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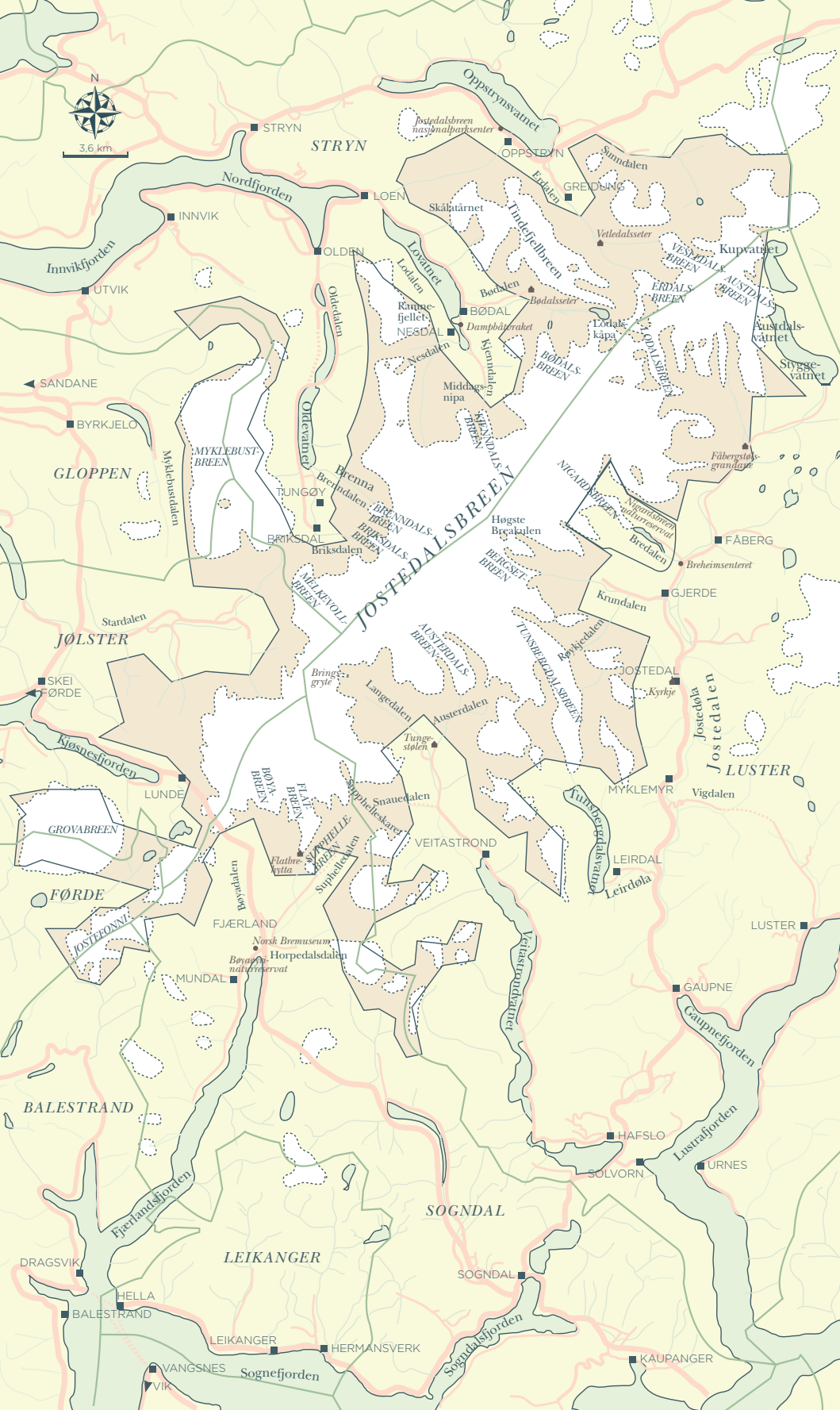
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THE JOSTEDALSMBREEN – ICE IN MOTION

One's first encounter with the glacier Jostedalbreen can be quite unexpected. At the end of an otherwise green and fertile valley, you suddenly find one of the more than twenty tongues of this majestic plateau glacier that have been given names. Approaching the glacier front you will notice that the vegetation changes. Birches get more crooked and eventually disappear completely. Up to the glacier itself, mountain vegetation predominates; mainly lichen and moss.

With its about 487 square kilometres, the Jostedalbreen is the largest glacier on Continental Europe, and it covers 60 kilometres from the mountain Strynefjellet in the North to Fjærland in the South. The easy access and its impressive dimensions have made the Jostedalbreen one of the most popular tourist attractions of Norway. Seeing the glacier for the first time and walking on the ice in the company of a guide with local knowledge are experiences with nature that you will remember for the rest of your life.



WHAT IS A GLACIER?

A glacier consists of ice and snow that accumulate over a long period. A simple but very telling definition of a glacier is “ice in motion”. At many places the glacier is over 500 metres thick. At a depth of more than 30 metres the glacier does not act as a rigid body any longer, but as a plastic or porridge-like mass, and the force of gravity makes the ice move slowly downwards. As it is the slope of the glacier surface and not that of the ground that determines the direction the ice will take, glaciers can also move uphill. A cubic metre of pure ice weighs about 900 kilos. Underneath and inside the glacier you find tremendous forces that crush whatever they meet on their way.

The rate of movement of the ice varies from one glacier to the other. The glacier Bøyabreen in Fjærland, which is one of the fastest, moves about

two metres a day. As ice melts continuously at the front of the glacier during summer, this motion is not easy to observe. Crevasses are often the only sign. They are produced because the rate of motion is sixteen times higher at the glacier surface than close to the bottom and at the sides of the glacier. The glacier surface also cracks when the glacier meets an obstacle like, for instance, a knoll. On the Jostedalbreen the crevasses do not get deeper than 20 or 30 metres. Further down in the glacier the pressure is so high that these cracks are pressed together again.

Where the glacier plunges down a steep rock wall we find so-called re-generated glaciers at the bottom of the valley. Now and then tonnes of ice fall down, and a new glacier is generated from the ice-avalanche masses. The glaciers Bøyabreen and Supphellebreen belong to this category.



THE GLACIER SHAPES THE LANDSCAPE

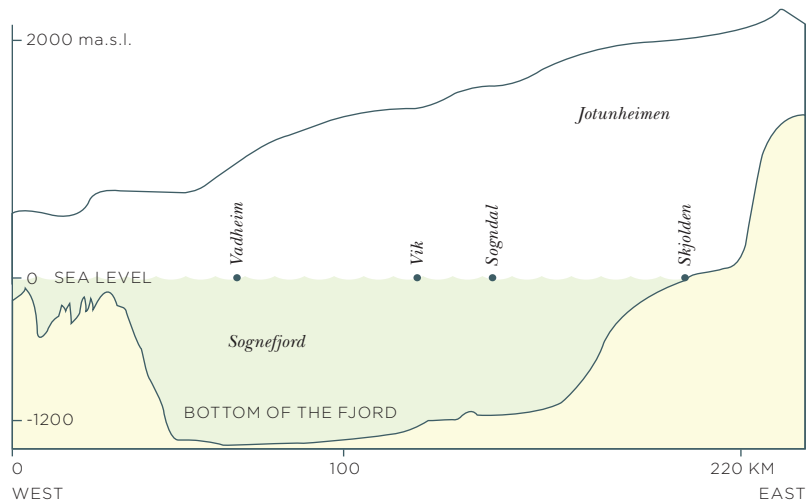
The landscape in Western Norway has been formed by glaciers over the last two or three million years. The glaciers have gradually carved out the valleys and thus formed the unique fjord landscape. The landscape has not changed much since the latest glaciation finished about 10,000 years ago.

VALLEYS AND FJORDS ARE BORN

Valleys that have been hollowed out by the glacier are usually U-shaped with steep hillsides and a relatively wide bottom. Lengthwise the valleys are often divided into several basins or troughs with separating barriers. But as the glacial rivers carry considerable sediment which they deposit as the water decreases its speed, today many basins are filled up and therefore not visible anymore.

It is the thickness of the glacier, the speed of the ice, and the ground below that decide how deep a glacier can carve out this shape. Where several glaciers meet, they can go exceptionally deep and form a basin. That happened at many places where a tributary valley led into a main valley. Tribu-

↪ The sander Fåbergstølsgrandane in the valley Jostedalen with the glacier Stigaholtbreen in the background.



Vertical view of the Sognefjord from the mouth in the west and eastwards.

tary valleys are often hanging valleys, i.e. the mouth of the tributary valley is situated further up the hillside of the main valley. An excellent example of this is the valley Horpedalsdalen in Fjærland, but also most of the branches of the Sognefjord are hanging valleys in relation to the fjord basin itself. The glaciers that carved out the branches of the fjords were thinner and lighter and could not hollow out the ground as deeply.

The canalisation of the ice stream also implies that the glacier can go even deeper. The valley pattern of the Sognefjord was created by rivers that carved themselves into softer areas of the mountains. This happened in a period when Western Norway was rather flat; long before the glaciations of our latest glacial era started. Later on it was the glaciers that widened and deepened these valleys. In the Sognefjord the ice probably eroded about 1,900 metres of bedrock. Seen from a bird's-eye view the Sognefjord with its many branches still looks like a river system.

Fjords are valleys that the glaciers have eroded so much that the bottom of the valley went below sea level and the ocean flowed in when the ice melted. The Sognefjord reaches 1,306 metres deep, but at the coast the bottom of the fjord has a very characteristic barrier that reaches to about 150 metres from the water surface. Here the ice masses could spread, and the glacier got thinner at its edge. As the forces of erosion of a glacier diminished according to its thickness, this thin glacier could not erode the bedrock as efficiently. Barriers could also be created because of harder bedrock that the glacier did not succeed in eroding as in the rest of the valley.



ICE AND STONE - AN EFFICIENT COMBINATION

It would be impossible for a glacier of pure ice to shape a valley. But glacial ice contains particles of all sizes. They may originate from loose materials on the basal rock or from rock slides. By means of this material the glacier can model the landscape in different ways.

Owing to the weight and motion of the ice there is tremendous pressure underneath the glacier. When the ice presses a stone against the rock surface, small, curved fracture marks or scratches may be formed. If the glacier encounters an obstacle, like for instance a knoll, the pressure on the windward side may become so high that the ice melts even though the temperature is below freezing point. On the side away from the wind the pressure is minor, and the water will refreeze. As water increases its volume when it freezes, it can break up the bedrock in rifts or fissures. This is called frost weathering.

Since the glacier is moving, the pressure underneath the ice may vary a good deal. These pressure differences contribute to fracture the bedrock. A decrease of the pressure on the stationary rock may cause relief fissures that may later be a point of action for frost weathering. The loose material may freeze onto the glacier bottom or sole and will then be transported along with the ice. When it scores along the underlying rock, glacial striations are formed. Fine-grained material within a glacier has a polishing effect, just like sandpaper against a wood. Fast running meltwater carrying sand and stones also polishes the bedrock.

During these processes the stone material in the glacier sole is crushed or ground into smaller and smaller particles. Measurements from the Nigardsbreen in the valley Jostedal show that the glacier erodes one or two centimetres off the stationary rock each year.



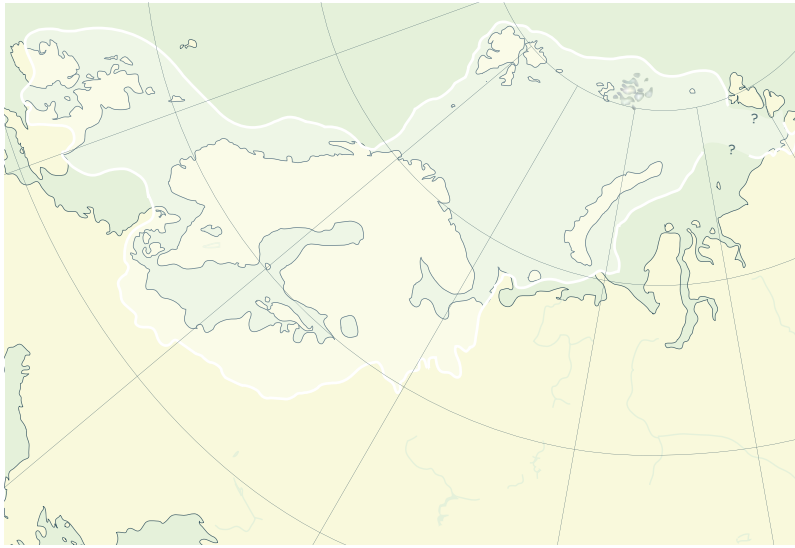
GLACIERS AND CLIMATE

The climate is constantly changing, as it has done since the Earth was created about 4.6 billion years ago. The most common climate till now has been so warm that ice did not exist on Earth.

Climate is the average weather during a relatively long time, whereas weather is a combination of among others temperature, solar radiation, atmospheric pressure, wind, atmospheric humidity, clouds and precipitation during a short period of time. The extreme values, like for instance highest and lowest temperature, also describe the climate.

The climate decides whether glaciers increase or decrease. Cool summers and snowy winters make glaciers thicken, whereas warm summers and winters with little snow lead to a reduction of ice masses.

Since climate and glaciers are that closely connected, glaciers become very interesting to climate researchers. By analysing the traces that the glaciers left behind and combining that data with other research methods, researchers can find out what the climate was like in the past. Following the development of the glaciers they can furthermore say something about how climate is changing in our day.



↪ Maximum ice extension about 20.000 years ago during the latest glaciation.

⇒ The glacier Austdalsbreen with the lake Austdalsvatnet.

THE GLACIATIONS

In the history of the Earth there have been, as far as we know, five glacial periods. The shortest and most recent period is the present one, the Quaternary. This period comprises the last 2–3 million years and has been influenced by climatic fluctuations including colder periods, the glaciations, where large parts of the landmasses were covered by an up to several kilometres thick sheet of ice, and warmer periods where the glaciers had more or less melted away. Today we are in this type of a warm period.

In the Quaternary period we know of at least 40 glaciations lasting up to 100,000 years each. The warmer periods in-between usually lasted 10,000 to 15,000 years. The latest glaciation ended about 10,000 years ago.

THE LITTLE ICE AGE

More recently, the Jostedalbreen reached its greatest extension during the so-called Little Ice Age. That was a period with a cooler climate, which started in around 1650 and lasted for 200 to 280 years. The summer temperatures were about one degree lower than today, and during this period farmers had several years of poor harvests. Winter precipitation increased, particularly in the beginning of the 18th century. Glaciers grew considerably, and for instance the Nigardsbreen advanced as much as 2.8 kilometres between 1710 and 1735. Extreme weather conditions, followed by flooding together with





The glacier Nigardsbreen in 1890 when it still covered today's glacial lake.

avalanches and slides, were not unusual. Many farms in Western Norway had their pastureland and fields seriously damaged, especially between 1680 and 1750. Between 1740 and 1750 it was at its worst. Around 1750 the tongues of the glacier also reached their largest expansion since the latest glaciation. This is evidenced by the end moraines in almost all valleys around the glacier plateau. An example is the 1748 moraine at the Nigardsbreen in the Jostedalalen, just next to the National Park Centre Breheimsenteret.

THE EVOLUTION OF THE JOSTEDALSBREEN DURING THE LAST TWENTY YEARS

On a worldwide scale, glacial areas have shrunk considerably during the last decades. However, in Norway some glaciers close to the coast had a major surge in the 1990s. The reason was increased winter precipitation in the late 1980s and the early 1990s. In the area around the Jostedalsbreen it was the western outlets that advanced, such as for instance the Briksdalsbreen that spread 304 metres between 1987 and 1996.

This glacier expansion was very unique in a global context. Only glaciers in New Zealand and in Alaska followed a similar trend. Since the year 2000 the tongues of the Jostedalsbreen have retreated again, both in length and in volume, due to very hot summers, so now their evolution is similar to that of glaciers in the rest of the world again.



HOW OLD IS THE JOSTEDALSBREEN?

After the latest glaciation ended, there have been periods with climates both warmer and colder than today's. By analysing pollen from moors in the Jostedalalen, researchers found out that between 6,000 and 8,000 years ago summer temperatures at the Jostedalsbreen were up to four degrees centigrade higher than today. Elms, very warmth-loving trees, were growing around today's timber line for birch on the north-west side of the Jostedalsbreen. The majority or maybe all of the Jostedalsbreen had most likely melted away in that period. If that is true, the Jostedalsbreen is not one of the remains from the latest glaciation but has probably regenerated during a worsening of the climate between 6,000 and 5,500 years ago.



THE GLACIER AS A RECORD OF THE CLIMATE

A glacier is formed from stratified snow falling on the upper part of the glacier during winter. As time goes by, these layers become glacial ice. The ice therefore has the same chemical composition as the original fresh snow, as long as the ice is not exposed to ablation in summer. In this way the glacier works like a record of the climate, storing information about atmospheric composition and precipitation.

In Greenland and in the Antarctic the ice is more than seven kilometres thick. Scientists have recovered drill cores containing information about the climate from up to approximately 890,000 years back. Information about the climate in the past is very important in order to increase knowledge of the climate system and for the development of data models that are able to simulate future climate changes.

GLOBAL WARMING OR A NEW GLACIATION?

During the last 2–3 million years the warm periods between the glaciations lasted between 10,000 and 15,000 years in most cases. Should this be the case for our present warm period also, it will soon come to an end. However, many things indicate that our warm period may last a lot longer, maybe as much as another 50,000 years. The reasons are changes in the Earth's orbit around the sun; changes that recur at certain intervals.

Since the mid 1900s the average global temperature has been rising. The Intergovernmental Panel on Climate Change (IPCC) states that eleven years of the period 1995 to 2006 are among the twelve warmest years since measuring began in 1850. Heavy precipitation has become more frequent in most territories, the sea ice in the Arctic regions is melting and global sea levels are rising because of the melting of land ice.

The majority of global warming is most likely due to emissions of greenhouse gasses from human activities. The content of carbon dioxide, methane and nitrous oxide (laughing gas) in the atmosphere is now much larger than in pre-industrial times.

Today several data models give grounds for believing that the high level of greenhouse gasses can delay the natural cycle of glaciations and interglacial periods for several hundred thousand years. At this time, nobody knows for sure whether the human being has started a process that will lead to a warmer climate or whether the climate system will tend towards a new glaciation anyhow. More insight is necessary, and here glaciers are highly valuable sources of information.



THE JOSTEDALSBREEN NATIONAL PARK

The Jostedalbreen National Park, with its 1,315 square kilometres ranges amongst the largest national parks in Norway and is situated in the municipalities of Balestrand, Førde, Gloppen, Jølster, Luster, Sogndal and Stryn. Almost the whole area is situated at 800 metres above sea level, and about half of it is covered with ice. Several minor glaciers that are not connected to the Jostedalbreen, like the Jostefonni, the Grovabreen and the Myklebustbreen, are also part of the national park. The Jostedalbreen National Park was established in 1991 and extended in 1998. Approximately 75 per cent is owned by the Norwegian State, the rest is in private hands.

A characteristic feature of the Jostedalbreen National Park is the strong contrast between the glacier landscape in the high mountains and the luxuriant valleys with rivers, brooks and waterfalls. The preserved values are first of all bound up with the glacier itself, the glacier streams, geological formations and vegetation, but also to the cultural landscape, particularly to the mountain summer farms. The Jostedalbreen area is, furthermore, one of the largest natural areas in Southern Norway with the so-called feature of wilderness.



The Breheimssenteret at the glacier Nigardsbreen in the valley Jostedalen.

THE NATIONAL PARK CENTRES

The Jostedalsbreen National Park today has three authorized information centres: The Jostedalsbreen National Park Centre, the Norwegian Glacier Museum in Fjærland and the Breheimssenteret in the Jostedalen.

The Jostedalsbreen National Park Centre is situated in very idyllic surroundings at the lake Oppstrynsvatnet. The buildings of the centre are meant to symbolize the encounter between past and future. The main building is a stave construction, typical building technique for houses in the Viking period. The cinema auditorium, made of polished Norwegian stone, is built in modern style. The science exhibit lays emphasis on subjects like geology, avalanches, animal life and activities on the glacier. In the cinema you can watch a film about the Jostedalsbreen. In the open-air part of the centre there is a geological park with many different kinds of Norwegian rocks. In the botanical garden, which was founded by the well-known Norwegian botanist-professor Olav Gjærevoll, there are more than 400 wild plants, most of them from the local environment. They are in full bloom from the end of May through July, but the first plants already blossom in early spring, and the last ones finish in September.



FLORA AND FAUNA

The vegetation in the Jostedalsbreen National Park is greatly influenced by local climatic conditions and thus shows great variation depending on altitude above sea level, distance from the glacier and water supply. In the valleys you often find warmth-requiring diversified plant communities whereas the high mountains are dominated by alpine species. Near the glacier you find the so-called pioneer species, which are the first plants that managed to make a habitat in the poorly developed soil after the ice has melted away. Such pioneer plants are for example different kinds of lichen and moss, but also tree species like birch. Furthermore, in Norway birch forms the timber-line, which in the national park is located between 700 and 900 metres above sea level.

There is not much animal life in the high mountains and on the glacier. In the valleys there is extensive fauna with abundant deer and some rare species of birds like the white-backed woodpecker. Regarding birds of prey you find, among others, the golden eagle and the rough-legged buzzard.



THE LANDSCAPE AND THE PEOPLE

Each of the valleys around the Jostedalsbreen has its own particular history and characteristic landscape. At the same time they have a lot in common, not least because of their proximity to the glacier. The valleys and settlement sites we are going to focus on are the Jostedalen, Veitastromd, Fjærland, the Oldedalen, the Lodalen and the Erdalen.

Natural conditions are very similar around the Jostedalsbreen. The bedrock consists mainly of gneiss, and the valleys are characterized by glacier rivers, which transport large quantities of meltwater down to the fjords. Many of the valleys are partly or completely filled with one or various lakes or a fjord. When the Jostedalsbreen became a tourist attraction at the end of the 19th century, the rural districts also had joint tourist activities. In many valleys tourists were brought to the glacier by boat and/or by horse and carriage.

Before the roads in the valleys and in general the modern road system of the province were ready, rural communities around the Jostedalsbreen were rather isolated. Many places you had to go by sea when travelling to and from

☞ The glacier Bergsetbreen in the valley Krundalen in the 1990s. Today the glacier has retreated considerably.

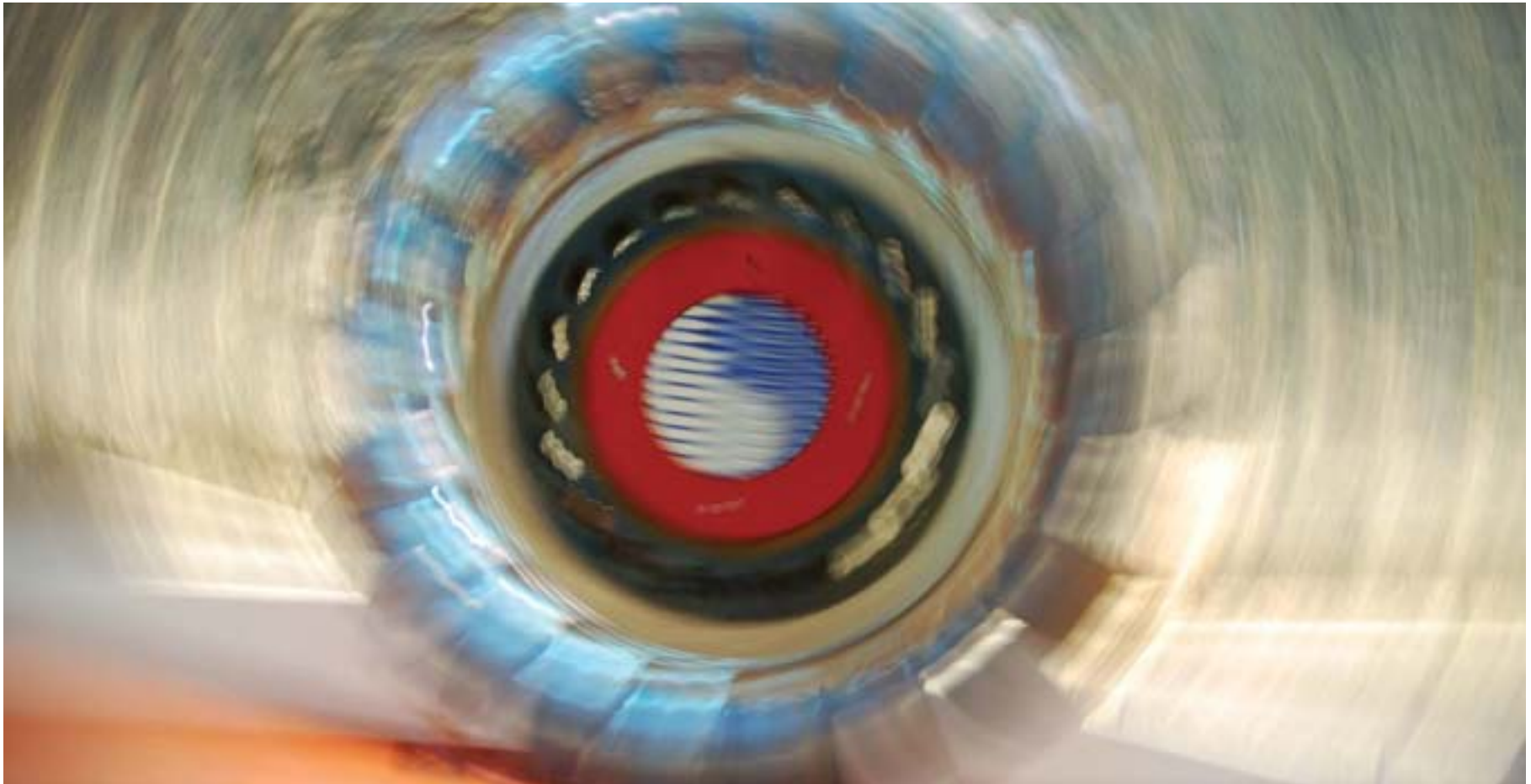


The village Flo at the lake Oppstrynsvatnet.

the rural districts. In winter even this communication line with the outside world could fail. It was quite frequent that lakes and the inner parts of the fjords froze up in winter. In some periods the ice might be too thin to walk or drive on, and too thick for boats to get through. Then, the rural districts were often isolated for many weeks at a time. Additionally avalanches made it difficult to make one's way through the valleys. But even in summer the fastest and easiest way to the neighbouring parish could be the one over the Jostedalsbreen. This contact with the other rural communities was important, as agriculture was based mainly on self-support. With the assistance of the neighbouring communities, households could be supplemented with

goods that the people on the farms could not produce themselves. In those times the Jostedalsbreen connected the rural districts. The tradition of traffic over the Jostedalsbreen dates back as far as to the 18th century, maybe even further.

Nowadays the Jostedalsbreen is somewhat a dividing line between the districts. By car you can go relatively quickly round the glacier from one rural district to the other. Traffic over the glacier is now mainly recreational. Furthermore, it is now more difficult to walk on the glacier than during the 18th and 19th century. At that time the glacier was larger, which meant a less hilly glacier with fewer crevasses.



HYDROELECTRICITY - THE GLACIAL RIVER AS AN ENERGY SOURCE

In the summer when it is hot, a lot of meltwater comes from the glacier, and so that is when the glacial rivers carry a lot of water compared to other rivers which have their lowest flow at this time of the year. In this way a hydroelectric power station receiving water from the glacier has a more constant power production than other types of power stations. The water is collected behind a dam and fed to the power station through tunnels. The greater the difference in height, the better. The generating station itself works like a dynamo powered by hydraulic energy.

The development of water power in the valley Leirdalen started in 1974, and in 1978 the power station started working. With a drop of 465 metres, it produces about 450 gigawatt hours, enough energy to supply 23,000 house-

holds. The power station uses meltwater from the glacier Tunsbergdalsbreen above all other sources.

The Jostedal power station in Myklemyr started production in 1989 and is mainly supplied by the lakes Kupvatnet and Styggevatnet. Through the dam Styggevattdammen the lakes Austdalsvatnet and Styggevatnet were brought together into one single reservoir. From there a 40 kilometre long tunnel goes to the turbine hall. A drop of 1,186 metres gives it the highest water pressure at a power station in Northern Europe. The production is about twice that of Leirdøla power station.

To avoid frost smoke and ice formation on the Gaupnefjord and subsequent frostbite on fruit trees, the outlet water from the power station discharges through a 15 kilometre long tunnel into the fjord 42 metres below water level.



Langedalen, Veitastromd.



The glacier Austerdalsbreen with the ice-falls Odin and Tor.

VEITASTROND - THE MOST ISOLATED PLACE IN ALL SOGN?

The about two-mile long trip along the lake Veitastondvatnet seems endless, but the visit to Veitastond is worth the effort. These well-run farms lie on the five-mile long alluvial plain, which stretches north-westward from the end of the lake Veitastondvatnet. Agriculture comprises mainly milk production from cows and goats. Today about 130 persons live in this rural district which is also well-known for its production of goat cheese.

Following the toll road, you pass several mountain dairy farms where you can see livestock at pasture in summer. One of the hanging valleys, which you can see from the road, is the Snauedalen with the pass Supphelleskaret at the end. If you follow the track, you get to Fjærland and to the Sognefjord. The motor road continues all the way to Tungestølen where the valley forks. From here tracks go to the glaciers Langedalsbreen and Austdalsbreen with its three characteristic ice-falls Tor, Odin and Løke. The English mountain climber W. C. Slingsby once called it "the finest ice-scenery in Europe".

PENNED UP BY THE ICE

Before the road to Veitastond was opened in 1956, water was the most important arterial thoroughfare. When goods like meat, cheese and butter were to be sent to Bergen for sale, they had to be delivered to Solvorn at the Lustrafjord, later to Hafslø. This was a day trip, and the goods had to be transported by rowboat and in backpacks. On their way back people brought

commodities like salt and grain which were needed in their rural district. Also, mail had to be fetched at Solvorn, and before Veitastond got its own churchyard in the 1890s, people had to carry their dead to Hafslø to be buried. In 1895 a steamer started to run regularly on the lake Veitastondvatnet.

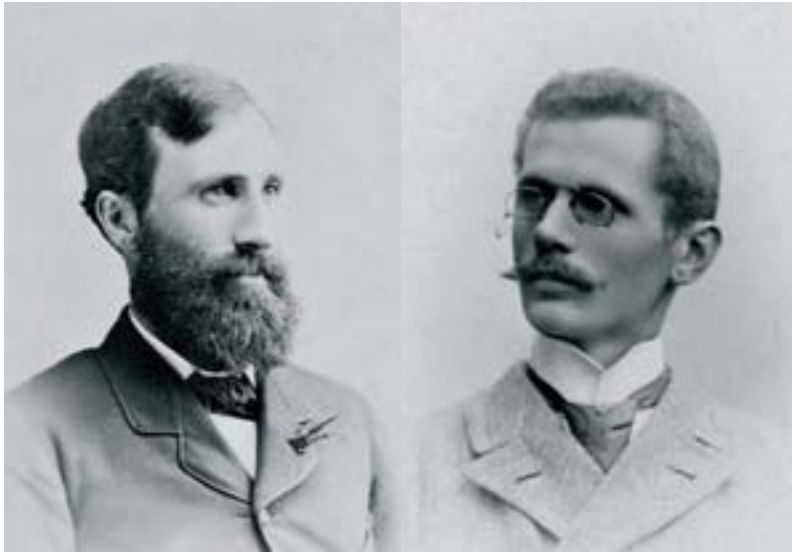
In winter the trip to Hafslø could be difficult. The ice was often too thin to walk or to drive on and too thick to get through by boat. This hampering ice could cut off Veitastond from the outside world for weeks. In that case the postman often decided to go by the valley Snaudalen to Fjærland in order to fetch the mail there.

Even after the road was built, people in Veitastond have experienced periods of up to 90 days with isolation because of avalanches. After the construction of today's tunnels, conditions have improved.



THE MOUNTAIN DAIRY FARM TUNGESTØLEN

Nowadays most people attach the name "Tungestølen" to the tourist cabin that is situated 300 metres above sea level and where the valleys Langedalen and Austerdalen meet. The cabin was built in 1910 by the glacier guide Lasse Neset. From 1921 his daughter, Randi Neset, was landlady of the cabin. She was only 16 years old at that time. She cooked and took care of the tourists who came to visit, very often in connection with a hike on the glacier. At the same time she was a milkmaid at the mountain dairy farm and milked five cows and thirty goats twice a day. She also made cheese, so they were busy days, indeed. In 1965 a larger cabin was built, just next to the old one, and today it is administered by The Norwegian Trekking Association. From the cabin there is a fine view over the valley, and here the track to the Austerdalsbreen begins.



♣ William Cecil Slingsby (1849–1929) and Kristian Bing (1862–1935).
⇒ On the glacier Austerdalsbreen towards the ice-fall Odin.

BING, SLINGSBY AND THE AUSTERDALSBREEN

The glacier Austerdalsbreen has been a well-known tourist attraction for a long time. Nevertheless it was not until 1894 that someone set foot on this glacier: Native of Bergen, mountain climber and member of the tourist association, Kristian Bing.

On the 11th August 1894 Bing and a friend of his started the journey from Lunde in Jølster, crossed the glacier plateau and came down on the mountain ridge between the ice-falls Odin and Loke. Here they built a cairn with a white quartz rock on top of it, today called Kvitesteinsvarden. The next day they went down onto the glacier Austerdalen and via Tungestølen and the Snauedalen to Fjærland.

Chance so ordained it that another well-known mountain climber, William C. Slingsby, went for a hike on the very same day, together with a relative and the glacier guide Mikkel Mundal. From Fjærland they went over to Veitastrom where they spent the night at a mountain summer farm. Next day they arrived at the Austerdalsbreen. They went up the same mountain ridge as Bing had descended on, and continued to Briksdalen. Bing and Slingsby did not know about each other, but Slingsby realized that he was not the first man in the area when he found footprints and saw the cairn. It turned out that both Bing and Slingsby had named the three ice-falls above the Austerdalsbreen. But posterity decided to use Bing's names: the names of the Norse gods Tor, Odin and Loke.





FJÆRLAND - WHERE GLACIER AND FJORD MEET

At the end of the about 20 kilometre long Fjærlandsfjord you find Fjærland, a small rural district with its centre in Mundal. The about 300 residents are mainly engaged in agriculture, most of all milk production. The farms are larger than the average in Western Norway, and the flat ground makes them easy to run. The Norwegian Glacier Museum & Ulltveit-Moe Climate Centre is located not far from the glacier arms Bøyabreen and Supphellebreen. At the end of the fjord we find the Bøyaøyri Nature Reserve, wetlands with more than a hundred different observed species of birds and a tower for bird-watching with access for wheelchair users.

In Mundal in Fjærland we find The Norwegian Book Town which sells second-hand books in former cowsheds, the former post office and in other houses round about the village. Book towns all over the world have merged into IOB (International Organisation of Book Towns). The book town in Fjærland, founded in 1995, was the first one in Scandinavia. A good helper at the start-up was the world-famous author Jostein Gaarder. Today the book town has about 250,000 books for sale and is visited by thousands of interested customers during the summer season. All year round books are posted from this small village.

The track leading up to the cabin Flatbrehytta at 1,000 metres above sea level is one of the most popular walks up to the Jostedalbreen. From the cabin, which is situated at only a stone's throw from the glacier Flatbreen, there is a beautiful view over parts of Fjærland and the Fjærlandsfjord.



↻ The cabin Flatbrehytta with the Fjærlandsfjord in the background.

↻ Fjærland.



The glaciers Lodalsbrekka and Erdalsbreen.

During the last decade the registered number of visitors to the Skålatårnet Tower has been between 1,000 and 1,500 per year, 60 to 70 per cent of these were guests staying overnight. Furthermore, the uphill race “Skåla opp” has increased the turnout to the tower. In 2007 the event had 1,170 contestants.

THE ERDALEN - THE MAIN ROAD ACROSS THE GLACIER

The valley Erdalen at the northeast end of the Jostedalbreen is about 13 kilometres long and surrounded by 1,600 to 1,800 metre high mountains. The population is concentrated in the lower part of the valley. Many of the approximately 60 inhabitants engage in agriculture, although working away from the village has become quite common, too. The paved road ends at the farm Greidung. From there a toll road continues a bit further. After that, one has to continue on foot following the track that goes to the mountain summer

farm Erdalssetra, which is today one of the 50 prioritised areas of cultivated landscape in Sogn and Fjordane. At the Vetledalsseter tourist cabin the valley forks into the valleys Vesledalen and Storedalen with the glaciers Vesledalsbreen and Erdalsbreen at each end.

Erdalen is a fine starting point for short trips, daytrips or the traditional tour on skis “Josten på langs“. The Jostedalbreen National Park Centre is located a few kilometres from the Erdalsbreen, on the way to Stryn.

CROSSING THE GLACIER WITH MERCHANDISE

Until the second half of the 19th century the Jostedalbreen was maybe the most important trunk road between the rural districts around the glacier. There were many different routes. One of the most used ones was the Erdalen – Erdalsbreen – Lodalsbreen – Jostedalen. In the Jostedalen the dialect of today has a sprinkling of the Nordfjord dialect as a lot of natives from Nordfjord settled down there. People from different valleys married, they went to meetings and gatherings. Traders also used the routes across the glacier. The merchandise was often transported in backpacks.

The most important business related to the glacier traffic was cattle-droving. The increase of the population in towns and villages in Eastern Norway increased the need for meat and dairy products. In winter the cattle dealers travelled – most of them lived in Inner Sogn – to Nordfjord in order to make agreements on the purchase of cattle, horses, sheep and goats. In spring the animals were gathered at fixed places. The herding of cattle across the glacier took place in early summer before the surface acquired too many crevasses, preferably at night on hard frozen snow.

The crossing took from ten to twelve hours, but could take longer in event of bad weather. Afterwards the animals were sent up to summer pastures in the mountains. In autumn the journey continued to the market places in Eastern Norway. Later in the year the cattle dealers travelled around to get the rest of the money from those who had bought animals during the journey.

The cattle trade started in the 18th century, perhaps even earlier, and flourished till about 1910. The last cattle herd from the Erdalen to the Jostedal took place in the 1920s.

CONCESSIONARY GUIDES

By the end of the 19th century more and more tourists wanted to take walks on or across the glacier. This generated a demand for experienced guides with knowledge of local conditions. The farmers from the rural districts around the Jostedalbreen were very qualified for this task. In 1890 The Norwegian



Trekking Association (DNT) established the concessionary guide system. Official glacier guides were selected and supplied with map, compass and a book in which all trips had to be entered. The concession, which was valid only for certain routes, was personal and had to be renewed each year. The guides had to be available at short notice, be polite with the party of tourists and carry up to 12 kilos of luggage for the guests. In case of any serious complaint, the guide might lose his concession. There were fixed tariffs on the routes, and in 1890 the glacier guide got 12 Norwegian Kroner for the trip from the Jostedal to the Erdalen. This was a good extra income for the farmers.

The grand days of the concessionary guides lasted till the Second World War. Now there is only one active glacier guide with a concession left, Johan Støyva from Byrkjelo. Those who want to be glacier guides today have to be authorized by the Norwegian Mountain Guide Association which was established in 1988 by initiative of the Glacier Committee of DNT.

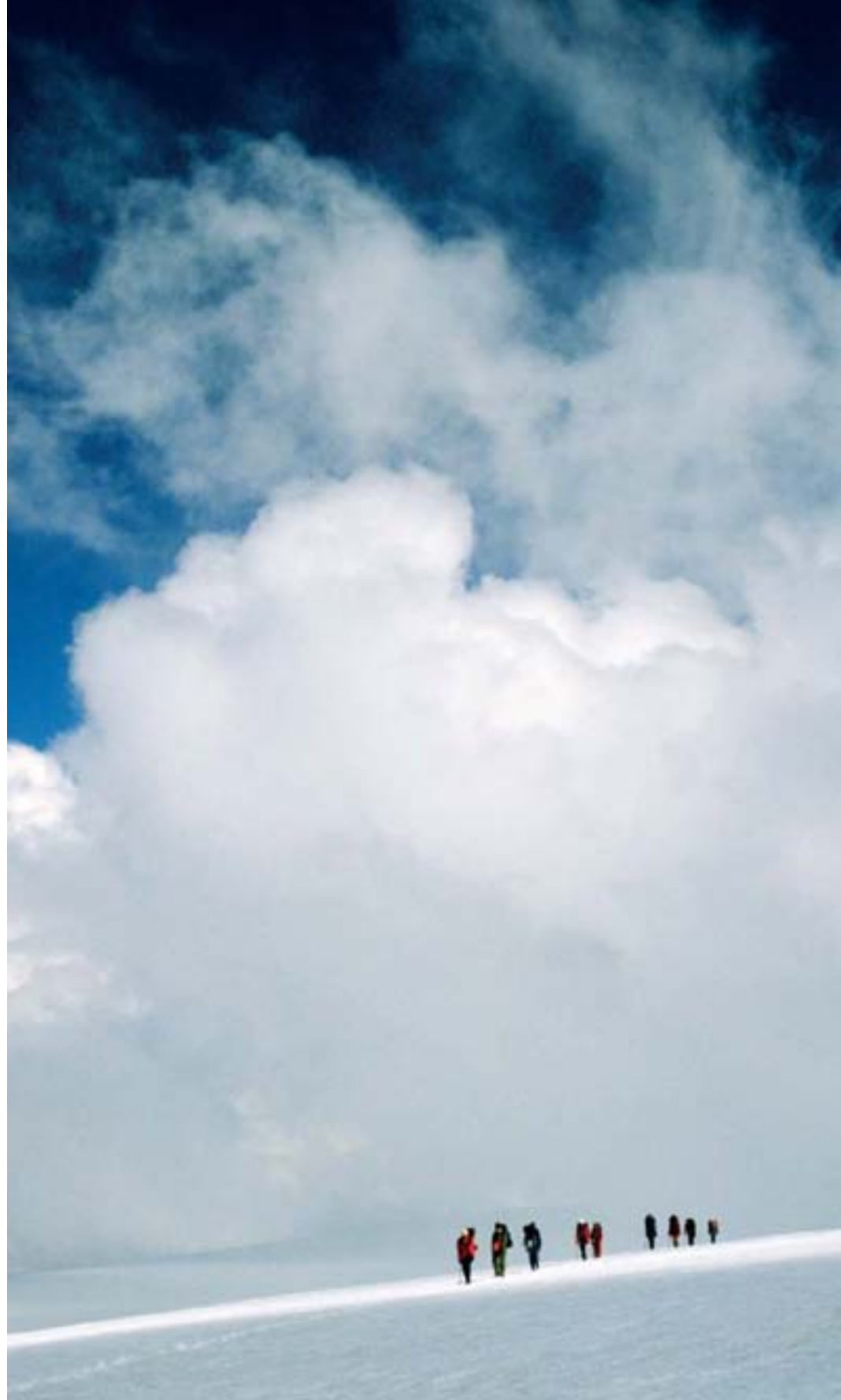
"JOSTEN PÅ LANGS" - JOSTEDALSBREEN LENGTHWISE

Crossing the Jostedalsbreen lengthwise is considered one of the toughest skiing trips in Norway. Nevertheless, it has become very popular.

The first person who crossed the Jostedalsbreen lengthwise on skis was probably the Fjærland native Ola Sjurson Sva, also known by the name of Ola Bøyasva. In winter 1798 or 1799 he did the about 60 kilometre long trip from Fjærland to the Erdalen in one day. Two days later he went back by the same route.

It was not until 1898 that this trip became really well known. That year the mountain climber Kristian Bing crossed the glacier on foot in three days. At the first attempt he and his travelling companions had to suspend the trip because of bad weather and an apparently insurmountable obstacle in the shape of a wind-made snow formation, today known as Bings Gryte. At the second attempt the same year Bing went from the valley Sunndalen to Fjærland together with two men from Oppstryn. They brought a large woolen blanket to sleep on at night. As they had to wade through wet snow large parts of the trip, Bing wished he had brought a pair of light skis, a piece of valuable advice for whoever were to take the trip later.

When you come down into Fjærland after the trip, you have to pass the farm Øygarden in the Supphelledalen where the glacier guide Anders Øygard lived until his death in 1993. In his old age his hobby was to ask everybody coming down from the Flatbreen what route they had hiked on. In 1992 he registered more than 800 persons having crossed the Jostedalsbreen lengthwise on skis.





FACTS

THE JOSTEDALSMBREEN

Area:	487 square kilometres
Length:	60 kilometres
Maximum height:	1,957 metres above sea level (Høgste Breakulen)
Minimum height:	60 metres above sea level (the foot of the Supphellebreen)
Maximum thickness:	600 metres
Maximum measured annual snowfall:	12 metres
Glacier volume:	73 cubic kilometres
Content of fresh water:	73 x 10 ¹² litres
	= 300 billion tubs filled with water
	= The water consumption of all Norway for a hundred years.

THE JOSTEDALSMBREEN NATIONAL PARK

Established:	1991
Area:	1,310 square kilometres
Information centres:	The Jostedalbreen National Park Centre, Oppstryn Norwegian Glacier Museum & Ulltveit-Moe Climate Centre, Fjærland Breheimsenteret, Jostedal

FACTS OF THE MUNICIPALITIES WHOSE AREA THE JOSTEDALSMBREEN COVERS:

MUNICIPALITIES	SOGDAL	LUSTER	FØRDE	GLOPPEN	STRYN	BALESTRAND	JØLSTER
Area (km ²)	746	2.707	586	1.028	1.381	430	671
Population ¹	6,822	4,884	11,465	5,723	6,706	1,399	2,928
Population per km ²	9	2	20	6	5	3	4
Administrative Centre	Sogndal	Gaupne	Førde	Sandane	Stryn	Balestrand	Skei
LANDSCAPE COMPONENTS (KM ²)							
Agriculture	13 (2 %)	25 (1 %)	13 (2 %)	23 (2 %)	23 (2 %)	4 (1 %)	19 (3 %)
Forest	294 (39 %)	416 (15 %)	194 (33 %)	307 (30 %)	316 (23 %)	116 (27 %)	141 (21 %)
Lakes	10 (1 %)	104 (4 %)	33 (6 %)	67 (7 %)	55 (4 %)	18 (4 %)	51 (7 %)
Other	429 (58 %)	2.162 (80 %)	347 (59 %)	631 (61 %)	987 (71 %)	291 (68 %)	461 (69 %)
CLIMATE							
Observing station	Fjærland-Skarestad	Mykemyr	Førde-Vie	Sandane	Loen	Balestrand	Skei Jølster
Normal average temperature ² January (°C)	-3,3	-7,1	-1,9	-0,4	-1,4	-0,6	-7,0
Normal average temperature ² July (°C)	14,3	14,0	13,7	14,2	14,0	14,8	14,0
Rainfall ² (mm per year)	1,905	1,350	2,100	1,260	1,075	1,370	1,760
EMPLOYMENT (%)							
In employment, 15–74 years of age	76	73	78	76	77	73	79
Unemployed	1,2	1,4	1,7	1,4	1,5	0,9	1,1
Administration	35	35	39	30	24	42	33
Private business and public service	65	65	62	70	77	58	67
Primary industries	6	10	3	12	10	4	13
Secondary industries	20	24	16	22	30	23	20
Tertiary industries	74	65	81	65	59	72	67

¹ 11.1.2007

² the period 1961–1990