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# Kiln at Tregonning Hill Brickworks, Breage, Cornwall

## Archaeological excavation, watching brief and updated historic building record



**Historic Environment Projects** 

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Archaeological excavation, watching brief and updated historic building record

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The excavation was carried out by the author and Ryan Smith, the watching brief was undertaken by the author with assistance from Martin Andrewes and Brett Archer and the measured survey was carried out by James Gossip along with the author.

The Project was managed by the author and Nigel Thomas.

The views and recommendations expressed in this report are those of Cornwall Archaeological Unit and are presented in good faith on the basis of professional judgement and on information currently available.

#### Freedom of Information Act

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Cover illustration

View of the kiln looking south-west (taken in June 2013).

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## Abbreviations

CAU	Cornwall Archaeological Unit
CRO	Cornwall County Record Office
HER	Cornwall and the Isles of Scilly Historic Environment Record
NE	Natural England
NGR	National Grid Reference
OD	Ordnance Datum – height above mean sea level at Newlyn
OS	Ordnance Survey

## 1 Summary

Cornwall Archaeological Unit (formerly HE Projects), Cornwall Council were commissioned by PDP Green Consulting Limited on behalf of Roger Benney to carry out an archaeological excavation and watching brief/controlled strip at a Grade II listed beehive Scrivener kiln at Tregonning Hill, Breage, the only remaining building associated with the former 19<sup>th</sup> century Tregonning Hill Brick Works. This work follows the completion of an historic building record of the kiln (Sturgess 2013) which recommended that an archaeological excavation should take place prior to the repair and rebuilding of the kiln if ground disturbance was proposed as part of this work. Since a decision was made to rebuild ruined areas of the kiln by reusing collapsed masonry that lay scattered in an earth matrix both inside and outside of the building, an excavation and watching brief became a requirement to ensure associated belowground structural features were recorded. The kiln, originally constructed for firing bricks, is located at NGR SW 6049 2993 (Figs 1 and 2). The building record, excavation and watching brief were carried out in advance of consolidation work, to stabilise and protect the structure, as part of a Higher Level Stewardship agreement entered into by the Benny family with Natural England.

The kiln, which now stands alone in a field on the north-east slopes of the hill, was originally built as part of the Tregonning Hill China Clay and Brick Works established in the early 1870s by William Argall (a local mine captain and manager of the earlier clay works at Tregonning Hill) with the financial backing of John Toy of Helston and William Harvey of Hayle (both iron founders). The works were sold in 1893 and leased to John Miners Holman of Camborne, Frank Harvey of Hayle and F W Thomas, manager of Dolcoath Mine in Camborne. Later, in 1903, the complex was sold again to John Lovering & Co. of St Austell. It seems likely that the business lasted only a short time after being bought by John Lovering & Co. since the Second Edition OS map of *c*1907 (Fig 7) shows the works as 'Disused'. It is unclear whether it reopened again after 1907.

The kiln is a single phase structure which bears evidence for episodes of repair work. It is likely to have been in use as part of the brickworks for a period of approximately thirty five years before its abandonment. The excavation and watching brief have provided substantial information regarding the design, construction and layout of the kiln revealing the location of its adjoining chimney and flue as well as the entrance to the stoking chamber and details of the internal floor and below-floor structure.

Significantly this 19<sup>th</sup> century kiln survives whilst all the other buildings and structures associated with the Tregonning Hill China Clay and Brick Works have not (with the exception of a ruined corner of a building which survives in the wooded area to the south-west of the site). The surviving kiln is designated as a Grade II listed building and contributes to and is part of the Tregonning and Gwinear Mining District within the World Heritage Site for Cornish Mining. The granite and brick structure with its original domed roof (for the most part intact) is a fine example of a 19<sup>th</sup> century beehive Scrivener kiln, once common in Cornwall, but now becoming increasingly rare.







Fig 2 Site location visible on 2005 aerial photograph

## 2 Introduction

#### 2.1 Project background

The 19<sup>th</sup> century, Grade II listed brick-making kiln lies within a protected landscape on Tregonning Hill, near Helston. The kiln and surrounding land are owned by the Benney family who have entered Nansloe Farm into a ten year Higher Level Stewardship agreement with Natural England. As part of this agreement the brickworks kiln has been selected for assessments and surveys leading to its much needed consolidation and stabilisation.

A brief dated 20/2/2013 outlining the required works was prepared by Ann Reynolds, Senior Archaeologist, Countryside Advice, Historic Environment, Cornwall Council. This brief sets out the entire works schedule and includes requirements for historic assessment, an historic building record and analysis plus recommendations for consolidation works and future management. Cornwall Archaeological Unit was subsequently commissioned by PDP Green Consulting Limited, who had been contracted to undertake the works for NE, to carry out a building record and historic assessment and include recommendations (Sturgess 2013). Following on from the building record, CAU were commissioned again by PDP Green to carry out an excavation inside the building, a watching brief/controlled strip during groundworks to collect building stone for the repair works and a measured survey to include new features and structures revealed during the course of the works. These works were undertaken between April and June 2014.

#### 2.2 Aims

The aims for the works carried out in 2013 were to undertake an historic building survey of the kiln and provide recommendations for consolidation. The aims for the work carried out in 2014 were to gain an archaeological record of the below-ground structural elements associated with the kiln. The excavation aimed to establish the depth of the floor, locations of below-ground structural elements and establish their state of preservation and stability. The works also aimed to provide input into future presentation and management of the site.

#### 2.3 Methods: Historic building record and assessment (2013)

The building record undertaken in 2013 was designed to be equivalent to an English Heritage Level 2 survey (see English Heritage 2006). It comprised a walk-over, photographic survey, annotation of existing measured drawings and the production of brief building descriptions.

#### 2.3.1 Desk-based assessment

During the desk-based assessment historical databases and archives were consulted in order to obtain information about the history of the brickworks and the structure. The main sources consulted were as follows:

- Cornwall HER
- Early maps and photographs (see Section 10.1)
- Published histories (see Section 10.2)
- Internet (see Section 10.3)

#### 2.3.2 Fieldwork

Analysis of the building fabric was undertaken on site (recorded as notes). Measured information and detail, as appropriate, was added to copies of existing measured drawings provided by Nationwide Surveys.

The photographic record comprised:

- general views
- internal and external elevations
- examples of structural and architectural detail

The principal photographic record comprised black and white photographs taken using a 35mm camera on fine grain archive quality film. Supporting colour photographs were taken with a digital camera for illustrative use.

A metric scale was included in all archive shots where possible.

#### 2.3.3 Post-fieldwork

All project materials were prepared for long term storage. A report was prepared to summarise the results of this stage of the works (Sturgess 2013).

# **2.4 Methods: Excavation, watching brief/controlled strip and measured survey (2014)**

#### 2.4.1 Fieldwork

The archaeological excavation was located in the centre of the kiln and initially covered an area measuring 3m east-west by 2.5m north-south. This was later extended to include the whole of the interior of the kiln.

Rubble and soil from the interior of the building was removed by hand and the surviving areas of floor and structural features were archaeologically recorded by context record, plan, section (where appropriate) and photographic record.

A watching brief / controlled strip was undertaken during groundworks outside the kiln to collect building stone. A mechanical excavator equipped with a toothless bucket was used to strip areas around the outside of the kiln. Any archaeological features exposed during the watching brief and controlled strip were excavated by hand and archaeologically recorded by context record, plan, section and photographic record.

A measured plan was created of the interior of the kiln along with the adjoining chimney, plotted by hand on permatrace at a scale of 1:20 and annotated. Locations of other external features associated with the structure were also added to the plan. All archaeological contexts encountered were recorded. A photographic record was maintained throughout and a sample of artefacts was retained.

A digital measured survey combining data from a GPS survey and Total Station survey was also created.

#### 2.4.2 Post-fieldwork

All project materials were indexed and prepared for long term storage. The report produced in 2013 describing the results of the historic building record was updated to include the results of the excavation, watching brief / controlled strip and measured survey and to summarise the overall results of the project.

## **3** Location and setting

The beehive Scrivener kiln is located on the north-eastern slope of Tregonning Hill near Breage, approximately six miles to the west of Helston at NGR SW 6049 2993 (Figs 1, 2, 3 and 4). It now stands alone in a field but was once surrounded by a small complex of buildings and structures associated with a 19<sup>th</sup> century china clay and brickworks.

The kiln is sited on farmland which slopes down to the north-east and lies at a height of 130m OD. Uphill to the south-west lies the large china clay pit which provided the brickworks with its raw material and immediately to the north-west there is an Iron Age

settlement enclosure with associated field system (Fig 3). Bedrock in the area comprises an unnamed igneous intrusion, Carboniferous to Permian, Felsic-rock (Cornwall Council GIS data). This decomposed granite was known locally as Moorstone, Growan and Growan Clay.

This phase of work at the kiln has exposed the footings of its chimney and connecting flue to the south-east, a brick and stone surface and drain outside the northern door opening (known as a wicket) and the entrance to the stoking chamber below the kiln on the north-east side. The work also uncovered the remains of the kiln floor and part of the below-floor structure.

## 4 Designations

The kiln itself is a designated as a Grade II listed building. The listing description gives the wrong date for the structure but is as follows:

'Brick kiln, partly ruinous. Probably C18. Granite rubble walls with dressed granite jambstones to doorway. Parabola-domed brick roof with gravel and lime mortar covering. Round flue vent over the middle. Round plan with entrance to the south. Slightly battered walls. Left hand side of doorway fallen, the right hand side survives to over half its original height. The inside of the wall is brick lined and there is still a coating of tar over much of the surface. This is a rare brick kiln in Cornwall, surviving fairly complete and situated in marginal farmland on the east slope of Tregonning Hill'.

The area in which the kiln is located is designated as part of the Tregonning and Gwinear Mining District within the World Heritage Site for Cornish Mining. The site is also part of the Tregonning Hill Conservation Area and lies just to the south-east of a large area designated as a Scheduled Monument. It is also part of an Area of Great Landscape Value and an Area of Great Historic Value.

## **5** Site history

The first discovery of china clay in Cornwall was made by William Cookworthy at Tregonning Hill in 1746 after he had seen it used by the miners of near-by Great Work Mine for repairing their furnaces (www.viewsofcornwall.com). The clay from Tregonning Hill, which was then used to make porcelain, was later found to contain dark specks of mica, which detracted from a top quality finished product. Better quality china clay was discovered in St Stephen-in-Brannel, near St Austell and the main focus of china clay extraction then shifted to this area (www.cornwall-calling.co.uk).

The china clay setts on Tregonning Hill continued to be worked into the 19<sup>th</sup> century. In 1839, because of a slump in the china clay industry, the Tregonning workings were abandoned. Then in 1851, the sett (which includes the study area) was leased to William Browne of St Austell and Robert Dunn of Redruth, who opened new works called Leeds, close to Cookworthy's original operations (www.cornwall-calling.co.uk) as part of 'Tregonning Hill China Clay Works'. The processed china clay was shipped to Staffordshire potteries from Porthleven, the closest harbour to the site.

In 1871 Browne and Dunn sold their Tregonning Hill works to William Harvey of Hayle (iron founder), William Argall of Breage (works manager and mine captain) and John Toy of Helston (iron founder). The three partners saw that no great future or fortune was to be made from exporting clay only. They also realised that the quality of the clay would make superior fire-bricks for use in their foundries and for other industries and set up a brick-making works at the site called 'Tregonning Hill China Clay and Brick Works'. William Argall had been employed previously by Browne and Dunn to run the earlier clay works. He took on the management of the new brickworks (located at a site

occasionally referred to as Wheal Bunny) which enabled him to employ his previous workforce (Polglase 2003).

The surviving beehive Scrivener kiln within the study area was constructed as part of the 'Tregonning Hill China Clay and Brick Works' during the early 1870s. Once the Tregonning Hill works had been established the company expanded the business in 1875, taking over Wheal Grey clay works, where they built new brick kilns (www.germoeparishcouncil.org.uk, Barton 1966). By 1878 they had become known as Wheal Grey China Clay and Tin Company and were prospering enough to take over another sett on Tresowes Hill (Barton 1966). By 1890, William Argall and Company had control of the whole area (www.germoeparishcouncil.org.uk).

A newspaper article dated 1878 in the Royal Cornwall Gazette gives an insightful description of the Tregonning Hill china clay and brick works as a fully established working site. The following is an extract from the article entitled 'A Ramble O'er Tregonning Hill' in which the author is given a guided tour of the works by Captain Hooper:

'Everything seems life and bustle ... At the factory men and boys are at work... kneading the clay into shape for bricks, tiles, copings and every style of ornamental and architectural work. After these are moulded they are put into a huge kiln or bakehouse and a roaring fire composed of six tons of coals plays for twenty-four hours upon them, after which they are taken out, cooled and set aside for sale. It is really interesting to see the different stages of the china clay until you come to a monster shed where it lies waiting for market. These works situated on the northern slope of the hill are in two hundred shares and are laid out with great care... Mr W. Argall of Breage, feeling assured that a lot of money was still to be made from china clay, started the present company (which was formed in 1870) to work the property, and I am assured on the best authority the works are proving a great success. The company has been giving dividends for the past three or four years, and at the present moment too, when china clay, in common with other merchandise, is feeling the depression. Outside the factory men and boys are seen to be working in pits and on small tramways with the little wagons driven by 1-boy power, through long dark tunnels under the hill to the place of loading. This clay is used for porcelain, bleaching calico, papermaking, refining of wine, and the manufacture of alum, ultramarine, sulphate of alumina and colours; also for photography. It is also used for mixing with pigs' meat, and in the adulteration of flour; and horses will eat it heartily.' (Royal Cornwall Gazette 1878).

The First Edition OS 25 inch scale map of *c*1880 (Fig 6) shows the layout 'China Clay and Brick Works' with buildings, settling tanks and other structures. The kiln is shown with its walled entrance to the stoking chamber on the north-east side and its chimney to the south-east. Immediately to the south-east of the chimney a rectangular building is shown with another chimney at its south-east corner. It is possible that this was a rectangular or Scotch kiln which is alluded to in an article in The Cornishman in 1883, but it may actually have been a drying shed with associated chimney. To the southwest of these buildings and east of the clay pit two circular structures are shown. These were almost certainly pugmills, devices for mixing and refining clay from the pit. Immediately east of the two pugmills the map shows what appears to be a rectangular unroofed structure (possibly a settling tank) alongside a roofed building, most probably a drying or moulding shed. A series of other rectangular, unroofed tanks, pits or structures are also shown scattered around the site.

Kelly's Directory (1883) states that William Argall was the manager and purser of Tregoning Clay and Brick Works at this date, and that James Hooper was the agent. Kelly's 1889 Directory lists William Argall as the manager and purser of Tregoning Clay and Brick Works but does not mention an agent.

William Argall retired in 1893 and the works was sold. At his retirement he was presented with a dinner service said to be made from Tregonning Hill clay. The Asiatic Pheasant pattern dinner service was specially emblazoned with Argall's monogram *WA* surrounded by *Tregonning Hill*. A few of the remaining pieces of the service are on display in Helston Folk Museum (www.germoeparishcouncil.org.uk) (see Figs 9 and 10).

The works were sold in 1893, and together with Tresowes and Wheal Grey, the Tregonning Hill works were leased to John Miners Holman of Camborne, Frank Harvey of Hayle and FW Thomas, manager of Dolcoath Mine at Camborne. The three setts then worked as the Tregonning Clay and Brick Works (www.cornwall-calling.co.uk). A plan attached to an Indenture of this date (1893) shows the 'Tregonning Hill Clay Works' (Fig 8). The plan shows that the works at this date remained pretty much as they had been in *c*1880. On this plan the buildings are shown in grey and other structures such as settling tanks and pits are shown in blue.

The Encyclopaedia Britannica makes the following statement about the Tregonning Hill Company:

'The company made fire-bricks and tiles from the refuse of the clays, taking about two-thirds of silica and one-third of mica, which are mixed together in a pug mill, moulded and burnt in round ovens holding about 16,000 bricks, and that a very superior fire-brick is made from clay direct from the "stopes," which are employed by founders, smelters, gas companies, &c. The price paid at the works is from 50s. to 55s. per 1000. The source of the materials is decomposed granite, of which Tregoning Hill consists' (Encyclopaedia Britannica 1902).

In 1903 the works were bought by John Lovering & Co. of St Austell and they had by then become known as the Wheal Grey China Clay Works (www.cornwall-calling.co.uk).

It seems likely that the business lasted only a short time after being bought by John Lovering & Co. since the Second Edition OS map of c1907 (Fig 7) shows the works as 'Disused'. Although the site had become disused by this date, all the buildings and most of the settling tanks are depicted as surviving on the c1907 OS map (Fig 7).

Whether the Tregonning Hill works reopened again after 1907 is not known. However, in 1932, following the formation of English Clays, Lovering, Pochin, Ltd., Wheal Grey, along with the Balleswidden and Leswidden near St Just and Baker's Pit near Towednack, was closed (www.cornwall-calling.co.uk).

All that survives of the works today is the beehive Scrivener kiln and an L-shaped section of ruined walling in the wooded area to the south-west. The current phase of work has revealed the footings of the kiln's chimney and adjoining flue as well as an associated exterior surface and a paved and walled entrance to its stoking chamber. No other buildings or structures survive above ground although many can still be identified as earthworks and are visible on aerial photographs. These have been plotted by the National Mapping Programme (see Fig 3).

## 6 Design and operation of a 19<sup>th</sup> century beehive Scrivener kiln

The process of making bricks at the Tregonning Hill works involved quarrying the clay from the pit, refining it by mixing with water in pug mills, moulding the processed clay into bricks and placing the bricks in a drying shed to reduce the water content. After the drying process the un-fired bricks (known as 'green bricks' at this stage) were transferred to a kiln for burning.

The surviving kiln at Tregonning is known as a Scrivener kiln and was a common kiln type in Cornwall during the 19<sup>th</sup> and early 20<sup>th</sup> century. This was an intermittent kiln

which meant that it was loaded, fired, cooled and unloaded for each burning. The normal fuel for these kilns was coal.

The Scrivener kiln comprises a circular, single-chamber building with an attached chimney stack operated on a downdraught principal. This meant that the flames were initially directed upward into the building through a central brick-built tube from a fire box deep below, as the flames shot into the chamber hitting the domed roof and sides they were forced downward by the draw of the chimney to fire the bricks. The heat was then drawn further downwards through holes around the edge of the floor into a series of connecting channels below arranged in concentric circles, designed in order to distribute the heat evenly from below. From the base of the below-floor channels the heat and smoke was drawn through a small hole leading to a flue which connected to the external chimney. A surviving above floor example of a central brick tube exists at Carbis Brickworks in Roche (Fig 53) as well as original spaced brickwork around the edge of the floor to draw heat into the channels beneath (Fig 54).

The design and method of use of Scrivener kilns in West Cornwall is described by E.M. Crofts in an article in 'The Cornishman' in 1883. Crofts, after a visit to some kilns near Penzance, describes the kilns as round, domed buildings bound with bands of wrought iron. His description states that each has an arched doorway leading to a large circular chamber with a domed roof which has a central aperture in the apex. A tube of brickwork projects from the centre of the floor and rises more than halfway to the roof. This tube leads to a large fire-box below the kiln floor where the coal was burnt to produce fierce flames. Adjoining the fire-box below ground there is a large stoking pit from where the fire can be fed. Level with the top of the central tube inside the building the walls of the chamber are vitrified where the flames have been forced out to fill the kiln. There are a series of small holes in the kiln floor which connect with the flue to the chimney stack to allow draught and expel smoke and gases. Inside the bricks are stacked in circular rows and diagonally between the circles so that there are channels between them where the flames can pass. Once the kiln is full the doorway is bricked up and covered with clay and test holes in the roof are also plugged. The fire is then lit and the heat raised gradually until full white heat is seen in the whole chamber by removing loose bricks in the doorway and roof. Testing rods are then used to measure the shrinkage of the bricks and as soon as they have shrunk to the required amount the firing is stopped and the kiln left to cool (which takes five or six days) before being opened and the contents removed (Crofts 1883).

The Tregonning Hill kiln operated in much the same way as those described by Crofts but with minor differences such as it having two loading doors (known as wickets) instead of one. In preparation for firing the Tregonning kiln was loaded with coal via the external walled entrance to the stoking chamber below floor level. This large opening at the base of the kiln has a brick paved access leading to it which is set on a very gentle incline so that carts full of coal could be delivered direct to the entrance with ease. From here the coal could be shovelled directly into the firebox below the interior of the building. Cast iron firebox openings (now without their doors) remain *in situ* in the stoking chamber at one of the kilns at Carbis Brickworks (Fig 55).

Once the green bricks had been loaded in stacks inside the kiln with narrow spaces between them so that the heat could circulate, the two opposing wickets and the aperture in the roof were sealed using rubble, bricks and clay. The fuel in the firebox was then lit and the kiln gradually brought up to temperature which was carefully regulated. At first the heat was kept low in order to remove any remaining moisture in the bricks and then after two or three days the temperature of the fire was increased until it reached around 1500 to 2000 degrees Fahrenheit. Any inspection holes in the wicket openings were then blocked and the fire was allowed to burn out. The kiln was then left to cool. Altogether it took approximately ten or more days to complete the process; one or two days for loading, two or three days for 'drawing any remaining moisture from the bricks, one or two days for heating to full temperature, one day at full heat, then another three or four days to cool down and another day to unload.

Since the Tregonning kiln has two opposing door openings (wickets) at floor level it seem likely that the southern opening was used to load unfired bricks into the kiln (since the drying shed appears to have been located to the south) and that the northern opening was used to remove the bricks once they had been fired. The brick and stone surface outside the northern entrance would have provided hard standing for carts whist they were loaded with the newly fired bricks. Another likely reason for the two opposing openings is that once unblocked after firing they would have created a through draught to aid the cooling process.

# 7 Building description and results of the excavation and watching brief

(See Figs 11-30 for pre-works building record, Figs 31-48 for photographic record taken during excavation and Figs 49-52 for plans, sections and elevations).

The Tregonning Hill kiln is a circular beehive Scrivener kiln with a domed (parabola) roof. In plan it measures 8m externally in diameter and stands to a height of approximately 4m (including the roof). It has two opposing loading doors or wickets (one facing north-east the other facing south-west), both of which are now partially ruined. During the excavation the kiln floor and part of the below-floor structure were uncovered. Further work outside the building revealed the entrance to the stoking chamber on the north-east side of the kiln, the remains of the chimney and connecting flue to the south-east and a stone and brick surface with associated drain outside the north-west wicket.

#### 7.1 Above-ground structure of the kiln

(See Figs 11-30 and 49)

The walls of the kiln are 2.4m high by approximately 1.4m wide and are constructed from coursed, faced, granite blocks on the external face, with a granite rubble core and single skin brick lining on the internal face. The remains of the door (wicket) jambs are constructed from dressed granite blocks. The rubble core and outer granite face of the walls are bonded with decomposed granite, probably mixed with lime to form a coarse mortar. The inner brick face is bonded with very thin layers of fine lime mortar. This single depth brick lining is laid as stretcher courses in the lower half of the wall and as header courses in the upper part of the wall. The header courses continue upwards from the wall lining to form the parabola roof structure culminating in a circular opening at the top which measures approximately 0.5m in diameter (Figs 28 and 29). Overlying the tops of the granite side walls, and laid to form a sealed, smooth, domed roof covering, is a layer of white, decomposed granite, possibly mixed with lime to form a coarse render. This is the same material which has been used to bond the granite walls. At the top of the walls this render roof covering reaches 0.9m deep where it fills the angle between the top of the wide granite wall and the inner brick lining which continues upwards as the roof structure (Fig 25). Prior to consolidation a variety of plants were causing damage to the structure, the majority growing on the roof and along the southern part of the wall. These included gorse, ivy, hawthorn and brambles.

On the north external face of the kiln wall there is a recess where one of the granite facing blocks has been removed. In a row approximately 1.5m above and to the east and west of this recess are a series of four decomposed granite and lime mortar filled recesses each measuring approximately 0.2m by 0.4m (Fig 15). As there is no apparent disturbance to the corresponding internal brick face, these mortar filled recesses are likely to be repairs for damaged stones. At a point roughly midway between the two wicket openings at the base of the north wall there is a square recessed granite block

measuring approximately  $0.5m\Box$  (Figs 16 and 17). The reason for this is unknown but it may be just an anomaly in the build.

The south-western part of the wall and roof in the area of the south-west wicket has suffered a significant collapse leaving an opening approximately 3m wide and only the lower part of the southern jamb intact (Figs 18-20). In the remaining part of this jamb a granite block bears a drilled socket for an iron fitting (Fig 20). The footings of the western jamb were revealed during excavation showing that the two wicket openings lay directly opposite each other and were of equal dimensions (0.8m wide on the internal face splaying outwards to a width of 1.2m on the external face). Neither opening retains any part of its original arch, although it seems likely that these were of brick construction. On the external face of the wall to the west of south-western opening there is a stone containing a drilled socket for an iron fitting (possibly for an iron band surrounding the building) which is just visible at the base of the wall. Immediately to the west of this a length of brick curbing (16) was revealed abutting the base of the external wall face. It comprises a single course of bricks laid on edge and bonded with lime mortar. This curbing extends for a distance of 1.6m before being truncated to the west; it is possible that it originally surrounded the entire structure (see Fig 39). The wicket on the north-eastern side of the building has fared better with both outer jambs mostly intact but the arch above has collapsed along with a small section of roof and inner jambs (Figs 13, 23, 24 and 25). On the external face of the south jamb in the lower half there is a drill hole containing a rusted iron fitting and opposite it on the north jamb are two closely set drill holes for similar fittings. Roughly 0.5m below these two sockets on the north jamb is a substantial iron pin (Fig 14). At the base of the opening lie the remains of granite rubble blocking bonded with china clay and decomposed granite. This blocking remains in situ from the last firing of the kiln when both openings (wickets) would have been blocked.

The china clay brickwork which lines the whole interior face of the kiln chamber has been vitrified in a band around the tops of the walls and base of the roof structure. This area has clearly been exposed to the full force of the flames as they emerged from the central tube during firing (Figs 26-28). An area of replacement brickwork lining is evident immediately south of the collapsed walling on the south-west side (Fig 27).

#### 7.2 Stoking chamber entrance

(See Figs 22, 32, 33, 50 and 51)

Approximately 0.85m to the south-east of the north-east wicket opening lies the entrance to the stoking chamber which was uncovered as part of the watching brief. Previously this access and opening had been completely obscured by a backfill of loose soil and rubble as well as domestic and agricultural rubbish dating to the first half of the 20<sup>th</sup> century, so that the area was brought up to same height as the ground level elsewhere around the kiln. Before excavation the top of a brick arch was just visible at the base of the wall. This turned out to be the top of the stoking chamber opening (Figs 32 and 51). Following removal of the backfill it was seen that the base of the stoking chamber entrance lay approximately 2m below the ground surface either side of it. The opening is flanked by two retaining walls (12) and (13) built of randomly coursed, faced granite blocks and smaller granite rubble bonded with lime mortar. These walls extend under the kiln wall for a distance of 1.4m where they reach a height of 1.6m, but they also continue externally for a distance of approximately 1.7m to a point where both walls have been truncated. However, the lower courses of the western wall (12) were seen to continue for at least 5m from the outer face of the kiln wall. The walls are splayed leading outwards from the interior so that a coal cart could be brought directly up to the chamber opening. In the western wall (12) directly outside the brick arch of the opening there is brick-built square socket measuring  $0.15m\Box$  and 0.1m deep with associated iron fittings. There is, however, no socket opposite it in wall (13) but there is an iron nail in this location. At the northern end of wall (13) close to its point of

truncation a recessed slot measuring 0.08m□ and 0.03m deep has been carved out of a granite block 1.35m up from floor level and an iron pintle hinge is located immediately to the south of it. The width of the opening inside the kiln measures 1.06m, the width at the external face of the kiln is 1.7m and the width outside where the walls have been truncated is approximately 2m. The height of the opening below the kiln wall is approximately 1.8m. Extending under the width of the kiln wall the roof is formed by a brick arch bonded with lime mortar which continues 0.13m internally beyond the ends of the retaining walls. It is possible that the arch continued beyond this point further into the kiln but collapse of the floor and below-floor structure of the kiln above this point has obscured structural evidence beyond. Between the two retaining walls the floor (14) is randomly but tightly paved with china clay bricks, tiles and setts of various sizes (see Fig 33). This surface which dips slightly towards the centre and rises very gently to the north-east was covered with a thin lens of coal dust. It was seen to continue for at least 5m beyond the external face of the kiln wall but may continue for a much greater distance.

#### 7.3 Kiln floor and below-floor structure

(See Figs 30, 34-37, 50 and 52 sections 5 and 6)

Internally the original chamber floor was not visible prior to excavation; it was covered with a layer of granite and brick rubble collapse mixed with topsoil (1) 0.15m deep (Fig 30). The central tube connecting to the fire-box (below ground) which once would have stood approximately as tall as the height of the walls was missing, but the remains of it, truncated at floor level, were uncovered during excavation.

The initial area of excavation inside the kiln comprised a centrally set rectangle measuring 3m east-west by 2.7m north-south. This was later extended to cover the whole of the interior. Removal of the modern layer of collapse and topsoil (1) exposed the remains of the centrally set brick-built tube (6) backfilled with rubble and topsoil (1), a brick floor (5) overlain by fine lenses of china clay and ash (2), a large area of collapse and backfill (4) to the east with further collapsed and filled areas all around the edges of the kiln wall and what appeared to be a floor repair patch (3) to the west.

The centrally set tube or shaft (6), truncated at floor level, is constructed from bricks laid in header courses and bonded with lime mortar around what was originally a circular shaft leading to the firebox below. Overall the structure is circular in plan and measures 1m in diameter. In order to repair damage from intense heat the south-east side of the opening has been refaced causing the opening to become oval in shape and now measuring 0.56m north-east to south-west by 0.4m north-west to south-east. The depth of the shaft is unknown although backfilled rubble and topsoil (1) was removed to a depth of approximately 1m and an iron cart axle which had also been used as backfill measuring approximately 1.6m in length was also removed. The inner face of the shaft has been subject to such intense heat that the surface of the bricks is completely vitrified. At a depth of approximately 0.5m below floor level the vertical sides of the tube start to splay gradually outwards, presumably to form the roof of the firebox below.

The kiln floor (5) survives mainly extending outwards from the central tube towards the two wicket openings to the north-east and south-west. To the south-east and north-west it has been truncated. It is clear that the original floor design comprised bricks bonded and surfaced with lime mortar laid out in concentric circles radiating out from the central tube. The outer ring of bricks (none of which remains *in situ*) is likely to have comprised individual bricks with narrow gaps between them for heat and gasses to pass to the chambers below distributing heat from beneath (examples of this survive at Carbis Brickworks, see Figs 53 and 54). During excavation the remaining floor surface was seen to be covered in approximately three alternate lenses of china clay and ash (2) each approximately 0.01m deep. This is possibly the result of a clay and water mix being thrown on the kiln floor after firing to aid the cooling process. Below

these lenses the floor surface which is covered with a lime screed, shows patches of repair where firing has damaged the original structure. One area of repair lies just inside the south-west wicket. Here large china clay tiles, bricks and a granite block have been used as a patch repair. On the north-west side of the kiln there is a large area of floor repair (3) which was presumably created towards the end of the kiln's working life since (although it was left unexcavated) it is likely to have filled sections of the under-floor heating channels below. This is a patch repair (3) consisting of light grey compact gritty decomposed granite and ash measuring 2m north-south by 0.8m east-west. The floor is missing in a large area on the east side of the kiln as well as a strip running around the edges of the walls. These areas have collapsed and been backfilled during the late 20<sup>th</sup> century with a fill (4) of mid yellowish brown friable gritty silt containing frequent brick and granite rubble as well as occasional plastic, tin cans and barbed wire.

Two small trenches were excavated through the collapse and backfill (4) on the eastern side of the kiln to reveal the remains of the floor and below-floor structure. In section (see Fig 52 sections 5 and 6) the floor itself (5) is three courses of brickwork deep bonded with lime mortar. Although collapse and damage is clearly visible in these trenches, enough of the below-floor structure remains in situ to see that it comprises six brick walls, although only five were discernable and some more damaged than others: (7), (8), (9), (10) and (34). Each wall when built was laid in stretcher courses a single brick wide and was bonded with lime mortar. The walls formed concentric circles to support the brick floor above. There are gaps between each wall of approximately 0.18m to create circular channels for below-floor heat distribution. Heat was also enabled to pass from one channel to another via small openings lower down in the walls (seen in (8), (9), and (10)). The north-eastern of the two trenches was excavated to a depth of 0.6m and a base was not found. At the base of the south-eastern trench, however, a brick structure (11) was uncovered at a depth of 0.6m below the kiln floor surface. This structure (11) comprises what appears to be a surface on which the below-floor channel walls are built. It seems likely that this feature forms the base of the below-floor channels across the whole kiln, but it is also possible that it just forms the top of the flue which enters the kiln at this location. Immediately next to the kiln wall there is a small square opening in surface (11) measuring  $0.1m\Box$  leading downwards into an open chamber below. This chamber is presumed to be the flue or a chamber connected to the flue. The opening in surface (11) was designed to draw the gasses down from the below-floor channels into the flue and out to the chimney.

#### 7.4 Chimney and flue

(See Figs 40-46, 50 and 52 sections 1-4)

The chimney and flue which served the kiln were uncovered during the watching brief immediately below topsoil to the south-east of the kiln. The remains of the demolished chimney, which is circular in plan, stand approximately 3m away from the kiln. Its wall (30) is constructed from large granite blocks which have been faced to form a curved outer edge and behind these it has a granite rubble infill. It is bonded with natural decomposed granite subsoil mixed with lime to form a mortar. The chimney at this level is divided in two halves by the flue walls (25) leading directly into the rounded chimney centre from the south-west and a raking-out channel leading out from the centre of the chimney to the north-east continuing on the same alignment as the flue. This continuous channel through the chimney has vertical brick-lined sides reaching a maximum height of 0.63m and a flat granite rubble base set within a compact clay matrix (22). The centre of the chimney was filled with a loose mix of reddened ash and black soot containing frequent burnt bricks and brick fragments (21). This loose fill (21) was removed to reveal the structure of the continuous channel through the chimney base. Either side of the channel at the chimney centre the brick lining (23) curves outward to form a circular base for the chimney flue above, creating an opening approximately 0.8m in diameter. Here the lining comprises courses of brick headers

bonded with lime mortar and stands nine courses high. The top two courses of the north wall lining are stepped inwards by 0.05m and both wall linings have been heavily heat damaged and sooted.

The section of flue leading to the chimney from the external face of the kiln wall measures approximately 3m in length and lies within a cut [18] 0.8m wide although the flue channel itself is only 0.46m wide. Since the structure remained intact, it was left unexcavated. When first exposed a layer (35) of burnt mid reddish orange decomposed granite 0.1m deep overlay the flue lintels (27). This layer of redeposited natural subsoil (35) had clearly been subjected to very high temperatures from the vapours in the flue below, turning the deposit from white to reddish orange. Once this layer had been removed the top of the structure was exposed. The western part appears as the original construction comprising fired-clay slabs used as lintels (27). Each slab measures approximately 0.46m by 0.3m by 0.03m and they appear to be laid two slabs deep. Either side of the fired-clay lintel slabs there are randomly laid granite rubble edging blocks (28) used to keep the lintels in place. At the east end of this section of flue before it enters the chimney structure the lintels have been repaired. Here a large stone slab and broken fired-clay slabs have been used to replace a damaged section of the original structure. At the point where the flue enters the outer stone structure of the chimney it turns at a slight angle further to the north, and at this point the lintel structure changes to rows of brick arches (26) spanning the width of the flue. There were originally 15 rows of brick arching but most have collapsed leaving two whole but slumped arches to the south-west. Each arch originally comprised six tapered bricks (many of which are now heat damaged) and would have supported the stone structure of the chimney above. In the area where the arches have collapsed the flue has now been filled by (24) a mid greyish brown gritty silt containing frequent brick, brick fragments and lenses of soot and ash.

The raking-out channel leading from the chimney centre north-eastwards shares the same dimensions within the chimney structure as the arched-over flue to the southwest. At a distance of 0.4m from the chimney centre this channel has been blocked by a brick wall (20) laid in headers with no bonding material, four courses high. The reason for this blocking wall is unknown but it is presumed that it was built when this raking-out hole fell into disuse. The original covering of the raking-out structure does not survive but the vertical brick lining walls (19) do and they come to an end to the north-east at the edge of the chimney structure. Here the brick lining (19) stands six courses high and the granite and clay base (22) can also be seen to finish neatly at the edge of the chimney. Beyond the edge of the chimney the cut [18] for the raking-out channel continued as a cut through the decomposed granite subsoil. Here it slopes fairly steeply upwards and at the same time widened into a splay approximately 1.1m wide. Section 1 shows the profile at the north-east edge of the chimney where the channel is 0.44m deep and section 2 shows the profile through the earth-cut feature 0.5m from the chimney edge where it is 0.2m deep indicating the rise north-eastwards from the base of the channel structure. The raking-out channel and earth-cut extension are filled by burnt mid reddish orange gritty, sandy silt containing lenses of blackened burnt material and occasional brick and granite fragments (17).

Immediately north-east of the external section of the chimney flue and north-west of the chimney lies a thin layer or spread of soot and ash (29) measuring approximately 2.4m north-south by 1m east-west.

#### 7.5 External surface and drain

(See Figs 47, 48 and 50)

During the watching brief a brick and stone surface was uncovered approximately 1.75m to the north-east of the kiln adjacent to the north-east wicket and abutting the top of the northern retaining wall (12) of the stoking chamber entrance (see Fig 47). This surface (15) is trapezoidal in plan, measuring 3.9m along its south-west side,

2.5m along its north-east side (although this has been obscured by a large granite boulder overlying the south-east corner) and measures 4.1m in length. The surface is edged with china clay bricks and the centre comprises randomly laid granite setts and areas of granite metalling which appear to be repairs. Along the north-west and south-east edges larger pieces of granite rubble have been used to create a rough raised kerb. On the south-east side this kerb extends 1m beyond the edge of the surface towards the kiln. It seems likely that this surface served as hard-standing for carts collecting the fired bricks from the kiln.

At a later stage during the watching brief a drain [33] was uncovered directly outside the north-east wicket running around the kiln from the west to a point just east of the eastern jamb (see Fig 48). From here (although not seen) it appears to turn at rightangles to the north-east following the edge of retaining wall (12) and running below surface (15) in order to direct surface water downslope away from the stoking chamber entrance. The drain was seen as a built structure running from west to east for a distance of approximately 5m, but at the west end continued as an earth-cut gully. The structural part of the drain appeared narrow and fairly shallow at the west end measuring 0.1m wide by 0.17m deep but increased in scale to the east (although this end remained intact and was therefore not excavated). The structure comprised a flat earth cut base [33], with built elements (32) consisting of brick-lined sides (two courses deep where visible at the west end) and china clay tile lintels of varying sizes (average tile measures 0.3m by  $0.25m \times 0.07m$ ). Beyond the end of the structural element of the drain at the west end, the earth cut gully measures 0.3m wide by 0.2m deep and has vertical sides and a concave base. The base of the structure part of the drain contains a fill (31) of mid brownish grey, very compact sandy gritty silt with occasion small coal fragments and the earth-cut gully is filled completely with the same deposit.

## 8 Significance and comparative material

The surviving kiln on Tregonning Hill is a Grade II listed building. It is the only building that survives on the site of the 19<sup>th</sup> century Tregonning Hill China Clay and Brick Works. Although there were as many as 25 active brickworks in Cornwall recorded in 1900 (Smith 1987), comparably few works have survived. Beehive Scrivener kilns of the type at Tregonning Hill were common in Cornwall during the period 1860 to 1930. Many brickworks had them, but only a few examples now survive (John Smith, pers comm.). The kiln at Tregonning Hill is the only one of its type in Cornwall to have undergone archaeological investigation. Other surviving Beehive Scrivener kilns in the county include:

**Wheal Grey, Tresowes Green** – one kiln with associated chimney completely overgrown, the chimney is listed grade II SW 591 291.

**Grampound Road** – one kiln at Halezy with surviving roof, not listed SW 9157 5133.

**Carbis, Roche** – three roofless kilns at Carbis Wharf, Listed grade II, SX 0012 5960 (one has recently reconstructed parabola roof- shown with no roof on google maps aerial view *c*2007).

Carkeet, St Cleer – one roofless kiln, Listed grade II, SX 2200 7330.

**Sandhill, Drakewalls** – two roofless kilns in a private garden, not listed, SX 4250 7110 (one has new slate roof)

**Chilsworthy, Gunnislake** – (Hill Westlake and Co.) one kiln with surviving roof, not listed, SX 4176 7188 (early 20<sup>th</sup> century).

The kilns at Carbis Brickworks are the closest in comparison to the Tregonning Hill kiln. They are also circular granite built structures which once had parabola roofs. They also have two opposing loading doors (wickets), a similar stoking chamber access at below-

ground level and a similar floor structure and central tube. At least two of the kilns at Carbis have intact floors which show bricks laid in concentric circles around the central tube and around the outer edge of the floor the bricks have narrow gaps separating them to allow heat and gasses to pass into the chambers below. This venting design around the outer edge of the floor is likely to have existed at the Tregonning Hill kiln as well. One of the roofless kilns at Carbis also has an intact central tube surviving to its original height above floor level (approximately 1.7m). This has occasional narrow vent slots scattered between some of the brickwork and is likely to be of a similar design to the one which existed in the Tregonning Hill kiln.

The china clay and brickworks on Tregonning Hill is an important part of the World Heritage Site for Cornish Mining and the brickworks can be defined as an important ancillary industry of Cornish mining. The china clay quarried and used at this site was suitable for the manufacture of heat resistant refractory bricks which were needed for many specialised industrial applications such as furnaces, mine chimney stacks, arsenic calciners, tin and lead smelters and china clay pan-kilns (Smith 1987).

## **9** Recommendations made prior to consolidation

Recommendations for progressing with the consolidation of the kiln were made as part of the historic building record before groundworks and consolidation took place. They included the following:

- Careful vegetation clearance should be undertaken ensuring that original fabric is disturbed only when necessary.
- If collapsed rubble is to be used to rebuild walls, then it is recommended that the rubble is removed under archaeological supervision or by archaeological excavation prior to the start of consolidation works. The removal of rubble may expose important information about the kiln design. It is recommended that this is discussed with Ann Reynolds (Senior Archaeologist, Countryside Advice, Historic Environment, Cornwall Council).
- It is recommended, since this is a Grade II listed building, that like for like materials as close to the original as possible are used for repairs and reconstruction.
- The existing bonding material for the granite walls (which appears identical to the rendered roof covering) should undergo content analysis to achieve a like for like mix.
- The collapsed areas of the structure could either be made good as they are, or if reconstruction is necessary to stabilise the building, then every effort should be made to mimic the original 19<sup>th</sup> century design. Although the wicket arches are missing, it is clear from other surviving kilns of this type that arched openings were used. In this building the arches may have been constructed from granite but are more likely to have been brick-built.
- It is recommended that the roof structure is repaired using its original covering material (see above). This is a layer of decomposed granite which may have been mixed with lime to form a tough render. Photographs taken in the 19<sup>th</sup> century show this to be a typical roof covering material for brick kilns of this date. The previously suggested introduction of a turf roof may encourage future growth of damaging plants such as gorse, ivy and hawthorn, etc.

## **10** Summary & results of consolidation work

The consolidation works, carried out by Heritage Cornwall Ltd (formerly Darrock and Brown Ltd), were undertaken in order to stabilise the building along with associated features uncovered during the excavation and watching brief (see Figs 56-8).

The major work carried out on the kiln itself involved rebuilding the areas of collapse around the two wicket openings. This included building up the jambs, inserting brick arches to both openings, reinstating collapsed parts of the brick roof and giving these sections of the roof a new decomposed granite covering. Vegetation that had covered the rest of the roof was cut and treated. The external wall faces were also cleared of vegetation and the stonework repointed with a lime mortar. Internally, the brick floor was left exposed, areas of collapse around the edges of the floor were filled with decomposed granite and the two excavated slots exposing the below-floor structure were left open to display the brick-built partitions separating the below-floor channels. These were also consolidated with mortar. Externally the truncated ends of the walled entrance to the stoking chamber were built up and some of the original walling was repointed. A new section of granite rubble walling was also added on the north side to retain the area of dumped material to the north. Areas of unstable collapse of the kiln floor exposed in the stoking chamber were consolidated with mortar. The excavated slope through infill deposits down to the stoking chamber entrance was covered with a layer of decomposed granite. To the south of the kiln the chimney base and flue connecting to the kiln were left as excavated with minor repairs. Around the site stockproof estate fencing has now been installed.

## 11 Plan for future management

It seems likely that minimal future management of the site will be required. Future vegetation growth on the roof and walls of the kiln as well as the chimney base and flue should be kept in check by spraying with weed killer on a yearly basis. Checks should also be made to ensure that the fencing remains secure and in good condition. Any damage to the kiln and associated features should be reported.

## **12 References**

#### **12.1 Primary sources**

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Royal Cornwall Gazette, 15 February 1878

Smith, JR, 1987. Cornish Bricks and Brickmaking (CAU unpublished report)

#### 12.3 Websites

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www.viewsofcornwall.com/static/mining\_in\_cornwall\_great\_work.php.

www.cornwall-calling.co.uk/mines/wendron/wheal-grey.htm

www.cornwall-calling.co.uk/mines/wendron/tregonning-hill.htm

1902 Encyclopaedia Britannica: www.1902encyclopedia.com/F/FIR/fire-clay-fire-bricks.html

www.germoeparishcouncil.org.uk/wp-content/uploads/tregonning-hill.pdf

www.germoeparishcouncil.org.uk

www.viewsofcornwall.com

## **13** Project archive

The CAU project numbers are 146261, 146367 and 146386

The project's documentary, photographic and drawn archive is housed at the offices of Cornwall Archaeological Unit, Cornwall Council, Fal Building, County Hall, Treyew Road, Truro, TR1 3AY. The contents of this archive are as listed below:

- 1. A project file containing site records and notes, project correspondence and administration.
- 2. Electronic drawings stored in the directory ...\CAD ARCHIVE\Sites T\Tregonning brick kiln 2013-2014
- 3. Black and white photographs archived under the following index numbers: GBP 2308, 2335 and 2336
- 4. Digital photographs stored in the directory ...\Images\Sites Q-T\ Tregonning Hill kiln 2013-2014
- 5. English Heritage/ADS OASIS online reference: cornwall2-196358
- This report text is held in digital form as: ..\HE Projects\Sites T\ Tregonning brick kiln HBR and excavation 2013-2014\Tregonning Hill brickworks updated HBR and excavation report 2013



*Fig 3 Ordnance Survey digital mapping (2013) with National Mapping Programme plot overlain (NMP mapping © English Heritage)* 



Fig 4 Extract from the OS First Edition One Inch Map c1809



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Fig 5 Tithe Map for the Parish of Breage, c1840



Fig 6 First Edition of the Ordnance Survey 25 Inch Map, c1880



Fig 7 Second Edition of the Ordnance Survey 25 Inch Map, c1907



Fig 8 Plan of 'Tregonning Hill Clay Works' attached to Indenture dated 1893 (CRO Ref:RH/1/3239)



*Fig 9 Photograph of William Argall and a Tregonning Hill brick on display in Helston Museum* 



*Fig 10* Part of a dinner service made from Tregonning Hill china clay presented to William Argall on his retirement and emblazoned with his monograph and 'Tregonning Hill' on display in Helston Museum

## Building record 2013



Fig 11 North-east elevation of kiln



Fig 12 North elevation of kiln



*Fig 13* North-east wicket (loading door) with collapsed arch and evidence for iron fittings



*Fig 14* North jamb of north-east wicket (loading door) with drill holes and iron pin below for fittings



*Fig 15* North-west elevation of kiln with red boxes showing filled recesses where stones have been damaged



Fig 16 West elevation of kiln



*Fig 17* South-west elevation of kiln showing collapse around wicket (loading door)



*Fig 18 Collapse around south-west wicket (loading door) showing section through stone wall with brick lining* 



*Fig 19 Remains of east jamb of south-west wicket (loading door) showing drill hole for fitting* 



Fig 20 South-east elevation of kiln



Fig 21 East elevation of kiln



*Fig 22* North-east elevation of kiln. The ranging rod is resting on top of the backfilled stoking chamber entrance



*Fig 23* Collapse around north jamb of north-east wicket (loading door) showing section through stone wall with brick lining and decomposed granite roof covering



*Fig 24 Detail of decomposed granite roof covering bridging the angle between the top of the stone wall and the brick roof structure* 



*Fig 25 Interior of north wall of kiln showing vitrified brickwork in the upper half of the wall* 



*Fig 26* Interior of south wall of kiln showing vitrified brickwork in the upper half of the wall and a replaced section of brickwork to the right



*Fig 27* Interior of brick roof structure looking south



Fig 28 Interior of brick roof structure



Fig 29 Detail of brick roof structure



*Fig 30 Collapsed rubble and earth covering the interior floor surface* 



## Excavation and watching brief 2014

*Fig 31 Remains of granite rubble blocking bonded with china clay and decomposed granite in north-east door opening (wicket)* 



Fig 32 Entrance to stoking chamber looking south-west



Fig 33 Paved floor (14) in entrance to stoking chamber looking south-west



Fig 34 Exposed floor (5) inside kiln looking south-west



Fig 35 Truncated central tube (6) inside kiln looking south-west



*Fig 36 Below floor channels in south-east trench and opening to flue below brick surface (11) inside kiln looking south-west at section 5* 



Fig 37 Below floor channels in north-east trench inside kiln looking north



*Fig 38 Exposed western jamb of south-west wicket (loading door) looking northeast* 



*Fig 39 Brick curb (16) outside south-west wicket (loading door) of kiln looking north-east* 



*Fig 40 Remains of chimney and flue looking south-west* 



Fig 41 Chimney (30) looking south



*Fig 42 Chimney centre showing brick lining (23) looking south* 



*Fig 43* Brick wall (20) blocking raking out channel in chimney looking south-east (section 3)



*Fig 44* Section 1 through south-east end of raking-out channel looking north-west



*Fig 45* Section 4 through south-east end of flue channel at centre of chimney looking north-west



Fig 46 Chimney flue looking north-west



Fig 47 Brick and stone surface (15) looking south-west



*Fig 48 Surface water drain [33] looking west* 



*Fig 49 Pre-excavation plan, elevations and section (based on Nationwide Surveys drawing)* 



*Fig* 50 Plan of excavated kiln with associated features, showing context numbers and locations of section drawings and elevations





*Fig 51 Elevations of stoking chamber entrance* 



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Fig 52

Section drawings 1-6



*Fig 53* Surviving central, internal brick-built tube in one of the Beehive/ Scrivener kiln at Carbis Brickworks, designed to direct flames from the firebox below floor level into kiln chamber © Ashley Dace and posted on www.geograph.org.uk



*Fig 54* Interior of a Beehive/ Scrivener kiln at Carbis Brickworks showing an intact floor surface with spaced ventilation bricks around the perimeter to draw heat and gasses into the channels below © Ashley Dace and posted on www.geograph.org.uk



*Fig 55 Beehive/ Scrivener kiln at Carbis Brickworks showing the entrance to the stoking chamber* © *Ashley Dace and posted on* <u>www.geograph.org.uk</u>



Fig 56 Kiln after consolidation work looking north-east



Fig 57 Kiln after consolidation work looking south-west



Fig 58 Interior of kiln after consolidation work looking south-west