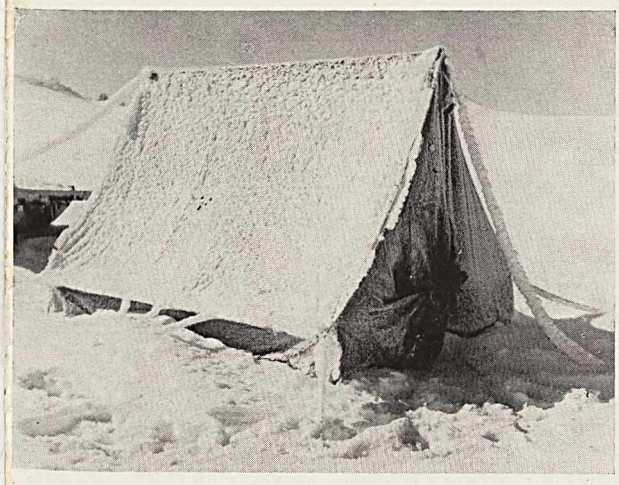
Titill
On the variations of Svínafellsjökull, Skaftafellsjökull and Kvíárjökull in Öræfi.

Höfundur
Sigurður Þórarinsson (1912-1983)

Tímarit
Jökull
6. árgangur 1956
1. tölublað
Bls. 1-15

Vefslóð
https://timarit.is/gegnir/000571539



JÖKULL

ÁRSRIT

JÖKLARANNSÓKNAFÉLAGS ÍSLANDS

6. ÁR REYKJAVÍK 1956

On the Variations of Svínafellsjökull, Skaftafellsjökull and Kviárjökull in Öræfi

BY

SIGURDUR THORARINSSON

INTRODUCTORY:

In his paper on the glaciology of Spitsbergen, based on studies made in 1931, Ahlmann stated that the stage from which the present regression of the Spitsbergen glaciers has taken place "is — at least for many of the glaciers — quite close to their maximum extension since the last glaciation of the Quaternary Ice Age" (Ahlmann 1933, p. 185).

In a paper published in 1935 and mainly based on studies of the outlet glaciers of Drangajökull carried out in 1931, Eythórsson writes: "My observations of glacier margins in Iceland and of their terminal moraines have more and more convinced me that the stage from which the glaciers are now receding must have been a very advanced one, compared with the maximal extension they have reached within the historical time in Iceland (i.e. the last 1000 years) and probably since the close of the Ice age" (Eythórsson 1935, p. 136).

Further studies of the lateral and frontal moraines of glaciers in the glaciated districts around the northernmost Atlantic led Ahlmann and myself to the conclusion that the moraines which were formed during the advance of the glaciers in the first half of the 18th and about the middle of the 19th centuries (in some cases as late as ab. 1890) mark their maximum extension in historical and probably even in Postglacial Time (Thorarinsson 1936, p. 194; 1944, p. 148; 1952, p. 8; Ahlmann 1948, p. 67 ff.). Tephrochronological studies at Hagavatn proved definitely that the recent terminal moraines from which the Hagafellsjökull eystri has been receding during the last few decades, mark the maximum extension of that glacier during the whole Postglacial Time (Thorarinsson 1949, p. 250). But in the same paper I stated that there are in front of some of the glacier tongues of Vatnajökull terminal moraines, "which might indicate, that in early Subatlantic Time these

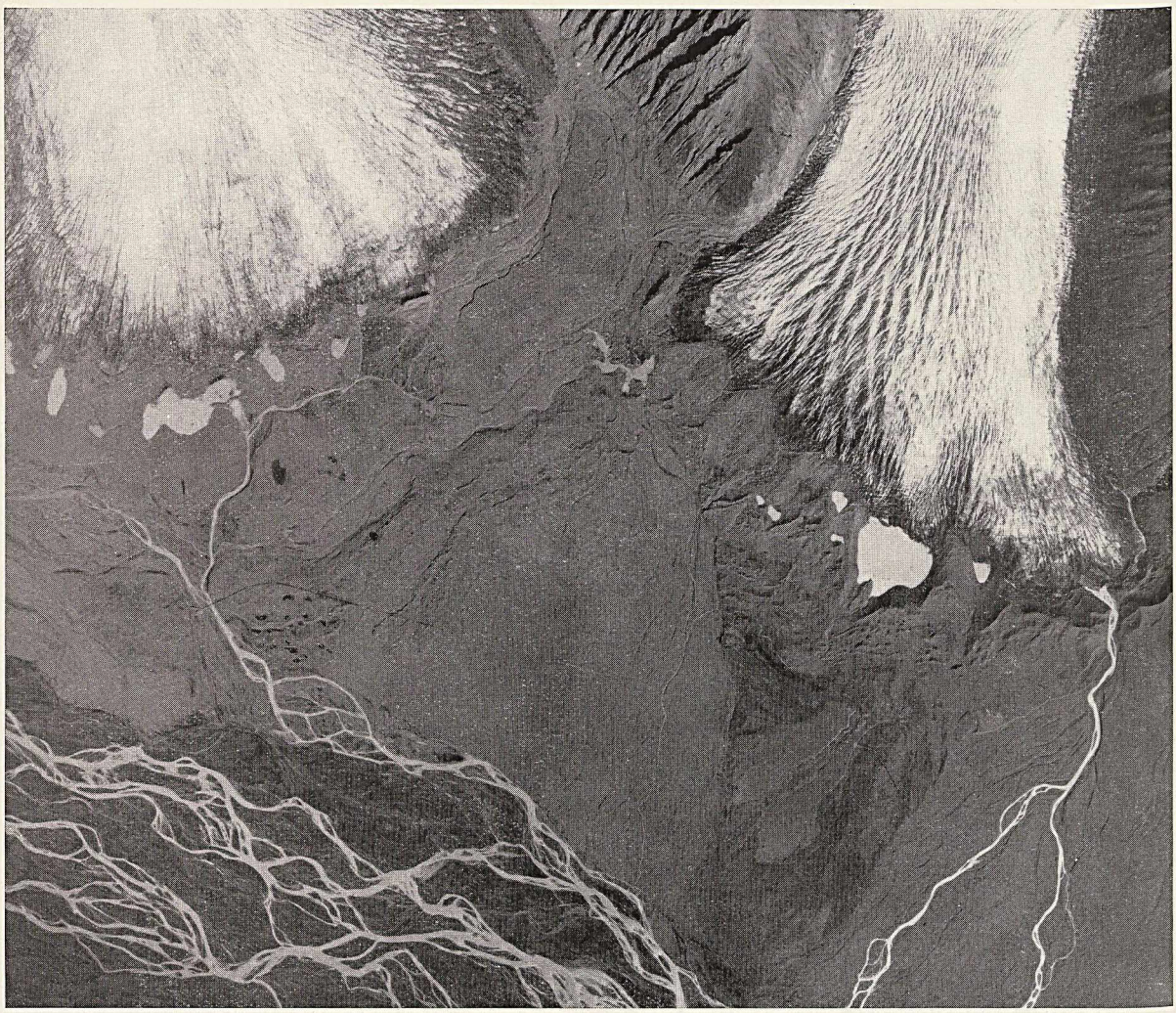


Fig. 1. *Svínafellsjökull and Skaftafellsjökull in Öræfi. Stóralda (cf. figs. 4 and 5) is visible in front of Svínafellsjökull. Approx. scale 1:33000. Aerial photo Á. Bödvarsson 15 Sept. 1954.*

glaciers advanced a little further than during the last few centuries" (op. cit., p. 250). This statement was based on studies during trips through Austur-Skaftafellssýsla in 1945 and 1948, when I i. a. studied the extension of a rhyolitic tephra layer found everywhere in soil profiles in these districts and could prove that this layer was deposited by the eruption of Öræfajökull in 1362 A.D. The glacier tongues I had in mind when writing the statement quoted above, were especially Svínafellsjökull and Kvíárjökull in Öræfi. I had also in mind terminal moraines in Stadardalur in Suðursveit inside which the tephra-layer of 1362 is found, as pointed out to me already during my stay there in June 1934 by Skarphédinn Gíslason of Vagnsstadir, but at that time neither I nor anyone else did have any proof of the age of this layer. In a paper of 1946 I expressed the opinion that both the Stadardalur moraine and a moraine in front of SE Breidamerkurjökull that was overrun by this glacier in 1869, were

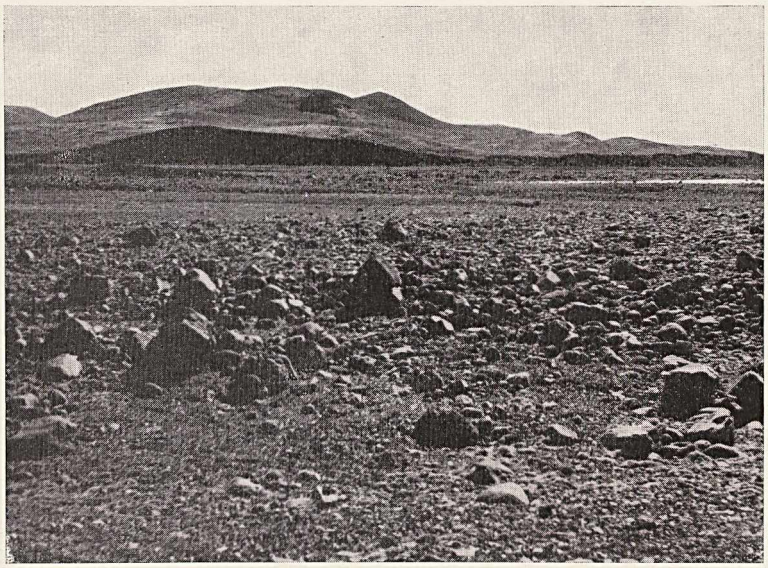


Fig. 2. *Stóralda viewed from N. Photo S. Thorarinsson 14 Sept. 1955.*

probably formed by a glacier advance during the first centuries of the Subatlantic Time (Thorarinsson 1946, p. 260–261) Todtmann has, in my opinion rightly, identified this moraine in a thrust moraine (Stauchmoräne) found beneath recent moraine cover in front of SE Breidamerkurjökull (Todtmann 1936). In a paper 1952 Todtmann regards this thrust moraine as prehistoric. She mentions in the same paper that she has found the 1362-tephra on the moraine Stóralda in front of Svínafellsjökull, which would mean that this moraine also was prehistoric, and she says further about Kviárjökull that "vielleicht ist auch der Kern der hohen Seitenmoränen von sehr hohem Alter" (1952, p. 407). As the age of these moraines and that of Stóralda is of great interest from a climate historic point of view, I found it necessary to try to fix their age more definitely by means of tephrochronology, and during a short stay in Öræfi in the autumn of 1955 I visited both Svínafellsjökull and Kviárjökull for a further study, the result of which I shall now relate.

SVÍNAFELLSJÖKULL AND SKAFTAFELLSJÖKULL

When travelling along the road from the Svínafell farm in Öræfi towards the farm Skaftafell and having travelled ab. 1.5 km over the sandur plain west of the river Svínafellsá, one has on the right a plain patch of grassland called Svínanes. Above this grassland rises a curved high moraine ridge and in front of it there are some lower, flat concentric ridges. This moraine complex as a whole is called Stóralda and I refer here to the innermost and highest ridge as Stóralda proper. Its relative height on the steep proximal side is 20 m, that of the less steep distal side 16 m. The max. absolute height of Stóralda proper is 115 m and its length ab. 0.5 km. The ridges in front, at least six in number, are flat gravel ridges, 50–80 m broad. These ridges are rather like the flat folds in front of the thrust moraine formed by the sudden advance of Eyjabakkajökull in 1890 (Thorarinsson 1938, fig. 2). Whether the ridges in front of Stóralda proper are also folded by a rapidly advancing glacier (cf. Helgason 1935, p. 15) or possibly formed as "Scherflächen" moraines has to be decided definitely by more detailed studies. The Stóralda proper, however, gives the impression of being a thrust moraine (cf. Todtmann 1952, Hoppe 1953).

Information on the oscillations of Skaftafellsjökull and Svínafellsjökull until Eythórsson started measurements of their frontal variations in 1932 has been collected by Bárdarson (1936, p. 2) and supplemented by Thorarinsson (1943, pp. 32–33). It seems likely, from information I have got in Öræfi, that these glaciers have

on the whole been receding since ab. 1870, although the recession has now and then been interrupted by stagnation and minor advances. According to Eythórsson (1949, p. 251), the front of Svínafellsjökull was as a whole very near the same in 1932 as in 1904. The variations of the glaciers until 1932 may by summed up as follows:

Beginning of 18th century: Glaciers considerably larger than in 1935.
1740's: Glaciers larger than in 1935.
Years or decades immediately preceding 1794: Advance.
1794: Glaciers larger than in 1935.
1830's: Probably advance.
1865: Svínafellsjökull probably as large as in 1904.
1932: Svínafellsjökull about the same as in 1904.

The variations since 1932 are, according to Eythórsson measurements (1949, p. 251, 1951, p. 16, 1952, p. 31, 1953, p. 49, 1954, p. 46, 1955, p. 40; Mercanton 1952, p. 117) as follows:

	Skaftaf.jök.	*Svínaf.jök. (N)*	*Svínaf.jök. (S)*
1932–34:	+ 60	— 65	— 33
1934–35:	— 45	— 15	— 20
1935–36:	—155	0	— 10
1936–37:	— 71	+ 3	+ 7
1937–38:	— 21	— 15	— 10
1938–39:	— 5	— 10	— 13
1938–40:	— 65	— 20.5	— 7
1940–41:	— 80	— 33	— 16
1941–42:	—133	— 27	— 26
1942–43:	— 17	— 2	— 2
1943–44:	— 49	— 43	— 3
1944–45:	— 65	— 50	+ 3
1945–46:	— 22	— 4	— 3
1946–47:	— 63	— 58	— 3
1947–48:	— 29	— 5	0
1948–49:	— 20	— 3	— 1
1949–50:	— 50	— 2	— 6
1950–51:	+ 28	— 18	— 13
1951–52:	+ 4	+ 5.5	
1952–53:	+ 20 (N) — 12 (S)	+ 9	+ 8
1953–54:	— 49	+ 3	+ 7
1954–55:	— 31	— 15	+ 3
1955–56:	— 47	— 1	+ 4

Probably it would be possible to correlate stagnations and advances of Svínafellsjökull with terminal moraine ridges found within the 1904 limit of the glacier front but no attempt has hitherto been made at such a correlation.

THE AGE OF STÓRALDA.

Fig 3 shows soil profiles dug and measured in Öræfi in September 1955. Profile De 18a was measured on the crest of Stóralda proper near its highest point. Three tephra (= volcanic ash) layers could be identified in this profile. The thickest layer is without doubt the tephra from the eruption of Öræfajökull 1727 A.D. This layer is black, bastaltic and — due to the vicinity of the volcano — more coarse grained than other recent tephra layers in the Öræfi profiles (particle diam. ≦ 1 cm). During this eruption the main tephra fall was carried WNW-wards and the layer increases in thickness and coarseness towards N in the western part of Öræfi. The two black medium-coarse sandy layers immediately above the 1727 layer in this profile can hardly be other than the layers formed by the eruption of Katla 1755 and the Laki eruption 1783. During the eruption of Katla in October 1755, one of the biggest from that volcano in historical time, the tephra was mainly carried eastwards. The tephra fall had a devastating effect in most of the inhabited area between Katla and Skeidarársandur and the tephra fall was also heavy in entire Austur-Skaftafellssýsla. (Safn t. s. Ísl. IV, p. 243). The tephra layer from the Laki eruption 1783 is in Öræfi more finegrained than the 1755 tephra and the layer is thinner than one would expect from descriptions of this eruption. Upon the whole, the tephra production of the Laki fissure seems to have been much less than assumed by Thoroddsen. The devastating effect this eruption had on the vegetation nearly all over the country has partly been caused by poisonous gases such as affected the vegetation in the vicinity of the jökulhlaup (glacier burst) in Skeidará 1954 (Thorarinsson 1954) and from which originated the bluish mist after which the 1783 disaster was called *Móðuharðindi* (The Mist Disaster).

The black tephra layer found beneath the 1727-layer in profile De 18a has not yet been identified but it is likely to be from the eruption of Katla in 1625.

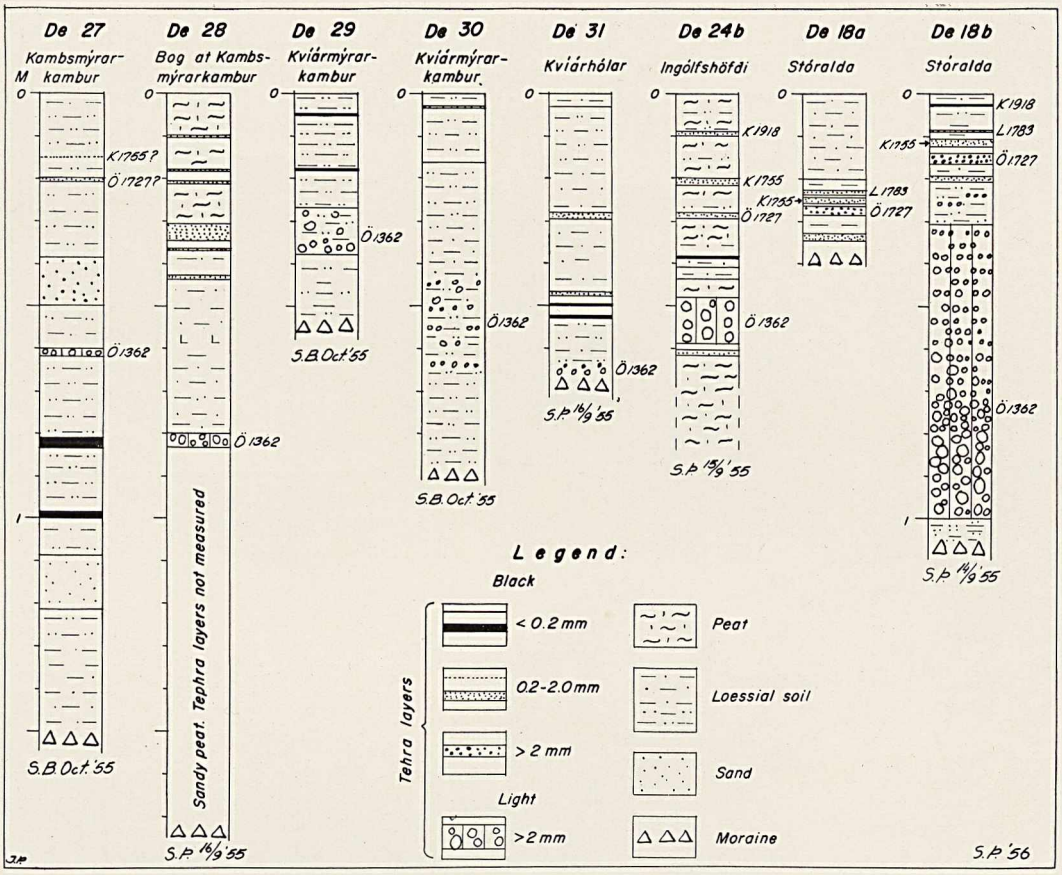


Fig. 3. *Soil profiles measured in Öræfi in Sept. 1955.*

Profile De 18b was dug on the flat gravel ridge immediately in front of Stóralda proper. There we find the tephra layers already mentioned and besides, the black Katla tephra of 1918 and the greyish white rhyolitic (liparitic) Öræfajökull tephra (pumice) of the great eruption in Öræfajökull 1362. The pumice is here mostly redeposited by wind and only the lowermost part of the layer is still *in situ*. Beneath that layer we find ab. 5 cm thick layer of medium sand mixed with humus.

There seems to be no doubt that the ridge on which profile De 18b was dug is practically of the same age as Stóralda proper. Thus both Stóralda proper and the ridges in front of it are clearly older than 1362. The fact that only a thin layer of humified sand is found between the 1362-layer and the underlying gravel could be explained by the gravel being only a little older than the 1362-layer. J. Thorkelsson (1921, p. 267) was of the opinion that the farm Svínafell had been destroyed shortly before 1343 by a jökulhlaup caused by an eruption in Öræfajökull. In that case one could possibly regard the Stóralda moraine complex as being formed by a catastrophic advance of Svínafellsjökull in connection with that jökulhlaup. But the material in these moraines has no resemblance to a normal jökulhlaup sediment and besides, it is very unlikely that Öræfajökull erupted at all in historical time before 1362. The tephrochronological studies of the 1362 tephra show that this eruption has been a typical initial eruption following a long period of quiescence and the vague mentioning of fire in "Knappa fells jökli" 1332 (Gottskálksannáll) and in "Hnappa vallar iokli" 1341 (Skálholtsannáll) is no proof of an eruption in Öræfa-

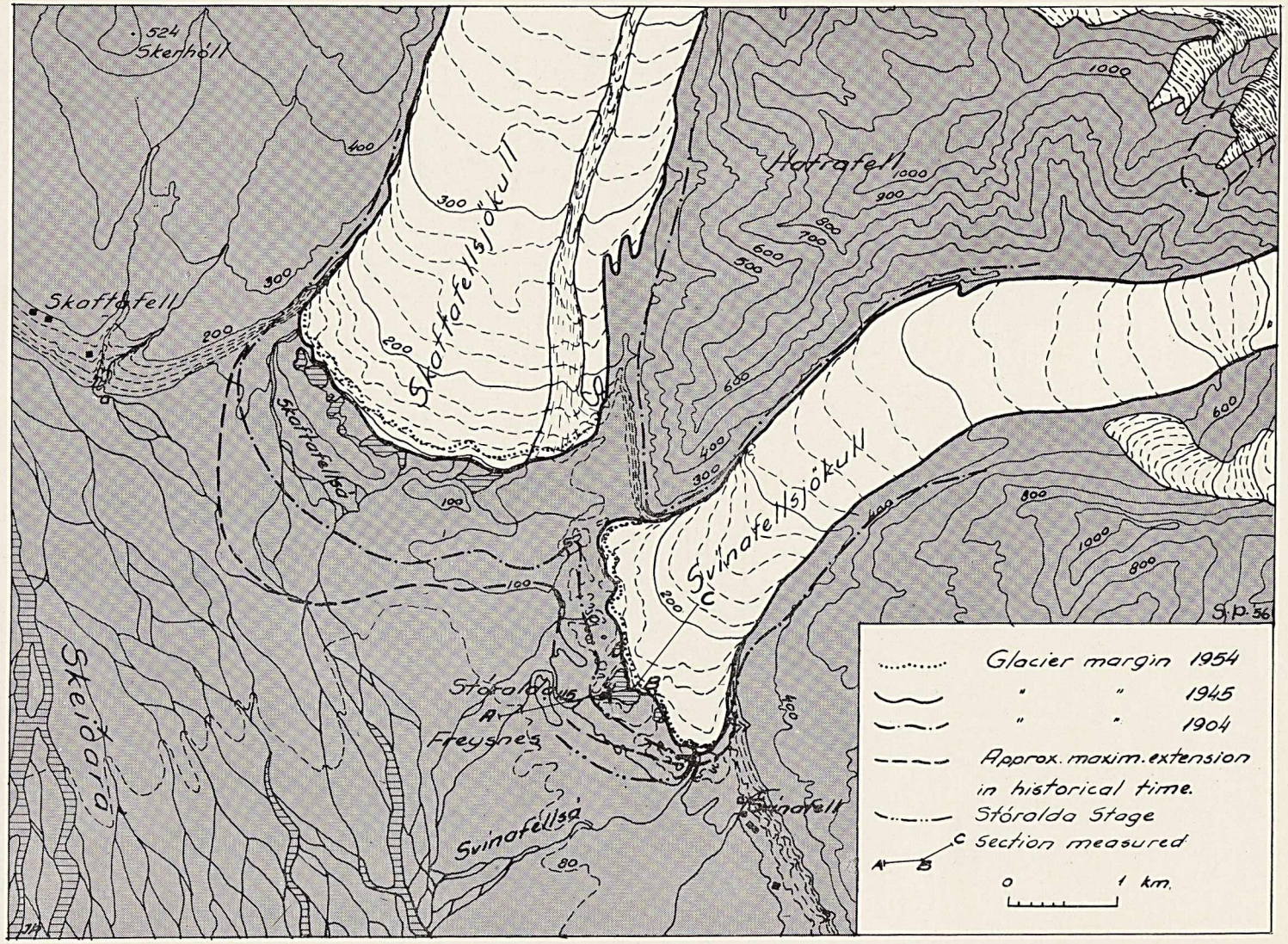


Fig. 4. *Skaftafellsjökull and Svínafellsjökull. Map compiled by S. Thorarinsson 1955.*

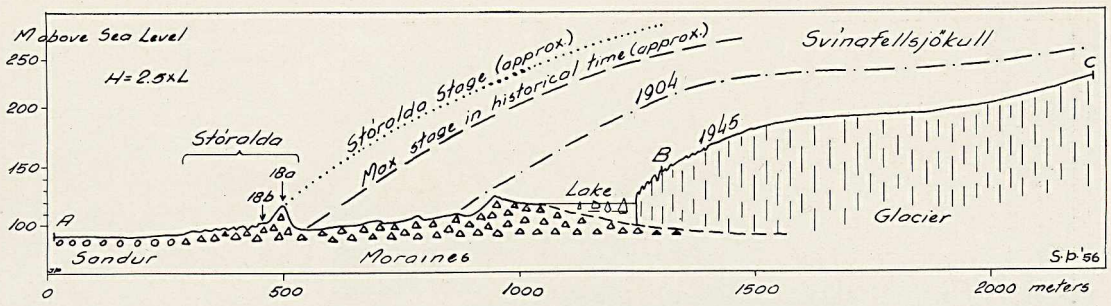


Fig. 5. *A longitudinal section of the snout of Svínafellsjökull based on the map fig. 4.*

jökull at that time. In all probability Stóralda is older than the settlement of Iceland and its lack of soil cover at the time of the 1362 eruption can be satisfactorily explained by assuming that soil erosion, caused by the arrival of man and his livestock, has deprived the moraines of their soil cover. In olden times a farm, Freysnes, was probably situated not far from Stóralda. Being prehistoric Stóralda must be formed either after or before the Postglacial Warm Period and in my opinion is was most likely formed as a result of the climatis deterioration during the first centuries of Subatlantic Time, that began ab. 600 B. C.

REDUCTION OF SVÍNAFELLSJÖKULL AND SKAFTAFELLSJÖKULL IN RECENT TIME ACCORDING TO MAPS AND AERIAL PHOTOS.

The oldest topographical map showing the margins and contour lines of the glaciers in question is the Danish General Staff map of 1904, scale 1:50.000 (sheet 87 Öræfajökull SV). A new map in the same scale was made in 1950 by the U. S. Army Map Service (sheets 6019 III and 6018 IV). This map is based on aerial photos taken in Aug. 1945. The height figures on the glaciers are scanty on the 1904 map. However there is reason to believe that on this map and the U. S. Army map the contour lines are exact enough on the lower part of the glacier tongues to enable us to calculate their thinning 1904–1945 with less than 20% error.

On the map fig. 4 the contourlines and river courses are according to the 1950 map. The glacier margins 1904 and 1945 are according to corresponding topographical maps and so are the lines showing the glacier thickness on the longitudinal section fig 5. The dot line showing the glacier fronts in 1954 is according to the excellent aerial photos taken by Á. Bödvarsson Sept. 15, 1954. The dash line showing approximately the maximum extension of the glaciers in historical time is partly based on field studies and partly on Bödvarssons photos. I emphasize that this line is only approximate, especially as regards Skaftafellsjökull and the northern part of Svínafellsjökull. Nor do we know at what time the glaciers reached their maximum extension but a least Svínafellsjökull seems have been very near this stage ab. 1870. At that time the southernmost part of its front extended so far that blocks of ice broke off from it and rolled down the southern slope of the outermost moraine ridge N of the Svínafell farm. The following figures are based on the above mentioned comparison between the 1904 and 1950 maps. The figures for the frontal areal changes are fairly exact but the figures for the total areal changes are not so reliable as the mapping of the upper parts of the glaciers in 1904 can not have been very exact. Because of the steepness of the uppermost part of the ablation areas the changes of the 1100 m contours due to thinning of the glaciers since 1904 are negligible.

SKAFTAFELLSJÖKULL.

Area below the 1100 m contour (approx. firn line) 1904	38.5 km²	
Area below the 1100 m contour 1945	33.0 „	
Total areal loss 1904–1945 ..	5.5 „	(14.3%)
Frontal areal loss 1904–1945	4.0 „	(10.4%)
Max. linear recession 1904–1945	1.0 km	

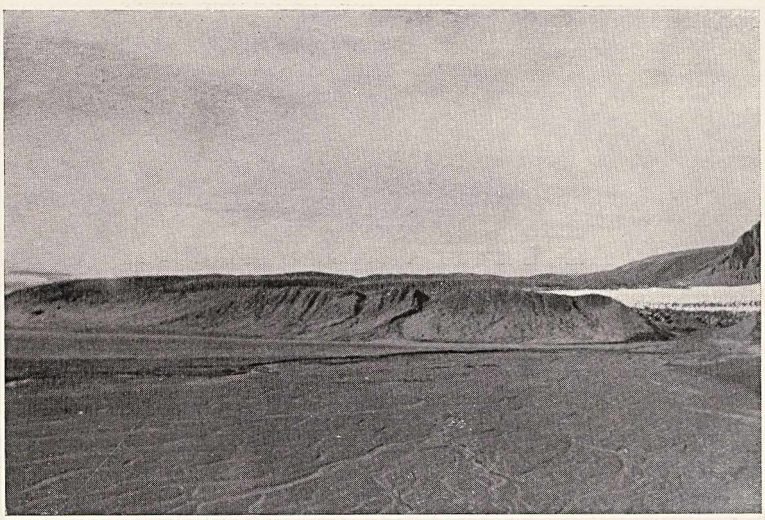


Fig. 6. *The moraine amphitheatre of Kvíárjökull seen from E. Photo S. Thorarinsson 13 July 1951.*

SVÍNAFELLSJÖKULL.

Area below the 1100 m contour 1904	15.0 km²	
Area below the 1100 m contour 1945	12.5 „	
Total areal loss 1904—1945 ..	2.5 „	(16.7%)
Frontal areal loss 1904—1945	0.7 „	(4.7%)
Max. linear recession 1904—1945	0.45 km	
Average thinning of tongue along the present 100 m contour 1904—1945	65 m	

KVÍÁRJÖKULL

The most striking feature of Kvíárjökull, the biggest of the three southern outlets of Öræfajökull, is the enormous moraine amphitheatre bordering the entire lowland part of the glacier tongue (fig. 6). On the western side of the glacier the marginal moraine, Kvíármýrarkambur, reaches a height of nearly 100 m above the outside plain. Corresponding height of the eastern ridge, Kambsmýrarkambur, is ab. 70 m. In front of the glacier tongue the river Kvíá has cut a breach through the moraine ridge and flows there at present, but for long periods the bulk of the meltwater has flowed through a breach in Kambsmýrarkambur. That river, Kvíá eystri, is since 1935 practically non existing.

In a paper published in this issue of Jökull, Flosi Björnsson, a farmer in Kvísker, a farm situated 3 km east of Kvíárjökull, gives an account of the variations of Kvíárjökull since the 1790's (cf. also Thorarinsson 1943, p. 30). As his paper is in Icelandic, I sum up his results.

From Sveinn Pálsson's description of his ascent of Öræfajökull Aug. 11th 1794 Björnsson concludes that the glacier was at that time somewhat thicker than ab. 1900. He also states that the maximum extension of the glacier during the 19th century was ab. 1870, when the glacier quite filled the moraine amphitheatre and its margins were so high that one autumn blocks of ice broke off from the western margin and rolled down the outer slopes of Kvíármýrarkambur. Ab. 1890 the thickness and extension of the glacier tongue was somewhat less than ab. 1870. Shortly before 1903 the glacier advanced a little and increased somewhat in height. From 1904 to ab. 1915 the glacier receded and thinned very slowly. Ab. 1920 or shortly before 1920 the glacier again began to advance and grow in thickness, 1921 and 1922 the thickness increased rapidly. Ab. 1927 the SE part of the glacier front became stagnant and soon started receding, while the SW part advanced ab. 300 m 1931—34, gliding over a dead ice cake within the end moraines (cf. Todtmann 1936). Since 1934 the frontal variations of Kvíárjökull, according to Eythórsson measurements, have been as follows (quoted from the same

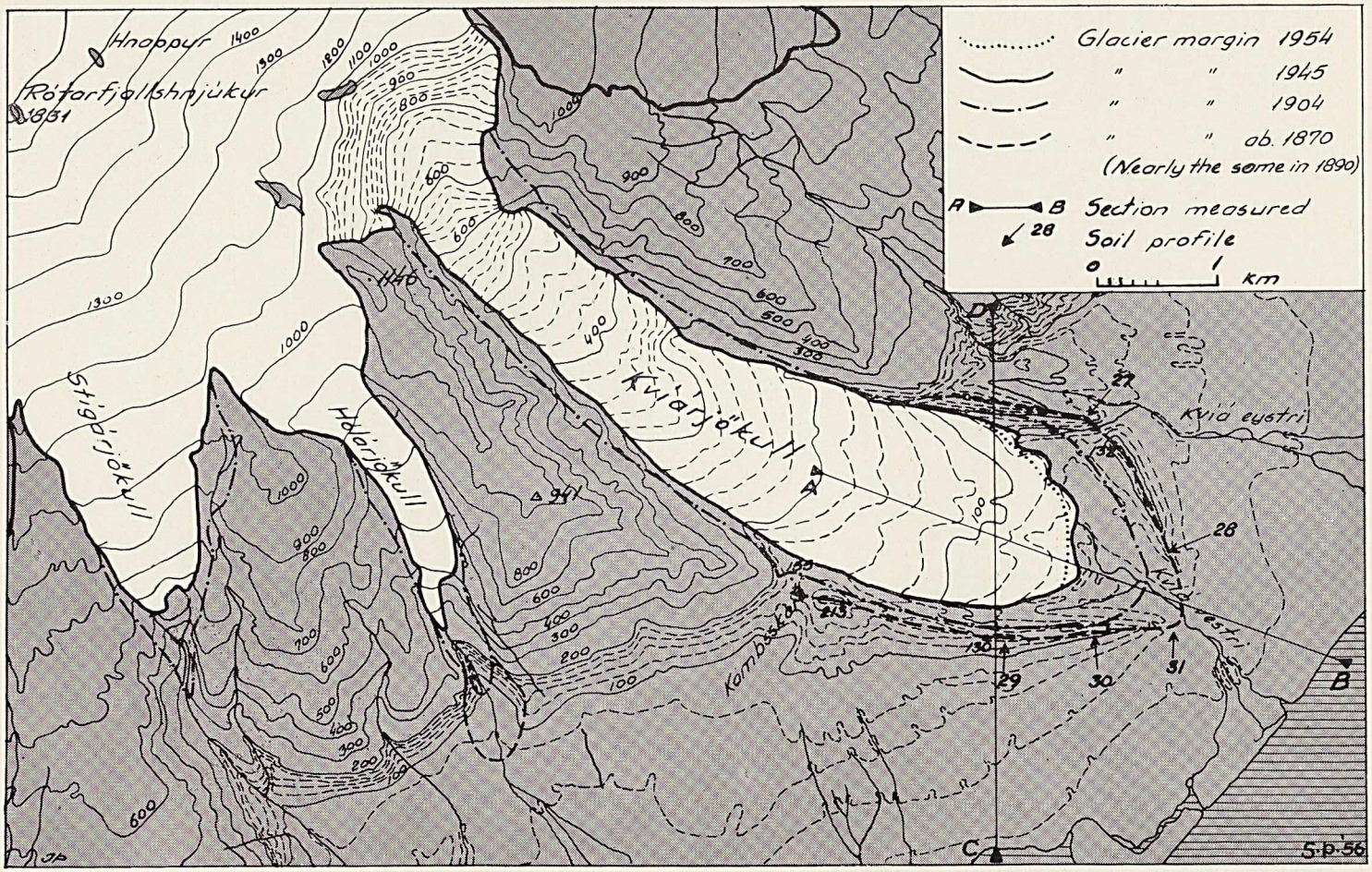


Fig. 7. *Kviárjökull. Map compiled by S. Thorarinsson 1955.*

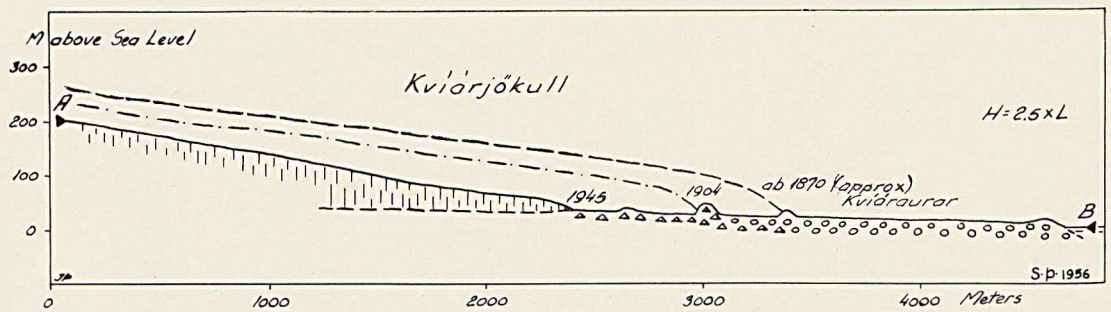


Fig. 8. *A longitudinal section of Kviárjökull. Cf. the map fig. 7.*

papers as the variations of Svínafellsjökull—Skaftafellsjökull):

1934—35:	0	m
1935—36:	— 10	,,
1936—37:	— 80	,,
1937—45:	—280	,,
1945—47:	no measurements	
1947—48:	+ 50	m
1948—49:	+ 20	,,
1949—50:	— 45	,,
1950—51:	— 7	,,
1951—52:	— 4	,,
1952—53:	+ 7.5	,,
1953—54:	— 23	,,
1954—55:	— 32	,,
1955—56:	— 20	,,

ENTONNOIRS ON KVÍÁRJÖKULL.

At the end of his paper Björnsson describes some peculiar features on the surface of Kvíárjökull. These are circular or somewhat ellipse-shaped depressions, commonly 20—30 m broad and 6—8 m deep with rather steep slopes and a flat bottom. In the bottom is a narrow water furrow. These depressions are found in great number on the relatively flat southwestern part of the glacier tongue, W of the median moraine. I may here add that these depressions are visible on an aerial photo taken by P. Hannesson May 28th 1938 (published in Thorarinsson 1943, p. 31), which supports Björnsson's statement that these depressions have existed at least two decades.

Depressions of this type have been described from Gorner Glacier and some other glaciers in the Alps. They are also known from Malaspina Glacier (Alaska) and Tasman Glacier (New Zealand). They have been especially studied on Gorner Glacier (Renaud 1936) where they are termed *entonnoirs*. However, their formation seems not yet to be quite satisfactorily explained.

REDUCTION OF KVÍÁRJÖKULL SINCE AB. 1870.

The map fig. 7 is based on the Danish General Staff map of 1904 (sheet 87 Öræfajökull SA), the U. S. Army Service maps of 1950 (6018 I and 6018 IV), based on aerial photography 1945 and Á. Bödvarssons aerial photos of Sept. 15, 1945. The sections figs. 8 and 9 are based on the same maps. The dash lines marking the extension and thickness of the glacier ab. 1870 must be regarded as approximate. The extension of the glacier at that time must however have been practically the same as its maximum one in Postglacial Time.

The following figures are based on the 1904 and 1950 maps.

KVÍÁRJÖKULL.

Area below the 1100 m contour 1904	11.1 km²	
Area below the 1100 m contour 1945	9.5 ,,	
Total areal loss 1904—1945	1.6 ,,	(14,5%)
Frontal areal loss 1904—1945	1.0 ,,	(9.0%)
Max. frontal recession 1904—1945	0.55 km	
Average thinning along section C—D 1904—1945	60 m	

The average thinning below the present 200 m contour ab. 1870—1945 may be estimated 80—

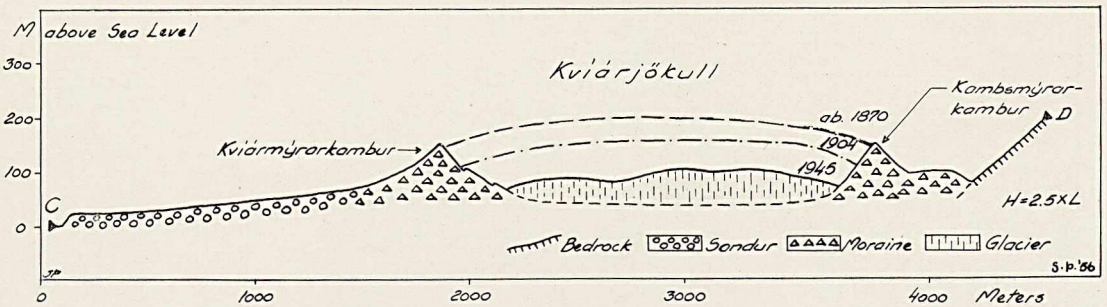


Fig. 9. *A transversal section of the snout of Kviárjökull. Cf. the map fig. 7.*

90 m and as the area of the glacier below that line was ab. 6 km² 1870 the volume loss of this area has been 0.5 km³. The volume loss of the total ablation area I estimate ab. 0.8 km³. Probably the glacier has lost between ⅓ and ½ of the total volume of the ablation area since ab. 1870.

STÍGÁRJÖKULL AND HÓLÁRJÖKULL.

The map fig. 7 also shows the great areal reduction of the two outlet glaciers Stígárjökull and Hólárjökull. Since ab. 1870 Hólárjökull has receded ab. 1200 m and since 1904 it has receded 650 m. On the lowland in front of Hólárjökull's gorge there is a very regular semi-circular terminal moraine (cf. fig. 12). The photo fig. 11 was taken by Fr. W. W. Howell either in 1890 or 1891 (Howell 1893, p. 62). It shows the glacier tongue extending to the inner margin of the above-mentioned terminal moraine but the moraine is considerably older. It might be from the middle of the 18th century, but it may also be prehistoric. Tephrochronological studies might probably decide whether it is prehistoric or not, but I have not yet had opportunity to dig profiles there. A comparison between the photo fig. 11 and fig. 12, taken 60 years later, show clearly how Hólárjökull has been reduced during that period.

According to the maps Stígárjökull receded 750 m 1904—1945.

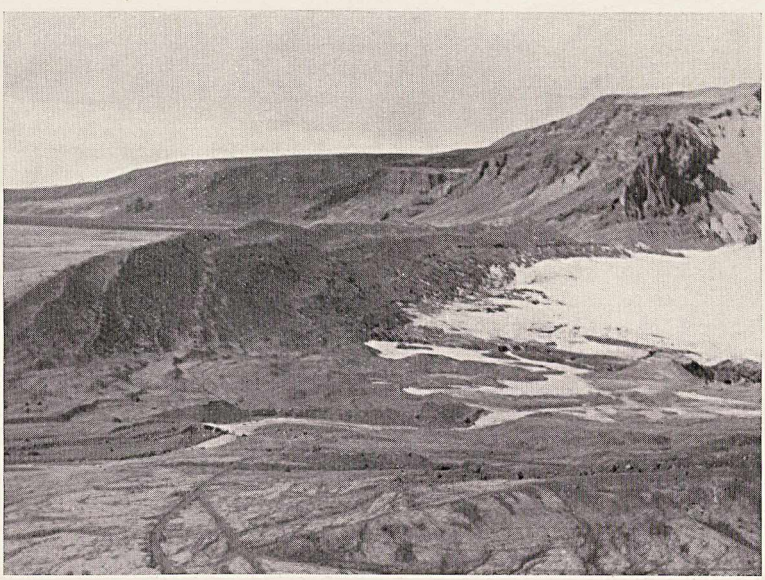


Fig. 10. *The inner side of Kviármýrarkambur with a series of small „Satzend" moraines. Aerial photo S. Thorarinsson 28 Aug. 1950.*

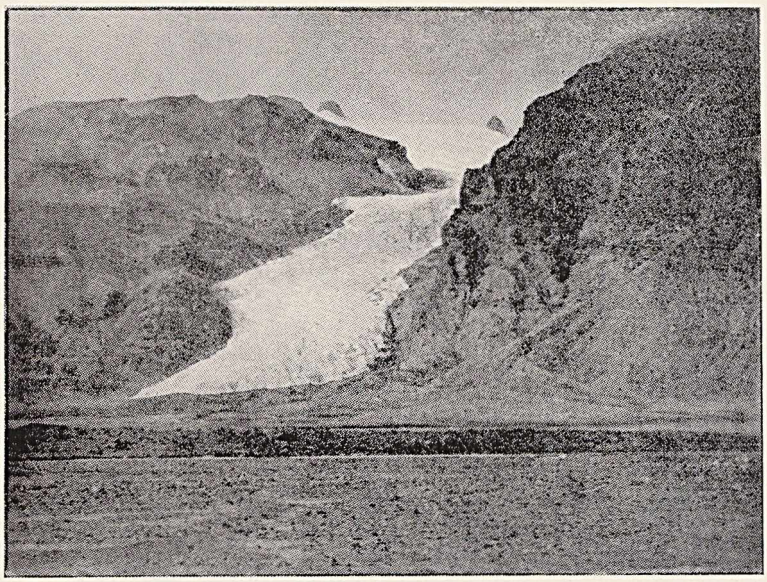


Fig. 11. *Hólárjökull 1891 or 1892. Photo Fr. W. W. Howell.*

THE AGE OF THE MORAINE AMPHITHEATRE OF KVÍÁRJÖKULL.

In order to find out the age of the moraine amphitheatre of Kvíárjökull I visited that glacier on Sept. 16th 1955 together with Sigurdur Björnsson in Kvísker and dug the profiles De 28 and De 31 shown on fig. 3. In Oct. 1955 Sigurdur Björnsson on my request dug three more profiles, De 27, 29 and 30 on fig. 3. The location of these profiles is shown on the map fig. 7. De 27 is dug on the E slope of Kambsmýrarkambur N of the outflow of Kvíá eystri, De 28 is on a gravel terrace which is a continuation of the outer slope of Kambsmýrarkambur and clearly of the same age. De 29 and 30 are dug on the outer slope of Kvíármýrarkambur and De 31 on the NW slope of the innermost of two small moraine hillocks, Kvíárhólar, (fig. 13) that form a continuation of Kvíármýrarkambur towards S on the W side of Kvíá vestri. These hillocks may formerly have been directly connected with Kvíármýrarkambur and later separated by water erosion.

The profiles measured show without doubt that the lower parts of the outer slopes of Kvíármýrarkambur and Kambsmýrarkambur are much older than the 1362 eruption. From field studies it was evident, however, that the crest of Kvíármýrarkambur is very young, in all probability from the 1870's, and the contact between the recent moraine and the underlying older one is clearly visible on the aerial photos of 1954. Thus the glacier tongue had in the 1870's nearly exactly the same extension as it had at the time when the moraine amphitheatre was originally formed. As to the age of these moraines, it is possible to fix it somewhat closer than merely stating that they are prehistoric. Between the northern end of Kvíármýrarkambur and the steep southern slope of Stadarfjall there is a breach named Kambsskard. This place name is found in an ecclesiastical deed *(máldagi)* of the church of Hnappavellir from 1343 — *per se* a proof of Kvíármýrarkambur being still older. A small basaltic prehistoric but definitely postglacial lava flow has spread over the gravel plain SW of Kambsskard and can be followed to the breach where it disappeares under moraine. The source of this lava is on the E side of Kvíárjökull and the lava has flowed to southwest at a time when Kvíárjökull did not reach the lowland and that must have been sometime during the Postglacial Warm Period. My impression from a short visit — admittedly too short for a sufficiently thorough study — was that the lava flow is older than Kvíármýrarkambur. Consequently that moraine ridge should be younger than the Postglacial Warm Period, and as it certainly is prehistoric it seems to me most reasonable to regard both Kvíármýrarkambur and Kambsmýrarkambur as

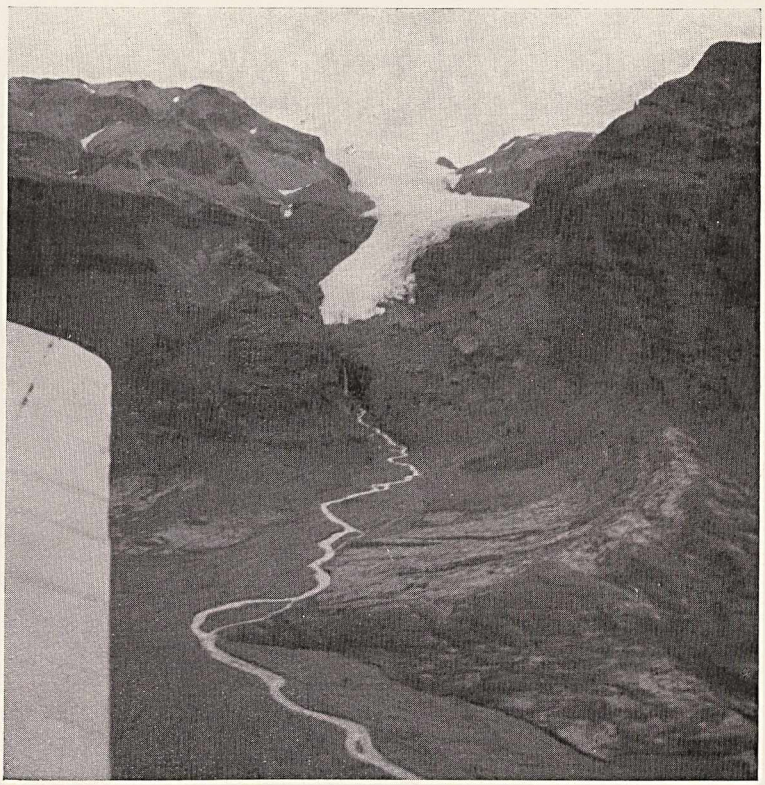


Fig. 12. *Hólárjökull 1950. In the front to the right the curved terminal moraine marking the max. extension of the glacier tongue in postglacial time. Aerial photo S. Thorarinsson 28 Aug. 1950.*

a result of an advance of Kvíárjökull during the first centuries of the Subatlantic Time. This conclusion is supported, although not proved, by the fact that a rhyolitic tephralayer hardly more than ab. six thousand years old and found in many soil profiles in Öræfi, was not found in any of the profiles dug on Kvíármýrarkambur and Kambsmýrarkambur.

Summing up the results of the tephrochronological studies in Öræfi as regards the oscillations of the glaciers it has been established as certain that both the Stóralda moraine and the core of the moraines bordering Kvíárjökull are prehistoric and as likely — although not yet proved — that these moraines were formed during the first centuries of Subatlantic Time as a result of the climatic deterioration that began ab. 600 B.C. The terminal moraine on the lowland plain in front of Hólárjökull may be of the same age. Consequently the climatic deterioration during the first centuries of Subatlantic Time has probably brought the glaciers in question to the same or to a little more advanced position than they ever reached during the last three centuries. It is still an open question whether the thrust moraine in front of SW Breidamerkurjökull mentioned earlier in this paper, is prehistoric or not. Todtmann mentions (1952, p. 407) that she has not been able to find the 1362 tephra on that moraine which rather points to its formation being later than 1362. As to the terminal moraines in Stadardalur, situated 5.5 km S of the present snout of Sultartungujökull, I am now — in light of our present knowledge of the postglacial shoreline movement in Iceland — of the opinion that these moraines are older than the Postglacial Warm Period. By detailed studies of tephralayers in the Stadardalur valley inside these moraines it ought to possible to decide whether this opinion is right or not. Ives and King mention "greatly dissected and partially buried remains of a moraine" in Morsárdalur ab. 5 km from the present snout of Morsárjökull. They think it probable that these moraines are of late glacial age marking the junction of Skeiðarárjökull and Morsárjökull at that time

Fig. 13. *The moraine hillocks Kviárhólar. To their left the slope of Kviármýrarkambur. Photo S. Thorarinsson 16 Sept. 1955.*

(Ives and King 1955, p. 478). My impression from a short visit in 1945 was that these "moraines" might be early postglacial dead ice moraines. There is no doubt that they are prehistoric, but nothing more can as yet be said with certainty about their age. Also here a tephrochronological study would probably prove useful for dating the moraines.

Finally it should be mentioned that shortly W of the road between Svínafell and Sandfell, ab. 2 km in front of the present snout of Falljökull, there are prehistoric terminal moraines called Rasshólar. They could be of the same age as the moraines in Morsárdalur and Stadardalur.

The conclusions quoted at the beginning of this paper, viz. that the moraines which were formed during the advance of the glaciers around the northernmost Atlantic in the 18th and 19th centuries mark their maximum extent in historical and probably even in postglacial time, are in my opinion still valid for the big outlets of Vatnajökull, but the tephrochronological studies in Öræfi related in this paper support the view that some of the outlets of Öræfajökull advanced in early Subatlantic Time as far and even a little further than in the 18th and 19th centuries. The reason why the outlets of Vatnajökull proper did not in early Subatlantic Time advance as far as the outlets of Öræfajökull, compared with their recent advances, might then simply be that at the end of the Postglacial Warm Period Vatnajökull proper was proportionally more reduced in area than the higher and more alpine Öræfajökull (cf. Eythórsson 1951 a). The rising of the firn line during the Warm Period had a greater reducing effect on the big Vatnajökull outlets with their relatively flat spoonshaped intake areas than it had on the steep alpine Öræfajökull outlets. But we must also take into consideration that Öræfajökull is an active volcano, as that may have affected its outlet glaciers.

REFERENCES:

Ahlmann, H. W:son: 1933. Scientific Results of the Swedish-Norwegian Arctic Expedition. Part VIII. Glaciology. Geogr. Ann. Stockh., 15: 161–216, 312–348. Stockholm.

— Glaciological Research on the North Atlantic Coasts. R. G. S. Research Series No 1. London.

Bárdarson, G. G.: Islands Gletscher, Vísindafél. Ísl. 1. Reykjavík.

Eythórsson, J.: 1935. On the Variations of Glaciers in Iceland. I. Drangajökull. Geogr. Ann. Stockh.

— 1949. Variations of Glaciers in Iceland 1930–1947. Journ. Glaciol., 1: 250–252. Cambr.

— 1951 a. Þykkt Vatnjökuls. Jökull, 1: 1–6. Reykjavík.

— 1951 b. Jöklamælingar 1950 og 1951. Jökull, I: 16. Reykjavík.
— 1952. Jöklamælingar haustið 1952. Jökull, 2: 31. Reykjavík.
— 1953. Glacier Variations 1952/53. Jökull, 3: 49. Reykjavík.
— 1954. Jöklabreytingar í metrum 1954. Jökull, 4: 46. Reykjavík.
— 1955. Jöklabreytingar 1954/55. Jökull, 5: 40.
Helgason, E.: 1937. Lönd og leiðir í Austur-Skaftafellssýslu. Árbók Ferðafél. Ísl. 1937: 5—32. Reykjavík.
Hoppe, G.: 1953. Några iakttagelser vid isländska jöklar sommaren 1952. Ymer, 73: 241—265. Stockholm.
Howell, Fr. W. W.: 1892. The Öræfajökull and its First Ascent. Proc. Roy. Geogr. Soc. Edinb., 14: 841—850. Edinburgh.
— 1893. Icelandic Pictures. London.
Ives, J. D. and King, C. A. M.: 1955. Glaciological observations on Morsárjökull. Regime of the Glacier. Journ. Glaciol., 2: 477—482.
Mercanton, P. L.: 1952. Rapport sur les variations de longeur de glaciers européens, de 1947 à 1940. U.G.G.I. Ass. Générale de Bruxelles 1951. Tome 1: 107—119. Louvain.
Renaud, A.: 1936. Les entonnoirs du Glacier de Gorner. Mém. Soc. Helvét. Sci. Nat., 71: Mém. 1. Zürich.
Storm, G.: 1875. Islandske Annaler, Kristiania.
Thorarinsson, S.: 1936. Vatnajökull. Chapter III. Geogr. Ann. Stockh. 18: 189—195.
— 1938. Über anomale Gletscherschwankungen mit besonderer Berücksichtigung des Vatnajökullgebietes. Geol. Fören. Stockh. Förh., 60: 490—506. Stockholm.
— 1944. Present Glacier Shrinkage and Eustatic Changes of Sea Level. Geogr. Ann. Stockh., 26: 131—159. Stockholm.
— 1946. Í veldi Vatnajökuls II. Stærðarbreytingar Vatnajökuls og orsakir þeirra. Lesbók Morgunblaðsins, 21: 260—263. Reykjavík.
— 1949. Some Tephrochronological Contributions to the Volcanology and Glaciology of Iceland. Geogr. Ann. Stockh., 21: 239—256.
— 1952. Tvöfaldar jaðarurðir í Kangerdlugssuak. Jökull, 2: 8—9. Reykjavík.
— 1954. Athuganir á Skeiðarárhlaupi og Grímsvötnum. Jökull, 4: 34—37. Reykjavík.
Thorkelsson, J.: 1921. Kirkjustaðir í Austur-Skaftafellsþingi. Blanda, 2: 247—268. Rvík.
Todtmann, E. M.: 1932. Glazialgeologische Studien am Südrand des Vatna-Jökull (Sommer 1931). Forsch. u. Fortschritte 8, Nr. 26. Berlin.
— 1936. Einige Ergebnisse von glazialgeologischen Untersuchungen am Südrand des Vatna-Jökull auf Island. Z. dtsch. geol. Ges. 88. Berlin.
— 1951. Im Gletscherrückzugsgebiet des Vatna-Jökull auf Island, 1950. Neues Jb. Geol. Paläontol., Mh. 1951: 335—341. Stuttgart.
— 1952. Im Gletscherrückzugsgebiet des Vatnajökull auf Island, 1951. Neues Jb. Geol. Paläontol., Mh. 1952: 401—411. Stuttgart.
— 1953. Am Rand des Eyjabakkagletschers Sommer 1953. Jökull, 3: 34—37. Reykjavík.

ÁGRIP.

Ofanritуð grein fjallar að mestu um aldur jökulöldu þeirrar, er Stóralda nefnist, framan við Svínafellsjökul í Öræfum, og jökulgarða þeirra hinna miklu, Kvíármýrarkambs og Kambsmýrarkambs, sem umlykja sporð Kvíárjökuls. Höf. hefur einkum beitt þeirri aðferð að athuga öskulög í jarðvegi á jökulgörðunum, en í jarðvegssniðum þessum hefur tekizt að ákvarða öskulög frá Kötlu 1918 og 1755, frá Öræfajökli 1727 og 1362 og öskulagið frá Skaftáreldum 1783. Niðurstöður höf. eru þær, að nefndir jökulgarðar séu örugglega forsögulegir og að öllum líkindum myndaðir við framskrið jöklanna á fyrstu öldum kuldaskeiðs þess, er hófst í byrjun norrænnar járnaldar, um 600 f. Kr. Séu þessar niðurstöður réttar, sem ekki er þó enn fullsannað, hafa nefndir jöklar náð aðeins stærri útbreiðslu á þessu kuldaskeiði en þeir náðu á 18. og 19. öld.

Höfundur rekur einnig þær breytingar, sem orðið hafa á Skaftafellsjökli, Svínafellsjökli og Kvíárjökli síðan 1904, og byggir þær á kortum danska herforingjaráðsins frá 1904, á amerískum kortum í sama mælikvarða (1:50000), sem gerð eru eftir flugmyndum teknum 1945, og á flugmyndum, sem Ágúst Böðvarsson tók í september 1954, svo og á mælingum Jóns Eyþórssonar á lengdarbreytingum þessara jökla. Frá 1904 til 1945 styttist Skaftafellsjökull 1.0 km, Svínafellsjökull 0.45 km og Kvíárjökull 0.55 km. Á sama tímabili, 1904—1945, þynntist sporður Svínafellsjökuls að meðaltali 65 m, en sporður Kvíárjökuls 60 m. Síðan 1945 hafa jaðrar þessara jökla lítið breytzt.