Preston Island: archaeological research and excavations

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Introduction

Topography

Preston Island is an artificial peninsula, one third of a hectare in area, set on the north edge of the half-tide Craigmore Rocks in Torry Bay. The island lies 800m due south of the village of Valleyfield, and c 1.5km east of Cuiross (Illus 2). Longannet Coal-Fired Power Station, the source of the Pulverised Fly Ash (henceforth PFA) around the Island, lies 4km further west.

The geology of the area is characterised by an alternating series of clean sandstones and coal-rich shales. Much, if not all, of the sand found around Preston Island is derived from these rocks. The widespread practice of ‘sea coal’ collection by the inhabitants of the coastal villages up to recent times indicates the presence of exposed coal seams.

The surrounding area has been incorporated into the waste dump from Longannet power station since 1970. By 1983, when the Island received its first full survey (Scottish Industrial Archaeology Survey - SIAS), the lowest structural elements had been buried by PFA and the island was in danger of being completely obscured.

A levee of colliery waste has been built around the site, enclosing an area 80m by 60m, the long axis running north-south. This bank of material was built over the existing height of PFA, which at that point, in 1983, was beginning to encroach upon the structures of the island. After the island was secured by this construction, PFA continued to accumulate to an additional depth of 2m. In the early 1990s a breach occurred in the protective bank and a flood of liquid PFA engulfed much of the island to a depth of between 0.5m and 2.5m. This material has since dried out to form a grey silty deposit, covering over 75% of the island.

Origins of the island

The island’s construction was begun after Sir Robert Preston’s accession to the Baronetcy of Valleyfield in 1800, with coal mining commencing within a few years of that date. Certainly it was in operation by 1807, when a steam engine for the site was ordered from the Carron Iron Works (SRO GD 58/6/1/44/162).

The site itself (Illus 3) presently comprises a total of four groups of buildings, along with the overgrown remnants of five associated structures.

Originally, the Island had straight-edged west and south-west sides and an irregular east side, and was built on the very edge of the coal outcrops, with a pier or harbour wall extending to the north. A small inlet, formed against the west sea wall, provided a place for boats to moor. It is possible that the sea wall was only constructed on the north and west side of the island and that the east side was protected by a levee.

It appears that, following the construction of the sea defences, the interior was levelled above the high tide mark. Then the buildings associated with coal extraction were built, with the salt pans following on.

During the first decade of the 19th century, Sir Robert Preston sank three shafts on the island, built an engine house, accommodation for the miners, and piped fresh water to the island. The only surviving contemporary account of this work is Renwick and Bald’s report of 1813. This post-dates the firedamp explosion of 1811, which resulted in loss of life, and describes how there were still thirteen colliers employed on the island, producing 141 tons of coal per fortnight. However, the mine was uneconomic, and was only being supported by the salt production. In fact, the mine was making a loss of £419/-1d per fortnight, with the

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five salters working the salt pans producing a profit of £10 4/-, giving a fortnightly net profit of £5 4/-11d.

As elsewhere on the Forth, salt production and coal mining were inextricably linked on Preston Island; the salt could not be produced without the coal mining, and, certainly by 1813, the coal mining could not continue without the financial support of the salt production.

Despite the fact that at that time no more than two panhouses could be supplied with small coal, the Ordnance Survey map of 1861 (25° Perthshire sheet no CXLIII, Culross Parish) shows four panhouses on the island. This would suggest that at one time the island was a bigger and presumably more profitable operation, with perhaps as many as thirty people working on the island at its economic peak.

The mining was successful for some time, but after the firedamp explosion in 1811 Sir Robert decided to abandon the project, having incurred a loss of £30,000. Salters then leased the island, and remained there after the death of Sir Robert in 1834. The final salter was ultimately involved in illicit distillation during the 1850s, and fled from the island after the authorities were alerted by the 'wrang reek' coming from the site!

Sir Robert Preston (Illus 4)

The Preston family were in possession of the estate of Valleyfield from 1534 at least. Sir Robert Preston (b. 21st April 1740) was the eighth of nine children. The three oldest sons predeceased their father; the fifth child, Charles, became the 5th Baronet upon his father's death in 1779. Charles died childless on March 23rd 1800, and the Baronetcy passed to Sir Robert. He had married Elizabeth Brown, the daughter of a wealthy London merchant and 25 years his junior, in 1790. They had no children and Elizabeth died in 1832, two years before her husband.

Robert had been a commander in the service of the East India Company and had been the captain of the trading vessel Asia. He returned to Britain in 1777 and set up business in London. Known as 'Floating Bob', he had acquired a large fortune, partly through his trading skills, partly from his business partner, who made him his heir, and also from marrying Miss Brown.

He served as Tory MP for Dover from 1784 to 1790, and as MP for Cirencester from 1792 to 1806, although throughout his twenty years in the House of Commons there is no record in Hansard of him ever having spoken. Before inheriting Valleyfield, he also owned a house in Essex and a house in Downing Street, which he sold to the Government, whereupon it became the Colonial Office (Thorne 1986, 886).

After inheriting, Sir Robert immediately set about developing his property. In 1800 or 1801, Humphry Repton was commissioned to improve
the landscape around his house, the mansion at Valleyfield (Stroud 1962, 120), which had been surrounded by rough grass on a bleak hilltop. This was developed into a full designed landscape of parkland. Sir Robert also greatly expanded his land holdings in Culross and Torryburn parishes (Writs of Valleyfield [SRO GD 241/127]).

Sir Robert also wanted to develop his property industrially; he sent iron ore samples to be tested in 1805; the results were only ‘fair’ (Carron Company Letters Book [SRO GD 58/6/1/43,422]). Finding traces of coal on Preston Island, which as it lay above the low water mark was part of his property, he decided to establish a colliery. He had several motives in doing so: firstly, to make money (although he already had a massive fortune); secondly, he craved fame and recognition, and felt that the Island could become a lasting monument to his achievements; and thirdly, he was keen to emulate the achievements of his distant kinsman and predecessor, Sir George Bruce of Carnock, who had established a mine nearby at Moat Pit Island early in the 17th century.

Sir Robert was a well-known figure in the artistic and political circles of the day, and his friends included William Pitt the younger, Sir Walter Scott, James Boswell and the painters Alexander Nasmyth and J M W Turner (Beveridge 1885, I, 6). He was also a gourmand, believing in hearty, if not fancy meals (Sir Walter Scott noted that he was ‘as big as two men, and eats like three’ [Anderson 1972, 599]). He was a romantic; late in life he suggested that Culross Abbey should be renamed, after his late wife.
In keeping with the enlightened philanthropy of the day, Sir Robert donated some of his fortune to charitable works. The Valleyfield Endowment provided financial help for the poor of Culross and Torryburn (Stephen 1921, 84). He also condescended to be informally generous; excess food from Valleyfield was distributed to the poor (Beve-ridge 1885, II, 247).

Sir Robert Preston was a fairly typical man of his time, who, not expecting to inherit, went overseas and made a great fortune (he was reportedly worth a million pounds on his death {Gentleman’s Magazine 1834, 386}). He wanted to leave his mark on the landscape, and to this end he remodelled

Illus 3. Location of principal structures on the site.
and rebuilt Valleyfield House along with his other large properties. The development on Preston Island was envisaged as a lasting monument to his name and status.

The archaeological excavations

Introduction

Archaeological excavations were carried out over two seasons on Preston Island in 1993. The results of the excavation are here summarised in terms of the following phases of construction and occupation.

Phase 1- (c 1800) The construction of the sea wall and subsequent levelling of the interior.

Phase 2- (1800-10) The construction of the winding and pumping engine houses for the coal mines and the excavation of the pit shafts. At this time the other structures on the west of the island were completed, including the first salt panhouse, offices and a cistern to receive fresh water piped from the shore.

Phase 3- (c 1811) This comprises five sub-phases, 3a - 3e (see below), and represents the transformation of the island from a purely coal mining enterprise to a salt production operation. The building of an accommodation block and a row of three panhouses was undertaken during this phase.

Phase 4- (1850) Abandonment and dereliction.
Phase 5- (1899) A brief attempt to resume mining. This was unsuccessful.

Phase 6- (1914-1918) An installation was constructed over the ruins of the stoking shed.

The programme of archaeological excavations comprised the following:

The interior of Panhouse B was excavated down to its remaining structural elements. A trench was dug outside the frontage of Panhouse B to examine the full depth of the south wall of the structure. Additionally a sondage was dug on the external face of the north wall of Panhouse B, in an attempt to locate the sea wall.

The area to the south of the north Panhouse range (Structures A, B and C) was excavated. This area contained the remains of the Forehouse (Structures D and E).

The cistern (Structure H) was excavated.

Finally, a watching brief was completed in September 1994 while stabilising operations took place to support the E wall of Panhouse C. At this time, a section through the deposits in Structure F (the Panhouse adjacent to the Accommodation Block) was cleaned and recorded.

Panhouse B

The most extensive excavations were concentrated on Panhouse B, the middle one of a row of three
panhouses, situated on the sea wall along the north margin of the island. The associated buildings to the south of this row of panhouses have been demolished to foundation-level and then buried under 0.50m of PFA.

The sea wall (Phase 1, Illus 5 & 6)
A trench 1.20m deep was cut behind the north wall of Panhouse B to locate the sea wall. At this depth a substantial stone structure (F166) was located. The north wall of the row of panhouses was founded on this feature, which stood to a height in excess of 1.80m. The wall comprised large sandstone blocks, averaging 0.19m in height by 0.38m long and exceeding 0.35m in width. The full extent of the wall was obscured by the overlying structures, F104/105 (the north wall of the panhouse) and F101 (the chimney). The stonework was heavily eroded, with no mortar visible.

Panhouse B (Phase 3a)
Panhouse B is a roofless, rectangular structure,
measuring 9.60m in length and 7.10m wide internally. The building is aligned north-south and appears to be partially founded on the Phase 1 sea wall. A chimney 8.60m high, built of stone and brick, occupies the central point of the north wall. The south frontage has two vertical, rectangular slots cut through it at ground level, the entrances to two stone-lined flues. There is a doorway into the structure in the western part of the south frontage wall.

Save for the topmost part of the chimney, all these elements are constructed from yellow sandstone slabs and blocks. This material is roughly dressed, except for the chimney, where the stonework is of significantly higher quality.

Interior features include the flues, the supporting brickwork for the pans themselves and fire-grate, along with the working surfaces. However, there was no trace of the actual iron salt pan or any element of the roof.

Only after the selective removal of 0.40m of ash, cinders, broken brick and stone fragments was the solid structural core of the panhouse finally revealed. A 1.00m wide trench cut along the south wall (F106) allowed the full height of the walls to be measured.

The north wall (Illus 6)
The north wall (F104/105) stands 3.90m over the sea wall but with only the top 1.50m visible inside the panhouse, and has an internal length of 5.90m and a thickness of 0.58m.

The north wall exhibits two particular features. To the east of the centrally positioned chimney (Illus 7), a small window 0.30m wide is positioned just below the wall head. In the north-west corner of the panhouse, a small drain is cut through F104 at floor level. This is visible externally as an aperture above the sea wall. It may have served to dispose waste products from the salt production or have been associated with the supply of salt water.

The chimney (Illus 6 & 7)
The chimney (F101) is the dominant element of the panhouse, standing 6.20m over internal levels and 8.60m over the sea wall, upon which it is founded. The effects of water action and erosion have severely undermined two of the other chimneys (Structures A and C).

The construction of the chimney F101 combines two building materials - the base and main shaft are of squared sandstone blocks, with the top 1.80m constructed of the red, hand-made bricks. All the chimneys on the site are of similar build; the flue is 1.68m square in section at its base, over a brick-lined hearth, 0.89m wide at floor level, which displays signs of heat damage.

The side walls (Illus 8)
A pair of irregular holes have been cut through the east wall and are matched by irregular gaps in the west wall. These may be enlarged operational features or later ventilation holes. Similar, albeit more regular, features were noted in Panhouse F (below). The internal length of the east wall is 8.80m and that of the west wall is 9.10m. - the west wall is slightly longer due to the presence of a doorway at its south end. Both walls stand 1.80m over internal levels.

The south wall (Illus 9)
As the front wall of the panhouse, the south wall (F106) served several purposes. Firstly, it contained the entrances to the flues, secondly it supported the southern edge of the pan itself, thirdly it formed one side of the doorway into the panhouse and lastly it separated the panhouse from the Forehouse (Structures D and E). Excavations to the south of this wall exposed the full height of the frontage, but also uncovered debris from collapse, and fully exposed a crudely constructed wall (F138) which blocked the entrances to the flues. A ledge, 0.38m above the flue entrances, probably supported one end of the salt pan itself. The doorway lies to the west, and measures 0.80m wide and 2.30m high, standing 1.10m above the external ground level, and requiring a series of steps in order to enter the panhouse. The steps were later removed, leaving only the side walls. A ramp (F145) was then constructed in the place of the steps, presumably for operational convenience.

It has already been noted that wall F106 was rebuilt 0.30m to the south of an older wall line. It is likely that the original wall either collapsed due to the effects of heat and the weight of the pan itself or, more likely, that a new pan of greater length was required, and the panhouse was extended accordingly. Bald and Renwick in 1813 noted that Preston Island had both a 16 foot pan and a 19 foot pan. The 19 foot pan would fit very well over the slightly lengthened flues.

The flues (Illus 10, 11 & 12)
The west flue (F110) with its entrance (F132) is set approximately central to the building and is aligned almost exactly with the base of the chimney, whereas the east flue (F130/131) lies 0.50m to the east. The flues have a depth of 0.65m and a width of 0.52m and run for a distance of 5.90m, terminating at vertical faces 0.60m high at their northern ends. The salt pan itself would have covered 5.80m of the full length of the flue. These channels accommodated independent fire sites, under the pan itself, fuelled and ventilated from the south. The fire was probably laid on some form
of grate, and the channels were intended to provide a suitable draught, as well as to facilitate the removal of ash and debris from the fires. They operated in addition to the fire at the base of the chimney, although all the fires must have vented out via the chimney. The implication is that the two fire sites did not operate simultaneously, perhaps a reflection of the first stage of brine preparation, discussed below (Appendix I).

Phase 3b - landscaping
A feature (F127) discovered by excavation in the south-east of Panhouse B reflected the gradual build-up of deposits within the structure, as it cut through all the upper deposits within the panhouse down to foundation material. The basal deposit in pit F127 comprised fine shell sand and originally lay at the same level as the base of flues. It is possible that this material underlay all the internal structures within the panhouse. Coal ash (0.12m deep) was sealed by 0.23m...
Illus 8. External elevation of West wall, Panhouse B.
of grey ash. This in turn was sealed by 0.45m of green silty clay and finally by 0.15m of mortar rich ash. These are the deposits which infilled the interior following the construction of the walls and flues. The deposits tip down toward the flues from the side walls, forming a slope upon which the Phase 3c brickwork beneath the salt pan was built. To the west of the panhouse interior, these deposits form a flat level area between wall F102 and the brickwork of Phase 3c. This forms the working surface in Phase 3d.

Phase 3c

During this Phase, the loose brick and stone terracing which supports the salt pan was built. Set on the ash and sand landscaping of Phase 3b is a rough stone terrace which both provides a stable backing to a series of brick terraces and also creates a ledge to support the iron salt pan itself. A total of six tiers of bricks set edge-to-edge were placed on the stone sides of the flues. This construction (F112 and F128) slopes towards the walls at an angle of 45 degrees, running the entire length of the flues. Brickwork over the stone wall between the flues supported the pan, as well as protecting the stonework from direct exposure to heat.

Phase 3d - working areas

This Phase represents the defining of the working areas in the panhouse, specifically a walkway and platform (F113) at a height of 1.60m above the bottom of the flues. This was defined by ash and cinder infill behind the stone revetting (F109), which itself formed the edge of the pan ledge. This 1.20m wide walkway ran the full length of the panhouse on the west side, from the doorway to the chimney. There is no equivalent walkway on the east side except for a narrow strip along the east wall, and the alignment of the flues is offset from a central line towards the E in order to accommodate this walkway.

Phase 3e - rebuild of F106

This Phase saw the collapse/demolition of the front (south) wall F106, either due to its deterioration or because of the incorporation of a new, larger pan (indeed Whatley [1984,14] states that panhouses required frequent repairs due to crumbling stonework).

Evidence for the Panhouse roof

The excavations within Panhouse B uncovered no evidence of roofing material. While broken pan tiles were found over parts of the Forehouse, none was found in the panhouse itself. However, it is likely that the panhouse would have been roofed, but whether this was in the form of pan tiles, metal sheets or even tar paper is not known. In the absence of any trace of pan tile or roofing nails, it was concluded that metal sheeting may have been the most likely roofing material (J Hume, pers comm.)

The Forehouse (Illus 12 & 13)

A trench was laid out across the frontages of all
three Panhouses (A, B, and C) to the north of the Island. This trench was intended to reveal the south frontage walls of all three panhouses as well as the entire Forehouse. A relatively thin overburden was removed revealing a three-sided stone building, set against the south face of Panhouses A and B. The structure stands less than 0.40m high over most of its length. There were two doorways, one opposite the stairway into Panhouse B and another obscured by a late concrete structure (Phase 6) opposite the remains of a stair into Panhouse A. The base of the building featured remnants of the grey sandstone flags which once floored the entire structure, now covered by broken pan-tile debris and ash. The north face consists of the flue arrangements of the two west pan-

houses. In front of Panhouse C were the remnants of an associated structure (Structure E), separated by a narrow wall (F014) from Structure D, entered from the south.

Structure D (Illus 12)
This building was probably a stoking shed for Panhouses A and B, with two doorways along the south wall. The walls are of yellow sandstone blocks sitting on a single thin layer of sandstone foundations and bonded by white mortar.

The west wall (F030), which survives as a single course of masonry, is bonded into the west wall of Panhouse A, has the same dimensions, and is on the same alignment.
The east wall stands a little higher than the rest of Structure D, averaging a height of 0.40m, but at the junction with the east wall of Panhouse B it rises to 1.20m. This wall may be bonded into the panhouses, although the rebuild of the front wall (F106) of Panhouse B obscures the relationship.

The south wall of Structure D is divided into two sections by two doorways, 5.00m from the east and west ends of the wall. The west and south walls of Structure D were 0.58m thick, while the east wall (F014) was only 0.40m, indicating that F014 was an internal wall rather than an end wall. All the walls were set on 0.07-0.10m thickness of foundations slightly wider than the walls, which are in turn set on coal dust and ash, similar to those beneath the panhouses themselves.

The south wall of Panhouse B is a rebuild situated 0.33m further south than the original. This panhouse has therefore been deliberately extended, possibly to contain the 19ft pan mentioned by Renwick and Bald in their survey of Preston Island in 1813. Across the front of the flues is a blocking or revetment (F138) of very crude construction standing 0.83m high and abutting the south face of F106.

The entrance to Panhouse B lies at the west end of the south wall (F106), access to which was converted from steps to a ramp.

Much of the south wall (F018) of Panhouse A has been demolished or has collapsed since abandonment. The centre of the wall is now stand-
ing to a height of only 0.80m, therefore the tops of the fire-box entrances have been lost.

The floor of Structure D comprises a residual area of flagstones, two large concrete platforms and a box-like structure (F007). The flags (F008) consist of 14 complete stones and a mass of broken fragments, forming an irregular area of approximately 9 m² in the west part of Structure D, in front of the flues of Panhouse A. The flags are a hard, grey sandstone 0.08m thick and averaging in size 0.50m by 0.80m. The level of this flooring is the same as that of the entrance to the flues. These flagstones probably covered the whole of the interior of Structure D, and traces of robbed slabs were observed in the underlying ash and coal dust.

The final significant structures are a pair of long concrete platforms, part of a set of three, which overlie the remnants of the Forehouse and are believed to be late 19th or early 20th-century in date. There was also a very crude box-like setting of bricks and stones (F007) beside the east flue of Panhouse A, defined by two sides, measuring 1.50m east-west by 1.50m north-south set against the east part of the Panhouse A frontage (F018). This box-like structure, which is only 0.30m high, opens towards the flue entrance and is clearly associated in some way with the flues. A similar feature was recorded in Panhouse F (F021).

Structure E (Thus 12)

This building is probably an extension of Structure D towards the east. Conceivably the two elements are one and the same building, divided by a cross-wall (F014). Structure D fronts Panhouses A and B, whereas Structure E fronts Panhouse C.

Structure E measures 6.60m east-west by 4.60m north-south, and comprises only the east wall of Structure D (F014) and a short extent of the south wall (F026). An area of flagging (F020) was revealed near the centre of the structure, which is in turn partly concealed by a later concrete platform (F005). A small stone 'box' (F021), similar to that found in Structure D, has been built on to the east side of the frontage of Panhouse C.

The south wall of Structure E (F026) is similar to the south wall of Structure D, standing 0.58m wide and measuring 2.50m in length. The west end of F006 defines a doorway at the west extremity of the building, lying opposite the staircase and entrance into Panhouse C and so exactly matching the arrangements in Panhouses A and B. Posi-
Illus 13. The Forehouse from the south.

Illus 14. The cistern from the south.
tioned across this wall and running north-south is a large, thin rectangle of concrete, 6.10m long and 1.10m wide (F005).

The frontage of Panhouse C is in better condition than that of Panhouse A but is more ruinous than that of Panhouse B. The Panhouse C south wall stands to a height of 2.20m at the sides but only 0.90m in the areas around the flues. The lintels of the flues do not survive.

The general arrangement of features in the frontage are virtually identical to the south faces of Panhouses A and B, and quite clearly all three panhouses were built to an identical plan. The flues are part-filled with red, white and black ash and debris to a level of 0.50m and appear to have been left uncleaned after the last burning, as have all the other fire-boxes in this series of panhouses.

The staircase (F022) has undergone a sequence of alterations. The original steps, as in the other two panhouses, have been removed, leaving a rough masonry foundation. This has been covered with 0.50m of grey ash and coal dust to form a ramp. This in turn has been roughly sealed with masonry to a final height of 1.60m, and finally the whole structure has been cut back to a stump 1.10m long. It is believed this was caused during the construction of a coastal installation now represented by the substantial concrete platforms F003/004/005.

The concrete platforms (Illus 12)

A series of three large shallow concrete platforms have been laid across the demolished remains of the Forehouse. They appear to form three sides of a square, placed across the entire frontage of the three panhouses, partly obscuring the structural elements of Structures D and E of the Forehouse.

Although the exact purpose of these platforms is unknown, they may be the foundations of an observation platform or signalling device dating from World War I. Additionally, these structures lie on clean, rubble-free levels, indicating that they were laid after a general clearance of buildings in this area. The flues in Panhouse B, directly behind the installation, were then possibly blocked off to prevent loose ash blowing out.

Structure H, the Cistern (Illus 14,15 & 16a-b)

An area measuring 12.00m by 12.00m was laid out to encompass the entire structure, and removal of between 0.05m and 0.20m of ash and mud revealed the tops of walls defining this building. In plan, the feature is a slightly irregular square with a pointed corner at the north-west extremity, the north and south walls of which were 11.50m long whereas the west wall was 11.00m long and the east only 9.10m. The walls proved to have a three-layer construction. The outer and inner faces (F032 and F033) are of roughly dressed sandstone blocks, 0.60m and 0.54m thick respectively. Sandwiched between the two was a 0.40m thickness of grey clay (F034), forming the waterproofing necessary for a cistern.

A cut, 0.70m wide and 0.60m deep, in the north wall of the cistern indicated the position of a pipe. Beneath this, at a depth of 0.80m below the wall head, a clay pad was located, which in turn sat on an extensive surface of sandstone fragments and grey clay. The purpose of this pad only became clear when a concrete tank (F035) was located, buried in the fill of the cistern. This tank was an open-topped, square structure 0.90m across and 0.60m deep, with three ceramic pipe inlets. It is likely that this tank sat on the clay pad below the cut in the wall. A pipe, now absent, would have pumped water into the tank where initial settling would have taken place, before the water entered the main cistern. Excavation of the cistern interior removed a total of 0.75m of ash, mud and coal waste. A sondage was dug in the centre of the structure to gauge its full depth, revealing a total depth of 1.80m of modern debris deposited over a clay membrane at least 0.20m thick.

A wall (F032) was built (with no foundation course or buttressing) directly on the surface of the ash as it existed at the time. Within this wall-line
a shallow, flat-bottomed depression had been created below the bottom of the wall. It was into this depression that the principal feature of the structure, an impermeable clay membrane 0.40m thick, was laid. The membrane stretched across the bottom of the depression and up the inside of the perimeter wall (F032). In order to keep it in place, an internal wall (F033) was built against the
Illus 17. East-facing section of Panhouse F
membrane, sandwiching it between two lines of masonry. Presumably the inner face overlay the membrane itself in order to maintain the seal, resulting in a distinct inwards lean of sections of F033. Eventually this problem became so acute as to necessitate the construction of a revetting bank (F038) of sandstone chips and clay right round the inside edge of the cistern.

The cistern was used to collect and store fresh water, which was pumped via a long pipe from the mainland to the island. The fresh water was used for two main purposes - firstly for general domestic consumption, and secondly for the powering of the steam-engines which operated the pit head machinery. It is no coincidence that Structure H lies midway between the Engine Pit and the Lady Anne Pit, conveniently close to both.

The engines were of a condensing variety (J Hume and W Harvey, pers. comm.), utilising the condensing of steam to create a vacuum. The existence therefore of a quantity of permanently available fresh water would be essential, for use in the boiler(s) and probably also for condensing.

Structure F, a fourth Panhouse (Illus 17)
Structure F lay at the south end of the Accommodation Block (Structure G) and was in outline similar to the main block of three panhouses (A, B, C) to the north. The building is rectangular, roofless and built of squared blocks of yellow sandstone, although it is slightly smaller than the others, with an external length of 8.40m and an internal width of 5.60m.
The front or south wall of Structure F is missing, but a fragment of the associated Forehouse wall is bonded to the west wall at its south end. There is no sign of its chimney, as the entire north wall was demolished when the Accommodation Block was built.

The layout of flues and brick terracing exposed in section is identical to the other panhouses sealed by 0.90m of ash and ash/soil levelling and infill. There are two drains at work surface level, cutting through the west wall of the panhouse, compared with one drain cutting through the back wall of the north panhouses. Two slots 0.10m wide in the west wall, 0.90m below the wall head, are noteworthy as Panhouse B also features two roughly cut holes in its east wall in much the same position, believed to be secondary modifications. Whether these features were for support (for the roof or to raise the pan itself) or ventilation is not known.

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The Lady Anne Pit engine house, Structure J

The surviving structure consists of the chimney, which stands 13.20m high at the south side of a boiler house. The surviving wall remnants are no more than 3.00m high and are in a poor state of preservation. Unfortunately most of the lower elements of the engine house visible in 1983 are now buried under PFA. In terms of fabric, this structure is built of standard squared blocks of yellow sandstone with a white mortar. The chimney is of similar construction to the others on the site, being of stone, except for the top 1.20m, which is of red brick.

The Accommodation Block, Structure G

The building comprised four domestic units, in two double-storey blocks, with a total length of 23.00m. The north block is 10.70m long with a wall height of 3.70m. There are two doors centrally placed one over the other on the east side to provide access into the two floors. There are also the remains of an external masonry staircase leading to the second floor. In addition, a doorway survives just to the north of the central door, giving additional access to the lower unit of the north block.

The south block is similar but lacks the second lower doorway. This south part is slightly smaller than the north, at 10.20m in length. Again, an external stair leads to the upper floor, which may be subdivided. The southern end of this block fits into the ruined north wall of Panhouse F. These houses are comparable to the contemporary two-storey cottages prevalent on the Fife coast and are part of a well-defined vernacular style (Naismith 1985,180).

Discussion

Panhouses A, B and C (Illus 19)

The excavation of Panhouse B, and the examination of the south (front) wall of Panhouses A and C, confirms the evidence collected by the Scottish Industrial Archaeology Survey (SIAS) in 1983, which indicated that all three panhouses were built to an identical plan. The structures exposed by excavation, and not recorded by SIAS, consisting of the full layout of the flues and associated structures in Panhouse B, as well as the south wall frontage, show very close similarities in both fabric and arrangement.

The principal structural unit which ties all these panhouses together is the north wall. This structure appears to be a single phase construction. Following the construction of the panhouse, the wall lines of the Forehouse would have been laid out. Certainly, these walls are bonded into the walls of Panhouses A and B, while the completion of the Forehouse (Structures D and E) might have been delayed while the internal elements of the panhouses were put into place. A considerable tonnage of ash, coal dust and sand had to be placed within the panhouse to create the banks of material on which the brick terracing and working surfaces could be constructed. Conceivably, it might have been advantageous to delay the com-

Illus 20. Reconstruction of the island c 1811.
pletion of the frontage until this building phase had been completed.

Finally, the emplacement of the iron salt pan itself would have taken place before the last details of construction, such as the roof, were completed.

Structures D and E, the Forehouse/Stoking Shed
The Forehouse was a double chambered structure with a common end wall. Excavations have revealed that a building (Structure E), similar in basic design to Structure D, did in fact exist in front of Panhouse C. Both buildings have flagged floors, a stairway into the panhouses and a doorway opposite the stairs. Erosion has removed most of Structure E, but the short length of wall that remains matches the equivalent wall line in Structure D.

The 1813 report by Renwick and Bald states that only two pans were in use in that year, and they recommended no further pans should be constructed until the supply of coal had been improved. It is possible that Structure D was the Forehouse for the two panhouses in operation in 1813. This indicates that Panhouse C is a later construction, and that consequently Structure E must also be later.

Panhouse F
The brief examination of the interior of Panhouse F revealed it to be of a similar design to the row of panhouses on the northern edge of the island but somewhat smaller. The significant difference between these panhouses is that A, B and C to the north were all abandoned and dismantled at the end of profitable salt panning in the 1830s and 1840s, whereas Panhouse F had been ruinous and partly demolished at a relatively early stage in the island's history. That Panhouse F was at one time in production is confirmed by the depth of ash and cinders in the flues. However, the chimney and north-west wall were completely removed to allow for the construction of the Accommodation Block (Structure G). In more recent times, the Forehouse has been robbed and further damaged by marine erosion.

Bruce Lenman (Whatley 1984, 8) suggests that nearly all of Fife's coastal collieries had salt panning associated with them, and that the salt industry was one of the prime reasons for the survival of these collieries. This would suggest that some level of salt industry would have co-existed with the mines of Preston Island from the very beginning. It may therefore be the case that a single panhouse, Structure F, was built at approximately the same time as the coal pits were opened, and that the purpose of the panhouse was to use the 'small' or 'pan' coal, which was of relatively low value.

Later, the need for an accommodation block on the western or upwind side of the island would require it to be built next to the panhouse, as this would be the only effective site available, necessitating the partial demolition of Panhouse F.

The cistern
All the accounts of Preston Island suggest that fresh water was piped over from the shore from the outset of industrial activity on the site. It is likely therefore that the cistern (Structure H) was a primary element in the overall complex, acting as a general collecting point for the water. Although no surviving evidence of a roof was discovered, some sort of covering, perhaps similar to that over the panhouses, would have been necessary to keep the water clear of dust and debris.

Conclusions
The excavations have allowed for the reconstruction of a unique early 19th-century industrial site (Illus 19 and 20). The information retrieved from both field-work and archival research has demonstrated very graphically the importance and unique nature of Preston Island. The personality and energy of Preston Island's patron, 'Floating Bob', have created a most significant monument, which straddles the end of a traditional medieval subsistence industry and the beginnings of true industrialisation. Although ruinous, the site is still impressive (the remains are the most complete of any salt pans in Scotland), with many of its surviving major buildings constructed of the attractive pale yellow local sandstone. However, its present dilapidation belies its original status as a testament to hard-headed commercial interest on one hand, and the rarified ideals of the enlightened Scottish landed gentry on the other. The recent researches have therefore shed new light on a remarkable site, confirming its importance as one of Scotland's most interesting industrial monuments.

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In 1614, salt was Scotland third largest export, after wool and fish (Adams 1965, 153). The earliest salt pans were founded in the Forth area, with production centres emerging later in Tayside and Ayrshire, and with local production all along Scotland's coasts.

By the late 16th century, salt pans were established at several sites in Fife and the Lothians. The Tayside industry began to emerge in to 1790s, but no very large works were established after 1793. Preston Island, established in the first decade of the 19th century, was one of the last new developments in Scotland.

Scotland began to lose foreign markets in the late 17th century, and initially the imposition of salt duties in 1713 also adversely affected salt production in Scotland. This taxation led in turn to a great deal of salt smuggling in the 18th and early 19th centuries. By the late 18th century, rising demand for coal led to the reduction of profit margins in salt making. But it was the development of the Cheshire rock-salt industry, and the repeal of the salt duties in 1823, leading to a flood of cheap English salt, that effectively brought the Scottish salt industry to an end. Very little production continued into the 20th century, although the last salt pan in Scotland, at Prestonpans, did not finally close until 1959 (Chadwick 1982, 158).

The Industry in Fife and the Forth Basin

The Forth basin was the centre of salt production in Scotland; this area held a large proportion of the country's population before the industrial expansion on the Clyde in the 19th century, it faced the North European markets, and coal outcropped directly on the shore. The principal overseas markets for Forth salt were Veere in the Netherlands, and the Hanseatic ports around the Baltic (Chadwick 1982, 158).

In Fife, salt pans were in place by 1574 at Kirkcaldy, Dysart, Culross, West Wemyss and Fordel. Those at Culross became predominant over the next fifty years, but the complex was badly damaged by a storm in 1625. Salt pans were then established at Wemyss and Methil, and forty pans
were built at Kincardine, but these may have been less productive, as from the late 17th and early 18th centuries the West Fife saltworks were losing importance to the Kirkcaldy district. Late in the 18th century, nine new pans were built at St Monans by Sir John Anstruther (Lewis 1989, 361). This was then the largest concentration of salt pans in Fife; salt pans no longer existed at Kirkcaldy Links, Leven Links, Newpans and Valleyfield (Whatley 1984, 41). In Lothian, salt pans were in place at fourteen sites along the coast.

On the Isle of May, where a herring salting industry was being supported (Dundonald 1784, 33), a limited seasonal industry based on solar evaporation briefly flourished (Chaloner 1961, 58).

Coal extraction and salt production

In Scotland, where climatic constraints meant that solar evaporation was unattractive, the salt industry was constrained by ready access to fuel. Within the country there are only two areas where salt production was not based on artificial sea water evaporation; the Isle of May, and around the Solway Firth (Chadwick 1982, 160), where a technique called 'sleeching' was used. This involved the washing of salty sand to produce a brine, and was very inefficient.

Marine salt pans certainly existed in Scotland from the 12th century, and possibly earlier. But before the 13th century, production relied on wood and peat for fuel. The first joint reference to coal and salt is in 1209, when the monks of Newbattle Abbey were given permission to dig for coals to fuel salt production at what is now Prestonpans. Until then, most salt pans had been located on the carseland at the upper tidal limit of the Forth basin, below Stirling, on peat deposits, and each pan needed a large area of land to support it (Adams 1965, 154). Within a century, there was a revolution in location and these pans had been abandoned in favour of the coal outcrops of the lower Forth (Adams 1965, 153). The change from peat to coal led to new location and a new status for salt working, as salt production became an adjunct to coal production. When technical improvements took place in mining, as happened in the early 17th and the late 18th centuries, the salt industry benefited and grew.

Salt pans could not rely on coal from inland pits, as until the eighteenth century, the price of coal doubled over every two miles it was carried (Adams 1965, 155). It was only with the development of the coking industry that an alternative market for 'small coal' developed. This coincided with transport improvements, as wagonways and then railways made it economic to transport small coal over greater distances.

Salt panning on Preston Island

The very fabric of the panhouses, built of best quality local stone on an artificial island, speaks of high financial investment. It is certain therefore that the panning process itself would have been of an equivalent quality, if not for sheer efficiency then perhaps to outshine the many other salt pan operations being carried out along the banks of the Forth.

Up to the early part of the 18th century, salt panning was a fairly crude business, with coal being shovelled on to the ground below large iron pans filled with sea water, which in turn were supported on stone or brick emplacements. The pans used in this particular method were known as 'sole' pans.

The methods used along the Fife coast in 1720 at Methil and Bagie, consisting of lighting a strong fire less than 600mm below the pan, were considered crude and liable to damage the metal through overheating. In the latter part of the 18th century, a more sophisticated and efficient system began to be put into operation. This involved raising the pan on a form of grid over custom-made furnaces. This improved the heat distribution, reduced the amount of off-burning and improved output by 25%. These pans were known as branders or banders, and the more modern minded salt producers were quick to seize the advantage. For instance, the saltworks at St Monans in East Fife used branders, and these works were considered in 1790 as 'one of the nearest and best contrived salt-works upon the coast' (Lewis 1989, 366).

The pans themselves were, by the 18th century, of a fairly standard size. That is - approximately 18ft long by 9ft wide by 15 or 18in deep (Whatley 1984, 21). These substantial structures were made of riveted sheet iron, which required continual maintenance, as salt production was a corrosive exercise.

Panhouse B

At Preston Island a setting was discovered on the top terrace of the brickwork within Panhouse B to support a structure. This setting or ledge ran the full length of the panhouse, and would have needed a pan of a size 25ft long by 13ft wide. This compares with the largest known pan at Preston Island, the size of which was described by Renwick and Bald in 1813 as being 19ft in length. In addition, the length of the deep part of the flues is 19ft. Obviously some other structure sat in the setting on top of the brick terracing. This would be the grid, or support, which raised the pan above the surface of the working area. This arrangement is that of a brander, which would have sat on the brickwork, and formed a seal to keep the fumes out of the panhouse upper area. The pan would then have sat on the brander at a height of 1.90m.
over the bottom of the flues. If the height of the fire is added, then the pan would sit at 1.50m over the flames. This concurs exactly with the situation at the Cuckenzie pans east of Edinburgh (Chadwick 1982, 163).

If, as seems most likely, the pan was the standard 19ft (5.80m), then a gap of 1.90m remains between the end of the pan and the chimney opening. This is presumed to have had a metal covering or hood to convey the fumes from the flues to the chimney. In addition, this area would of course have been extremely useful for the drying of salt. Chaloner (1961) states that ‘wet salt was often allowed to dry in hot-houses between the furnace and the chimneys’. This may have been the case at Preston Island.

Water supply

The source of salt water for salt panning in Scotland was the sea. In order to have sufficient supplies of water to continue working when the tide was out, it was standard practice to build some form of tidal reservoir as near as possible to the pan houses. These reservoirs were called ‘bucket pans’. At St Monans in Fife and Usan in Tayside, rock cut channels leading into rock cut pools provided a permanent water source. In other places, such as Culross, just to the W of Preston Island, a gigantic reservoir 75.00m by 60.00m in extent and with walls 3.50m thick and 4.00m high could hold over 15,000 m$^3$ of salt water, and so service five panhouses simultaneously (this huge pond eventually fell victim to one of Sir Robert Preston’s more whimsical ideas, and was filled with turtles).

At Preston Island, the source of water was probably a combination of the Forth and the flooded George Pit mine shaft.

It is assumed that the first panhouse to be operational was Structure F on the south-western corner of the island. It is also assumed that during this period - from 1800-1811 - the pits were being fully developed, and that the use of water in the pit shaft was an afterthought. Consequently, it is likely that a ‘bucket pan’ would have existed close by Panhouse F. Unfortunately, the area is now flooded by PFA, and there is no available documentary evidence for such a structure. Additionally, the maps of 1842, 1861 and 1891 show no structure on the foreshore equivalent to a bucket pan.

Following the disaster in the George Pit in 1811, flood water was pumped out for use in the new panhouses on the north side of the island. The Renwick and Bald report in 1813, which was an analysis of the economic possibilities of the island, states that at the time of the survey tests were being carried out on water recovered from the George Pit. This water was purer, yet more saline, due to the act of passing through the rocks below the sea. Furthermore, they recommend that both sea water and pit water be analysed, and that the purest water could then be the sole source of brine for the two existing panhouses.

The fuel

The pans utilised the small or pan coal, which was less marketable than the better quality Great Coal; to be exact - the price of producing Great Coal was 3/- 6d. a ton, while small coal was 1/-1d. a ton to dig. Thus the small coal fuelled the salt pans while the Great Coal was sold (Renwick and Bald, 1813). The account of 1813 states that the pans used 50 tons of small coal per fortnight at a cost to the salters of 4/- 6d. a ton (a profitable mark-up for the colliers).

The report of 1813 also indicates that there were two operational mines, the George Pit and the Eye Pit, but that these mines could not produce enough coal to allow for an expansion of salt production from the two existing panhouses.

Filling the pan

The principal method of transporting the water was by carrying it in containers from the bucket pan on the seashore into the panhouse and pouring it into the pan. This was the most basic and primitive method, and by the 17th century, pumping was beginning to take over. It seems likely that in a determinedly modern site like Preston Island, pumping should have been the case. However, no evidence of pumping equipment remains, and there is no description of this part of the process. What does exist, however, are features in the panhouses described as drains for the disposal of waste products. Each of the Panhouses, A, B and C, have such a feature, and Panhouse F has two. These ‘drains’ may have acted as access points from the sea into the panhouses, water being pumped up through them into those structures, as opposed to salt waste products being removed. If this was the case, then there would be no need for bucketing from the seashore and it would mean that the ‘bucket pan’ reservoir would have backed directly onto the panhouses.

After 1813, the other source of water came from the George Pit, when it was still being tested for salinity. Presumably this would be pumped out of the shaft and then either carried or wheeled into the panhouse. Conceivably the demolition of the steps from the Forehouse into the panhouse and the creation of ramps might have been to allow small carts with a water barrel attached to be dragged up to the edge of the pan.

What is clear is that copious amounts of brine
were necessary for salt production. The largest of the Preston Island pans, the 5.80m pan, would have a capacity of 10 m$^3$ and would have needed to be refilled between 3 and 5 times before a full pan of salt could be recovered (Whatley 1984, 10).

**Heating the pan**

It is likely that a 5.80m pan sat on a metal frame, thereby raising the pan 0.50m above the brick terracing below. This "brander pan extended the length of the flues and was seated at its southern end on a ledge 0.35m above the top of the entrance to the flues in the south frontage wall.

The pair of flues ran beneath the pan. Above these flues were six tiers of red brick, forming a wide terracing on both sides of the flues, thus exposing the whole base of the pan to direct heat. Evidence suggests that burning did not actually occur on the floors of the flues themselves, but instead that a grate was placed over the flues, perhaps onto the brickwork, the fire sitting on this framework, thus admitting enough air for efficient combustion.

The fires would have caused extensive damage to the panhouse structures over time (Whatley 1984, 14) necessitating frequent repairs and rebuilding. A fire in the stone flues would have seriously damaged them over a long period, and as they form a part of the primary structure, this would necessitate the dismantling of the brick terracing to access them; this would have been avoided if possible. Associated with this, the brick terracing is easily removable and replaceable. The bricks are held in place with a small dab of mortar at the back of the brick. This indicates that they were designed to be easily taken out. A fire burning at the level of the bricks would burn them badly. Indeed surviving bricks show considerable heat damage, although this may not be direct contact heat.

Following the filling of the pan and the lighting of the fires, a series of necessary preliminary procedures had to be observed. Before the salt crystallised, as many impurities as possible had to be removed from the water. After evaporating to the point of crystallisation quantities of egg whites or blood was thrown in (Whatley 1994, 10). This organic material coagulated in the heat, entrapping impurities to form a 'black frothy scum' which could be drawn off. Following this process, the liquid was allowed to cool and precipitate salt crystals. According to Whatley, up to six tons of coal were required to make one ton of salt, a process which took at least twenty-four hours, and which therefore required round-the-clock stoking and servicing. It is because of the requirement for full time manning that the Accommodation Block was built.

The actual manpower involved may not have been great. Renwick and Bald’s survey of the salt pans of Preston Island (1813) states that the prime costs for the running of two salt pans for a fortnight consisted of four salters, one woman and 50 tons of coal.

When the pan of salt had completed its evaporation, the fires were dampened down to prevent burning the salt and thereby tainting it. The salt was drawn to the sides of the pan, allowed to drain briefly and then shovelled into conical wicker baskets called ‘packs’ or ‘drabs’, and then allowed to drain again, possibly within the panhouse itself.

The salt was then transferred to the ‘girnel’, or storehouse, possibly in the upper parts of the Forehouse where it would be warm. Salt produced this way tended to lose up to one seventh of its bulk after removal from the panhouse, therefore the salt had to be stored for three months before merchants would buy it (Whatley 1982, 94).

It is noted that the floors of ‘girnels’ were flagged to assist drainage from the many baskets of salt, and also to assist in keeping the place clean. Such an arrangement existed in the Arran’girnel’, and the Forehouse at Preston Island is floored in a similar fashion.

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**Abstract**

A programme of archaeological research, excavation and monitoring was undertaken on the site of an early 19th-century salt pan and coal-mine complex at Preston Island (NT 007582), Torry Bay, Fife. One salt panhouse and associated forehouse were excavated, along with a freshwater cistern; elements of the sea wall and a second panhouse were also recorded during the restoration of the main buildings on the island. The work was commissioned by Fife Regional Council, and was supported by Historic Scotland, Scottish Power and the European Regional Development Fund.

Key words: salt, coal, saltpans, industry, Fife