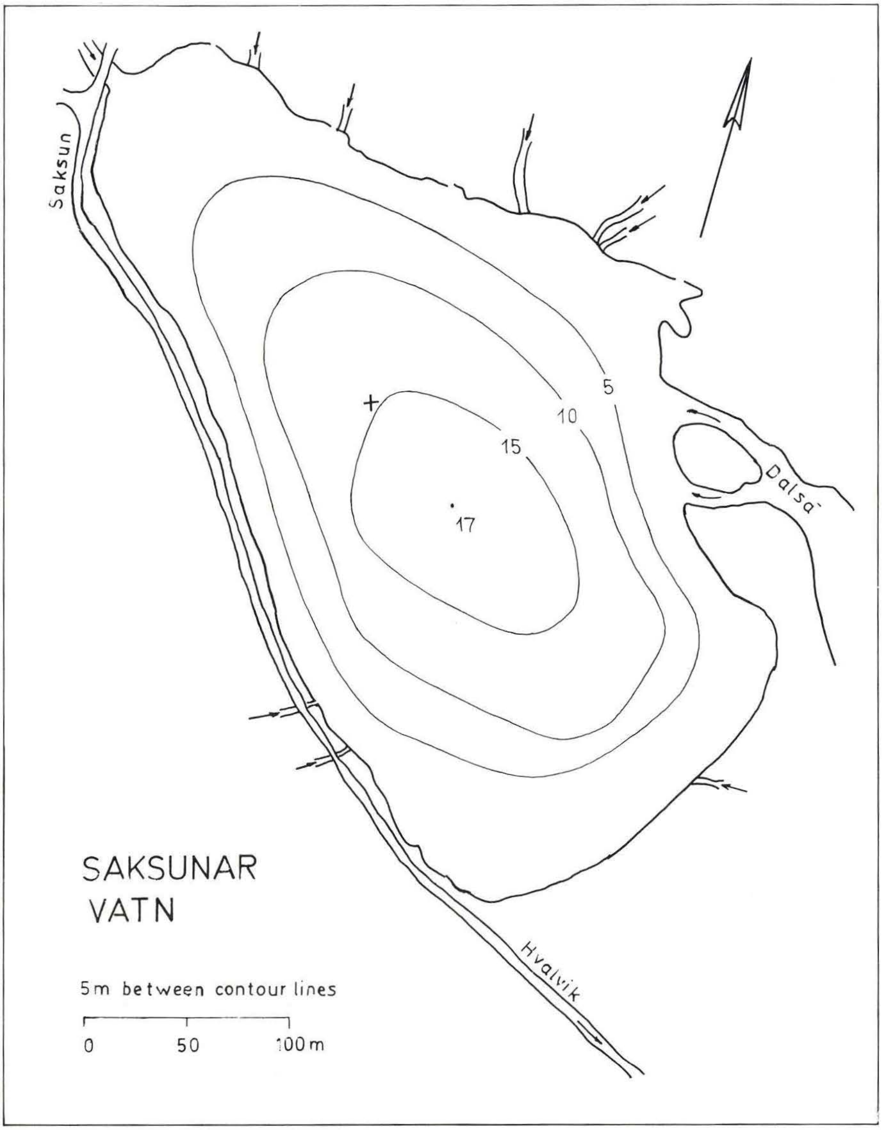

Fig. 2. Sketch plan of Lake Saksunarvatn with bottom topography. Coring point at x. From S. í Dali, Uppmáting av vøtnum í Føroyum, 1977.

nana (Jóhansen 1968). As the peaks of the *Betula* curve in the two diagrams presented here are of the same age, I found it unnecessary to repeat the size measurement procedure. Further, because the samples, when counted, had been stored for different lengths of time (from 0 to 10 years), as well as at different temperatures (+ 5 to about + 15°C), a repetition would have yielded unreliable results. I have not been able to separate *Oxyria* and *Rumex acetosa* on morphological criteria. I presume that most of the oldest pollen of this type is *Oxyria* and most of the youngest is *Rumex acetosa.*

Dryopteris in the diagrams also includes *Athyrium.* The perine was always lacking.

The other pollen taxa which are identified to species level, genus or higher taxonomic rank can be seen in the diagrams, or in the complete list of pollen and spore types not drawn in the two diagrams. In the diagram Hovi B, all pollen taxa are included.

Lake Saksunarvatn

Lake Saksunarvatn is situated in the 10 km long Saksunardalur on Streymoy which runs in NW-SE direction. The lake is 17 m deep and its height above sea level is 23 m. A sketch plan (fig. 2) shows the bottom topography, size of the lake and the coring point (Dali 1977). Saksunardalur is peat covered, while the area around the lake is rather bare with rock outcroppings, scree and a thin peaty layer here and there. A block diagram (fig. 3) gives an impression of the topography of northern Streymoy and Eysturoy (Schou 1949). The highest mountains around Saksunarvatn – Borgin and Gívrufelli – are both 640 m high.

Sampling methods

The coring was made from a pontoon, and a core of 36.75 m was obtained without reaching solid rock or moraine. The material was taken up into 1 or 0.5 m long iron tubes with a diameter of 78 mm. The cores were transferred to plastic tubes, sealed with wax at both ends and closed. The tubes were later cut longitudinally into two halves. One half was stored in a cool room for eventual future use. From the other half, samples for pollen, macroscopic and chemical analysis, and samples for radiocarbon datings were taken. In this paper only the result of pollen analysis and the radiocarbon datings (Table 1) will be described and discussed.

The profile

The entire core was 36.75 m. Only 21.75 m has been used in this study. The uppermost 15 m of sediment had to be discarded because of serious irregularities during sedimentation. Due to erosion in the catchment area, heavy inwash of terrestric material of different ages has taken place. This was

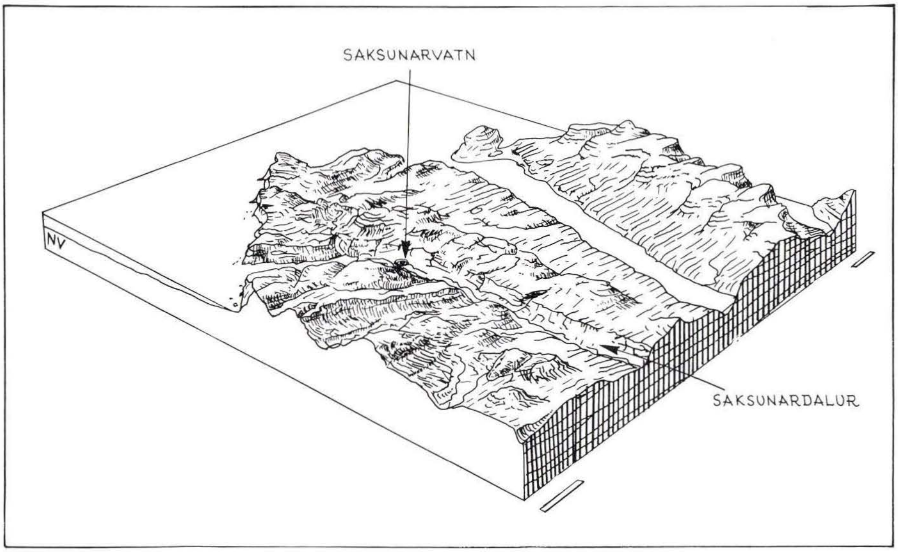

Fig. 3. Block diagram of the northern part of Streymoy and Eysturoy. From A. Schou. Atlas over Danmark, 1949.

documented through close radiocarbon datings and has been described in an earlier paper (Jóhansen 1977). In this paper I shall therefore deal only with the profile from 15 m downwards (Plate 1). From 15 m down to 29.85 m the material consists of homogenous brown lake mud or gyttja. At 29.85 – ca. 30.30 m, a layer of black volcanic ash (from Iceland) was found. Under the ash layer, from 30.30 – ca. 30.75 m there was a layer of clay. Under the clay layer, we again have brown lake mud down to about 32.30 m, where it gradually begins to change into clay. (In the paper mentioned above, the depth of the ash layer was unfortunately incorrectly stated).

The pollen diagram

The pollen diagram (Plate 1) has been divided into 5 local pollen assemblage zones, S 1–5.

The lowermost part of the profile – from 34.00 m to 36.75 m – is quite minerogenic and contains no pollen and cannot be dated.

Table 1. The radicarbon datings from Saksunarvatn, (all uncalibrated) drawn on the diagram Plate 1. Depth of water, 14 m included.

Saksunarvatn		
K–2157	28.94–29.01 m	2890 ± 100 BP
K–2321	30.99–31.07 m	3320 ± 100 BP
K–2322	32.02–32.07 m	3680 ± 100 BP
K–2323	33.00–33.10 m	3780 ± 100 BP
K–2158	34.70–34.81 m	4140 ± 100 BP
K–2324	34.93–35.03 m	4310 ± 100 BP
K–2325	36.24–36.28 m	4520 ± 100 BP
K–2326	38.10–38.20 m	4930 ± 100 BP
K–2327	39.11–39.21 m	5330 ± 100 BP
K–2328	40.33–40.41 m	5790 ± 100 BP
K–2329	40.97–41.07 m	6190 ± 100 BP
K–2330	42.04–42.12 m	7240 ± 100 BP
K–2331	43.05–43.13 m	8230 ± 100 BP
K–2159	44.75–44.83 m	9180 ± 140 BP
K–2332	45.22–45.32 m	9380 ± 130 BP
K–2160	45.99–46.10 m	9390 ± 150 BP

Zone S 1

Depth 31.25 – 34.00 m. Age ? – 9300 BP

Betula nana – Sedum – Salix – Oxyria/Rumex acetosa – Poaceae.
Betula nana dominates with up to 40% of the total pollen and spore sum. *Sedum* is important with max. 25%. *Oxyria* lies at 3% at the bottom, has a peak of 18% and decreases to 2% at the upper end of the zone. *Salix* (leaves of *Salix herbacea* have been found at this level) rises from 0 at the bottom to 9% in the middle of the zone and decreases at the upper end to 6%. *Poaceae* are of no importance, except for sample 44 where the percentage is 24. In the lowermost sample, *Armeria* lies at 16%. *Dryopteris* lies at 5% in most samples, highest – 16% – at the bottom, falling to 2% in the next spectrum, and then 5%.

Number of taxa: 50, (5 pollen spectra).

Zone S 2

Depth 30.25 – 31.25 m. Age 9300 – 9000 BP

Poaceae – Cyperaceae
This zone is a transitional zone between S 1 and S 3.

Betula nana is extinct. Grasses and sedges dominate from now on. *Sedum* is still important with 10%. In the beginning of the zone, *Plantago maritima* and *Selaginella* occur for the first time. *Dryopteris* goes up to 11%.

Number of taxa: 34 (3 pollen spectra).

Zone S 3

Depth 28.50 – 30.25 m. Age 9000 – 7500 BP

Juniperus – Poaceae – Cyperaceae

Poaceae and *Cyperaceae* dominate with about 60% together.

Juniperus, which in the two preceding zones occurred sparsely (1–2%), increases here to 8%. *Dryopteris* lies at 10–12%, while *Sedum* decreases to 5%. *Huperzia* is at its minimum – 1%. In this zone *Thalictrum (alpinum)* becomes rather common – up to 6%.

Number of taxa: 52, (6 pollen spectra).

Zone S 4

Depth 26.50 – 28.50 m. Age 7500 – 5800 BP

Juniperus – Calluna – Poaceae – Cyperaceae

Juniperus lies at 5%, but decreases to 3%. From the beginning of this zone, *Calluna* becomes a member of the flora around Saksunarvatn. Starting from 1%, it increases to 5%. *Ericaceae* go from 3% to 8%. The Ericaceous pollen has not been specified apart from *Calluna,* but probably includes mainly species of *Vaccinium. Dryopteris* has its Flandrian maximum – 17%. *Succisa* occurs for the first time. Two pollen of *Hedera* were found.

Number of taxa: 51, (6 pollen spectra).

Zone S 5

Depth. 15.00 – 28.50 m. Age 5800 – 3000 BP

Calluna – Juniperus – Poaceae – Cyperaceae

Poaceae and *Cyperaceae* lie at 40% and 20% respectively.

Calluna is almost steady at 5%. *Juniperus* decreases, but very slowly. In the lower part of the zone, two pollen grains of *Hedera* and three of *Ilex* were found.

Number of taxa: 61, (26 pollen spectra).

Table 2 gives a list of pollen and spores not drawn in the diagram, expressed as percentages of the total pollen and spore sum.

Total number of taxa from Saksunarvatn: 74 (45 pollen spectra).

Table 2. Pollen and spores from Saksunarvatn not drawn in the diagram, plate 1, expressed as percentages of total pollen and spore sum.

											Zone S 5							
Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Land herbs																			
Ambrosia																			
Artemisia																			
Atriplex										0.2									
Botrychium		0.2				0.4						0.4				0.2			
Brassicaceae				0.7							0.2	0.2			0.4				
Caryophyllaceae	0.4	0.2	0.2	0.5				0.4			0.5	0.2	0.4	0.4		0.2	0.4		
Chenopodiaceae																			
Cystopteris																			
Epilobium						0.4				0.2									
Equisetum									0.2			0.2			0.5				0.
Galium		0.2																	
Geranium		0.2										0.2							
Hypericum																			
Koenigia																			
Labiatae					0.2		0.2		0.4		0.2		0.2		0.5				0.
Lotus																0.2			
Pinguicula																			
Polypodium																			
Pteridium		0.2																	
Rosaceae	0.4	0.9	0.2	0.5	0.4	0.4	0.5		0.2		0.4		0.2			0.5			0.
Sagina sp.				0.2															
Saxifraga sp.		0.2	0.2	0.2								0.2				0.2	0.2		0.
Saxifraga nivalis						0.2						0.2							
Saxifraga oppositifolia																			
Saxifraga rivularis						0.4													
Saxifraga stellaris						0.2						0.2							
Scrophulariaceae				0.2					0.2										
Sphagnum	1.6	2.9	1.8	0.4	1.4	1.8	0.7	1.4	0.5	0.4	0.7	4.8	1.6	0.2	0.2	1.8	2.0		2.
Thymus						0.2													
Urtica dioica																			
Indet.	0.2	0.9	0.4		0.5						0.5		0.7			1.4			0.
Corroded	1.3															0.2			0.
Aquatics																			
Callitriche																			
Eleocharis palustris																			
Isoetes echinospora														0.2	0.2	0.2	0.2		
Isoetes lacustris		0.2	0.2										0.2		0.7	0.2	0.4	0.4	0.
Menyanthes																			
Myriophyllum alterniflorum	0.2						0.2	0.2											
Potamogeton			0.2														0.5		
Trees																			
Alnus	2.9	1.4	1.1	0.5	1.8	1.1	1.3	1.8	2.2	1.4	1.4	1.4	1.3	0.7	1.1	0.5	0.9	1.6	1.
Corylus	2.0	4.5	1.1	1.4	2.3	0.5	2.7	1.3	3.1	1.3	2.7	2.2	2.0	1.1	4.0	1.8	1.8	1.6	2.
Fraxinus									0.2				0.2						0.
Hippophae																			
Quercus	0.2	0.2	0.2	0.5						0.2			0.4	0.4		0.4	0.4	0.4	
Picea																			
Pinus	1.8	0.7	3.4	0.4	0.5	0.5	1.3	0.5	0.5	0.5	0.7	0.7	1.4	0.2	1.1	0.5	0.7	0.5	1.
Tilia								0.2		0.2							0.4		
Ulmus	0.2		0.4	0.2	0.2	0.2				0.4		0.5	0.2	0.4		0.2	0.5	0.5	0.
Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

							Zone S 4						Zone S 3					Zone S 2			Zone S 1				
)	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
																					0.2				
2															0.2					0.2			0.4	1.1	0.2
																								0.5	
2												0.4			0.2	0.2					0.2	0.2	0.2		
						0.4		0.2				0.2	0.2		0.5			0.2	0.4	0.7		2.0	0.9	0.7	
	0.2	0.4				0.4	0.2		0.2	0.2	0.2		0.2	0.2				0.2	0.2	1.1	1.3	0.4	0.4	0.4	0.5
																0.2									0.2
										0.2		0.2											0.4		
																	0.2								
	0.2	0.9		0.4	0.4					0.4			0.4				0.9	0.2					0.2		
2	0.2										0.4													1.1	0.2
																							0.2		
					0.2													0.2	0.2	0.2					
2			0.4		0.2		0.2													0.2		0.2			
														0.2											
									0.2																
								0.2						0.2	0.2		0.2								
2		0.5		0.4			0.4		0.2			0.2	0.2				0.2								
						0.2																	0.7	0.4	
2				0.2						0.2	0.2			0.2	0.5						0.2		0.2		
						0.2																0.2			
																			0.2			0.2	0.2	0.4	
																						0.2			
2																							0.7		
	0.2	0.2								0.4					0.3					0.2	0.2		0.2		0.2
0	1.4	1.8		2.7	2.7	2.0	1.4	2.5	0.7	1.4		1.4		0.2					0.2	0.4	0.5				0.7
																							0.2		
		0.5		0.9			0.4					0.4	0.4				0.2								
							0.7										0.5				0.2	0.4	2.3	0.7	
											0.2														
														1.6	0.2										
			0.2						0.2		0.4				0.2										
.5		0.5			0.2	0.7	1.1		1.3		0.4	0.4		0.2											
							0.2				0.5														
												0.2	0.2	0.4	0.2	0.4		0.4	0.4	0.4		0.5	0.2		
			0.4					0.4			0.4					0.2									
.5	1.1	3.1	1.6	2.3	0.9	1.3	1.4	1.4	1.1	0.9	0.4	1.3	0.7	0.5	0.5						0.4				1.1
.6	2.7	2.5	1.1	3.2	3.1	1.4	2.5	1.4	2.3	2.2	3.4	3.1	3.1	2.7	2.7	3.4	2.9	2.9	1.6	1.8	4.0	0.9	0.7	0.7	1.8
	0.2	0.2				0.2																			
																									0.7
	0.5		0.4	0.4	0.2			1.1	0.2	0.2	0.9	0.2	0.2		0.7				0.2						0.2
												0.2													
.1	0.5	0.2	0.7	0.7	0.9	1.6	2.0	1.4	0.7	1.4	2.3	1.6	1.8	1.6	1.4	1.8	3.6	2.9	2.5	4.8	3.8	4.7	1.8	2.7	1.6
.2				0.2								0.2													
.9	0.4	0.9	0.2	0.2	0.4	0.2	0.2	0.4	0.4	1.1	0.4	0.4		0.5	0.2	0.7	0.7	0.2	0.2		0.2				
)	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Inferred vegetational history

The lowermost 2.75 m of the profile was devoid of pollen and spores, as mentioned earlier. This means that for a time, the area around Saksunarvatn was ice-free but carried no vegetation. Naked rock and moraines were the terrestric environment. We do not know how long this period lasted because no radiocarbon datings could be made on the material. The carbon content lay between 0.04–0.1% (measured at the radiocarbon dating laboratory by H. Tauber). The two lowermost samples which have been dated were from depths 31.27 and 32.06 m, respectively, and the difference in age was insignificant, indicating a high sedimentation rate.

Zone S 1

The first plant immigrants arrive. The number of taxa in the lowermost spectrum is only 16. However, some of these taxa, *Poaceae, Cyperaceae* and *Dryopteris,* represent many plant species. The plants we find are typical pioneer plants like *Sedum, Huperzia, Oxyria, Armeria* (the dimorphic form) and *Salix herbacea.* The soil has been base-rich and favourable to colonization. Evidence of an ice-free period without plants, mentioned above (the clay without pollen), suggests that the plants immigrated from neighbouring countries, but it cannot be stated conclusively whether or not some of them had survived the glaciation in the Faroes.

The widespread occurrence of *Betula nana* – a plant now extinct from the Faroes – is interesting. The percentage lies at about 25% of the total pollen sum and, in one sample, 40%. It has probably not had an areal coverage of that size. From Greenland it is known to be strongly overrepresented. Iversen (1947) has compared the pollen spectra of recent gyttja in two lakes at Godthåbsfjord with the vegetation around the lakes. He found that in lake 1, *Betula nana* was overrepresented with a factor of 4 and, in lake 2, with a factor of 2. Others (Fredskild 1973, Pennington 1979) have also found that *B. nana* is overrepresented in Greenland.

Nevertheless, there can be no doubt that *B. nana* had a wide distribution in the Faroes in the late Preboreal. The history of *B. nana* demands some consideration. It will be discussed on page 132.

Six pollen grains of *Hippophae* have been found. They are supposed to be long-distance transported.

Zone S 2

B. nana has probably disappeared completely. The increase of sedges which had already started in the preceding zone is strengthened and could indicate moister conditions. The grass heaths so well known today are being established. Still much bare ground is left – much more than today, as shown by the importance of *Sedum*. In the screes and rock fissures, species of *Dryopteris* were growing abundantly.

Zone S 3

During the Boreal and Atlantic, the grass heaths became the dominant plant community – at least with regard to pollen production. In the grass heaths of the Faroes today, the most important grass species are *Anthoxanthum odoratum, Deschampsia flexuosa, Agrostis tenuis, Festuca rubra* and *Festuca vivipara*. Further, the following plants are common: *Carex pilulifera, Carex binervis, Carex nigra, Luzula multiflora,* and *Leontodon autumnalis*. The composition of the Boreal grass heaths has probably remained the same until today, but from pollen analysis alone, we cannot be certain.

The high proportion of pollen of *Cyperaceae* was most likely due to *Carex echinata, Carex demissa, Carex nigra, Eriophorum angustifolium* and *Scirpus caespitosus,* all of which are extremely common in wetter areas today.

The most notable change in this zone is the rise of *Juniperus*. From this and other diagrams (Hoydalar, Jóhansen 1975) and Hovi (this paper) and from wood remains, it can be seen that *Juniperus* was widespread in the Faroes during the Boreal, Atlantic and Subboreal. This expansion must be taken as evidence of climatic amelioration, causing *Juniperus* to flower more profusely. This does not necessarily mean that the summer temperature was higher than today, as *Juniperus* grows as far north as Disko in Greenland, where the average temperature in the warmest month, July, is 8°C, while the Faroes today reach 11.1°C for Aug. (warmest month). But it must mean that the summer temperature was higher in this zone than in the two preceding zones.

The other herbs encountered are all common today, and climatically and edaphically they are rather indifferent.

Zone S 4

Calluna now came to the area around Saksunarvatn and attains 5% of total. This is not a sign of climatic deterioration, but indicates that leaching had now led to the formation of acid soils: peat and peat-like soils. *Calluna* in the Faroes clearly prefers southern and southwestern slopes. This is seen today in Saksunardalur where it grows in abundance on the SW slopes, but is lacking on the northern and northeastern side of the valley.

Juniperus has its Flandrian maximum in this zone, indicating favourable temperature conditions. It is, however, not possible to give any figures for the temperature.

A marked increase of *Sphagnum* spores (Table 2) shows that wet areas were spreading.

The other plants do not give any significant information about climatic or edaphic conditions. They were widespread during the entire Flandrian.

Zone S 5

During this long span of time – 2800 C-14 years – only small changes occur. The herb flora was surprisingly constant throughout the zone. It was a stable period where grass- and moorlands were widespread. *Calluna* has a small increase, indicating a steady expansion of moorland. The pollen percentage is low – max 11%. *Calluna* is pollinated by *Taeniopteris ericae,* a species of the Thrips group (Hagerup 1950) and may thus be underrepresented in the pollen rain.

Juniperus has been growing on drier hills and slopes, but never became important in Saksunardalur. The rather small percentages of *Juniperus* in the pollen diagrams from the Faroes including Hoydalar and Hovi (16% max, mostly lower, about 10%), are in contrast with the large quantities of *Juniperus* wood remains which occur in the Faroese peat from this period – Late Atlantic and Subboreal. Jessen (1923) mentions that *Juniperus* wood is found in all low-lying bogs, and that it has been found as high up as 375 m at Klaksvík. It has probably to some degree been sterile copses of *Juniperus* which have grown widely, and were overgrown by peat during the Subboreal. Three radiocarbon datings on *Juniperus* wood from Hvalba, Suðuroy, have been made and gave the following ages: 3380 ± 100 BP, 3660 ± 100 BP and 4210 ± 100 BP (K-999, K-1000, K-1001). The stems were twisted, and clearly the plants had the same prostrate growth as is known from the present *Juniperus communis nana.*

Four pollen of *Hedera* and three of *Ilex* in this and the previous zone (Plate 1) must be considered long-distance transported. From this profile, about 25.000 pollen grains have been counted which gives one *Hedera* pollen per 6.500 pollen grains, and one *Ilex* per 8.000 pollen grains. In comparison, Iversen (1944) found 32 pollen of *Hedera* per 10.000 pollen of trees. As the AP sum for the Atlantic period in Denmark will be very close to the total pollen sum, that means that one *Hedera* pollen was found per approximately 300 pollen grains in Denmark. From these figures, I find it unlikely that *Hedera* and *Ilex* were of local origin in the Faroes.

Further I have, among about 200.000 pollen from the Faroes, only found one *Hedera* pollen apart from these four from Saksunarvatn.

On the other hand, it can not be excluded that one or both of these plants were in fact growing near Saksunarvarn. In that case, the maximum summer temperature has been at least 2.4°C higher than today (Iversen 1944).

Hovi A

The locality at Hovi, Suðuroy, is a former lake which has been filled up, with the recent surface of the bog at 12 m a.s. It is situated in the Hovsdalur, a typical cirque valley (fig. 4) where the highest mountain is Borgarknappur, 574 m. The depth is 840 cm, and moraine was reached at the bottom. The diagram presented shows the pollen content from 100 cm, down to bottom at 840 cm. The material is gyttja from the bottom at 840 cm up to 280 cm, from 280 cm to 100 cm, brown herbaceous peat with *Equisetum* rhizomes. At the depth of 800 cm, there is a black, volcanic ash layer. This is the same as has been found at Hoydalar and Saksunarvatn, dated to 9140 BP and 9180 BP (both ± 160) respectively. This layer has been found in many places in the Faroes (unpublished) and has been petrographically described (Waagstein & Jóhansen 1968). Because a Hiller sampler was used, no samples for C-14 datings were taken.

The pollen diagram

The pollen diagram has been divided into four pollen assemblage zones, Hovi A 1–4 (Plate 2).

Hovi A 1. Depth 780–840 cm

Betula – Huperzia selago – Sedum
Betula ca. 20%, *Huperzia selago* 20–40%, *Sedum* about 14%, decreasing to 4% at the upper part of the zone. *Salix (herbacea?)* lies at 10% at the bottom, but decreases to 5%, and is under 0.5% at the end of the zone. *Caltha, Apiaceae, Dryopteris* type, *Poaceae,* and *Cyperaceae* are all represented with 6–9%. *Myriophyllum alterniflorum* has a maximum of 28%.

Number of taxa: 41, (7 pollen spectra).

Zone Hovi A 2. Depth 690–780 cm

Poaceae – Cyperaceae – (Empetrum – Ericales)
Cyperaceae and *Poaceae* increase to about 20–25%. There is a fall in *Huper-*

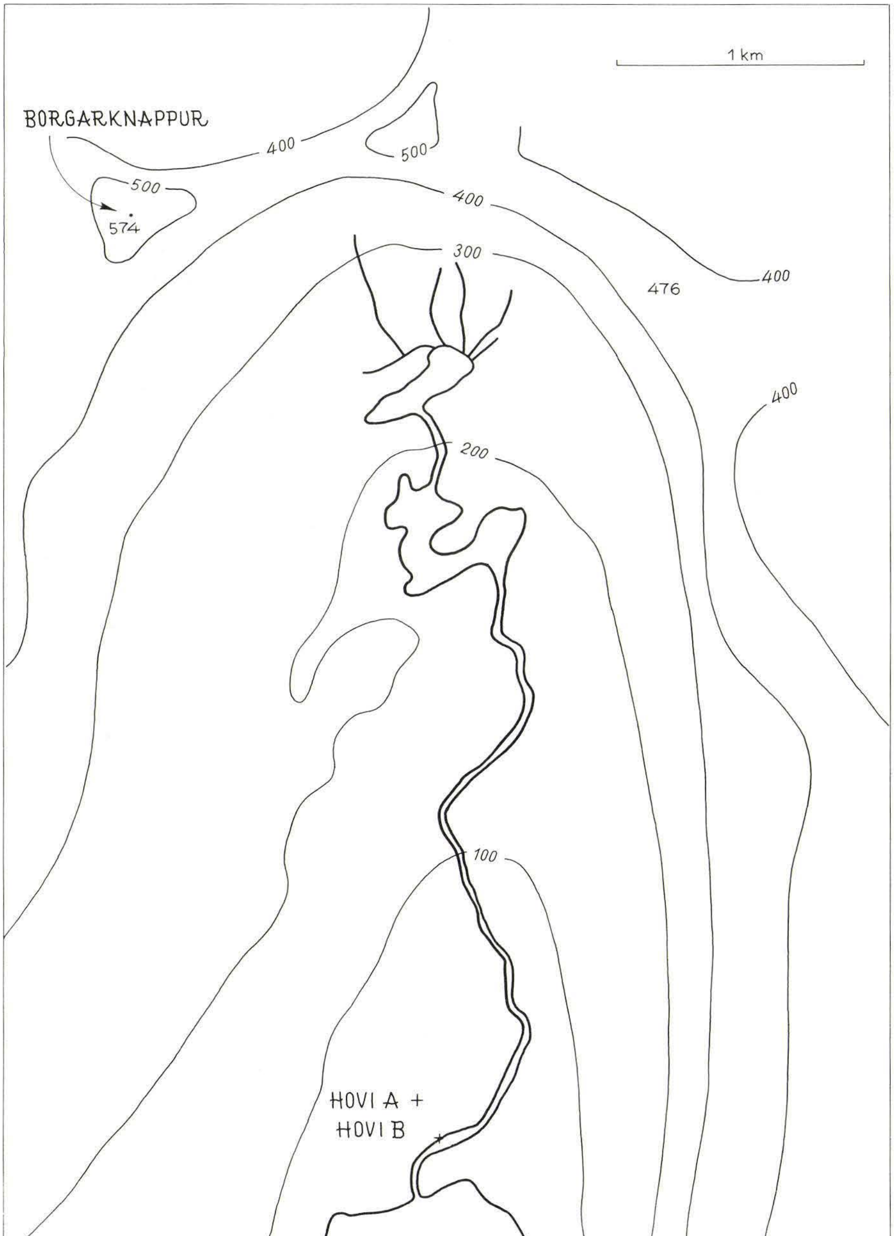

Fig. 4. Hovsdalur.

zia, Sedum, Caltha and *Apiaceae,* and *Myriophyllum alterniflorum.* A remarkable feature is the large amount of *Empetrum, Calluna* and *Ericaceae* pollen. It must be considered of secondary origin – probably from some unknown interglacial deposit which has now disappeared. The occurrence of *"Hystrix"* also points in that direction.

Number of taxa: 34, (6 pollen spectra).

Zone Hovi A 3. Depth 360–690 cm

Poaceae – Cyperaceae – Juniperus – Salix

Dominating are *Poaceae* and *Cyperaceae,* about 30% each. *Juniperus,* which was introduced in the preceding zone, lies at 5–6% throughout zone 3. The *Salix* pollen curve is rising again after the minimum in zone 2. It is considered to be pollen of *Salix phylicifolia,* the leaves of which have been found. The percentages lie at 5%. *Filipendula* increases to about 17% and is important throughout this and the next zone. *Dryopteris* and *Apiaceae* lie at constant levels, 4% and 8% respectively. *Isoetes echinospora* and *I. lacustris* have their maxima in this zone, and are almost totally lacking above and below.

Number of taxa: 45, (11 pollen spectra).

Zone Hovi A 4. Depth 100–360 cm

Ericales – Poaceae – Cyperaeceae

In this zone we have a rise of *Ericales* pollen. At this time, the pollen is local and contemporary, quite analogous with the development at Hoydalar and Saksunarvatn. *Salix* is still important, while *Juniperus* decreases.

Number of taxa: 39, (12 pollen spectra).

Total number of taxa at Hovi A: 74, (34 pollen spectra).

Table 3 gives a list of pollen and spores not drawn in the diagram, expressed as percentages of the total pollen and spore sum.

Inferred vegetational history

Zone Hovi A 1

The oldest part of the diagram corresponds closely to the diagrams from Saksunarvatn and Hoydalar (Jóhansen 1975). Also at Hovi, a pioneer vegetation with *Huperzia, Sedum, Salix herbacea* has prevailed in the Preboreal. *Betula nana* has been growing all over the Faroes during this period. I have found large quantities of B. nana pollen at *Hovi, Hoydalar, Saksunarvatn* and *Havnardalur* (unpublished, see map, fig. 1.). I have not found macrofossils, as

Table 3. Pollen and spores from Hovi A not drawn in the diagram, plate 2, expressed as percentages of the total pollen and spore sum.

	Hovi A 4												Hovi A 3						
Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Land herbs																			
Ambrosia																			
Armeria		0.2																	
Artemisia	0.2			0.2						0.2									0.
Atriplex																			
Botrychium															0.2				
Brassicaceae			0.7	0.4	0.2				0.2		0.4		0.2	0.4	0.5		0.2	1.4	
Caryophyllaceae	0.9	1.6			0.2	0.4	0.2	0.4		0.2			0.2	0.2		0.2			0.
Cystopteris		0.2																	
Epilobium																			
Equisetum	1.1	0.4	0.4		0.2		0.2			0.2		0.4			0.2			0.7	0.
Geum	0.2																		
Hypericum														0.2					
Koenigia																		0.2	
Liguliflorae		0.7	0.4	0.4	0.4		0.2				0.2						0.2	0.2	0.
Ligusticum														0.2				0.2	
Liliaceae								0.2											
Lotus													0.2						
Lycopodium alpinum		0.2		0.5															
Plantago lanceolata								0.2											
Polypodium	0.5	1.3	0.5	0.9	0.4	0.4	0.2	0.9	0.5	0.5	0.9	0.2		0.5	0.5				0.
Rhinanthus															0.2				0.
Rosaceae				0.5		0.4													
Sagina																			
Saxifraga nivalis														0.5					
Saxifraga oppositifolia															0.2	0.2			
Saxifraga rosacea	0.2		0.2											0.4					
Saxifraga stellaris																			
Saxifraga sp.																			
Scrophulariaceae		0.2	0.2											0.4	0.2	0.4			0.
Selaginella			0.2					0.2											
Thalictrum				0.2					0.2		0.4				0.2				
Tubuliflorae			0.2										0.2						
Urtica																			
Concealed	1.1			0.2															
Corroded			0.5	0.2							0.2			0.2					0.
Indet.		0.4																	
Aquatics																			
Callitriche														0.7		0.2	0.2		
Eleocharis palustris	1.4								6.6	4.1		0.9	1.8		4.9	5.6		1.4	3.2
Menyanthes		0.2			0.4					0.2									
Potamogeton							0.4				0.5		1.1	2.2		0.2	0.7	0.7	0.
Sparganium												0.2							
Trees																			
Acer		0.2																	
Alnus	0.5	1.6	0.4	0.4	0.2	0.2	0.5	1.1	1.1	1.6	0.4	0.5	1.6	0.7	0.4	0.7	0.2	0.9	1.
Corylus	0.5	0.7	0.7	0.5	0.2	1.1	1.1	1.4	1.4	1.8	0.9	1.4	0.9	2.2	2.3	2.0	1.4	0.2	1.
Fraxinus													0.2						
Pinus	0.9	1.3	0.2	0.5	1.3	1.5	1.3	0.7	1.1	1.1	0.4	1.4	0.7	0.5	0.9	0.5	0.7	0.9	0.
Populus																			
Quercus	0.7	0.2		0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.4	0.9	0.4	1.4	0.2	0.7	0.7	0.
Sorbus								0.2											
Tilia												0.2				0.2			
Ulmus		0.2			0.2					0.2	0.4	0.4	0.4	0.4	0.4	0.5		0.7	0.
Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

			Hovi A 2						Hovi A 1				
21	22	23	24	25	26	27	28	29	30	31	32	33	34
										0.2			
		0.2							0.4			0.4	0.2
									0.2	0.2			0.2
					0.2				1.3	0.5	0.4	0.4	0.7
0.2					0.2		0.2		0.7	0.4	0.2		1.1
		0.4	0.1		0.1		0.1		0.5	0.2	1.3	0.7	0.4
		0.2	0.2	0.2		0.2		0.2		0.2		0.5	0.4
0.2	0.7	0.4			0.2	0.2							
										0.2			0.2
									0.4	0.2	0.5	0.5	0.7
0.2	0.2		0.2								0.2	0.2	
						0.2	0.2					0.5	
0.2	0.2			0.2	0.4		0.4						0.2
	0.2		0.4	0.4		0.5		0.2	0.2		0.2	0.2	0.2
		0.2											
					0.2				0.2	0.7	1.4	0.7	0.5
													0.5
													0.2
													0.2
													0.4
									0.2	0.2		0.4	0.2
		0.2									0.2	0.5	
	0.2	0.2	0.2										0.5
	0.2					0.2	0.4						0.5
			0.7					0.2	1.3			0.2	
						0.4	1.3	0.2		0.2	0.7		0.4
									0.4			0.2	0.5
												0.5	
3.6	1.3	5.3		0.5									
0.2		0.2											
0.5	0.9	1.1	0.2	0.2	0.2	0.5		0.2					
1.4	0.5	3.6	6.3	3.5	2.9	2.0		0.7			0.5		
									0.2				
0.9	2.5	2.3	2.2	1.8	1.3	1.3	1.3	1.3		2.2	1.8	0.9	3.1
													0.2
0.2	0.4	0.9	0.2										
	0.2												
0.2	0.7	0.4	0.5		0.5	0.4	0.2	0.2					0.2
21	22	23	24	25	26	27	28	29	30	31	32	33	34

the material was obtained by coring, which did not yield very large samples. See discussion of *Betula nana* on page 132.

Zone Hovi A 2

With respect to the contemporary vegetation, this zone is identical with zones S 2 and H 3 (Hoydalar). The grasses and sedges became dominant. The remarkable thing in this zone is the large amount of *Empetrum* and *Ericales* pollen-tetrads. As mentioned, the cysts of Dinoflagellates, called *Hystrix* are also found. None of these can be of primary origin, but must have been washed out from older deposits. There are Tertiary deposits in the mountains around Hovi – the Coal bearing Sequence (Rasmussen & Noe Nygaard 1969). The pollen and microorganisms in this zone might perhaps be of Tertiary age, but the almost complete absence of Conifer pollen does not make a Tertiary origin very likely. It should probably be referred to some interglacial deposit which has now disappeared or, at any rate, is not known.

Zone Hovi A 3

During this period, the Faroe Islands have had the most extensive cover of shrubs of any time since the last glaciation. Just as at Hoydalar and Saksunarvatn, *Juniperus* has its maximum occurrence. Even though there are no C-14 datings here, this zone is broadly synchronous with S 3–5 and H 4: 9.000 – 3.000 BP. *Juniperus* has grown on all drier habitats in the Hovi valley. Wood remains are very common in the peat layers here, and are found up to heights of 200 m. On more moist soil and along the riversides, *Salix phylicifolia* has grown. Large quantities of leaves have been found in the deposit at Hovi, and fossil *S. phylicifolia* has been found by Jessen and Rasmussen (1922) and Rasmussen (1948). This plant has thus been very common in the Mid Flandrian. As is seen in the Hovi B diagram, it suffered a severe decrease when people settled at Hovi and, today, is restricted to a few localities (Hansen 1966).

A few pollen grains of *Sorbus* and *Populus* have been found both at Hoydalar and Saksunarvatn as well as Hovi. It is very difficult to draw definite conclusions from a few pollen grains (cfr. *Ilex* and *Hedera* at Saksunarvatn) but taking into account the fossil and recent record of it from Shetland (Jóhansen 1975, Spence 1979) and recent from Iceland (Grøntved 1942), they might be expected in the Faroes. During this period there was also an expansion of tall herb communities where *Filipendula ulmaria* was dominant. *Caltha,* members of *Apiaceae* and ferns of *Dryopteris* type were also important.

Zone Hovi A 4

The edaphic changes which are seen in other parts of the Faroes at this time (ca. 2.000 BC) are also seen at Hovi. *Calluna* is slowly increasing to about 10%. Other *Ericaceae* pollen are also increasing. This is a sign of acidification of the soil. However, willow shrub and the tall herb vegetation persisted during the rest of the time represented in this diagram, and exist until people arrived at Hovi in the Viking age (Diagram Hovi B, Plate 3).

To conclude the Hovi A diagram, it can be stated that, while confirming results from Hoydalar and Saksunarvatn, it displays some differences, especially the great importance of willow and tall herb communities.

Hovi B

The uppermost part of the Hovi profile, Hovi B, is from an open section. The length of the profile is 100 cm and the material is herbaceous peat. The age of the bottom of the profile is 1350 BC, and the top is of the present day. No attempts have been made to divide the diagram into assemblage zones. I have only drawn one horizontal line, which I call the landnam horizon. The date of this horizon is approximately AD 900. The radiocarbon datings are corrected according to Clark (1975), Table 4.

Table 4. The radiocarbon datings from Hovi B. Calibration according to Clark (1975).

Hovi B		
K–2659	2–6 cm	1.12% of modern
	C^{13} = – 25.5‰	
K–2950	20–22 cm	580 ± 65 BP
	C^{13} = – 26.6‰	AD 1385 Cal.
K–2951	32–36 cm	910 ± 70 BP
	C^{13} = – 26.4‰	AD 1060 Cal.
K–3067	39–40 cm	1190 ± 70 BP
	C^{13} = – 25‰	AD 770 Cal.
K–2952	60–62 cm	1770 ± 75 BP
	C^{13} = – 24.9‰	AD 235 Cal.
K–2953	80–82 cm	2330 ± 80 BP
	C^{13} = – 25.0‰	BC 440 Cal.
K–2660	97–100 cm	3040 ± 80 BP
	C^{13} = – 23.8‰	BC 1350 Cal.

The pollen diagram

The lowermost part of the diagram (Plate 3), is a continuation from Hovi A. *Juniperus* lies at 5%, but decreases slowly and, after 400 BC, it only occurs sporadically. *Salix (phylicifolia)* also decreases at the boundary between Subboreal and Subatlantic. This is an indication that we also have a climatic deterioration in the Faroes at the Subboreal-Subatlantic transition. The tall herb communities were still widespread. These communities consisted of *Angelica silvestris, Archangelica officinalis,* and ferns which cannot be identified, but *Dryopteris* and *Athyrium* were probably the most common. *Sedum,* most probably *S. roseum,* was common and so were *Filipendula* and *Caltha. Polypodium* was growing on the drier hills around the bog. On the bog surface, grasses and sedges dominated.

The landnam and the period afterwards

I have placed the landnam horizon at the level where *Plantago lanceolata* occurs for the first time. This happens sometime between AD 850 and 900, i.e. Viking age. This is in very good accordance with written sources, namely the Icelandic Færeyingasaga. There, it is stated that Hovi is a Viking age settlement, where one of the Norse chieftains, Havgrímur, lived. The first Norse colonization in the Faroes is generally supposed to have taken place about AD 825.

Barley (*Hordeum*) pollen is not found until the level of Medieval age. Where the fields were placed is not known, but they have probably been in the oldest part of the present village, which lies 1 km away from the bog. There was no cultivation near the locality until much later, and the bog today is still uncultivated, being used as pasture for sheep.

Plantago lanceolata pollen is found in Faroese deposits from about AD 600–650 (Tjørnuvík and unpublished results) and indicates the arrival of the first inhabitants, as it is always found together with cereals and other anthropochorous plants, e.g. *Rumex obtusifolius* and *R. longifolius.* Being a wind-pollinated plant, it appears very quickly in pollen samples and is therefore a good indicator of the first settlements. Another indication of settlement AD 600 in the Faroes was found at Mykines (Jóhansen 1979). But at Hovi, it is not found before AD 850–900.

The changes in the natural, spontaneous vegetation at Hovi were profound. The tall herbs were almost exterminated from the vicinity in a very short time. The members of Apiaceae disappeared, *Sedum roseum* could not withstand the extensive grazing which now began, and is today only found on cliffs and gorges which are impassible for sheep.

Caltha was widespread in the Faroes from the beginning of the Preboral. This is seen at this locality, diagram Hovi A, and also at Hoydalar. In Saksunarvatn, *Caltha* pollen is not found in the lowermost samples, but from about 9500 BP, it was also established there. It was very common at Hovi – up to 10% of the total pollen during the time up to the landnam, where it suffered near extinction. The leaves of *Caltha* are very attractive to sheep and cattle and where they have access to the plant, they will browse on it and very soon destroy it. Today *Caltha* is one of the most conspicuous plants in the Faroese meadows, where it flowers from the end of May to the beginning of June. These meadows are kept free from sheep during the summer by enclosures. If this was not the case, *Caltha* would be one of the first plants to succumb. This was actually the case at Hovi where *Caltha* was not protected from sheep and cattle, which the Norsemen brought with them. In wet places where sheep cannot reach it, *Caltha* can still be found in natural habitats as far up as 450 m (Rasmussen 1923).

Filipendula ulmaria behaves in the same way as *Caltha.* Very shortly after the landman, it was exterminated at this locality. Today it is found here and there (Hansen 1966). The large fluctuations of *Calluna* and *Ericaceae* and *Empetrum* are remarkable, but so far I have no explanation for them. The fluctuations are probably caused by very local changes in the conditions on the bog surface.

Remarkable also is the rise of *Potentilla* above the settlement level. I suppose it is *P. erecta,* which is so common today, but *P. palustris* is also found at Hovi even if it is rare in the Faroes (Hansen 1966). The rhizomes of *Potentilla erecta* have been used for tanning leather. It has been dug at all villages almost up to the present day. It is strange that it did not suffer more seriously from all this collecting, but the fact is, that it is one of the most widespread plants in the Faroes today (Hansen 1966). Also in Tjørnuvík (Jóhansen 1971), *Potentilla* rises after the landnam.

Rumex acetosa has also a distinct rise above the landnam horizon, but falls quickly and is of no importance later. Even if *Rumex acetosa* most probably is a native species, it seems to be favoured by man. Note however the difficulty in separating *Rumex acetosa* and *Oxyria* mentioned earlier. It is not attractive to sheep due to its acid taste. During the Medieval age and up to the present day there are no large fluctuations. There are no signs of cultural recession in the 14. century. The plague, which according to tradition – but not historically proved – devastated the Faroes in 1348–50, has not left any mark in this diagram and may very well never have reached the Faroes. The *Hordeum* pollen curve begins at this level and has its maximum about 200 years later.

Summary and conclusion

The oldest known flora in the Faroes after the last glaciation is of Preboreal age. No Late Weichselian deposits have been found. The vegetation was a fell field vegetation with hardy species. It can thus be stated that the first flora, although Preboreal of age, is quite analogous to the Late Weichselian flora of the southern neighbouring countries. *Betula nana* immigrated in the middle of the Preboreal , but disappeared already at the end of the zone. The history of *Betula nana* shall be discussed in some details.

Betula nana was widespread during the Late Weichselian in Northern Europe. The immigration of *B. nana* to the Shetland has been dated to about 10.400 BP and to the Faroes about 9.500 (Jóhansen 1975). Dates are lacking from Iceland, but to East Greenland it arrived about 8.000 BP (Funder 1978). With these dates it is clear that it has immigrated from Great Britain and/or Scandinavia to the North Atlantic islands and Greenland.

The reason for the extermination of *Betula nana* in large areas in Europe was the expansion of forests. This explanation is, however, not valid for the Faroes (nor for Shetland and the Outer Hebrides). In these areas there have never been real forests – only copses and groups of trees here and there and, in the case of the Faroes, only shrubs of willow and juniper. Edaphically, *B. nana* is very tolerant. It grows mostly on peaty soils, but in the Late Weichselian the soils were unleached and mineral, and it still grows on mineral soils f.ins. in Teesdale (Godwin 1975). The only explanation seems to be a change from a subarctic, continental climate towards oceanic conditions.

When we look at the present distribution of *Betula nana* in the North Atlantic (fig. 5), it is remarkable to see that the dwarf birch has disappeared from all of the most oceanic areas, where it was widespread in the Late Weichselian. It is extinct in Ireland, the Outer and Inner Hebrides, the Orkneys, Shetland and the Faroes. In the Scottish Highlands, it is uncommon in the western parts (Perring and Walters 1962). In Norway it is extremely common in the continental parts, but fades out to the oceanic southwest (Nordhagen 1943). It is common all over Iceland (Grøntved 1942). Concerning Greenland, it is found at Scoresbysund on the eastern coasts and, on the western coasts, from Godthåbsfjord to Disko. It is by all authors (e.g. Sørensen 1933, Trapnell 1933, Gelting 1934, Böcher 1938) characterized as a strictly continental plant, which avoids the coastal areas.

In the Faroes, *B. nana* must have grown under continental conditions, with cold winters and mild summers in zone S 1 and Hovi A 1. The peak of *Myriophyllum alterniflorum* in this zone both at Hovi and Hoydalar suggests higher summer temperatures than in the later zones. There can be no doubt that there was a great deal of ice left in the sea around the Faroes, and

Fig. 5. Recent distribution of *Betula nana* in Northern Europe and part of Greenland.

probably also on land in the Preboreal, which caused low winter temperatures. The overall climatic amelioration in the Preboreal, together with the sea ice, thus created conditions for *Betula nana* in the Faroes. The rather sudden decline of *B. nana* is remarkable. The reason must be that dwarf birch has lived in a very delicate equilibrium with the surroundings, especially the climate. When the threshold was exceeded by, e.g. milder winters with no continuous snow cover, which is important for *B. nana,* and unstable springs and cooler summers, the consequences for this plant were catastrophic.

During Boreal, Atlanticum and Subboreal a vegetation of shrubs grew very widely in the lowland. This scrub was first and foremost represented by

Juniperus communis. Also willow, *Salix phylicifolia* was very common. Possibly scattered stands with *Populus (tremula)* and *Sorbus (aucuparia)* occurred, but the pollen evidence is not strong as mentioned on page 128. The same is the case with *Hedera* and *Ilex.* They are both westerly, oceanic plants and a few pollen of them have been found at Saksunarvatn so they may have grown in the Faroes. This is discussed on page 128, where the pollen grains are considered long distance transported, although no definite conclusions are drawn.

Far the largest amount of pollen comes from grasses and sedges. Grass heaths have been the dominant plant community in the Faroes from the Boreal. Moorlands evolved from the same time but especially from the Atlantic onwards they became widespread. *Calluna* became important on drier slopes, while on wetter ground different species of Cyperaceae: *Carex, Scirpus* and *Eriophorum* dominated. Together with these communities, pollen of many tall herbs indicate a vegetation of base rich flushes e.g. *Filipendula, Caltha, Angelica, Archangelica.*

About AD 600–650 there is the first evidence of man's arrival. This evidence has been published previously (Jóhansen 1971, 1978). These people were after all probability Irish hermits. In Mykines it could be demonstrated that they cultivated *Avena.* In the present work the first landnam indication is from Viking age, AD 850–900 as demonstrated in the Hovi B diagram. The Norsemen cultivated *Hordeum* which was demonstrated with reasonable certainty in the above mentioned work from Mykines. (There was a clear change from *Avena* cultivation at 600–650 to *Hordeum* cultivation some time later, dates on the start of *Hordeum* cultivation could however not be obtained). During Medieval age up to recent time the only corn was *Hordeum.*

The influence of the inhabitants with their sheep and cattle on the original vegetation was profound. The scrub disappeared almost completely, likewise the rich tall herb vegetation. They are today only found in sheltered places which are inaccessible to the sheep. Together with man also many new plants were introduced: *Plantago lanceolata,* which is quite naturalized (Hansen 1966), *Rumex longifolius, R. obtusifolius, R. crispus* and many ruderals which only grow at or near villages.

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Dansk Sammendrag

Med de tre pollendiagrammer, der præsenteres her og dem, der tidligere er publiceret fra Færøerne, har vi nu et forholdsvis godt overblik over vegetationsudviklingen siden sidste istid. Senglaciale aflejringer kendes ikke. Først fra Præboreal findes den første pollenflora.

For 10.000 år siden voksede der en fjeldurtsflora med pil (*Salix*), stenurt (*Sedum*), og andre. Lidt senere omkring 9.500 før nu, var der en kort periode med dværgbirk (*Betula nana*). Fra Boreal og op til i dag var græsser og halvgræsser dominerende. Af træagtige vækster blev ene (*Juniperus*) sammen med pil (*Salix phylicifolia*) de vigtigste. I Atlantikum blev hedelyng (*Calluna*) fremtrædende. Omkring 600 e.Kr. skete der et landnam, som formodes at være foretaget af irske munke. I Hovi skete det dog først i vikingetiden omkring 900 e.Kr. Foruden de tidligere nævnte planter, var der en flora af høje planter: mjødurt (*Filipendula*), skærmplanter, store bregner, engkabbeleje (*Caltha*), og potentil (*Potentilla*). Næsten alle disse planter gik kraftigt tilbage ved landnamet undtagen potentil. Lancet vejbred (*Plantago lanceolata*), og ukrudtsplanter som f.eks. skræpper indføртes. Mens de første indbyggere – irske munke – dyrkede havre, indførte vikingerne bygdyrkning.

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SAKSUNARVATN, FAROE ISLANDS

GEOLOGICAL SURVEY OF DENMARK

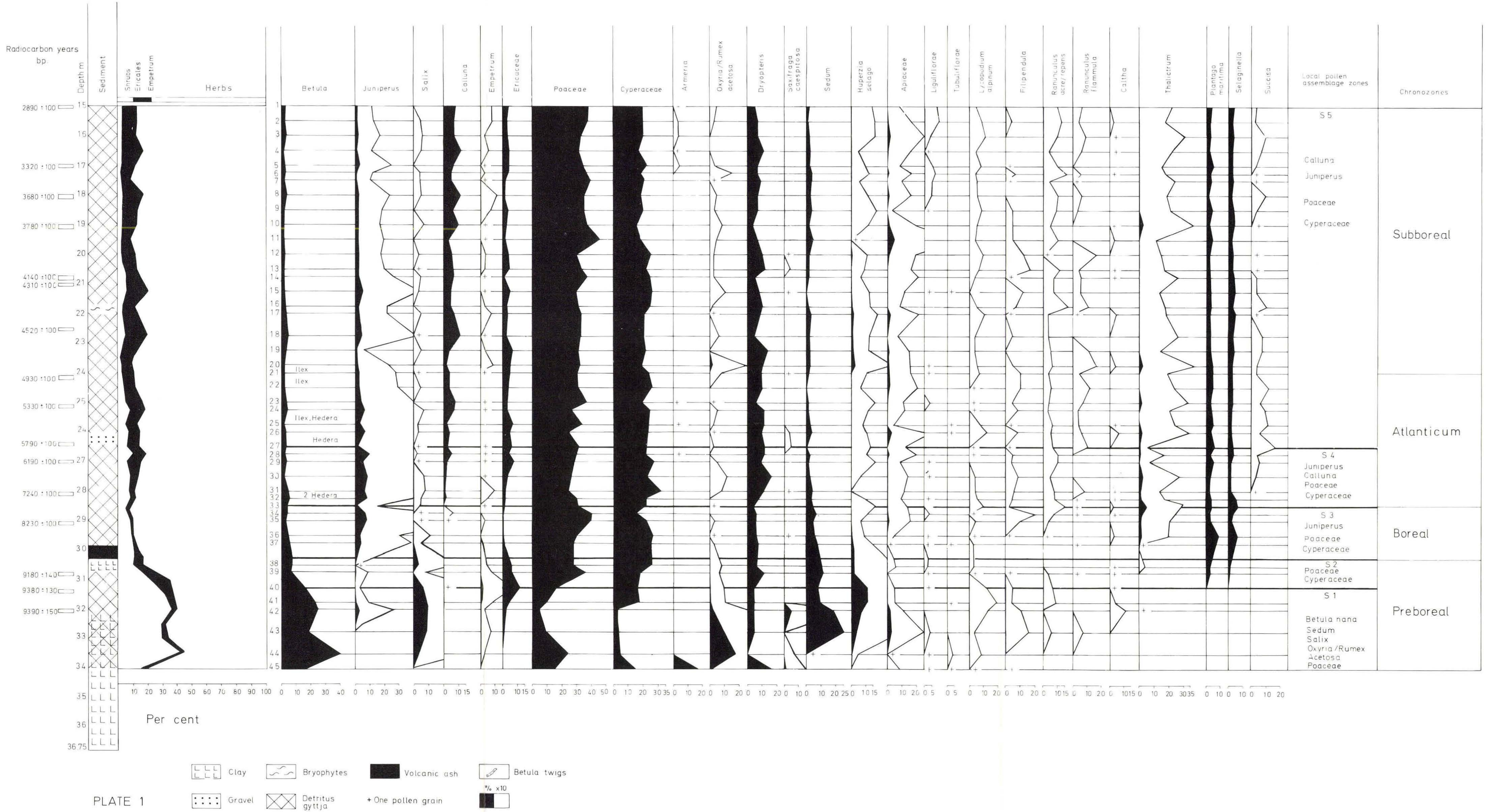

PLATE 1

HOVI A FAROE ISLANDS

GEOLOGICAL SURVEY OF DENMARK

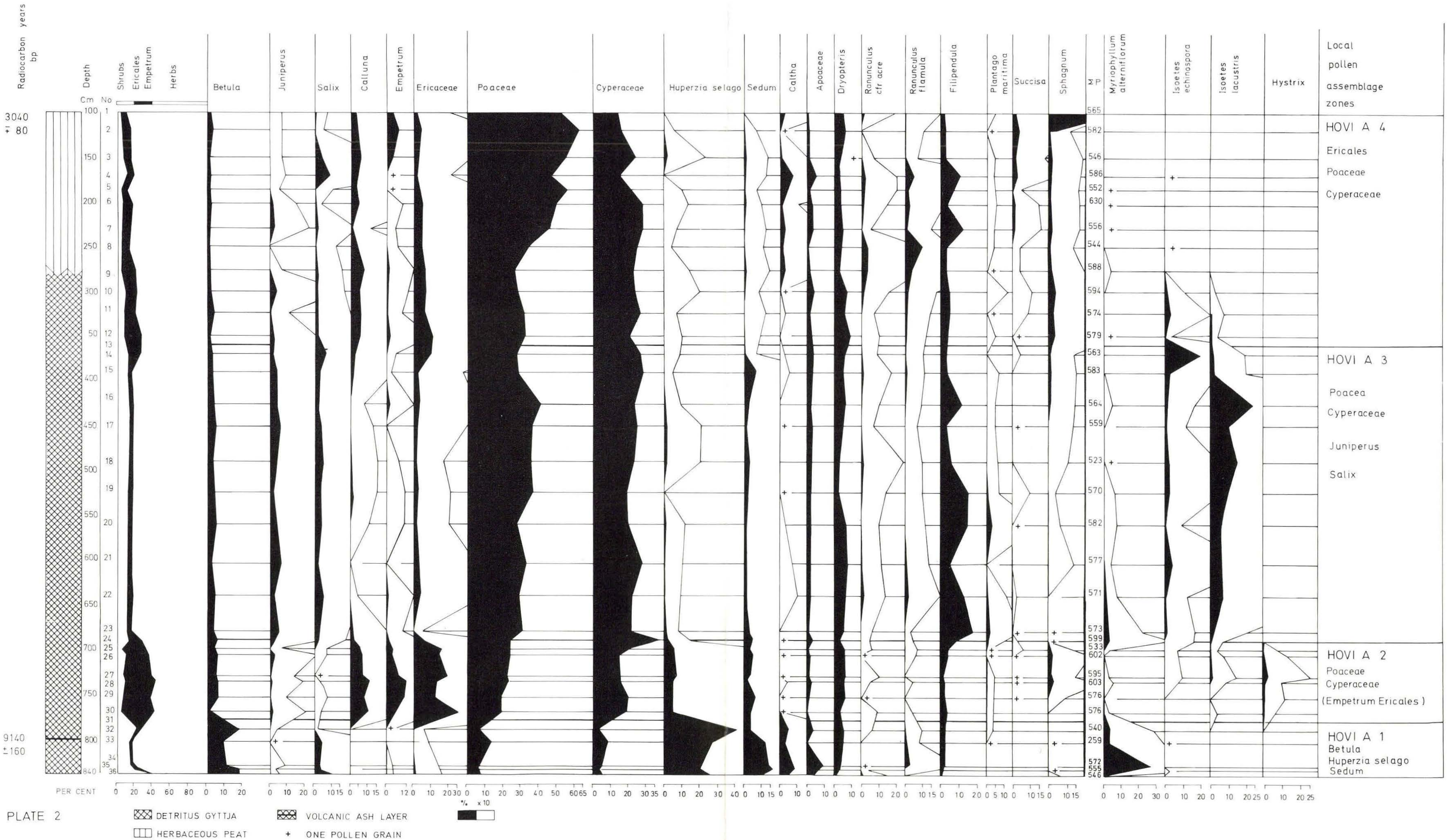

PLATE 2

HOVI B, FAROE ISLANDS

GEOLOGICAL SURVEY OF DENMARK

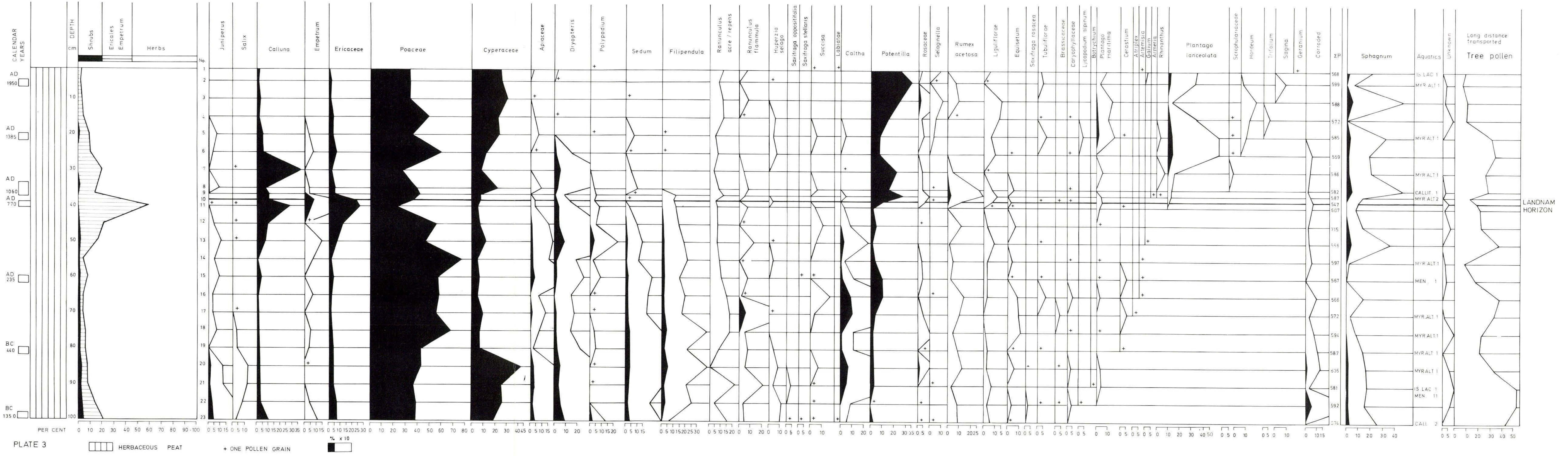

PLATE 3