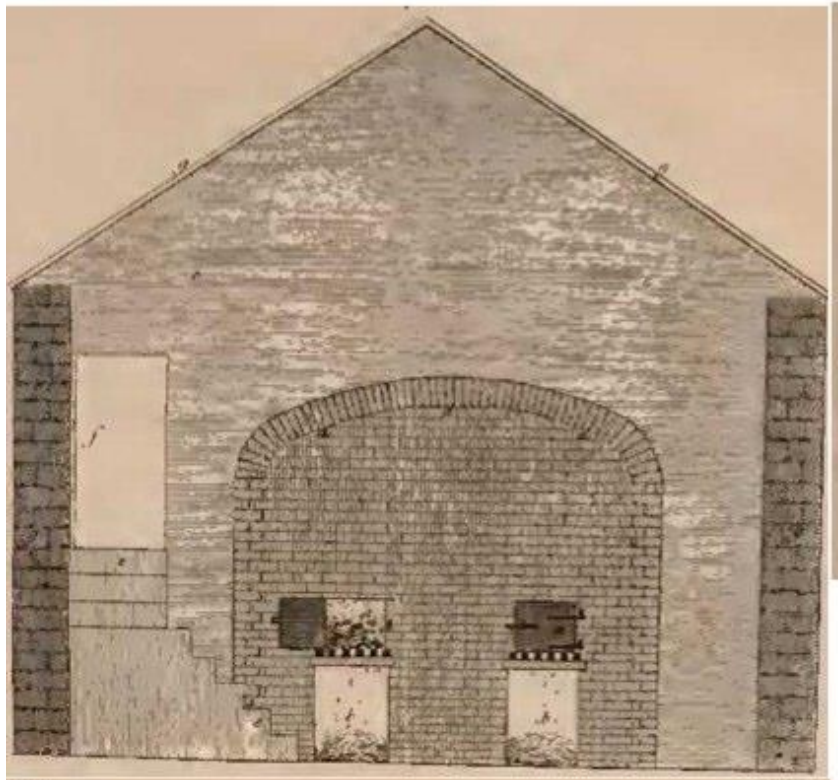
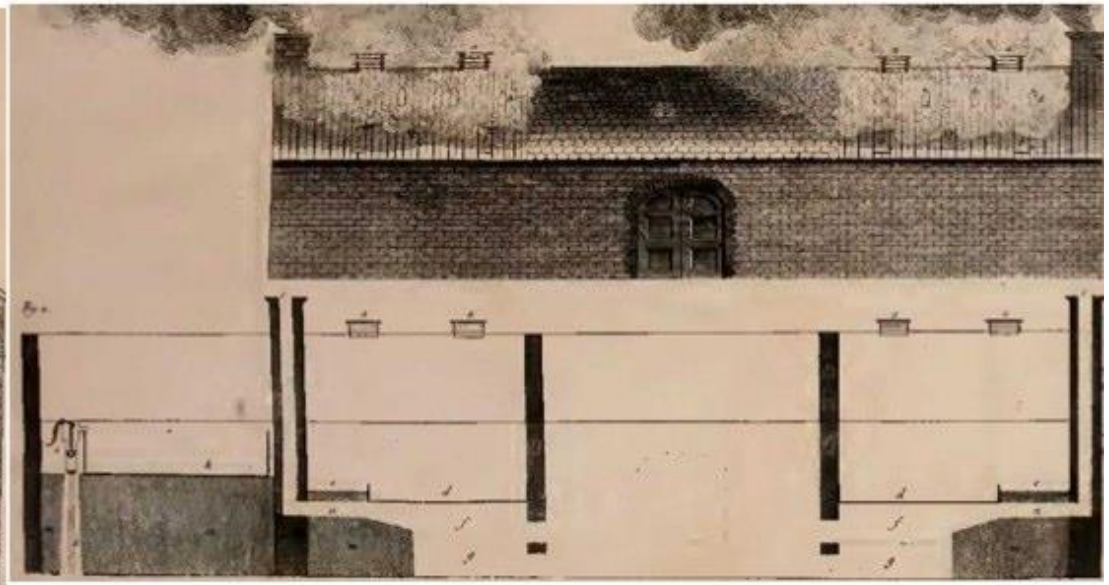
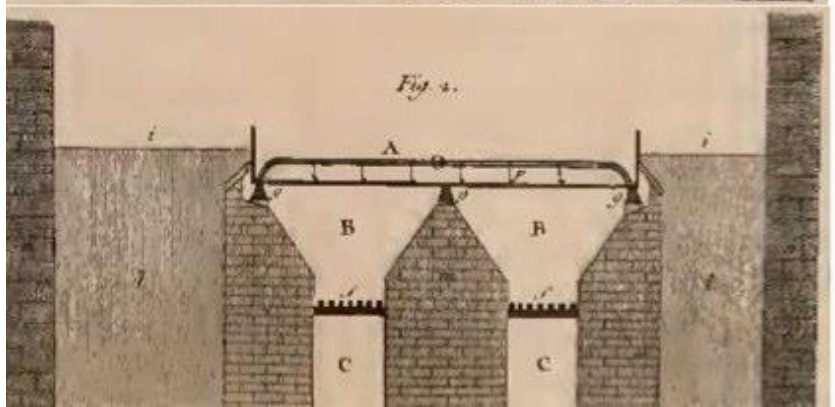
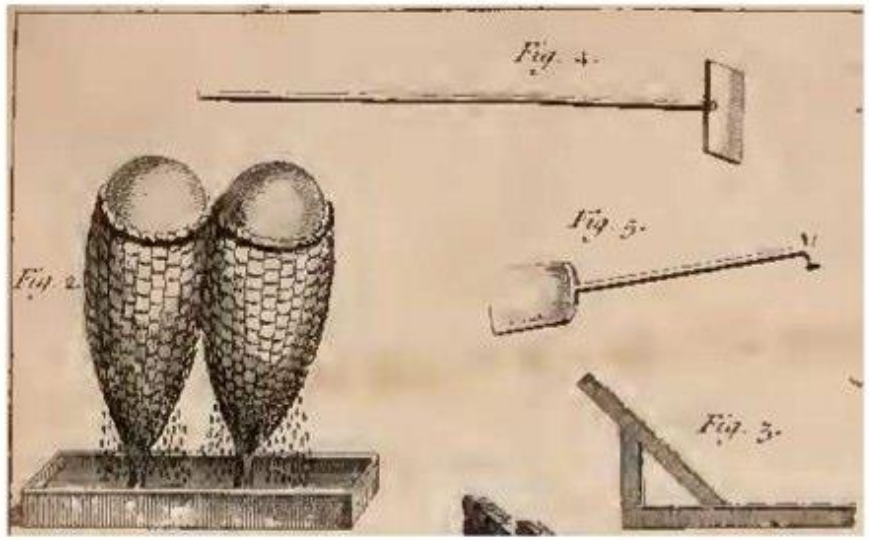
An 18th century salt pan

The salt pans, equipment and arrangement are based on technical drawings published in The Art of Making Common Salt by William Brownrigg in 1748









A hunting arrowhead in a salt pan?

Callum found the most exciting artefact of the excavation on his first day! He found the iron arrowhead in a pile of coal ash that had been dumped over the steps at the side of the building.

It is a hunting arrowhead, and very similar to examples found at Castle Urquhart from around the same period.

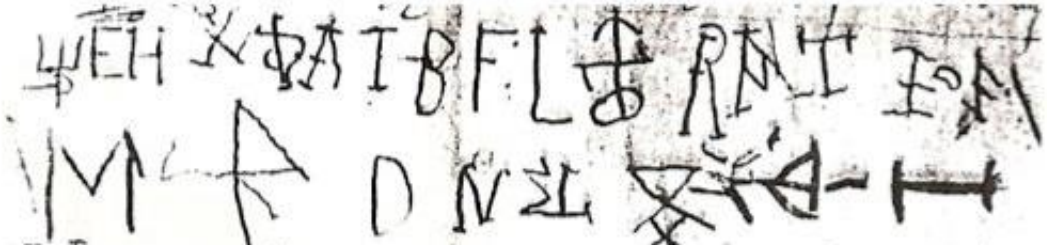
Only the land owners and their guests would have been allowed to hunt at this time, so what is a hunting arrowhead doing in a salt pan? Well we can only guess that it was shot and lost by a hunting party in the area, or was dropped by a visitor to the salt pans from Dunrobin Castle.

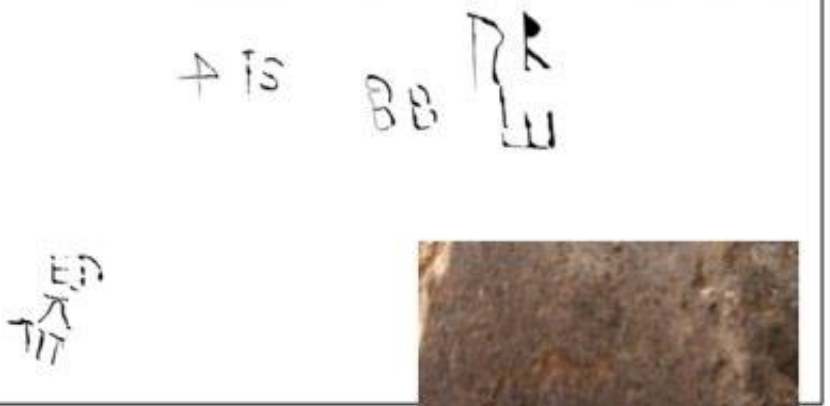
Late medieval hunting arrowhead, Castle Urquhart

What are the strange marks carved onto the fireplace?

We couldn't believe our eyes when we noticed what must be the oldest graffiti we'd ever seen carved into the fireplace lintel. At first we wondered if they could be witches marks, also known as apotropaic marks to ward off evil. At the turn of the 17th century, exactly when this building was constructed and used, fear of witchcraft was at its peak in Scotland. Watch this video and Jacquie will tell you more about the witches mark theory.

Another theory is that they are signature marks carved by the people who worked in the salt pans. Very few people could write in this period and it was common for people to have a mark instead of a written signature. Merchants would use their mark to sign their houses, documents, their goods and even animals.





How do we know what the workers ate at the salt pans?

Animal bone, pottery and shells and fish bone found during the excavation tell us what people building and working at the salt pans ate and what they ate and drank from.
Unsurprisingly at this coastal location, the remains of sea food was most common. The bones of over 1200 fish were recovered, mainly haddock and also cod, skate, ling, plaice, turbot and flounder. Oysters, mussels and cockles were also popular. The bones of cattle and sheep showed that mutton and beef were eaten, as well as animals that we don't usually eat in Scotland today such as horse and sea birds. Many of the bones had been gnawed by dogs, so there must have been dogs at the salt pans.
Only a few fragments of pottery were found, mainly from jugs. Some of these were very rough and probably locally made. Wooden bowls and spoons were almost certainly used but haven't survived.
The food remains suggest that at least some of the workers at the salt pans ate well. In the rest of the Sutherland estate at this time there were frequent famines and starvation was common.

Fish bone in sieved material from the excavation

An example of a typical 16th century jug

Some of the pottery finds from the excavation

A haddock

What historical documents tell us about the salt pans

"This yeir of God 1598, the cole-hugh was found besyd Broray, and some salt pans were erected a litle by-west the entire of that river, by Jane Countes of Southerland, vnto whom her sone, Earle John, had committed the government of his effairs dureing his absence in France. Ther wes good salt maid then at Broray, which served not onlie Sowtherland and the nighbouring provinces, bot also wes transported into Ingland and elswher. After some few years intermission, that cole-hugh wes agane repaired and set vp by this John Earle of Southerland, and a greater number of salt pans erected ther, the yeir 1614." From the accounts of Robert Gordon, 1630.

Our works be put to some salting this summer (1615), in the next, God willing, we think to lure some English men by your advice to come to the county' Letter from John to his brother, Feb 1615.

John the 12th Earl died in 1616. *'he left his house overburdened with debt' this was due in part 'also by enterprising some works - salt pans at Brora, which, at his great cost, were just finished and brought to perfection when he died. His death interrupted their working.'* From the accounts of Robert Gordon, 1630.

Jean Gordon in 1598, the year she established the salt pans.

John Gordon 12th Earl

Jean Gordon 1566, aged 21 at the time of her first marriage to the Earl of Bothwell. The marriage was annulled a year later so that he could marry Queen Mary I.

How do we know what the building looked like?

We can reconstruct quite accurately what the building would have looked like because so much of it survived. During excavation detailed records are made of everything and these are used in the reconstructions. We think the building had a turf roof because of the total lack of stone tiles (ceramic tiles were not used until later periods) and because we found widespread deposits of rich soil material on the floors. This was very likely to be the remains of the turf roof.

Why do we think this building is the pan house?

Until recently, the ruinous wall of an enormous building was visible eroding out of coast edge on Brora Back Beach. The wall was over 25m long and built of great blocks of local sandstone. Behind the wall were great layers of burnt material called clinker. This is the product of industrial scale fires. Although the wall has now completely disappeared, our recent excavations showed that the layers of ash and clinker probably came from this lost building on the beach and were used to make a compacted surface between it and the storehouse nearby. The scale of the building, the archaeological evidence of industrial fires and the relationship with the storehouse make it very likely that this was Jean Gordon's pan house of 1598.

The ruinous wall on the beach in the 1970's

The wall in 1999

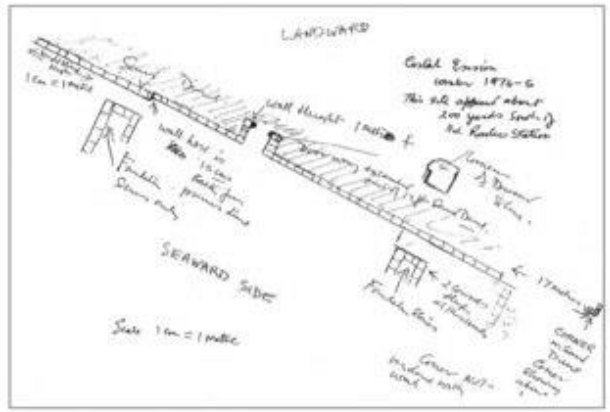
And in 2005

Thick layers of ash and clinker behind the ruinous wall

Detail of clinker

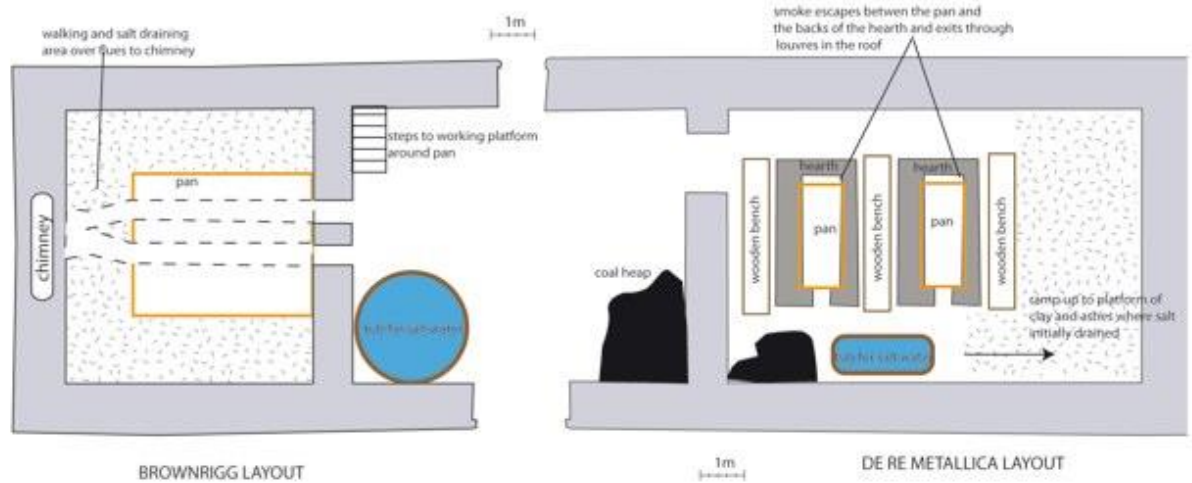
How do we know what the pan house looked like?

Unlike the excavated building, there is very little archaeological evidence to help us reconstruct the pan house. We have used the remains of the wall, which included a doorway to help us with the dimensions and layout of the building. We also have a sketch plan of the wall drawn in the 1970's which has been very helpful. Inside, we don't know how may pans there would have been or how they would have been arranged. Because we have no archaeological evidence, we decided to use historical sources to show you a reconstruction of a typical 16th saltpan and a typical 18th century saltpan. We also used a modern reconstruction of a pan house in Denmark for details. The pans at Brora would have had much in common with these examples, but we have no idea of their size or how they were laid out.



Sketch of the remains made in 1974/5

Modern reconstruction of a pan house at Laeso, Denmark.

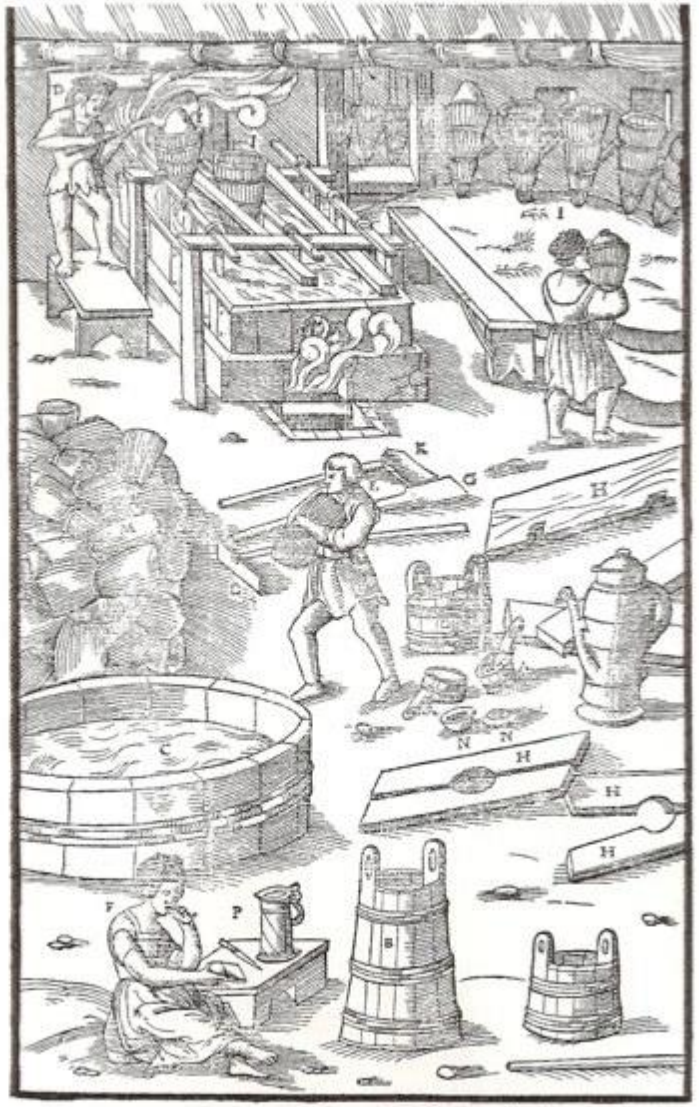


The best reconstruction we could achieve of the ground plan of the pan house based upon archaeological and historical information. The pan arrangements show two different periods of salt production.

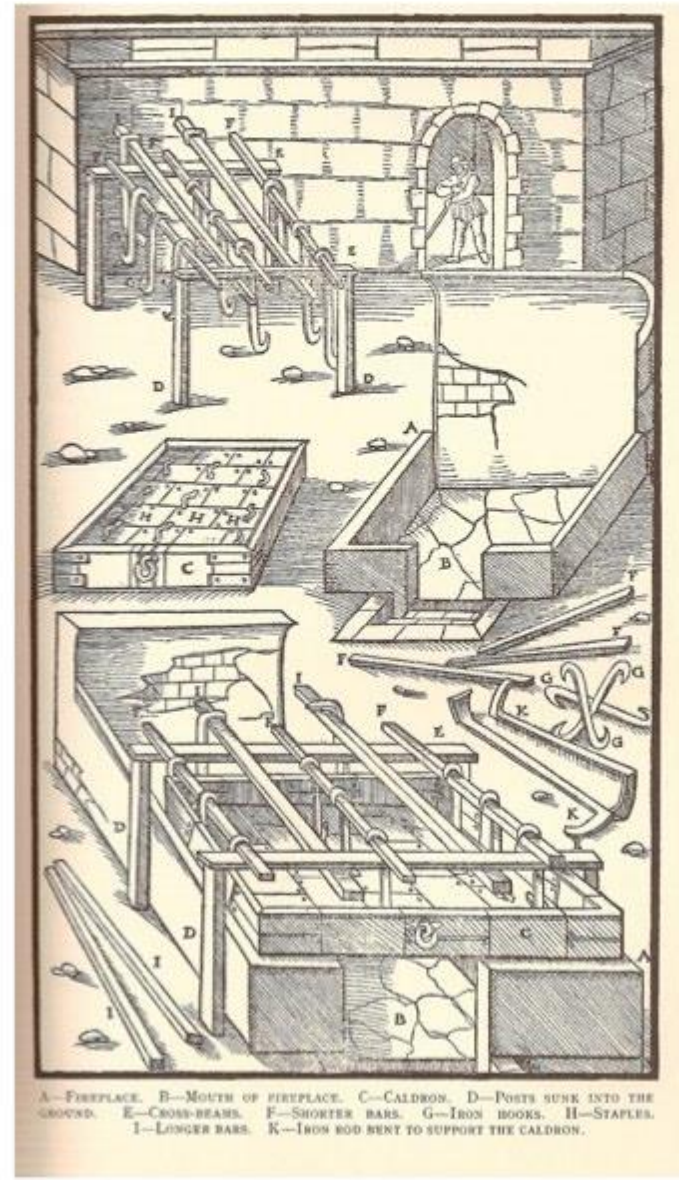
A typical pan house of the mid 1700's from Brownrigg, 1748

A 16th century salt pan

The salt pans, equipment and arrangement are based on technical drawings published in de re Metallica in 1556 by Georgius Agricola.



A—Wooden dipper. B—Cask. C—Tub. D—Master. E—Youth. F—Wife. G—Wooden spade. H—Boards. I—Baskets. K—Hoe. L—Rake. M—Straw. N—Bowl. O—Bucket containing the blood. P—Tankard which contains beer.



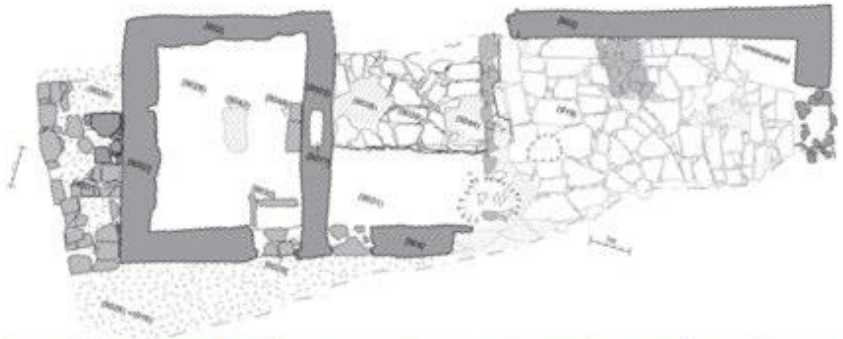
A—Fireplace. B—Mouth of fireplace. C—Caldron. D—Posts sunk into the ground. E—Cross-beams. F—Shorter bars. G—Iron hooks. H—Staples. I—Longer bars. K—Iron rod bent to support the caldron.

Why do we think this building is a storehouse or girnel

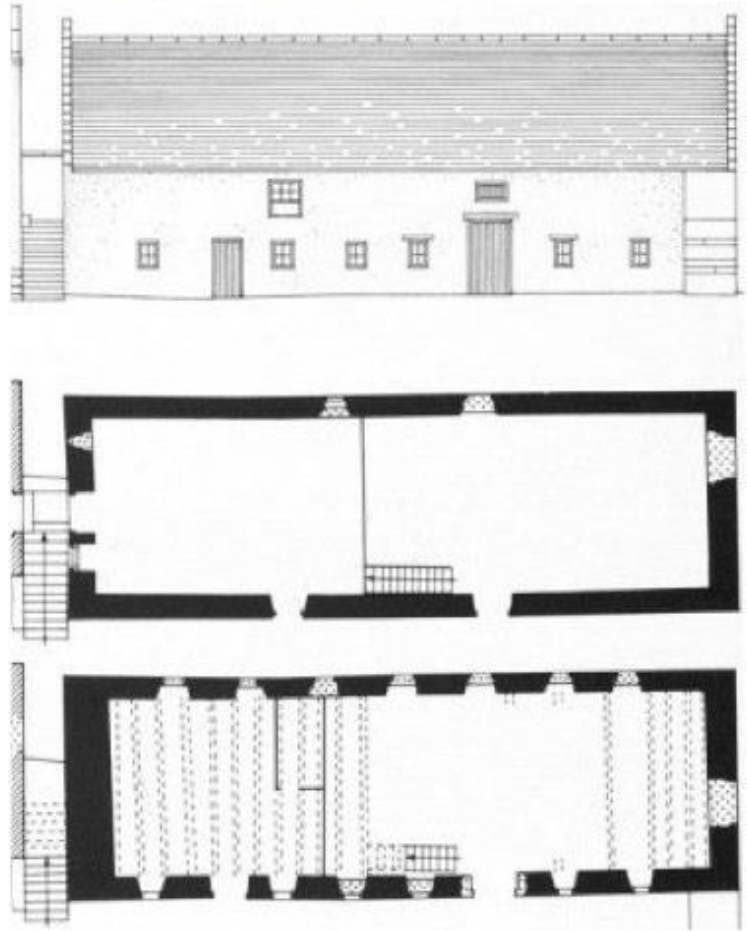
The excavated building consisted of one very large clean empty room paved with stone and a smaller room with a fireplace. There was no evidence of the structures and extensive burning associated with a pan house. Nearby in Portmahomack there is a mid 17th century storehouse also called a girnel built by the Earl of Cromarty that is still standing. The plan, dimensions and layout are almost identical to the building excavated in Brora.

Both the archaeological evidence and the evidence at Portmahomack suggest this building was a secure storehouse and office of the salt pans.

Interior and exterior photos of 17th century girnel, Portmahomack, *John Hume, 1977*



Plan of the Brora building. It is almost identical in scale and layout to the Portmahomack girnel.



Drawings of 17th century girnel, Portmahomack, *John Hume, 1977*

The technical stuff

The glass was analysed using both SEM (scanning electron microscope) with spectrometer and pXRF (portable X-Ray Fluorescence Spectrometer). Each technique has advantages and disadvantages and combined they give better results. The tested shards were HLLA (High Lime Low Alkali) glass. This is typified by a Calcium (CaO) content of over 20% and a combined Potassium (K_2O)/Sodium (Na_2O) content of less than 10%. The Sodium and Potassium alkaline oxides are used as a flux to lower the temperature at which the batch will vitrify and remain workable.

Analysis of English glass has identified two date groups of HLLA glass, HLLA1 c1567-c1600 and HLLA2 c1600-c1700. These are differentiated mainly through the level of Manganese (MnO). In HLLA1 glass MnO is around 1% and in HLLA2 around 0.25%.

Interestingly the Brora glass MnO level falls between these two at 0.65-0.8%. This might indicate a changeover composition between HLLA1 and 2 and date it to the period around 1600. This would fit neatly with the date of the first Saltworks at Brora. However, this interpretation may be too convenient and there is a second possibility.

There is no evidence as yet that glass was made from raw materials in Scotland before *c.*1610. If the glazing at Brora related to the creation of the first works in the 1590s then the glass would have to have been imported. It's different composition to contemporary English glass, makes it more likely it came from continental Europe.

What's special about the windows?

The most special thing about the windows is that they are here at all! Glass windows in a building of the late 1500's or early 1600's in Scotland is incredibly rare. No others are known in an industrial context like this one. It would be the late 1600's before window glass appeared in houses even in Edinburgh.

Secondly, there is no evidence as yet that glass was made from raw materials in Scotland before around 1610. The glass in Brora, therefore, would probably have been imported. Either from the continent of Europe or England. Chemical analysis of the glass shows that it has a slightly different composition to English examples of this period – so it is more likely to be a European import.

The location of a window sill during excavation

How do we know what the windows looked like?

Over 30 tiny fragments of very thin flat glass were found during the excavation. Some of then had rounded edges called a 'selvage' indicating that they were cut from the edge of a 'table' of broad or cylinder glass. The size of the table was limited by the size of the cylinder a glass maker could blow. Small diamond shaped pieces were then cut from it. Glass was extremely expensive in the early 1600's, and so windows were very small. They were also fixed, i.e. didn't open. We know the size of at least one window in the Brora building because we found a carved sill. This showed us that it would have had a central iron bar called a stanchion bar. This would have been for security. The best example of windows in Scotland of the same period to those at Brora are at Culross Palace on the Firth of Forth. The windows of the girnel at Brora would probably have looked very similar to these.

Fragments of window glass recovered during the excavation.

The window sill showing the stanchion hole and carved splay.

Windows in Culross Palace, built 1597-1600.
The building is almost exactly contemporary with the Brora girnel.