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The Falbygden Area

I have taken the train between Gothenburg and Stockholm so many times before. Mostly I tend to have my nose in a book, but I always look out of the window when the train passes through the area around Falköping.

Nowhere along the way is the rolling, light green, chequered countryside as lovely as it is here. Herds of cattle graze on the hillsides. Spinneys of hardwood deciduous trees appear sporadically among the fields. In the distance loom the flat-topped mountains typical of the region. So it was a pleasant surprise to discover that the earliest known ancestors of my paternal grandmother, Hilda, lived in the Falbygden district. That means that I, too, have some roots in this beautiful area.

Just 10 kilometres (6¼ miles) or so from the parishes where my grandmother's relatives lived in the eighteenth and nineteenth centuries, Swedish researchers have carried out the world's first analyses of nuclear DNA from Stone Age farmers. The parish in question, Gökhem, lies a few kilometres west of Falköping, at the foot of Mösseberg, a plateau mountain. It is home to several of the region's many passage graves, a specific type of megalithic structure built by Stone Age farmers during an intensive period of a few centuries between 5,500 and 5,000 years ago.

The first skeleton in the passage grave at Frälsegården was discovered when a farmer started digging out an earth cellar. Since then, archaeologists have found the remains of nearly 80 individuals. These people appear to have been buried in a squatting position along the walls of the passage graves.

One of them is known as 'Gökhem 4'. Initially, the archaeologists thought the remains were female and referred to 'the Gökhem woman'. However, subsequent DNA analyses

have shown that Gökhem 4 was a man. He died aged about 20, some 5,000 years ago. His mitochondrial DNA belongs to haplogroup H, just like that of my paternal grandmother, Hilda. After Ötzi from the Alps, Gökhem 4 was the first Stone Age farmer in the whole world to have his nuclear DNA – not just his mitochondrial DNA – published. Technically speaking, nuclear DNA is far harder to analyse, but it provides far more comprehensive information.

As I mentioned earlier, staff from *Science* came to Uppsala in 2012 to hold a press conference together with Uppsala University. The reason why 5,000-year-old DNA from the Falbygden area aroused so much international interest is that it has a bearing on the question archaeologists have pondered for a century: was it immigrants who spread early farming? Or was the technology itself simply adopted by local hunting populations?

The key point is that the province of Västergötland lies at the very northernmost extreme of the region to which early farming spread. If traces of immigration from the Middle East could be demonstrated so very far north, the question would be settled once and for all. And it has been – thanks to Gökhem 4.

The answer to this old controversy is that agriculture was disseminated largely by immigrants. Several studies of mitochondrial DNA from Sweden and other parts of Europe had already pointed in that direction. However, the new results from Gökhem were based on nuclear DNA, and therefore constituted far more solid proof.

The analyses showed that much of the DNA of the man from the Falbygden passage grave is typical of today's Turkey and Middle East. He was also clearly related to Ötzi, the Alpine man whose nuclear DNA had been published just a few months previously in *Science's* rival, *Nature Communications*. Conversely, the researchers were able to demonstrate a clear genetic difference between Gökhem 4 and a number of roughly contemporaneous hunter-gatherers from Gotland.

These results aroused strong reactions. Many people, both in the research community and among the general public,

were enthusiastic. They could see that new DNA technology had the potential to settle longstanding issues. Others, however, were all the more critical.

Some of these critics can be dismissed as disappointed racists. They disliked the idea that immigrants from the Middle East had played a key role in the early history of the Swedish people. Opinions of this type flourished on blogs and homepages, and I myself received quite a few emails with racist content when I reported the results in *Dagens Nyheter*.

Other critics may be characterised as disappointed archaeologists. Theories that hunters went over to farming independently were an integral part of their lives' work, which now risked being shot down in flames.

'I'm absolutely furious at that Skoglund man,' said one elderly professor to me in the course of an interview.

'I take a critical view of that DNA stuff,' was the first remark addressed to me by another professor, newly retired.

'DNA research has contributed nothing of any value to archaeology,' commented a third professor emeritus.

The arguments rained down. There was some substance and a measure of objectivity in some, less so in others. Particular targets were the young doctoral student and biologist Pontus Skoglund, cited as the first author, and Anders Götherström, who has a background in both archaeology and molecular biology.

Despite the intensive criticism they received from other archaeologists, the researchers who took part in the Uppsala press conference won major accolades after their noted *Science* study. They have published a series of other articles in the world's foremost scientific journals. Three of them – Mattias Jakobsson, Anders Götherström and Jan Storå – have been awarded exceptionally large grants by several of the organisations that finance research in Sweden. The idea is that this finance will enable them to pursue a major DNA mapping project, to produce a kind of atlas of Sweden's first inhabitants.

These research grants are far more generous than those normally awarded for archaeological research. I cannot help but suspect that much of the harsh criticism voiced by other archaeologists springs from envy. No doubt it also partly reflects an inability to come to terms with the new DNA technology and to break with long-established ways of thinking.

‘One thing’s clear – this criticism has nothing to do with advancing understanding. The motives behind it are very different ones,’ comments the German archaeologist Detlef Gronenborn when I meet him in Mainz. He has stopped working in the field of DNA-based archaeology, so tired is he of all the personal antagonism and biased attacks.

The more reasonable criticisms were based on the fact that the research team had only analysed the DNA of one farmer. And he lived 5,000 years ago, when agriculture had already been established in Sweden for nearly 1,000 years. The lack of DNA analyses from the farmers’ first few hundred years in Sweden was undoubtedly a weak point. The researchers had not succeeded in analysing the very oldest farmers from Skåne, as the skeletons were too badly decomposed. Conditions in Gökhem have been particularly favourable, partly because the Falbygden area’s calcium-rich soils have preserved the skeletons in good condition.

What makes the result so significant nonetheless is the fact that the Gökhem man and the other individuals in the passage grave belonged to the same Funnel Beaker culture that had predominated in Sweden since agriculture first appeared there. If genetic material from the Middle East was still present among Funnel Beaker people in Västergötland 5,000 years ago, it is reasonable to believe that the proportion of such material was at least as significant 6,000 years ago.

Two years later, in April 2014, the Swedish researchers published a new study in *Science*. Now they had compiled analyses of nuclear DNA from four Gökhem farmers, all of whom lived approximately 5,000 years ago. Their DNA was compared with that of seven hunters from Gotland, six

of whom were contemporaneous with the farmers from Västergötland, while the seventh lived about 7,500 years ago.

Moreover, the researchers were now able to make comparisons with nuclear DNA from another dozen Stone Age individuals from Europe and Siberia – both hunters and farmers – that had been published by other researchers. Many more sets of DNA from both hunters and farmers from the Stone Age have since been analysed.

The conclusion is plain. The DNA of the early Swedish farmers clearly shows input from the Middle East, Turkey, Sardinia and Cyprus. These farmers differ very clearly both from the earlier hunting people and from hunters living on Gotland during the same period. The widest genetic gap between two populations in today's Europe is that between Finns and Italians. The farmers from Västergötland and the hunters living on Gotland 5,000 years ago were genetically far more different from each other than modern Finns and Italians.

One discernable feature that emerges from DNA analysis is that hunters and farmers probably had slightly different skin colours. Some of the hunters were probably quite dark-skinned. They bore a gene variant common in Africa. The farmers, on the other hand, bore the gene variant which predominates in today's Europe and which is linked to light skin. They also seem to have had brown eyes. It is very likely that dark hair predominated in both groups. But more hunters bore gene variants that indicate they had blue eyes.

Doubtless the two groups also differed considerably in the leather clothing and personal adornments they wore and in the way they embellished themselves with pigments.

Genetically speaking, the hunters from Gotland were not particularly close to the people of any country in modern Europe, nor were they like today's Sami. However, it is clear that they are close relatives of other Stone Age hunters found in Motala, Spain, Luxembourg and Germany. There are even a good many similarities with the 20,000-year-old Mal'ta boy from Siberia.

The hunters can definitely not be described as inbred in the way some Neanderthal people were. They took care to have children with a partner who came from sufficiently far away. Yet they nonetheless show limited genetic variation. This indicates that Europe's original population of hunters was quite small. These people were exposed to harsh privations and to disasters with a high death toll, such as those caused by climate change and flooding.

There was more variation in the farmers' genetic make-up. An explanation for this is that they belonged to a far larger group of people. DNA analyses conducted by Svante Pääbo's team indicate that hunters' numbers multiplied between 15,000 and 10,000 years ago; that is, just when the Ice Age was coming to an end and the climate was becoming milder. But then, between 10,000 and 5,000 years ago, the number of people with the mitochondria typical of hunters declined.

It is also possible to see how the farmers increasingly intermingled with local hunters the further north they went within Europe. Ötzi, who lived 5,300 years ago, was already a descendant of farmers who had come to Europe from the Middle East and local hunters. The proportion of DNA from local hunters was even higher in the Gökhem farmers who lived 5,000 years ago.

Clearly, hunters sometimes moved in among the newly arrived farmers. As a result, children with genetic material from both groups were born in farming settlements.

A pattern can be discerned, supported by Joachim Burger's German study of mitochondrial DNA and isotopes, by Lasse Sørensen's extensive compilation of traditional archaeological finds and radiocarbon datings, and by the DNA results from Sweden and elsewhere. For over 1,000 years, two types of society lived alongside each other, in parallel. The hunters were predominant along the coasts, while the farmers predominated inland.

That is exactly what the 'prehistoric village' of Ekehagen shows, albeit on a miniature scale. The settlements are separated by a few hundred metres, rather than a few kilometres or more. Along the shoreline of a small lake stand the crescent-shaped huts of the hunters, while the Stone Age farmers' rectangular longhouses have been built higher up.

Ekehagen, which lies a few dozen kilometres to the south of Falköping, is an ambitious project supported by the local authorities. Buildings from different eras have been constructed on the basis of the best archaeological expertise available. Animals, plants, boats and gear show what life was like in prehistoric times. If you really want to soak up the atmosphere, you can spend the night in one of the houses.

There are traces of Stone Age hunters in the Falbygden region, but they predate the Gökhem skeletons by a long time. The very oldest finds, which come from Lake Hornborga, are about 10,000 years old. Archaeologists have found the oldest remains of dogs in Sweden, including a nearly complete skeleton that looks like a sturdier version of today's Swedish vallhund. However, no traces of hunters' huts have yet been found in the region.

Instead, Ekehagen's huts are inspired by examples from Denmark. To be precise, they are based on Ulkestrup, Zealand, where a Stone Age dwelling has been preserved exceptionally well by being buried in oxygen-free mud.

I peer into the two reed-thatched hunters' huts at Ekehagen. Both of them comprise an inner, oval room and a fairly large covered front yard looking out over the water. On the shore among the huts is a fireplace. There is fishing and hunting gear hanging up, including a fish trap woven from hazel switches and a fishing net made of plant fibres.

At the water's edge lie a few boats made of hollow tree trunks. A few tourists are paddling around in two of them. Wearing brightly coloured lifejackets, they paddle unsteadily but determinedly, splashing loudly. I imagine the hunters of the Stone Age manoeuvred their dugout boats more quietly, with better balance and greater skill.

The summer's day when I visit Ekehagen is unusually cool. But there is a cosy fire inside the Stone Age farmers' longhouse. There is no chimney. Instead, the smoke finds its way along the ceiling, then out through small apertures at the top on the short sides of the house. Although these draw quite effectively, the room is nonetheless smoky. Spending a lot of time in a dwelling like this would not have been good for people's airways. Smoke from simple fireplaces inside homes remains one of the main causes of illness and death in poor countries. There is a good deal of evidence that Stone Age farmers were adversely affected. Ötzi had traces of soot in his lungs, as did several of the individuals from the earlier Çatalhöyük site.

But the heat from the fire is pleasant on this chilly day, and it helps to provide light in the dim room. The only other sources of light are the small holes in the roof where the smoke escapes. A few visiting children, suffering from the cold, huddle around the fire with their parents to eat their packed lunches – sandwiches, presumably.

Cultivated grain – specifically, various kinds of wheat and barley – was also a staple in the diet of the Falbygden area's Neolithic people. They sometimes ate pork, and occasionally there was mutton or beef. However, cows were probably kept mainly for their milk.

It is unlikely that Sweden's first farmers habitually drank milk. A large proportion of Sweden's modern-day population have a particular gene variant that enables us to digest milk as adults. However, this variant is unusual in most of the world. Most adult humans suffer from diarrhoea and severe stomach aches if they drink a significant amount of milk.

Among the original hunting population of Europe, no one seems to have been genetically equipped to drink milk as an adult. Nor does the particular gene variant required appear to have occurred among the earliest population of farmers. Ötzi was unable to digest milk. The same probably applied to the Stone Age farmers from the Falbygden area whose DNA was analysed. It was not until later, at the start of the Bronze Age,

that the special gene variant occurred, according to the odd pieces of evidence researchers have discovered. But even then, it does not seem to have been particularly common. It was not a generalised phenomenon until shortly before the Iron Age. Up to that point, most adults were what we today call lactose intolerant.

Yet there is no doubt that the first Stone Age farmers in Sweden kept cattle. Apart from all the ancient bones from cows and oxen, chemical analyses of terracotta vessels have revealed traces of milk fat. The oldest in Sweden are nearly 6,000 years old and come from Fellingsbro in Västmanland. In Poland, ceramic colanders have been found that show people were producing cheese as early as 7,000 years ago.

If I were to speculate, I would say the children living in the Stone Age villages in the Falbygden area drank fresh milk, while the adults stuck to cheese and butter, and possibly yogurt or soured milk. These foods can often be digested by people with lactose intolerance.

The farmers' longhouses at Ekehagen have roofs thatched with reed, just like the hunters' huts. But the longhouses are far more solidly built. Each is supported by a row of large oak posts running down the middle. The outer walls are built of aspen wood.

There are a number of simple millstones in the yard. In each case there is a fairly sizeable stone with a dip in it and an upper stone that you have to move back and forth over the lower one. There are also a few tiny fields surrounded by wooden palisades, where the visitor can try hoeing weeds and clearing ground with only a hand-held flint tool. I can confirm this is pretty hard on the back and shoulders. It is easy to understand how oxen became a welcome addition, once people had properly understood how to harness their strength for farming.

The limestone-based soils in the Falbygden region have some of the best conditions for growing crops anywhere in Sweden. Sweden's first farmers must have noticed this early on. They probably came to the region roughly 6,000 years ago, immediately after making landfall on the shores of Skåne

and Halland. They may have followed the River Ätran from the coast and later struck out northwards. It is very hard to discern any signs of the first centuries of agriculture in the Falbygden area. Archaeologists have found some pollen from ribwort plantain (*Plantago lanceolata*), suggesting that the deciduous forests shrank and were replaced by a more open landscape.

But then, some 5,500 years ago, the people of the Falbygden area began building passage graves. Even today, you can hardly fail to notice these burial places, composed of huge stones or megaliths erected here and there in the countryside. In the course of a few hundred years, nearly 300 of these structures were built in the Falbygden area – more than anywhere else in Sweden.

Linnaeus, who travelled through the area in 1747, was among those who described the passage graves. In his book *Västgötareisa* ('Travels in Västgötaland'), he writes of what he calls 'ancestral sites' as 'hillocks raised above ground level, ringed in by stones, covered with earth and grass'.

Similar collections of megaliths have been found from Portugal all the way along the Atlantic coast, in Denmark, Germany and at many places in farming areas of southern Sweden. They are generally regarded as mysterious. However, the US archaeologist David Anthony has an explanation that seems reasonable to me. In his view, the societies that built these barrows were quite simply celebrating their own ability to move heavy objects. Being able to move things was so important for life in an early farming society. Lengths of timber for building houses needed to be moved; grain had to be moved from the fields.

Initially, the only way to move heavy objects was to get large numbers of people to heave on ropes. That called for a great deal of organisation and cooperation. It would also doubtless have required good food and drink – beer, perhaps – to motivate those who contributed their labour. This is what a number of archaeologists believe about Göbekli Tepe, the place of worship in Turkey used by groups of hunters at the dawn of agriculture.

Gathering together megaliths was a way of demonstrating how well organised and powerful you were as a group. Since people had begun to use oxen as draught animals, even relatively small groups of farmers – individual families, indeed – had had the capacity to erect stone structures that would impress anyone who came anywhere near them. A family tomb built of megaliths was the ultimate status symbol. In my opinion, David Antony – and Bernd Zich from Halle – are on the right track here.

While in the Falbygden area, I meet the archaeologist Karl-Göran Sjögren, Sweden's foremost expert on passage graves. It was he who discovered the Gökhem skeletons whose DNA has since been analysed.

Sjögren is a helpful, affable man in his sixties. He picks me up from the station by car and is happy to recount details of his own and others' excavations. However, he is more reserved when it comes to interpreting the finds. His personal interest is in how people in the Falbygden area lived for a specific, limited period. Broad-brush descriptions of Europe as a whole, and surveying several millennia, are not his thing.

He is cautious about drawing conclusions from new DNA results, even though he is listed among the co-authors of one of the groundbreaking publications about the Gökhem farmers that appeared in *Science*. He uses the term 'migrationism', which implies a pejorative view of the idea that inward migration has played a key role in history. Yet he cannot deny the findings set out in the *Science* article of which he is a co-signatory: that the Gökhem farmers whose DNA was analysed were largely descended from people from the Middle East, and that they were clearly genetically different from contemporary groups of hunters living on Gotland. 'Yes, a pattern is beginning to emerge,' he concedes, almost reluctantly.

Despite his sceptical attitude, Sjögren seems to approve of Bernd Zich's ideas that the wooden plough, draught oxen, the wheel and the cart may have developed as the Funnel

Beaker people left the loess soils of central Europe and migrated northwards towards the tougher soils of Denmark and Sweden. 'That would explain a great deal if it were true,' he says. He also agrees that oxen must have played an important role in enabling the farmers in the Falbygden area to assemble the stones for their megalithic tombs.

Even with the help of oxen, building the passage graves must have been a demanding task calling for a good deal of time and resources. Calculations show that 10 men working with a team of oxen needed about a month to build such a grave. Firstly, they had to drag quantities of large stones to the site and raise them to form the chamber itself, which could be up to 17 metres (56 feet) in length. The narrow passageway, which usually faces eastward in the Falbygden area, also had walls formed of large stones. Then an even larger stone, known as the keystone, had to be laid on top to close the whole structure. It could weigh up to 20 tonnes (44,000 pounds).

To enable the oxen to pull the keystone and the other stones forming the roof into position, extensive earthworks first had to be built around the whole structure. The final result was a large, round tumulus with a flat roof. This provided sound protection for the grave chamber. From the outside, the tumulus resembled a smaller version of the nearby plateau mountains, such as Mösseberg and Billingen. Some archaeologists believe the whole point was to create a strong link between the landscape and the passage graves.

Sjögren believes there was probably a degree of social differentiation between farming families in the Falbygden area. Clearly, some families were able to scrape together enough resources to build large, impressive passage graves.

At the time of my visit, Sjögren is leading a major excavation in Karleby, a few kilometres west of Falköping. Some of the very largest passage graves are to be found here, as well as traces of farmers who lived at the same time as the Gökhem people. A large group of students and volunteers are working on the dig, accompanied by a few professional archaeologists

from Gothenburg University. They scoop out earth trowelful by trowelful from precisely demarcated squares.

Sjögren shows me the summer's most significant finds, mostly fragments of animal bone, flint tools and pottery. The most notable discovery is a set of holes that once held posts, probably belonging to two houses. He is rather taken aback by the fact that they seem to have been circular; round houses – or, more probably, huts – tend to be associated with groups of hunters. But the people who were laid to rest 5,000 years ago in the Karleby passage grave were definitely farmers. Isotopes show that they lived chiefly on plants, probably mainly wheat and barley. When they ate meat, it was mostly pork from domestic pigs, with some beef and mutton. This is known from bones found at the site. The people who lived here seem not to have eaten very much game, and they ate hardly any fish.

In fact, there are several examples of villages built by Sweden's earliest farmers that feature both round and rectangular buildings; one example is the site excavated at the ESS nuclear research facility under construction near Lund. Round and rectangular buildings may have fulfilled different functions in early farming settlements. The round buildings may have served as granaries, as in Jordan and Cyprus at the dawn of agriculture several thousand years previously.

Isotopes also show that most of the individuals examined from the graves in the Falbygden area were born locally. However, about a quarter of them came from outside the region, possibly from Skåne or from other parts of Västergötland. This applies equally to men and women. Many of their cattle also seem to have been brought in from elsewhere. This implies that there were networks of farmers extending for many dozens of kilometres.

One of the focuses of Sjögren's research has been the objects found around the passage graves. The grave chambers themselves often contain amber beads, animals' teeth and small axes. Shards of pottery are usually to be found a few metres in front of the entrance to the chamber. They are a delicate, attractively patterned variant of Funnel Beaker

vessels, far more meticulously crafted than the everyday pottery found in the settlements. These attractive vessels next to the passage graves appear to have been smashed on purpose. It is common for archaeologists to find the burnt bones of oxen, pigs, sheep or dogs and burnt fragments of flint in the same place. Curiously enough, however, there is no sign of any fire. The objects seem to have been burned somewhere else and later placed in front of the entrance to the grave chambers.

This pattern, involving the same type of objects, recurs at one tomb after another. It looks as if special ceremonies were held that involved breaking pottery and burning flint axes and animal bones. Other rituals involved dropping axes and amber beads into lakes as votive offerings – and sacrificing living people.

There are about 30 known cases in the early farming cultures of northern Europe where people appear to have been sacrificed in lakes. They are generally known as bog bodies or bog people, as the shallow lakes gradually filled up with plant life and developed into peat bogs. Both men and women have been found in such bogs; those who died in the Neolithic period were mostly in their late teens.

The oldest of Sweden's known bog people is the Raspberry Girl, who lived at the same time as the Gökhem farmers and was found a few dozen kilometres further south, in a bog in the parish of Luttra. Today she is an exhibit in the Falbygden Museum.

Visitors to the museum can view her brown skeleton in a display cabinet. It is quite small. The Raspberry Girl was about 19 years old when she died, but only 1.45 metres (4¾ feet) tall – that is, some 10 centimetres (four inches) shorter than the average height of women at that time. She also appears to have been of unusually light build, and her face seems to have been fine-featured. Her teeth were even, complete and well formed, although the chewing surfaces were rather worn.

Immediately before her death, she ate a large quantity of raspberries. Her stomach contents, including the yellow raspberry seeds, are clearly visible alongside the skeleton in the display case. This shows she died in late summer when the raspberries were ripe, in July or August.

Researchers believe she was killed, rather than drowning in the lake by accident, because of the appearance of the skeleton when she was found. The position of her legs reveals that they were bent right back and bound, so that her feet were next to her buttocks. It also looks as if her wrists were bound together. In that position, she was thrown – dead or alive – into a shallow lake. Little by little, the lake filled up with vegetation and turned into a bog.

She was found there in 1943, some 5,000 years later, by a man who was digging up peat for fuel. As soon as it had been established that she was a prehistoric individual, she was sent in a large block of peat to Stockholm's History Museum, where she was examined and presented in a scientific report. After a few decades on display in the History Museum, she was put into storage. It was only in the 1990s that she returned to the Falbygden area, where she is now one of the main attractions at the local museum.

In addition to the actual skeleton, the Raspberry Girl is displayed as a life-size silicone model, a model-maker's impression of how she may have looked. It depicts a short, fine-boned young woman, just like the skeleton itself. Her features have been carefully built up on the basis of her cranial bones, in accordance with standard techniques. That is all just as it should be.

Yet I have some doubts about the Raspberry Girl's hair and skin, and the colour of her eyes. Firstly, I imagine that a 19-year-old woman – even one living in the Neolithic period – would have been more particular about keeping her hair nice-looking and attractively styled. The model's hair, however, is rather straggly and unkempt. It is quite fair, close to honey-blond, and she has a very pale complexion. She may well have looked like that, of course, but we cannot be sure. If she was one of the farmers, she is more likely to have

resembled the people of modern Sardinia and Corsica, with brown eyes and dark hair.

Her fair skin may be an accurate representation – if she came from a farming family. But if they sacrificed a girl from outside their community, from a group of hunters, it is equally probable that her complexion was considerably darker.