North west view of the Cathedral Church of St Paul, London, 1753
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DAVID CROSSLEY
1938-2017

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1938-2017

Throughout his career at Sheffield University David Crossley was an economic historian, so his pioneering excavation of the blast furnace at Panningridge from 1964 to 1969 was inextricably linked to the documented history of the site, perhaps the most complete of any in the Weald. It was during this period that he and Henry Cleere, who was separately excavating the Roman ironworking site at Bardown, recognised the need to update what was known about the iron industry in the region and to enlist and organise the assistance of volunteers to that end. Thus the Wealden Iron Research Group came into being.

Panningridge was the first of David's three significant explorations of the remains of ironworks in the Weald, the others being at Chingley Forge and Furnace in the Bewl Valley, and the Pippingford furnaces. He also recorded the remains at Scarlets Furnace. Panningridge, however, remained the most complete opportunity to study remains that were particularly well documented, David producing an edited volume of the Sidney ironworks accounts in 1975, in succession to his transcription of those of Ralph Hogge. One of the principal aims of WIRG had been the publication of a new survey of the industry in the region. *The Iron Industry of the Weald* – 'Cleere & Crossley' to WIRG members – was published in 1985 and acclaimed as a model regional industrial study. David contributed the chapters on the medieval and post-medieval periods. Six years later, with Richard Saville, he edited the *Fuller Letter Book* for the Sussex Record Society.

Inevitably, once his work on Wealden sites drew to a close, David's career at Sheffield largely kept him away from the Weald, though he retained his connection with the Group through his 43-year editorship of *Wealden Iron*. He was immensely respected as an economic historian, as the flurry of tributes following the announcement of his death testified. For his role in establishing the Group and guiding it in its early years, and for his scholarship in the archaeology and history of the Wealden iron industry, the Wealden Iron Research Group owes him a great debt.

FIELD NOTES

A bloomery site in Mountfield, East Sussex

A scatter of bloomery tap slag has been discovered on a possible former boundary bank in Millham Wood at TQ 7304 2013. The site, which is in mixed woodland, lies on the Ashdown Beds. A small quantity of tap slag and furnace cinder has also been noted nearby at TQ 7310 2010, adjacent to an old badger set. To the north-west of these sites, in Castle Wood at TQ 7270 2010, is a dense cluster of filled-in minepits, as well as open-cast ore workings, that probably served Darwell Furnace. We are grateful to Peter Miles for drawing attention to these locations.

Bloomery smelting slag in High Street, Crawley, West Sussex

Excavation, by Chris Butler Archaeological Services, of pits and other features on land set for redevelopment at 10 Grand Parade, High Street, Crawley (TQ 2675 3670), has yielded quantities of bloomery smelting slag with associated medieval pottery, though no remains of furnaces or other hearths. Substantial quantities of medieval iron slag have been found in the centre of Crawley, particularly to the west of the High Street, but as yet the remains of the furnaces that produced the slag have largely eluded investigators. The site would have been formerly in Ifield parish and would have been part of one of the parcels of land within a triangle bounded on the south by the road to West Green and to the west by the former Small's Lane.

Probable iron ore extraction in Sedlescombe, East Sussex

Robert Turgoose

Killingan Wood is about 9 hectares in extent. Its south west corner is at TQ 780190. The eastern part of the wood, which lies on Wadhurst Clay, consists of a single quarry extending about 200 metres from north to south and 150 metres from east to west. Although broadly oval in shape a number of irregularities in its rim suggest that it may have originally been several quarries that became joined as excavations proceeded. The quarry is of variable depth. At the northern edge it is about 10 metres but no more than 3 metres at the southern edge where there is what appears to be an exit ramp. The floor of the quarry is a mix of mounds and shallow depressions.

Within the wood and immediately outside the north western edge of the quarry at TQ 781193 are a number of circular pits each between three and five metres across. These could either be trial pits used to define the limits of the ore body, or the result of mining on a smaller scale than that associated with the large quarry.

Killingan quarry is about 1.5km south east of the Roman ironworks at Footlands and about 1.75km west of the site of Brede furnace, both places being accessible along present-day roads, tracks and footpaths.

IRON-WORKING GODS AND THE WEALDEN IRON INDUSTRY

Judie English

The process of taking dull stone, applying extreme heat under control and producing shiny objects with sharp edges and intricate designs appears to have been regarded with at least awe and perhaps as magic from its beginning in late prehistory. Many polytheistic cultures have a smithing god: for the Sumerians Gibil, god of fire and of the forge, had the responsibility of keeping the points of weapons sharp; in 8th century BC Egypt, Ptah was believed to have thought the world into existence and then, as a major deity alongside Ra, Isis, Osiris and Amun, to have taken on a number of duties including metalworking. The Yoruba of Nigeria have Ogun as a god of metal working (as well as rum making!) and Qaynan performed the same role in pre-Islamic southern Arabia.

In Europe, Hephaestus of the Greeks, Sethlands of the Etruscans, Vulcan of the Romans, Svarog of the Slavs, Ucuetis of the Celts in Burgundy and Ilmarinen, the Eternal Hammerer of the Fins, among others, fulfilled the same role. Hadûr, blacksmith to the gods, had copper as his sacred metal and was reputed to have forged *Isten kardja*, the sword found and given to Attila the Hun. A more likely origin for this weapon, which is held in the Kunsthistorisches Museum in Vienna as part of the Habsburg *Schatzkammer*, is as Charlemagne's sword, *Joyeuse*. Swords which provided divine protection for their owners, and which were often named, occur regularly throughout history and legend – Excalibur is probably the best known in Britain. Indeed, the particular 'value' of swords made them suitable as votive deposits – gifts for the gods. In Britain, deposition of swords in (mainly east-flowing) rivers has a currency covering most of the period of their practical use from the numerous Late Bronze Age examples (for example Bradley 1990) to the Late Medieval examples found in the Witham valley in Lincolnshire (Stocker & Evison 2003).

In Irish mythology, often considered to hold memories of Celtic religion from pre-Roman Britain, Credne was a divine goldsmith who also worked in copper and bronze, while his brother Goibniu made weapons for the gods. In the *Lebor Gabála* Érenn (A History of Ireland, the earliest surviving version of which was written in the 11th century) he is described as 'not impotent in smelting'. A third brother, Luchtaine, was a carpenter. This apparent differentiation between iron production, smelting and processing – smithing – is of considerable interest. Most archaeologists accept copper and copper alloy (for example bronze) production as having has a 'magic' dimension but regard iron production only from the pragmatic point of view. However, while iron also had to be smelted, smithing involved novel processes – forging, hammering, welding, annealing, tempering and quenching – and greater physical strength, stamina and good judgment, characteristics also of military leadership (Giles 2007). Both processes required craft skills but also, possibly, an input of occult knowledge (Budd & Taylor 1995).

So, is there any evidence of a concern for divine intervention in those occupied in the Wealden iron industry? One obvious example is a 'sceptre binding' found at a Romano-Celtic temple site on Farley Heath south-east of Guildford (Fig. 1). The bronze strip was discovered in 1848 and then lost until 1936 when it re-surfaced and the possible religious significance of figures and objects with which it had been embossed recognised (Goodchild 1938). Although wary of over-interpretation, the proximity of the site to extensive Romano-British pottery production around Farnham (Surrey) and

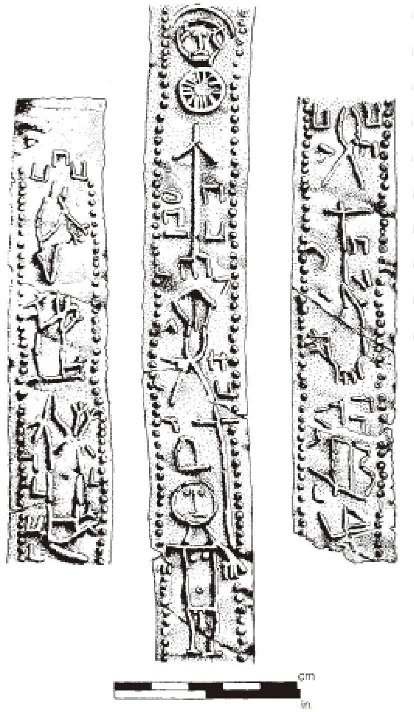

Figure 1: The 'sceptre binding' from Farley Heath temple, Surrey (drawn by the late David Williams and reproduced by his kind permission and that of Surrey Archaeological Society)

Wealden ironworkings, and the presence of a Vulcan figure were noted. In a later paper (Goodchild 1946/7) note was taken of then recent work from the Continent; the central figure was compared with the French 'Le Dieu au Maillet', usually named as either Sucellus or Silvanus, but compared with Dispater – 'protective deity of men, homes and crops, god of riches and fertility, god of the sky and of thunder, demon of death and father of the Celtic race' (Lambrechts 1942). Depictions of Sucellus have a widespread distribution on both sides of the Channel and he can be seen either alone or with a female consort. The presence of a bird, possibly a raven, on the 'sceptre binding' may well symbolise his frequent partner, Nantosuelta, a pairing which is also found on the Continent (Green 1989, 46-54). Other figures represented on the 'sceptre binding' include a dog, seen on Continental artefacts associated with *Le Dieu au Maillet* and a wheel, symbol of Taranis – the helmeted face may represent Taranis in his Roman guise of Jupiter (Goodchild 1946/7). The inclusion of a dog, particularly since it is seen nose to beak with a raven, again links *Le Dieu au Maillet* with Sucellus. A vessel from the Lyons area in the Rhône valley has an image of the god with his hammer, a dog, a tree and a flask with the inscription, *Sucellum propitium nobis* − May Sucellus favour us (*ibid* 82).

As well as direct and indirect depictions of the gods, the designs on the 'sceptre binding' from Farley Heath include a number of tools, mainly located between the wheel of Taranis and the Sucellus figure. Below the wheel is an arrow-shaped tool with a three-pronged base, which may be a standard capable of being planted into the ground. Below this is a pair of tongs which appears to be holding a bar, possibly a bloom or an ingot, on an anvil. Next come two implements, a handled hoop and a long-handled hammer. It has been suggested that the former is either a hat or a helmet belonging to Sucellus (*ibid*) but there is no connection between this object and the head, and the god is otherwise naked; a further suggestion is that a cup may be intended. The person who decorated the strip may have intended to show Sucellus holding the long-handled hammer in his left hand and a cup in his right, similar to bronze statuettes found in the Museum of National Antiquities in St Germain-en-Laye (Black 1985). In view of the juxtaposition of these two items with tools probably used in iron production or processing it might be worth considering the possibility that, as a symbol attached to the smithing god, the hammer was also the tool most closely associated throughout society with iron production and processing – certainly its sound would have been for many the foremost indication of the activity taking place. This ordinariness is emphasized on a number of sculptural depictions of Sucellus found in Burgundy – 'The god is definitely a local indigenous deity, in the clothes of a humble Celtic peasant, a people's god' (Green 1989, 54). Below Sucellus on the piece from Farley Heath there is a second pair of tongs, and below this again a hafted implement, either a hammer or an axe-hammer.

At present the 'sceptre binding', with its complex iconography, is unique in this country but other artefacts also depict ironworking tools and divine interest in the craft. Several items of religious significance have been found at Romano-British iron production sites in the Weald and two probably relate directly to smithing gods. At Beauport Park, Battle, a major ironworking site

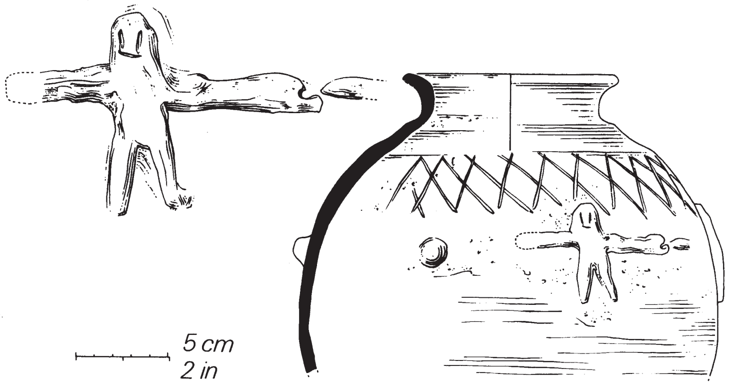

Figure 2: Depiction of a probable deity on a sherd of East Sussex Ware found at Beauport Park, Battle (reproduced from Brodribb & Cleere 1988 as permitted by Cambridge University Press)

with a military style bath-house, limited excavation produced more than 1600 tiles with the CLBR stamp of the *Classis Britannica*, and, from a late context, a sherd of East Sussex Ware pottery decorated with a crude human figure, possibly hooded, and carrying an unidentifiable tool or weapon In his left hand and a boss, perhaps a vessel, to his right. (Fig. 2). The figure has been identified as Hercules with his club (C Green in Brodribb & Cleere 1988) but could possibly represent Sucellus with a hammer and a flask or pot, even a *Genus Culcullatus* carrying a sword or dagger (Henig 1984, 62). At Bardown, Ticehurst, a site which produced a probable military-style barrack block, the head of a small, bronze statuette of Vulcan was found wearing a *pileus*, a felt cap worn by craftsmen (Rudling 2008, 129; fig. 6.13).

However, the nature of the administration of the iron production industry during the Romano-British period means that individuals holding a wide range of religious beliefs were present and the relative tolerance of the Empire would have led to that diversity being freely expressed. The iron industry in the eastern Weald is likely to have been placed under the military oversight of the *Classis Britannica* (Cleere 1975) raising the possibility that individuals directly from Rome or, more likely from the provinces from which units of the fleet were raised, and slaves from elsewhere in the Empire introduced both classical and exotic religious beliefs, and the Vulcan from Bardown may have been introduced through such people. There is, as yet, no evidence of fleet involvement in the ironworking sites of the central Weald. However the role of a guild of smiths (*collegium fabrorum*) in the construction of a temple dedicated to classical gods mentioned in a late 1st century inscription found in Chichester suggests an early level of Romanised organisation in that urban context. Iron production by Romanised Britons, possibly under licence, may have involved less exposure to smithing gods from elsewhere but, given the early date of Stane Street (the Roman road from Chichester to London), the bronze ibis head from Chiddingfold villa (Cooper 1984) originally connected with the Egyptian god Djehuty and

Figure 3: The ironworking god on a pottery sherd from the Roman fort at Corstopitum (Corbridge) (drawn by Julie Wileman after Ross 1967, fig 129)

the *terra cotta* pine cones from Rapsley villa (Hanworth 1968), associated with Attis, a Phrygian god worshipped in both Greek and Roman cultures (both Surrey) the area was hardly a rural backwater.

Other depictions of smithing gods and their tools come from the Roman militarised zone south of Hadrian's Wall where soldiers would have had a particular interest in the production of high quality iron for the manufacture of large numbers of good swords and other weaponry and armour. From *Corstopitum*, (a Roman fort in Northumberland just south of Hadrian's Wall) comes a sherd of pottery with *appliqué* decoration showing a smithing god holding tongs and a hammer over an anvil (Fig 3; Ross 1967, 196-6). Iron production is known to have been undertaken in the area and smiths would have been attached to army units based within the fort. Here again the emphasis in interpreting this figure has been to place the god in a Celtic context, rather than as an import from the classical pantheon. It may be relevant here that at least two of the part-mounted units stationed at *Corstopitum* had been raised in Celtic areas of Europe – the First Cohort of the *Vardulli* had come from *Hispania Terroconensis* (northern Spain) in the 3rd century whilst the First Cohort of the *Lingones* hailed from *Lugdenensis* in north-west France (Collingwood & Wright 1965). Also from a military context is the depiction on a face pot of a bearded face with a hammer, tongs and anvil from the 3rd – 4th century fort at Chester-le-Street (Evans *et al* 1991, 34, fig. 28). In addition a smithing god is shown working at a forge, possibly with a colleague holding a bloom or an ingot on an anvil on a vessel in Wisbech Museum (Fig. 4; Webster 1959, 93, fig. 2).

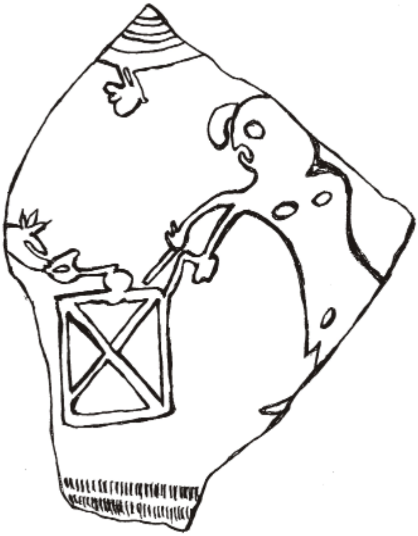

Figure 4: An iron production scene painted on pottery in Wisbech Museum (drawn by Julie Wileman after Webster 1959, fig 2)

Ironworking tools alone, tongs, hammer and anvil, have also appeared on pottery (Braithwaite 1984; Webster 1989), for example on a 4th century Hadham Ware jar from Colchester (May 1930, 146-7, fig. 3). Similar decoration appears on pottery vessels from Elmswell (East Yorks) and Malton (North Yorks) (Green 1978). However, it has been suggested (Black 2008, 15) that depiction of tools alone may represent Sucellus with ironworking tools seen as having a role in the act of creation. Here it might be worth remembering ethnographic comparison considers iron production to be a gendered activity particularly in Africa. Bloomery furnaces were seen as female and decorated with scarified breasts whilst 'male' bellows performed an act of congress and menstruating women were forbidden within the industrial area in case a 'failed pregnancy' might influence bloom formation (Herbert 1993, 32; Haaland 2004).

The need for a god to protect and assist in iron production did not end with the fall of the Roman Empire. The Germanic tribes who invaded across the Rhine / Danube frontier and the North Sea were led by warriors whose identity included possession of pattern-welded swords and other weapons, and iron continued in extensive use in more everyday items. In the Sheamus Heaney translation (2000) Wayland, weapon smith to the gods, made chain mail for Beowulf:

> No need then to lament for long or lay out my body.
> If the battle takes me, send back this breast-webbing that Weland fashioned and Hrethel gave me, to Lord Hygelac.
> Fate goes ever as fate must.

Swords made by Weland include the familiar theme of breaking and re-forging in the example of Gram, the sword of Sigmund in the *Poetic Edda*, which was destroyed by Odin, re-forged by Regin and used by Sigurd to avenge his father's death by killing the dragon Fafnir. One scene from the life of Wayland on one of the Andre stones from Gotland, Sweden (Fig. 5) shows

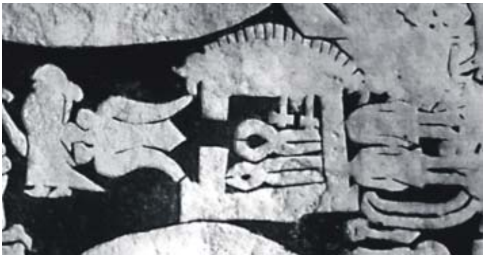

Figure 5: Wayland's smithy from the 8th century Ardre image stone VIII in Gotland (reproduced from https://commons.wikimedia.org/w/index.php?curid=1737617)

the smith in his forge while a further scene on the Frank's Casket (Fig. 6), probably made in Northumberland, has a hamstrung Wayland holding the head of the king's son, who he has just slain, in a pair of tongs. Association between smithing gods and sky gods continued into the Saxon period with Thor seen wearing heavy blacksmiths' gloves and carrying a hammer (Webster 1986, 56).

Belief is something we can seldom 'see' archaeologically but for the early

Figure 6: Left side of the front panel of the early 8th century Frank's Casket, depicting the Germanic legend of Wayland the Smith (British Museum) (reproduced from https://commons.wikimedia.org/w/index.php?curid=24524175)

iron workers of the Weald propitiating the gods would probably have been as important as identifying a source of good ore to exploit, and each stage of the process may have required suitable rituals to be observed.

Acknowledgment

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THE OLD SOW TRACK: The journey of the iron from Panningridge Furnace to Robertsbridge Forge in Tudor times

Geraldine Crawshaw

The route of the original trackway used to transport iron sows from Sir William Sidney's blast furnace at Panningridge to his forge beside the river Rother at Robertsbridge is discussed in the light of recent fieldwork investigation, documentary research and modern archaeological aids such as LiDAR. Sidney's interest in iron and reasons for acquiring a second blast furnace site are also considered.

INTRODUCTION

When Sir William Sidney acquired the site and lands of the dissolved Cistercian abbey at Robertsbridge in East Sussex, he perhaps thought of himself as an entrepreneur in the role of ironmaster, along with his other interests.

The letters patent of King Henry VIII (1539) show a bargain and sale to the king by Sidney and Lady Agnes, his wife, of land in Yorkshire and Lincolnshire. In return, the Sidneys, with an additional payment of £220 to the Court of Augmentations, received the late Abbey and Manor of Robertsbridge from the king.[1] He would have regarded them as close friends at court and had given them charge of raising his only son, the future Edward VI. [2]The grant

1. R. H. D'Elboux (ed.), *Surveys of the Manor of Robertsbridge*, Lewes, Sussex Record Society (hereafter SRS), **47**, 1944, 180; abstract of letters patent to Sir William Sidney and Lady Agnes.

2. W. T. MacCaffrey, 'Sir Henry Sidney', *Oxford Dictionary of National Biography*, Oxford University Press 2004 [accessed 2nd Feb 2018] https://doi.org/10.1093/ref:odnb/25520; in 1538 William Sidney was rewarded for his long service to the

of the Robertsbridge lands, finalised in 1540, was closely followed by the building of a blast furnace on the site of the old abbey tannery (TQ 751231) and a forge using the same water supply further north, close to the River Rother (TQ 756236).[3] The works were supervised by Sir John Horrocke who was the Sidney steward and vicar of Salehurst.[4] At this time the only blast furnaces in operation in this south eastern area of the Weald were Socknersh (John Collins 1535) and Darwell (Walsh/Oxenbridge 1539).[5]

Sir William Sidney clearly understood the importance of the growing market for iron as in 1541 he arranged a 21-year lease of a six acre site at Panningridge about eleven kilometres south west of the abbey site, where he built a second furnace to supply his Robertsbridge forge with pig iron.

Sidney had pursued an active military career, including command of the right wing at Flodden in 1513 and as captain of a royal ship in a battle against the French in the same year. In 1514 he had been sent as an agent of the Duke of Suffolk to the Low Countries to learn the language and it was possibly here that he first encountered the new blast furnaces in action. In later years he was charged with the supervision of English coastal defences as war with France looked inevitable.[6]

Sir William may have seen great potential in supplying Camber Castle, at the mouth of the Rother, with iron for building and artillery from his iron works just 28 kilometres up-river. The initial tower had been built by 1512 but in 1539 Henry VIII began the largest coastal defence plan since Roman times and the castle was hugely upgraded at a cost of £5,660. Between 1542 and 1543 royal funding provided £10,000 to restructure the castle.[7] Throughout the early accounts of the Sidney ironworks are notes of

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king when he was appointed chamberlain of Prince Edward's household. In 1544 he was advanced as steward to the prince.

3. D'Elboux, *Manor of Robertsbridge*, 144.

4. D. W. Crossley, *Sidney Ironworks Accounts 1541-1573,* London, Royal Historical Society, Camden Fourth Series, **15**, 1975, 3.

5. H. Cleere and D. Crossley, *The Iron Industry of the Weald,* Cardiff, Merton Priory Press, 1995, 328.

6. MacCaffrey, 'Sir Henry Sidney'.

7. Camber Castle, www.castlesfortsbattles.co.uk (accessed 2010); I. Longworth

sales to the castle. For example, in 1542-1543 'for one tonne of Iron for the Kyngs works at the castell at 106s 8d'.[8] This foresight into the increasing need for home produced iron may have been why Sidney decided to lease the additional site at Panningridge. The iron ore there was of superior quality and woodland for charcoal was plentiful.[9]

But it would mean transporting the sows of iron across country for nearly twelve kilometres to reach the forge. Sows, large ingots of iron cast in beds of sand at the furnace, weighed about ten cwt and two sows, or one ton of iron, constituted a load. In 1547 the rate paid to carters was 16 pence a load.[10]

As it transpired, the furnace at Robertsbridge encountered problems and went out of use in 1546, leaving Panningridge Furnace as the main supplier of cast iron for conversion to bar iron at the forge. The products would be sent overland to the Oke, at Udiam, or Bodiam river harbours, and thence downstream by small boats (called lighters) to Rye.[11]

The Robertsbridge ironwork accounts are the best surviving documents we have of this industry in the mid-sixteenth century.[12] Payment for carriage of sows is shown regularly in the Panningridge books. Henry Westall, clerk from 1542-1549, records in 1547: 'Item for carying of sows to Robertsbridge *hoc Anno* … £41 9s 7d.'[13] The accounts show that various local farmers such

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and J. Cherry (eds.), *Archaeology in Britain since 1945,* London, British Museum Publications,1986, 190.

8. Crossley, *Sidney Accounts*, 50.

9. H. R. Schubert, *History of the British Iron and Steel Industry from c.450 BC to AD 1775,* London, Routledge, 1957, 169.

10. Crossley, *Sidney Accounts*, 63 n. 8.

11. Cleere and Crossley, *Iron Industry of the Weald*, 353; Robertsbridge Furnace was not rebuilt until 1573 when the ironworks were leased to Michael Weston and partners. In 1563 the Panningridge works were leased to Relfe and Jeffrey and by 1572 had been sold to John Ashburnham. Panningridge Furnace had decayed by 1611; East Sussex Record Office, Brighton (hereafter ESRO), ASH 4501/488.

12. D. W. Crossley, 'The management of a sixteenth-century ironworks', *Economic History Review,* 2nd ser., **19**, 2 (1966), 274.

13. Crossley, *Sidney Accounts*, 63.

as John and William Stonestreet of Trotten Hill were regular carters.[14]

The journey to the forge would have been an almost daily event, given that in 1546 the average output of Panningridge Furnace reached one ton each day; in 1548 it was as low as 15 cwt but by 1556 was 21 cwt.[15]

Besides the cost of carriage, wayleave – the right to pass along roads or tracks on private land – would need to be paid. For example the book for 1550 lists 'hawkins for the libertie thorow his land for our carege of sowes 9s 4d'.[16] Other land owners who paid wayleave were Longley and James Reeve of Mountfield.[17] The Reeve Family were also carriers and rented land for iron ore (then known as mine) digging.

Despite this extra cost of transportation, Sidney and his steward must have viewed Panningridge as an advantageous site. They would have been aware of the existing routeway network before making the decision to enter into the 21-year lease. The late medieval network of tracks in this area was extensive and due in part to the land ownership of the Cistercian monks of Robertsbridge Abbey. Chapman, in her thesis on granges and landholdings of the abbey states that despite legislation against buying land in 1190 and 1214 'the monks of Robertsbridge continued to buy properties to lease, manors and land for granges with unabated zeal'.[18] The total area held by the abbey was 12,740 acres, 95% of which was surrendered to the Crown in 1538.

Transport links to the abbey manors of Udiam, Footland, Ferne (Vinehall) and Park (site of Sidney's Robertsbridge furnace), would be in place, as well as to their other manors of Posyngworth, Lamberhurst, Mapplesden, Madresham, Playden, Sandore-Sutton (Eastbourne) and Peplisham (Bexhill).[19] Abbey lands in the Panningridge area were:

14. ibid; D'Elboux, Manor of Robertsbridge, 141.

15. D. W. Crossley, 'A Sixteenth-century Wealden Blast Furnace – a report on excavations at Panningridge, Sussex 1964-1970', *Post Medieval Archaeology,* **6** (1972).

16. Crossley, *Sidney Accounts*, 71

17. ibid. n. 17.

18. A. Chapman, *Granges and Other Landholdings of Robertsbridge Abbey*, PhD Thesis, Kent State University, OH, USA (1977), 211.

19. Robertsbridge Abbey granges were sited at Derne, Worth, Snergate, Knock,

1. Gyffords, 110 acres in Dallington, owned since 1200 and just north of the furnace site (fed by Giffords Gill).

2. 'Heselden of the tenement of Dalinton' leased by the monks from the 13th century. Hazelden woods became a great source of wood and ore to the ironworks in the 16th century.

3. Rounden Wood, 80 acres, leased to William Spycer for 30 years in 1537. Spycer's rent to the monks was four wagon loads of lime a year, which was quarried in the wood. This tenant was in all probability the agent through whom Sidney bought the lease of a part of the glebe land at Panningridge.

Straker writes: 'The Abbot of Robertsbridge no doubt foreseeing coming events, had, not long before the Dissolution, granted many leases to various tenants who probably paid fines to secure them.'[20] The advowson of Mountfield Church, with the vicarage and rectory also descended from the abbey to Sidney ownership in 1539 and it will be seen that the sow track makes use of the route to these buildings.[21]

The monks had also been granted rights of way across certain lands, such as that recorded in a charter of 1210 through the Court of Glottenham as far as the 'great way to Brightling'.[22]

We do not know which rights of way William Sidney inherited from the abbey but his track from furnace to forge passed through some parcels of land which he either owned, as lord of the manor of Robertsbridge, or rented, such as the six acres at Panningridge (Penhurst glebe land). Many sections of the track would have been already in existence, joining up contemporary roads or re-using those which had previously gone out of use or been stopped up. The route of this track, following higher sandstone and limestone ridges and avoiding the heavier clay, points to its antiquity.

One of the earliest references to a sow track here, is an article by Ernest

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Grikes, Fother and Broomhill (on Romney Marsh).

20. E. Straker, 'Westall's Book of Panningridge', *Sussex Archaeological Collections* (hereafter *SAC*), **72** (1931), 256.

21. L. F. Salzman (ed), *Victoria History of the County of Sussex Volume 9,* Oxford, University Press, 1937, 236.

22. D. Martin, 'Three Moated Sites in North-East Sussex Part 1: Glottenham', *SAC*, **127** (1989), 89.

Straker in, describing an ancient Wealden ridgeway from Winchelsea and Rye to Uckfield.[23]

> 'In order to bring the sows to the forge … there is little doubt that advantage was taken of the Ridgeway for a great part of the journey from Mountfield to Netherfield. The track is clear through the woods, rising to a height of nearly 500 feet.'

Keeping to the ridgeways wherever possible has proven to be the most likely route from furnace to forge.

The topographical map (Fig. 1) shows the clear ridgeway with the proposed route of track marked.

THE ROUTE

1. Panningridge Furnace to Penhurst Lane

The route which follows the current bridleway from Ashburnham Furnace (TQ 6851 1710), just half a kilometre downstream from Panningridge pond bay, up to Penhurst Lane (TQ 6963 1805) seemed initially to be the obvious vestige of the sow track. Moreover, this bridleway is known in the locality as Sow Lane and is described as such in the High Weald 'Welly Walk' for Netherfield Primary School (produced by the High Weald AONB Joint Advisory Committee).[24]

This path probably was used to transport sows of iron, but from Ashburnham Furnace to the Netherfield road. Ashburnham ironworks were not established until 1554, 12 years after the Sidney furnace was built.[25] Straker, in *Wealden Iron*, suggests the route:

> '… in order to take an easy gradient it descended the valley to Ashburnham Furnace and then climbed in a north easterly direction.

23. E. Straker, 'A Wealden Ridgeway', *Sussex Notes and Queries*, **6** (1936-7), 172.

24. Netherfield Church of England Primary School High Weald Welly Walk. http://www.highweald.org/downloads/publications/teaching-resouces/school-specific-resources/netherfield-school/1013-netherfield-welly-walk.html (accessed 12 Mar 2018). This walk is about 7.6 kilometres and passes Panningridge pond bay on a permissive path.

25. Cleere and Crossley, *Iron Industry of the Weald,* 310.

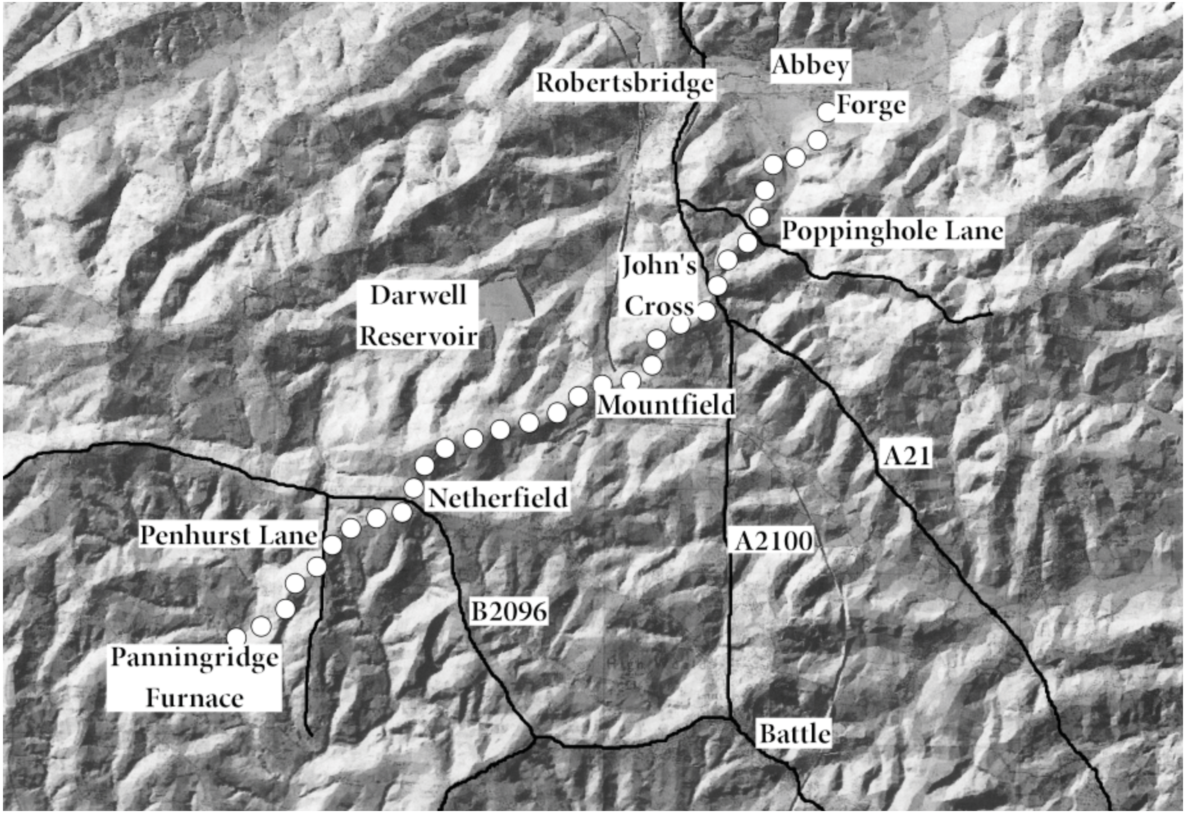

Figure 1: Topographical map of the sow track. Fieldwork suggests using the ridgeways was the most likely route

In one place it is cut in the rock.'[26]

This rock cutting is actually the edge of a sandstone quarry from whence building material was no doubt taken for the furnace. (TQ 691 174)

Nineteenth century maps, for example the Ordnance Survey (OS) Draft map (1805), the OS Old Series one inch map (1813), the first edition of the one inch OS Sheet 88 (1831) and the mid-19th century tithe map, all show parts of the path that is roughly followed by the current bridleway. However, this does not accord well with the proviso that Sidney would only have leased land for a busy furnace site that was on an existing routeway. This led to field and documentary research to find a way leading directly north eastwards towards the forge.

The plan of Panningridge Furnace in Crossley's excavations of 1964-1969 shows a section of an 'abandoned holloway' continuing the lane north east from the bridge over Giffords Gill, the old Panningridge Furnace spillway.[27] Quoting also from Crossley in the first ever WIRG *Bulletin* (1969 p.4): 'Pig iron was carried, probably along the existing holloway towards Netherfield ….'

The original site lease for six acres of glebe land belonging to Richard Clarke, parson of Penhurst, was made in 1541 by William Spycer (probably as an agent for Sidney as already mentioned). The contract describes a 'highwey South' bounding the lands leased.[28]

The parsonage which later became known as Bunces Farm was about 250 metres north of the proposed furnace site. Bunces, (TQ 689178) is listed in the tenancy analysis produced by the Rape of Hastings Architectural Survey (ROHAS) for Penshurst Parish as formerly 'abutting Parsonage Lane on the south'.[29] This pointed the way to a map of Penhurst glebe land made in 1679, showing the parsonage, the furnace pond still in water, the 'sinderbank' south of the pond bay and a clear road, the Parsonage Lane leading directly

26. E. Straker, *Wealden Iron,* London, Bell, 1931, 364.

27. Crossley, 'Panningridge Furnace', fig. 21.

28. Crossley, *Sidney Accounts*, 41

29. ESRO, HBR 9/35/9, Rape of Hastings Architectural Survey (hereafter ROHAS), Penhurst Tenancy Analysis.

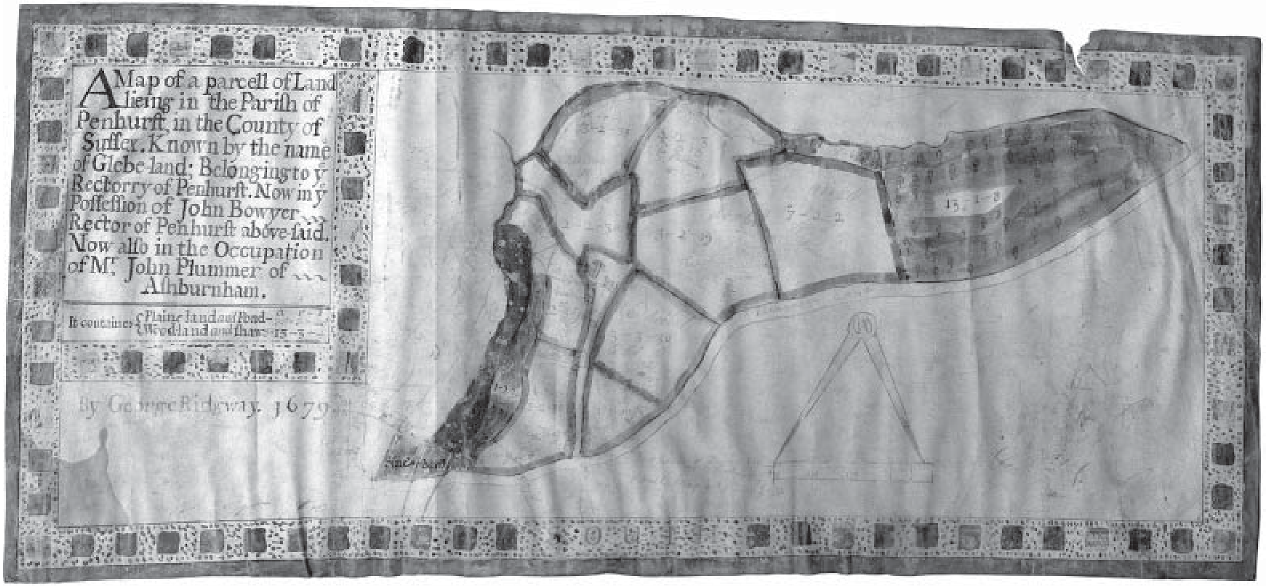

Figure 2: Map of Penhurst Glebe Land showing the line of Parsonage Lane from Panningridge pond bay, 1679 *(ESRO PAR 441/6/1/1)*

up towards Penhurst Lane (Fig. 2).[30] This lane could have been the start of the original sow track. Locating it on the ground was difficult because construction of a modern roadway made up to Rocks Farm (TQ 689174) had filled in a large section of the holloway near to the bay but is was clearly to be seen 100 metres uphill making its way along the woodland boundary, then secreted in a shaw between two fields to a point where it entered Link Wood (TQ 6905 1768). The old road was well preserved through the shaw and other tracks leading from it could be seen, such as the original path to the parsonage and a track to the sandstone quarry mentioned earlier (Fig. 3).

The LiDAR map (Fig. 4) shows the clear holloway, the covered-over section and the continuation of the original lane westwards, now Lakehurst Lane.[31] The initial section of the holloway is bounded by typical ancient hedgerow species: holly, hornbeam, beech and hazel. No slag was noted

Figure 3: The holloway, looking south west towards Panningridge. TQ 690176

30. ESRO, PAR 441/6/1/1, 'A Map of a parcel of land lieing in Penhurst...known by the name of Glebe-land' 1679.

31. LiDAR map accessed from Environment Agency (EA) 1m DSM data; https://houseprices.io/lab/lidar/map (2015)

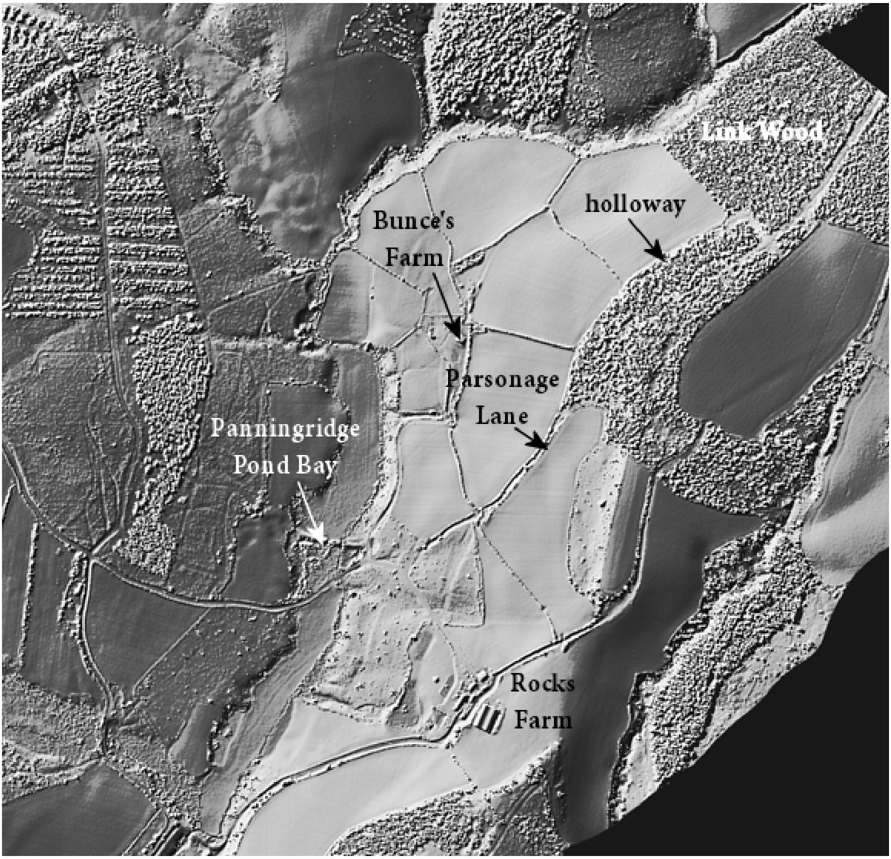

Figure 4: LiDAR image showing former routeways in the Panningridge area

on the present surface, although a large piece of rock weighing 1kg was found at TQ 6890 1760. A sample was analysed and proved to be a piece of calcined iron ore from mined shelly high grade siderite (total iron content 48%). Perhaps this was a remnant from later furnace re-building used for metalling.[32]

The sow track would have been a highway funnelling iron ore, charcoal, wood and stone towards the furnace. Where the way was inspected (at a gateway on a permissive path (TQ 6905 1768) entering Link Wood, clear

32. Rock sample analysed by WIRG member Alan Davies in 2017.

tracks leading to huge pits in the Wadhurst Clay (iron nodule-bearing strata) were noted. At this entry to the wood, the northern boundary of the holloway has been totally ploughed out for a distance of 300 metres on the border between the field and the wood.

By the field corner (TQ 6924 1791) the sow track enters Link Wood proper and is obscured by modern forestry tracks and coniferous planting. However, taking a steadily rising line, the old sunken lane again becomes visible through the trees, passing a small sandstone quarry on the way.

Detailed grid references were taken at this point as the forest area is subject to constant change, obliterating earlier tracks. The old road was clear at TQ 69390 18029 but within 20 metres had become overlain by a wide modern wayleave for overhead power lines. The reference point for the merging of the old track with the wayleave is TQ 69411 18040. The abundant *Equisetum,* or horsetail, growing in boggy conditions on the wayleave indicates a change in geology from Ashdown Sands to Wadhurst Clay.

The sow track, where feasible, would have kept to the sandstone but was forced on to the clay to cross Penhurst Lane (formerly Church Lane). No evidence for the old track was found south of the modern wayleave so we have to assume it is buried beneath it.

At the junction of the sand and clay here is a long string of many small mine pits where ore was dug. Figure 5 shows the sandstone/Wadhurst Clay boundary here.

The point where the old road emerged onto Penhurst Lane, just south of the

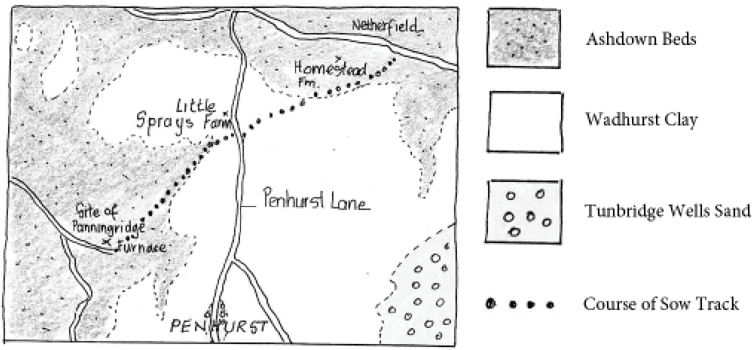

Figure 5: Local geology of the southern part of the sow track

present Little Sprays Farm, is also obscured by the modern forest entrance and boundary.

The whole route of the sow track so far described is supported by eighteenth-century maps such as Yeakell and Gardner Sussex 1778-1783 (Fig. 6) and the 1795 revision.

The best cartographic evidence for the old road from Link Wood joining Penhurst Lane is a plan drawn of a tenement farm (Dykes, now Great Sprays) belonging to Lord Ashburnham, dated October 16th 1717 (Fig. 7). On the plan, the old sow track still proudly bears the label 'the furnace road' along

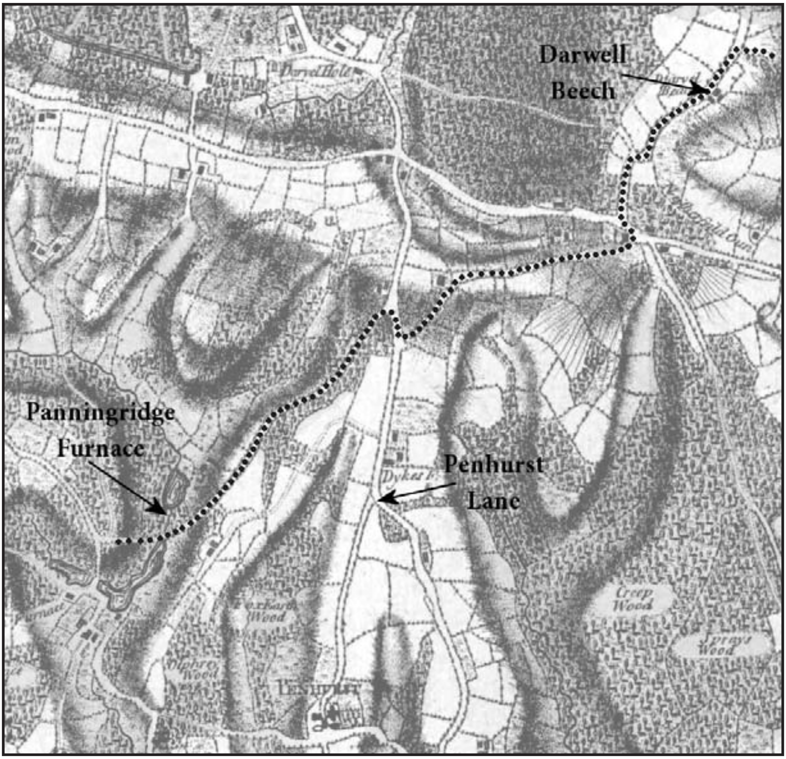

Figure 6: Part of Yeakell and Gardner's map of Sussex, 1778-93, showing the possible route of the sow track

Figure 7: Part of the plan of Dyke Farm showing the 'Furnace Road', 1717 (ESRO, ASH 4382)

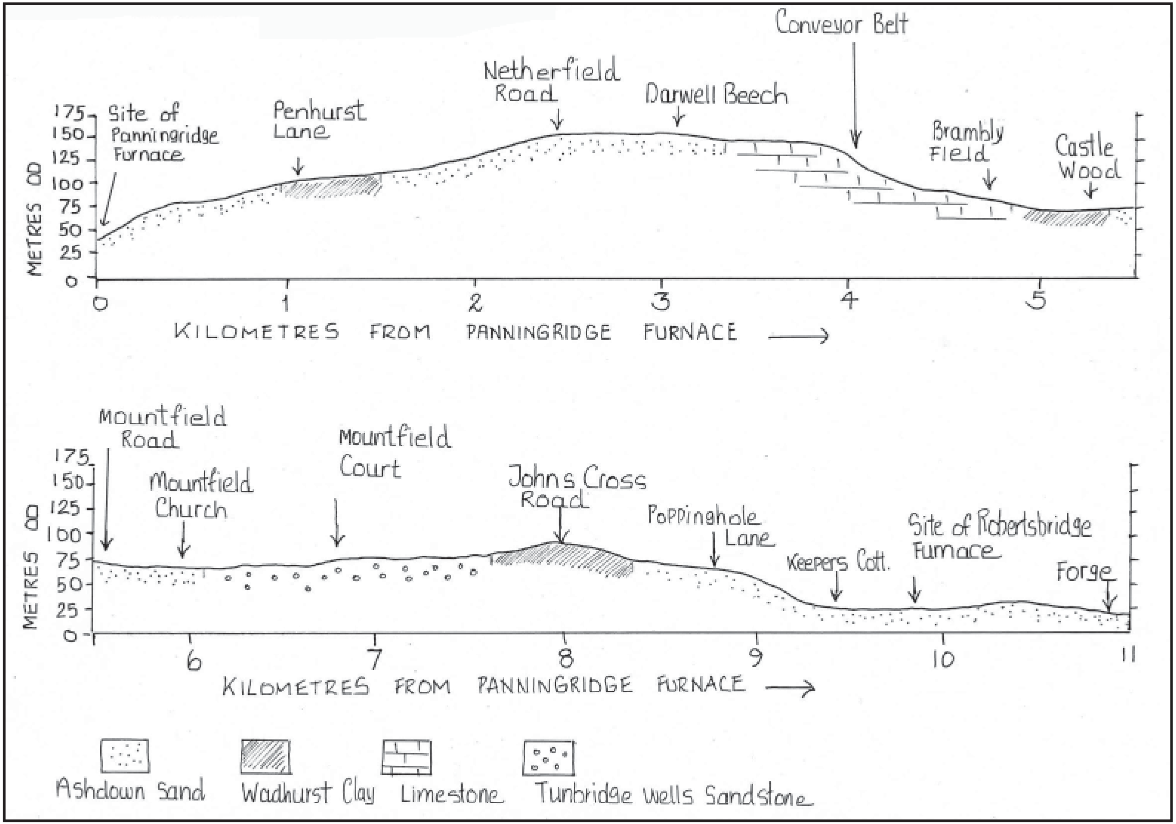

Figure 8: Profile of the sow track showing geology

the Link Wood boundary.[33]

The initial part of the carriers' journey to Penhurst Lane would have been the most strenuous section for the oxen hauling the cart with one ton of iron aboard. The first half kilometre of the track rises from 40 metres OD (above sea level) to 80 metres; the next half kilometre more steadily to 105 metres at the lane. Figure 8 shows the profile of the entire route rising to 150 metres at Darwell Beech, then with slight undulations descending to 10 metres beside the River Rother.

The first incline is steep but steady and well-suited to the pulling power of oxen. The number of oxen used is difficult to ascertain. Early Sidney ironwork accounts never list more than nine oxen in their possession and most of these would be for jobs around the furnace or fattening to eat. Since local farmers were employed as the sow carriers we may assume they used their own beasts, usually a team of six to eight oxen used for ploughing. Two oxen together could haul a greater weight with their combined effort than two single oxen. A longer distance plus a return journey could be accomplished with additional pairs. The two lead oxen would be used to working with at least one or two apprentice pairs behind.

As an aid on the steeper sections, carts may have had a 'scotch' fitted on each back wheel. This was a log attached to the axle by a chain which dragged behind as the cart moved forward but acted as a brake if it moved backwards.[34]

As oxen would be needed for farm work regularly, a number of different carriers were required. Westall's 1546 account book of Panningridge lists seven contractors to carry sows.[35] In this year they were: John Stonestrete, Lawrence Derby, Cressey, Thomas Hoope, John Awg, James Reve and John Reve.[36]

Besides the journey to the forge, teams would be used for general

33. ESRO, ASH 4382, 'Land scituate in Penhurst … now in ye tenture & occupation of Peter Gower,' 1717.

34. Jeremy Clarke, pers. comm.

35. Straker, 'Westall's Book of Panningridge', 256.

36. Henry E. Huntington Library, Pasadena, CA, USA, HEH BA Vol 27, Henry Westall's Book of Panningridge 1546.

maintenance:

> 'Repairing for carriage of cole and wood viz for making of 5 gates with the ironwork besides … 1 bridge in estmedowe and 1 called Cressesbridge and repairing the ways with Synder.'[37]

The latter bridge must have crossed land belonging to the Creasy Family who lived at Banks Farm, one kilometre west of Mountfield Church, half a kilometre from the track.[38] Several members of this family were employed, probably part time, by the ironworks in cutting wood, supplying iron ore from their land, and making or repairing 'colle wayens'.[39]

It should be noted that this first section of the sow track was observed using access provided by permissive pathways (2014-2017) not public footpaths. The next section can however be observed largely from a current footpath.

2. Little Sprays Farm, Penhurst Lane, to Netherfield

Both Yeakell and Gardners map and the earlier plan (Figs. 6 and 7) show a dog leg for the track to cross the lane and follow an old road into Netherfield. A choice of routes was likely here. To keep the momentum of the oxen, a route across the field opposite Little Sprays Farm may have been taken. Half a kilometre of clay must be traversed here so a steady uphill path may perhaps have been preferred. The only pointer to a way across this field is a former footpath marked on an OS map of 1882 (Fig. 9). We might have expected to see a 'crop mark' line on satellite photos of the field, but none is visible.

The track soon returns onto sandstone and follows an old farm track and field boundary in a holloway just to the south of Homestead Farm (Fig. 10).

At TQ 7045 1863 the modern footpath kinks to the east and follows a diverted route around modern buildings but the old track can be seen as a clear sunken lane with ancient hedgerows proceeding in a north easterly direction gaining the ridgeway road that passes through Netherfield (now B2096). (Fig. 11).

On the south side of the B2096 is a building for centuries called *The*

37. Crossley, *Sidney Accounts*, 176

38. ESRO, HBR 9/30/18, ROHAS, Mountfield Tenancy Analysis.

39. Crossley, *Sidney Accounts*, 147; in 1555 'E Cressy' was paid for 'mending of the ways in Folbroke Wood and Cranham Wood for the carryeng of yeren and mending of ways in Welland for the carriage of Colles'.

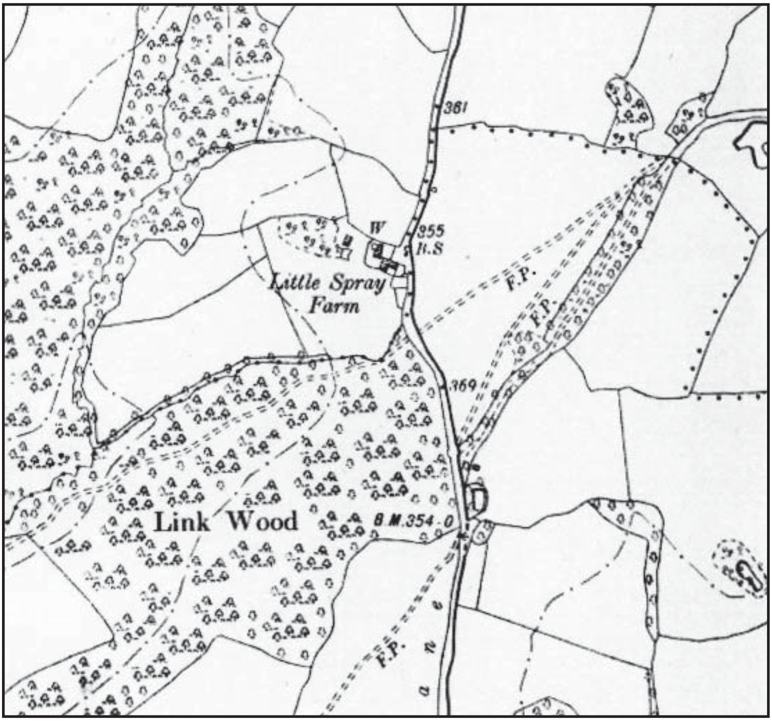

Figure 9: Possible track routes north east of Penhurst Lane *(OS 6in map 1913)*

Netherfield Gun. Panningridge Furnace never produced any guns although Ashburnham did. The derivation of 'Gun' was described by a former inhabitant, Richard Saunters, as coming from its use as a storehouse for gunpowder.

The old sow track crossed over the Netherfield road and followed a by-way to the old farmstead of Darwell Beech. Mr Saunters, now the farmer of this land gave his permission to explore the course of the old track here.

3. Darwell Beech to Mountfield

Where the sow track crosses the road is the early sixteenth-century Darwell Beech House. It was actually moved here in the 1990s from its original site half a kilometre further up the track to save the building from subsidence. The sow track would have passed beside the earlier part of this house at its

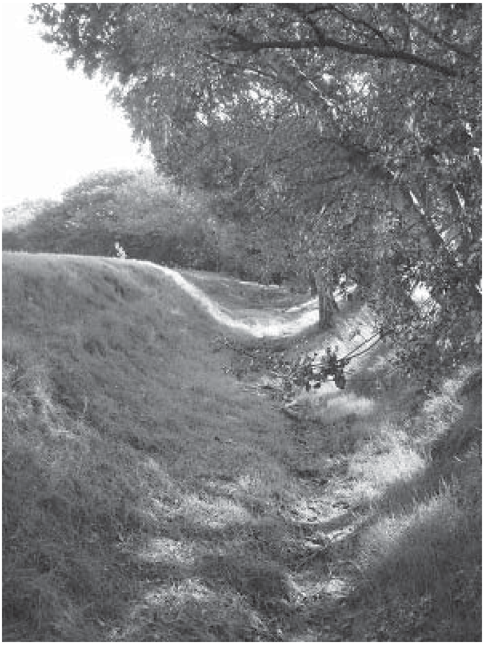

Figure 10: The sow track near Homestead Farm, Netherfield

Figure 11: The sow track in a sunken lane approaching Netherfield

former site.

Older maps show a track heading north from Darwell Beech to Darwell Furnace (1540-1660) now submerged under a reservoir. But the sow track to Robertsbridge would have continued along the ancient ridgeway to the north east. This is now pasture and ploughed land with no trace of a route, though the Mountfield tithe map of 1839 shows a clear track passing close to the highest point of the route at 150m, then entering Limekiln Wood.[40]

By combing the boundary between the field and the wood, tracks were found (at TQ 7154 1961) and inside the wood these led, after 25 metres to a holloway and proceeded steadily downhill on the southern side of an ancient woodland boundary. This sunken track, presumably the old sow path, had long been abandoned in favour of a newer route to the north, just outside the woodland boundary. Both tracks run almost parallel through the next section of Limekiln Wood.

Still descending, the old sow track clearly visible as a sunken lane, crosses a modern feature, the conveyor belt of Mountfield Gypsum Works (at TQ 7180 1965). This obliterates the track for a short distance. It can be picked up again and traced with more difficulty to a point entering Brambly Field (TQ 7238 1990). It was one of the woodland tracks still marked on the OS 1882 map. In the woods and in the field the route can be traced in part by the growth of sedges growing in old ruts.

An old limekiln lies in the centre of Brambly Field which the track passes, then enters Castle Wood at the eastern corner.

Immediately within the wood are four huge pits, as the geology here is Wadhurst Clay again. Castle Wood has many tracks, some crossing delicately between pits, though it seems likely the old Tudor route kept to the southern boundary where it would soon return to a sandstone surface. The enormous pits may well have been enlarged at a later date.

Local knowledge of this route is preserved on a sketch plan made of the putative moated site of Mountfield Castle surveyed in 1965 by Sterndale-Bennett which labels the course of 'The Old Sow Track' passing along the southern, most impressive, edge of the earthwork.[41]

40. ESRO, TD/E47, Mountfield Tithe Map 1839.

41. ESRO, ACC 5634/2/4/4, Sketch plan of Mountfield Castle surveyed by J. C. Sterndale-Bennett 1965.

The track proceeds to the junction of Castle Wood and the old Bulls Cross Corner on the Mountfield ridge road.

From Darwell Beech the route has made a gradual descent from about 500 metres to 65 metres and reached a halfway point six kilometres from the furnace with nearly six kilometres to reach the forge.

4. Mountfield to John's Cross

The iron carriers would then have followed Church Road eastwards past All Saints Mountfield, then at a sharp bend in the road by a pond, headed northwards towards the vicarage. Nowadays, this road is a driveway and public footpath leading to Mountfield Court (formerly Court Lodge) on a level ridgeway crossing parkland.

This is perhaps where the carriers passed Mountfield Vicarage, the advowson of which was held by William Sidney and his son Henry (who later sold it). This control over the church descended from the Etchingham family, Lords of Mountfield Manor, to Robertsbridge Abbey, then to Sir William.

The glebe terrier of 1615 gives the vicarage as abutting on the west the 'Highway from Mountfield Church to Johns Cross' showing it was an

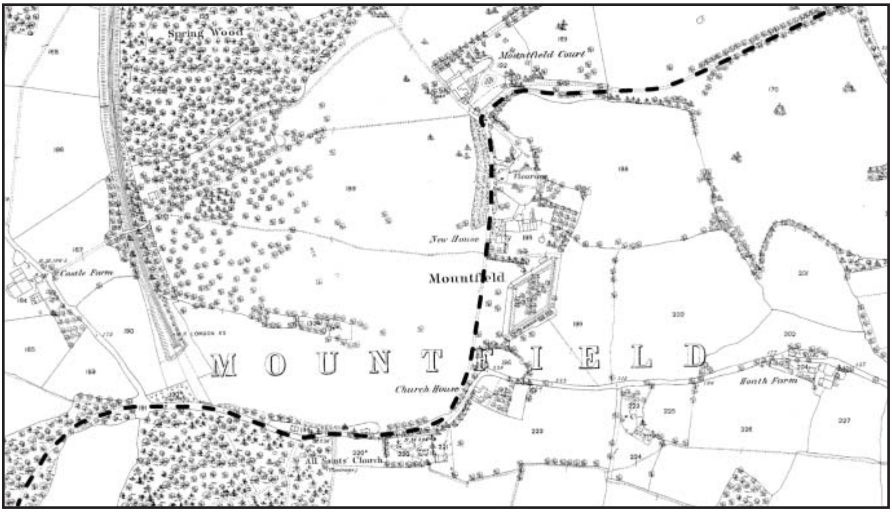

Figure 12: Route of the sow track through Mountfield, showing the tree-lined avenue (top right) *(OS map 1890)*

important thoroughfare.[42]

Passing the old vicarage, the path again sits in a deep sunken lane, then opposite Mountfield Court bends sharply to the east and continues along what is now a driveway lined with veteran sweet chestnut trees. Straker's description of the sow track here, used as a guide to locating the route, records: 'On the east of the Place it is bordered by an avenue of very ancient chestnuts'.[43] The OS map of 1890 (Fig. 12) shows this tree-lined avenue.

The earliest document showing this part of the route, with a then double tree-lined avenue is a map of Court Lodge made in 1750, the estate of John Nicoll.[44] By the mid-eighteenth century this stretch of the old route from Church Road may have been privatised, although still a right of way in 1679,[45] and the public forced to use Almshouse Lane which joined the ridgeway road at the eastern end of the drive. Almshouse Lane itself is now just a footpath. It is not considered to be an alternative for the sow track as this would have involved a long descent to the junction east of Hoath Farm and then a steep, sticky uphill haul.

The route continues along the ridge to join the main road through John's Cross (now the A21) passing at least three large marl or iron ore pits, once again being on Wadhurst Clay.

5. John's Cross to Poppinghole Lane

Of the final stages of the sow track from John's Cross (Vines Cross), Straker records:

> 'From here to Poppinghole Lane the line is obscure, but it continues

42. ESRO, HBR 9/30/28, ROHAS, Mountfield Tenancy Analysis, Old Vicarage.

43. Straker, *Wealden Iron,* 364.

44. ESRO, ACC 5634/2/4/2, Plan of Court Lodge Estate 1750.

45. ESRO, HBR 9/30/29, ROHAS Mountfield Tenancy Analysis, Mountfield Court; the present Mountfield Court, constructed between 1715 and 1718 survives almost in its original form. It may have been the site of the old Manor of Mountfield, although this is more likely to have been at Castle Farm, looking at the demesne lands described in a survey 1590-1620. In the glebe terrier of 1615, Mountfield Court is called just 'the Court Farm' but by the terrier of 1679 it is 'The Court Lodge' and a right of way through the forestall is described – almost certainly part of the original route taken by iron carriers of the sixteenth century.

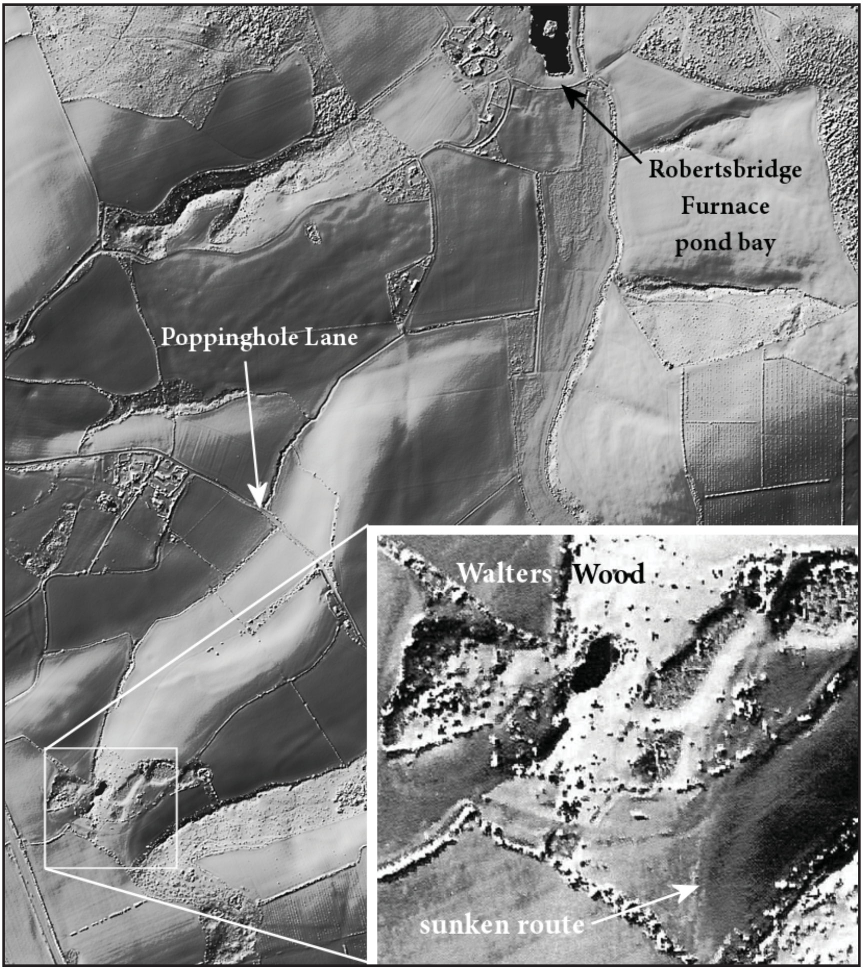

Figure 13: LiDAR image showing the sunken track to Walters Wood and the ridgeway route to Robertsbridge ironworks

> on the north side of the lane by a holloway to Robertsbridge Furnace and so on to the forge.' [46]

By now, keeping to the ridgeway seemed to hold good for retracing the sow track and, with the aid of LiDAR maps, helped to prove the likely route here.

46. Straker, *Wealden Iron,* 364.

Joining the main highway at John's Cross and heading north for 100 metres the track probably left the road (around TQ 7428 2132) where a current footpath traverses pasture to a stile in an ancient field boundary – perhaps an old gateway. There is no sign of any route across the fields to this point but where the modern path veers to the north east, LiDAR images show a sunken way making for higher ground in Walters Wood. (TQ 7435 2169).

In 2014 this hollow in the field was quite visible despite being planted with young conifers and by 2016 a fence line added with some infilling. This is shown in Figure 13.

A clear track still passes through Walters Wood between pits in the Wadhurst Clay and exits via a gateway still on the highest ground. A gateway often marks a very permanent gap through a field or woodland boundary over hundreds of years.

Initially there was no vestige of the sow track in the fields heading to Poppinghole Lane, though a course close to the crest of the ridge seems likely. observation along the curing hedgerow indicated a possible line along

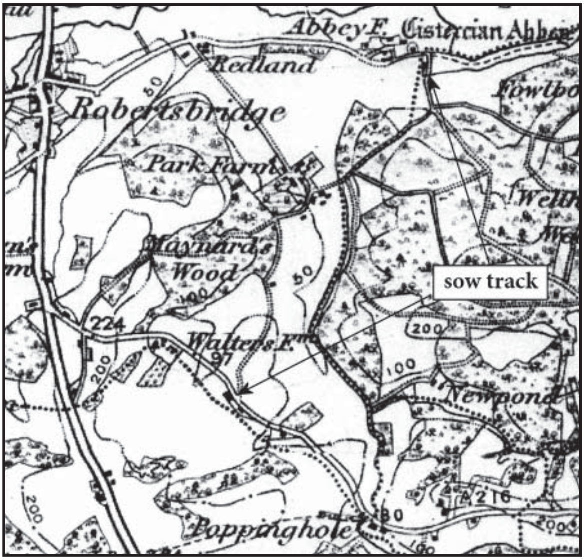

***Figure 14: The old track from Poppinghole Lane to the forge near the Abbey** (OS 1in 1900)*

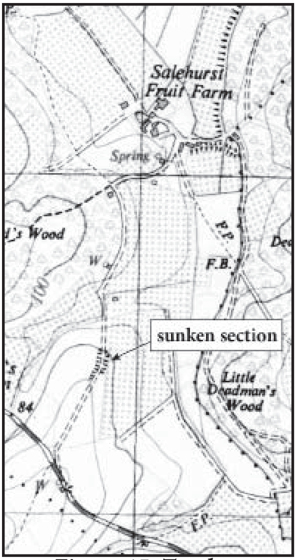

Figure 15: Track to Salehurst Farm passing N of the furnace pond
(OS 2½in 1937)

an elongated flattened area which passed between later cottages into the lane. The lie of the land and marks on a magnified LiDAR image also support this route.

6. Poppinghole Lane to Robertsbridge Forge Pond Bay

The sow track would have crossed Poppinghole Lane and continued on a descending ridge quite close to the present public footpath. The original route and holloway to which Straker refers was just to the east of this path.[47] All larger scale OS maps from the 1870s to the 1950s have this track marked, with a sunken section as it descends the steeper side of the ridge (Figs. 14 and 15).

Former farmworkers can remember the job of filling in the holloway here and then diverting the footpath.[47]

Next, the path heads through a field boundary hedge and joins the made-up track past Keepers Cottage (TQ 7490 2271), the original road to the furnace and forge.

Figures 14 and 15 show the sharp bend to the east which led north of the pond bay of Robertsbridge Furnace opposite Park Farm. Today the bay is barely discernible, having been mostly removed.

Along the track north of the bay is a stone bridge over a small river. The stone is pale in colour and almost certainly Caen stone re-used from the abbey church which was demolished after the Dissolution of the Monasteries. In 2015 a large carved stone, fallen from the fabric of the bridge was noted on the south east side lying just over the fence. Abbey stone was used to build Sidney's new blast furnace and forge in 1541-1542, though good use was made of many abbey buildings for residential purposes, storage, agricultural uses (there were three mills) and even the later steelworks were housed there in 1566.[48]

The sows would have continued their journey along the ancient road to the forge site, south-east of the abbey ruins. Now, it is indiscernible past the modern bungalow and rough pasture but becomes visible as it enters Wellhead Wood (TQ 7531 2317 on public footpath) at the junction with the old 'monken lane' which led through the woodland to Staplecross. One must

47. Peter Miles, pers. comm.

48. Peter Miles, pers. comm.

Figure 16: The ancient track used by sow carriers as it approaches Robertsbridge Forge

look inside the present woodland boundary to see the original Monken Lane.

The track continues along the western edge of Wellhead Wood, following an ancient boundary of laid hornbeams (Fig. 16).

A further short descent right into the Rother Valley brought the sow carriers to their destination at the forge. Unloading and storing each valuable 10 cwt iron sow would be work for several men but the carrier's work was done for the day.

CONCLUSION

The path of this Tudor trackway, used to deliver ore, iron, wood, charcoal, sandstone, limestone and other supplies to the furnace at Panningridge or the Robertsbridge ironworks can still be traced for most of its length. It almost certainly followed existing roads or tracks keeping along ridgeway routes where possible.

By consulting old documents, maps and accounts, along with modern aids such as LiDAR and satellite photography, clues have been suggested as to where the old sow track would be found on the ground. Almost the entire length has been observed. For parts of the route there would have been alternative tracks, to negotiate for example a particularly wet or eroded section.

Much of the sow track described can be walked or viewed using public footpaths and it is hoped that the reader, armed with the OS Hastings and Bexhill 1:25,000 map (Sheet 24), will take advantage of this and give it a try!

ACKNOWLEDGEMENTS

The author would like to thank David Brown who helped with the fieldwork and made me question everything, Anne and Chris Drewery who came with me to work out the 'trickier' sections of the route, Jeremy Hodgkinson for much background information, Peter Miles who offered considerable inspiration and arranged access to private land and Christopher Whittick for his help and advice on old maps and documents at The Keep. Lastly my thanks go to Holly and Bracken, the collies who came out walking with me when no one else was available!

ST PAUL'S CATHEDRAL RAILINGS

†J. A. Collett and J. S. Hodgkinson

Long held to have been cast at Lamberhurst, the iron railings or fence erected around St Paul's Cathedral in the early eighteenth century was probably the first such structure in England to be made of cast iron and was remarkable both for that and for its mode of construction, which included threaded components. It was a very costly project and, largely through the personality of Richard Jones, the contractor, was attended by a degree of controversy. The account which follows sets out the background to their commissioning, identifies the principal individuals involved and provides, for the first time, details of their design and assembly.

The idea of enclosing the new cathedral of St Paul with a fence was first noted at a meeting of the Commissioners in charge of the reconstruction held on 3rd March 1709. Sir Christopher Wren, who had been given a largely free hand in the management of the building works, opposed the idea, but the other Commissioners were in favour. Sir Christopher's attitude seems clear: 'As for the iron fence, it was wrested from me, and the doing it carried in a way that I may venture to say will be ever condemned'. Other decorative ironwork in the cathedral was of wrought iron, and Wren may have felt loyalty to the various smiths, notably Jean Tijou, who had worked for him. However, Richard Jones, described as a smith, with no previous record of dealings in connection with the rebuilding of the cathedral, was instructed to bring estimates of two sizes of cast and turned railings, with a costing for each, to enclose the whole church, and Thomas Robinson, the principal smith working on the cathedral at the time, was asked to bring estimates for either hammered or for cast and turned ironwork as well. Robinson had supplied tie bars which may have included screwed elements. In his choice of the type of iron for the railings, Wren's judgement seems to have been coloured by the way the other Commissioners had overridden his objections. Wrought iron was more susceptible to corrosion than cast iron, and the likely gauge of wrought-iron railings would have made them more easily damaged and less durable.

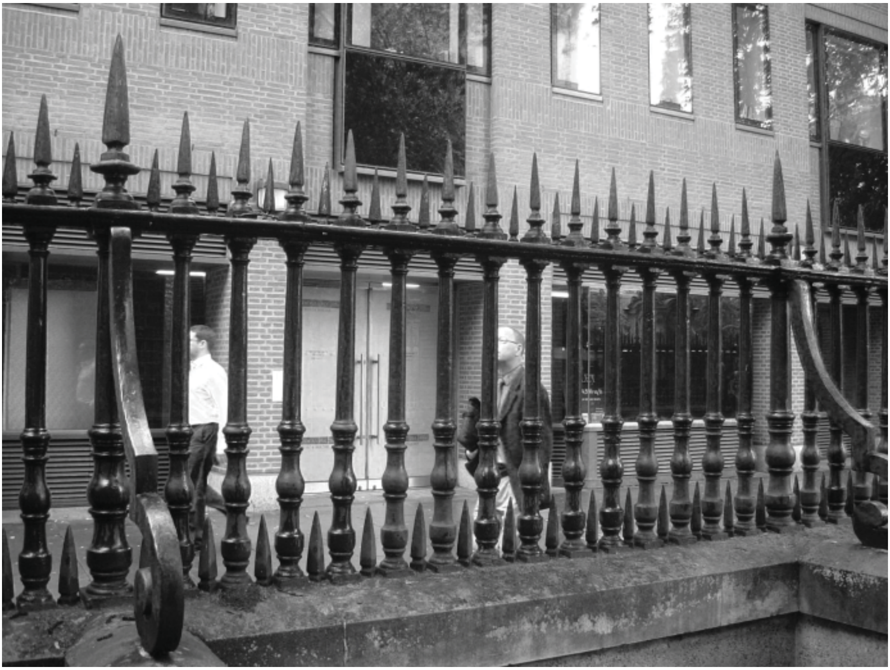

Figure 1. The railings on the north side of St Paul's Cathedral (photo: J. Hodgkinson).

Consideration of the estimates was eventually given on the 28th January the following year, when it was decided that the fence should be of cast and turned ironwork, and that Jones be given the contract at a price of 6 pence per pound for the fence, gates and 'all ornaments'. The contract seems to have been open-ended in so far as no estimate appears to have been given of the likely total cost. Sir Christopher Wren was given the right to make such amendments as he should think fit to the design, and the work was to be completed within eighteen months. It was also agreed that a sample baluster be kept at the cathedral as a standard, and that a proper design of the whole fence be approved and attached to the contract.[1] The statue of Queen Anne, which had just been erected in front of the west end of the cathedral,

1. A. T. Bolton and H. D. Hendry, *The Wren Society vol. XVI*, Oxford, Oxford University Press, 1939, 107-8; neither the contract nor the design appear to have survived.

was to be encircled by wrought iron railings designed by Tijou, who had designed and crafted much of the decorative ironwork within the cathedral, and it says something about the marginalising of Wren on this issue that Tijou was not asked to tender for the railings. In fact, because of their greater exposure following the removal of the cast railings at the western approach to the cathedral Tijou's railings round the statue were taken down in 1885 and replaced by a set, cast by Young and Co. of Pimlico, in the same style as the rest of the railings.[2]

The decision that the ironwork should be turned – i.e. that certain of the components should be finished on a lathe – may owe its origin to the practice, then recently abandoned, of finishing cast-iron cannon in a similar fashion. During a brief period in the 1670s and 80s, the government had been persuaded to adopt an expensive alternative to traditional cast-iron ordnance, developed by Prince Rupert. Finished to a higher specification, possibly bored from the solid and heat treated, or annealed, to give a coppery finish, the guns so produced cost considerably more than those made by normal methods.[3] When it was realised that their performance was not significantly better and did not merit the cost, the project was cancelled. The quality of the finish may well have been impressive, nevertheless, prompting similar treatment for what was intended to be a prominent public structure.

Richard Jones's works were next to the Falcon Inn on Bankside in Southwark. Sir Christopher Wren is alleged to have had a house adjoining the foundry, from an upper floor balcony of which, it is said, he would view the cathedral only 600m away across the River Thames.[4] The foundry may have been established by the Company for Making Iron Ordnance in Moulds of Metal, who supplied shells to the Board of Ordnance in 1693, and for which they would have installed an air furnace.[5] An ironmonger's shop there

2. London Metropolitan Archives, London (hereafter LMA), CLC/313/I/E/014/MS25809, vol. 1 f.25r.

3. S. Barter Bailey, *Prince Rupert's Patent Guns*, Leeds, Royal Armouries , 2000.

4. W. Rendle and P. Norman, *The Inns of Old Southwark and their associations*, London, Longmans, 1888, 353.

5. P. W. King, 'The Iron Trade in England and Wales 1500-1815: the Charcoal Iron Industry and its Transition to Coke', PhD thesis, Wolverhampton University 2004,

was advertised to let with its stock in 1703, and Jones may have begun his occupation at that time.[6] A testimonial from the Board of Ordnance in April 1709 noted that he had 'perform'd several large Contracts in forging Mortar Pieces and casting Shot and Shells for Her Majesty's Service'.[7] One of the accusations made against Jones was that, in 1708, he had fraudulently sold an Ordnance Office debenture for which he had originally been owed £250, but for which he had received part payment of £100. The fraud was that he had erased the acknowledgement for the part payment and sold it as being worth the full amount. It did not come to trial until 1711, by which time his contract to supply the iron fence was well under way, but he was acquitted. The original debenture was for 100 cohorn mortars of hammered iron.[8] After the completion of the railings, Jones went back to working for the Board of Ordnance and was contracted to supply cast-iron guns, although it is clear that Samuel Gott was undertaking the casting.[9] By 1716 Jones was failing to meet his orders and his name disappears from the Board's records. In January 1720, *The Daily Post* noted that Jones had left the Falcon for Paris, where he was to set up a foundry. In the following November the same paper reported that he had been committed to the Bastille for embezzlement.[10]

As a smith and urban iron founder of somewhat questionable origin, it is doubtful that Jones would have been in a position to complete the entire project himself. The fact that the work would entail nearly 200 tons of iron castings meant that only someone with access to a blast furnace would have been able to contemplate such an operation. For this reason, Jones subcontracted the casting to Peter Gott and his son, Samuel, who owned and ran the Gloucester furnace at Lamberhurst, on the Sussex-Kent border. Jones, at the Falcon Foundry, would do the finishing which, as will be seen,

51.

6. *Daily Courant*, Wednesday 9 June 1703.

7. A. Baldwin, *A continuation of Frauds and Abuses at St Paul's*, London, 1713, 9.

8. J. Morphew, *Fact against Scandal* [etc.], London, 1713, 65-73.

9. R. R. Brown, 'Notes from the Board of Ordnance papers 1705-20', *Wealden Iron*, Bulletin of the Wealden Iron Research Group, 2nd ser., **19** (1999), 38-42.

10. *The Daily Post*, 9 January 1720; 24 November 1720.

would have been a considerable job in its own right. Peter Gott (1653-1712) was a well-known figure. He was a Member of Parliament and had been a director of the Bank of England. His son, Samuel (1680-1724), had joined his father in Parliament and, of the two, was the more active in the iron industry by this time.[11] Casting the railings would be a profitable enterprise and, at £56 per ton, which included machining, the rate was more than three times that paid for cast-iron guns. It was alleged that Jones's proposal to the Commissioners was at the instigation of Peter Gott, one of whose other sons, also Peter (d.1724), the Receiver General of the Land Tax for East Sussex, was financially embarrassed at the time. However, as the younger Gott was not appointed to that office until 1710, and his mismanagement did not result in his brother, Samuel, having to refund £10,000 to the Treasury for him until after their father's sudden death in 1712, the allegation that this had been the motive for the bid to cast the railings was misplaced (although the profit would have undoubtedly been very useful). Nevertheless, the way in which Sir Christopher Wren's objections to the fence were overridden, the lack of other credible contractors, or at least consideration of them, and the lack of Jones's own experience for such a project were all, it was alleged, ignored, suggesting to some that the whole business had been a 'done deal'.[12] Jones was to be the subject of some character assassination, rumours of a criminal past as a felon and fraud being placed in print, and the alleged perpetrator of those rumours, Richard Jennings, a carpentry contractor for the cathedral rebuilding, was, himself, called to answer accusations of fraud and embezzlement.

The Gloucester furnace – so named because of a visit by the young Duke of Gloucester in 1696 - had been built with government assistance in 1695 by William Benge, a gunfounder, on land that had been used for ironworking since the mid-sixteenth century.[13] Benge had found himself in financial difficulties and in 1705 the site was purchased by Peter Gott.

11. E. Cruickshanks, S. Handley and D. W. Hayton (eds.), *The History of Parliament: The House of Commons 1690-1715 Vol. IV, Cambridge University Press*, 2002*, 52-3.*

12. Morphew, *Fact against Scandal*, 4-5.

13. H. F. Cleere and D. W. Crossley, *The Iron Industry of the Weald,* Cardiff, Merton Priory Press, 1995, 340-1.

That the furnace was already stocked for gun-founding may not have been particularly relevant to this project, but the site had an advantage over most furnaces in the Weald in that its water supply was not reliant on a series of ponds supplied by a modest stream, but was fed by a leat from the River Teise. Although no production figures are available for the site in the early eighteenth century, in the 1740s the same water supply was to enable the furnace to remain in blast for over three years, while others in the region were usually only operational for about six or seven months at a time. Given the eighteen-month time constraint initially placed on the preparation of the railings, such potential performance was a distinct advantage. Also, its recent construction had meant that it was larger than the other furnaces in the Weald, a fact remarked upon by Emanuel Swedenborg, the Swedish scientist and mystic, following a visit to the furnace some years later.[14]

Once the Commissioners had agreed Jones's proposals in January 1710 it was left with Sir Christopher Wren to negotiate with him the final design of the railings. This turned out to be quite a lengthy process, with Wren even proposing an alternative contractor, Josiah Kay, some ten months later, who offered to do the work for 5 pence per pound.[15] Nevertheless work must have started fairly promptly, as John Slyfield, the waterman, began floating ironwork across the Thames from Falcon Stairs to St Paul's Wharf in September of that year. The likely sequence would have begun with the production of castings at Lamberhurst. Stories abound, all unsubstantiated, of some of the casting being undertaken at other furnaces in the Weald. The Gotts had other ironworks - a furnace and forge at Beckley, and a forge at Westfield, both in Sussex. William Hobday, the last surviving Sussex ironworker, claimed that 50 or 60 of the balusters were cast at Ashburnham.[16] Sub-contracting is entirely plausible if the timescale was proving difficult to adhere to, and may account for the extraordinary charge for patterns for

14. J. Hodgkinson and A. Dalton, 'Swedenborg's description of English iron-making', *Wealden Iron*, Bulletin of the Wealden Iron Research Group, 2nd ser., **19** (1999), 53-5.

15. Baldwin, *A continuation of Frauds and Abuses,* 11; LMA, CLC/313/I/E/013/MS25584.

16. R. F. Whistler, 'Penhurst: being some account of its iron works, manor house, church etc.', S*ussex Archaeological Collections*, **36** (1888), 3.

the rail; extra patterns were necessary if they were being cast elsewhere as well as at Lamberhurst. The castings would then have to be carried overland from the furnace, probably to Millhall, near Maidstone, to be loaded onto sea-going hoys for shipment down the Medway and up the Thames estuary to a wharf downstream of London Bridge. They would then be transferred, either to barges for carriage upstream to Falcon Stairs, or onto wagons for the road journey through The Borough. Once at the Falcon Foundry, detailed work had to be undertaken to modify the castings for assembly on site. This included the forging of some of the components, and tapping for the insertion of threads and joining plates as described below. A notice of the Falcon foundry in 1723 'late Mr Richard Jones's' refers to the works' capacity for 'all manner of Turning and Boring', suggesting that the turning of the balusters and the tapping of threads was carried out there.[17] Problems with the completion of the railings were brought to public notice in 1712 by an anonymous critic in a pamphlet entitled *Frauds and Abuses at St Paul's,* in which the unfinished state of the railings was noted, and the delay in the provision of the stonework for the gates. Quoting a letter from the Commissioners, Sir Christopher was accused of being unwilling to deal with Jones and others because of his initial objection to the railings, and because Jones had not been Wren's personal choice of contractor.[18]

The financial account for the work was concluded on 31st December 1714 and amounted as follows:[19]

'Total weight at 6d. per pound	*207 tons 5 cwt. 3 qrs. 9 lb.*	*£11,608 6s. 6d.*
Deducted for parcels returned	*7 tons 5 cwt. 0 qrs. 12 lb.*	*£406 6s. 0d.*
	200 tons 0 cwt. 2 qrs. 25 lb.	*£11,202 0s. 6d.*

17. Quoted in M. W. Flinn, 'William Wood and the Coke-Smelting Process', *Trans. Newcomen Soc.*, **34**, 1 (1961), 56; pasted into the travel diary of Henrik Kalmeter, Vol 3, f. 80, 9 November 1723, Kungliga Bibliotek, Ms. M.249, Stockholm.

18. Anon, *Frauds and Abuses at St Paul's,* London, 1712, 6 & 24-9.

19. LMA, CLC/313/I/B/003/MS25473.

For extraordinary work:
For framing five pair of the gates in brass with screw brass locks,
escutcheons, bosses, and wrenches etc. *£80 0s. 0d.*
For masons' work in cutting holes for the bolts and balusters *£34 19s. 9d.*
For extraordinary charges for patterns for the rail *£50 0s. 0d.*
For 100 days work to lay the bottom stones for the gates
and punch holes for the piers *£13 12s. 6d.*
For extraordinary work in putting up the said gates *£50 0s. 0d.*

£11,430 12s. 9d.

To John Slyfield for carriage of Mr Jones's iron work from the water side to the church vizt.
For cranage, wharfage and carriage of 207¼ ton of iron to St Paul's from 13th Sept 1710 to the 10th June inclusive 1714, at 2s. 6d. per ton *£25 18s. 0d.'*

The job had taken the best part of five years.

A ground plan of the drains for the cathedral by William Dickinson, dated 1710, shows the proposed layout of the railings (Fig. 2). Contemporary pictures of the nearly- or newly-built cathedral show the grandeur of the architecture; the existence of the railings are acknowledged but their relationship to the building is merely representational, as are the human figures that are sometimes included to enliven the scene. Some of these drawings may have been made before the railings were even finished, but included to show how they were expected to look. However, certain consistencies do appear in these early drawings which imply that some early changes in the plan may have been made. For example, all show a continuous run of railings along the north side of the cathedral, but a discontinuous run along the south side. Breaks are shown for the great south door and for a smaller door under the south-west tower. Another feature that is shown on some later drawings, though omitted on others, is the sequence of lamps to light the way for pedestrians outside the railings; these were fixed to some of the large balusters in place of the regular finial or spike. These can be seen on Figure 3 and a single example is visible on the earliest photograph of the railings (Fig. 10). It is not known whether the lamps were an original feature of the railings or added before 1753. A plan of the cathedral churchyard

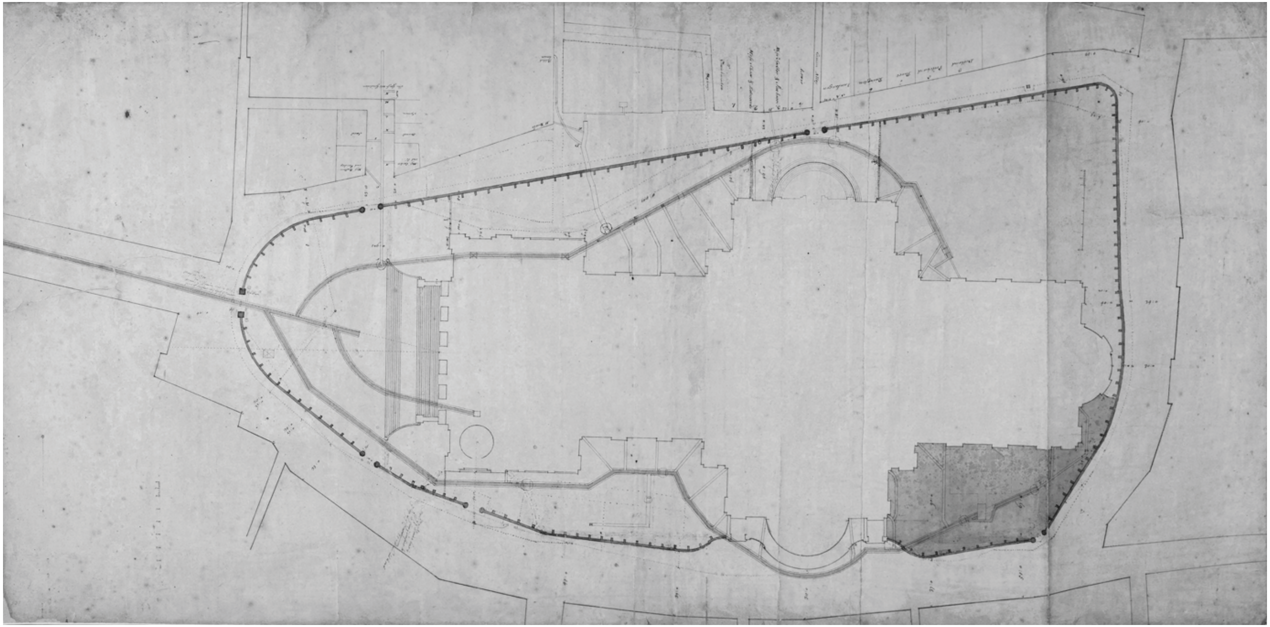

Figure 2. Plan of the cathedral and precinct showing the revised final scheme for the churchyard railings and the completed drainage layout, 1709-10, with amendments 1713; ©The Chapter of St Paul's Cathedral, WRE/7/2/3.

Figure 3. North west view of the Cathedral Church of St Paul, London, 1753 (Bowles & Carver 1794)
©Trustees of the British Museum.

drawn by C. R. Cockerell sometime between 1843 and 1857, which showed the line of the railings apparently unaltered, lacks the detail of the position of the main baluster scrolls.[20]

Alterations to the railings

In 1873 the decision was taken to improve the western approach to St Paul's. The Surveyor to the Cathedral, F. C. Penrose, drew up a plan for the removal of 370ft (113m) of the railings and the supporting wall at the western end to allow easier public access. The City Corporation made a grant of £15,000, and when the railings had been removed a public sale was held in December of that year which raised £340 5s.[21] In 1879 the wall supporting the remaining railings was lowered by 1ft 9in and the line of the railings was set back on the south side of the cathedral to allow a narrow pavement. At the same time, incurves were created where there were gates at the north-east and south-east corners.[22] Later reductions in the railings, which are more fully described by Schofield,[23] have occurred at the eastern end by the rebuilding of the cathedral school across the former eastern churchyard road, which has also resulted in some realigning, and by the removal of a length in the north-west corner. Most recently, some lengths of railing have been reinstated on the south side, work which has been carried out by the firm of W. & D. Cole Ltd (now Cole Ironcraft) of Bethersden, Kent.

Location of surviving examples

The section of railings that has been examined for this paper was acquired by the Wealden Iron Research Group in 1976 and displayed as part of an exhibition on the Wealden iron industry at Haxted Mill, near Edenbridge in Kent. When this closed in 1998 they were housed at Old Horam Manor Farm, near Heathfield, East Sussex, as part of a display of artefacts associated

20. SPCL, SPCAA/D/1/10/1, Plan of Saint Paul's churchyard, c.1843-1857.

21. LMA, CLC/313/I/E/014/MS25809, vol. 1 f.10v.

22. Op. cit., f.19r.

23. J. Schofield, *St Paul's Cathedral: archaeology and history*, Oxford, Oxbow Books, 2016, 101-2.

with the iron industry. WIRG recovered possession of the railings in 2007. Following detailed examination by John Collett, the section was donated to the Eden Valley Museum at Edenbridge. In 2018 they were transferred to the Museum of Rural Life at Tilford, near Farnham in Surrey.

Other sections can be seen at Lewes Castle, Sussex, in the Metalwork Gallery at the Victoria & Albert Museum, London, in store at the Museum of London, and outside Lamberhurst War Memorial Hall, Kent. Those in the Victoria & Albert Museum perhaps represent the most complete example of an original section. In each location the sections comprise the same sequence of a rail, four small balusters and a central large baluster with accompanying spikes and finials, all except the section at Lewes having a supporting scroll. One of the gates removed in 1873 was donated, in 1898, by the Dean of St Paul's to Hastings Museum, where it remains.[24] A section of the railings removed in 1873 was shipped to Canada. Shipwrecked in the St Lawrence river, some of the railings were salvaged and used to form a fence in front of the tomb of John Howard and his wife, Jemima, in High Park in Toronto. Some railings were acquired in 1896 by Sir George Barham, founder of Express Dairies, to enhance his estate at Snape, near Wadhurst in Sussex. Several generations of Barhams, from whom Sir George sought to trace his descent, had been ironmasters in that area in the 16th and 17th centuries. The railings he purchased form part of the entrance to the property and still bound a section of the garden.

Components, materials and their manufacture

Many writers on architectural ironwork have referred to the railings. John Starkie Gardner commented on their high cost and considerable weight but did not try to explain why they were so expensive.[25] W. R. Lethaby described them briefly and commented on the practical difficulties in transporting them from Sussex to London.[26] He was followed by John Gloag and Derek Bridgwater who, like Starkie Gardner, mentioned examples of railings in

24. LMA, CLC/313/I/E/014/MS25809, vol. 1 f.25r.

25. J. Starkie Gardner, *Ironwork Part III*, London, His Majesty's Stationery Office, 1922, 119.

26. W. R. Lethaby, 'English Cast-Iron - II', *The Builder*, **131** (5 Nov 1926), 741.

Oxford, Cambridge and London that were constructed in the years after the St Paul's set.[27] But again, no mention of how they were constructed. Even the splendidly practical Raymond Lister, whose firm had done restoration work on the near-contemporary railings around the Senate House in Cambridge, made no mention of how they were assembled.[28] The most recent publication to mention the railings is by John Schofield, for many years the cathedral archaeologist, whose comprehensive book on the archaeology and history of the Wren cathedral describes in detail the layout and construction of the railings but similarly does not address the technology of their manufacture.[29]

In the accounts of 24th June 1714 to 31th December 1714 the components are listed as follows:

12	*Gates*
149	*Large Balusters*
2516	*Small Balusters*
157	*Scrolls*
314	*Rails*
5051	*Spikes*
2422	*Baies for Spikes*
8	*Stubs and Braces*
146	*Plates for Scrolls*
31	*Stubs and Steps for the Gates to hang on and shut against*
194	*Bolts for the Breaks and Piers*
6	*Steeled Punches*
	Small plates, pins and wedges

There is some inconsistency in the numbers of components. E.g. there are 2516 small balusters, all of which would have a spike above. In between each baluster (large and small) would be a further two spikes, one in the wall and another in the rail, which would amount to 5330, making a need for 7846

27. J. Gloag and D. Bridgwater, *A History of Cast Iron in Architecture*, London, George Allen and Unwin, 1948, 115.

28. R. Lister, *Decorative Cast Ironwork in Great Britain*, London, Bell, 1960, 143-4.

29. Schofield, *St Paul's Cathedral: archaeology and history*, 62-6.

spikes in all (even the gates had spikes). Yet only 5051 are accounted for.

The design of the railings demonstrates a close affinity with domestic interior joinery. The balusters, large and small, include features that are found on new staircases of the period. Their lower parts have both vase- and bottle-shaped elements, while the upper parts' straight tapering form is consistent with what craftsmen in wood were making in the early-18th century. The arrangement of rings at various levels on the balusters is also typical.[30] The bottle shape was echoed in the finials for the large balusters that have survived on a few examples that were removed in the mid-19th century. The rail performed a different function to the handrail of a domestic staircase so its shape is less easily compared to interior house fittings.

The original railings (excluding gateways) comprised the following components, of which those examed are marked thus*:

Part no. (see Figs. 4 and 5)	Description	Material
1	Large baluster*	Cast iron
2	Small baluster*	Cast iron
3	Scroll*	Cast iron
4	Rail*	Cast iron
5	Small baluster spike collar*	Cast iron
6	Vase finial*	Cast iron
7	Wall spike*	Wrought iron
8	Rail spike*	Wrought iron
9	Small baluster spike*	Wrought iron
10	Ball and acorn finial*	Cast iron
11	Large baluster spike	Wrought iron
12	Scroll plate	Wrought iron?
13	Large baluster spike collar	Cast iron

A small selection of fragments of spikes donated by the late Joe Pettitt were

30. L. Hall, *Period House Fixtures and Fittings 1300-1900,* Newbury, Countryside Books, 2005, 112.

Figure 4. The railings outside Lamberhurst War Memorial Hall showing the components numbered (photo: J. Collett).

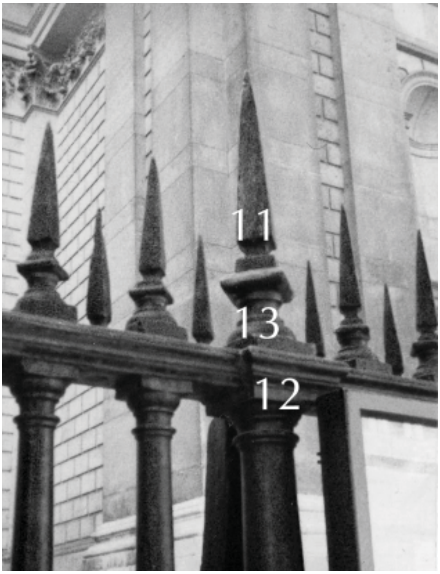

Figure 5. A large baluster spike and associated components, St Paul's Cathedral, north-east corner (photo: J. Collett).

also available for examination.

Each of the balusters and the scroll terminated at the base in a square dovetail that was set with lead into the 3ft 3½in brick wall that originally formed the base of the railings.

Large balusters (Fig. 6)

Made of turned cast iron; 4ft 2¾in (1.289m) long, including the dovetail set into the wall. At 3ft 10¼in (1.174m), the visible height of these balusters was 9⁄16in (14.28mm) shorter than the small balusters to allow space between the top of the baluster and the underside of the rail for the plate to which the scroll was riveted. The large balusters were not threaded at the top. Instead they had a shallow square recess which would presumably have housed a loose, thin, square nut for attaching the vase finial.

Small balusters (Fig. 6)

Made of turned cast iron; 4ft 13⁄16in (1.249m) long, including the dovetail set into the wall, 3ft 1013⁄16in (1.189m) visible. At the top was a hole drilled to about 17⁄20in (21.59mm), hand-tapped to about 5 threads per inch (tpi) at

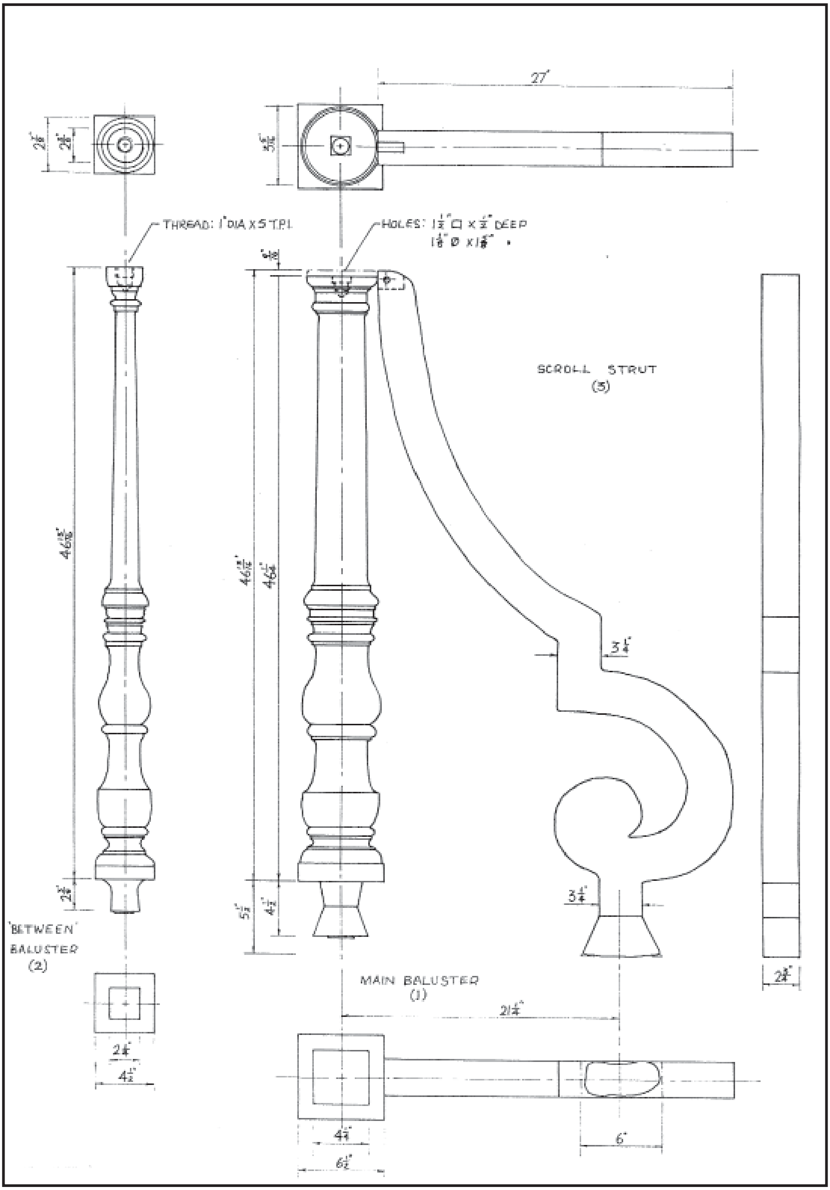

Figure 6. Drawing of small and large balusters and scroll; scale 1:8•8 (R. Houghton).

90°.

Rail and spikes (Figs. 7 and 8)

Made of cast iron, the rail that joined the balusters was made in sections. Short sections of rail included the large baluster and two small balusters on each side, with the rail widened into a square round the large baluster. Between these short sections longer sections of rail (not available for examination) generally incorporated 11 small balusters, although this number could be fewer to accommodate gateways, and it is evident from William Dickinson's plan that a small number of portions of the railings were curved. The sections of rail were joined by a wrought-iron tenon that was riveted into a mortise cast into the end of the rail.

Between each baluster and the spike screwed into it through the rail, an intermediate wrought-iron spike was riveted into the rail at an angle of 45° in plan. The threaded shank was of wrought iron. One of the additional examples available for examination showed that the shank had been twisted quite severely, anti-clockwise, as a result of being unscrewed with difficulty. Were the shank made of cast iron it would not have withstood such twisting and would have sheared. One of the small baluster spikes, now in the Eden Valley Museum, Edenbridge, was bisected to show it in section, with the surface etched to reveal the structure.

Scrolls (Fig. 6)

Made of cast iron. The scrolls supported the railings by attachment to a plate (not available for examination) that fitted between the top of the large baluster and the rail. The plate had a right-angled protrusion that was pinned into a slot at the top of the scroll. On the example in the Victoria and Albert Museum the top of the scroll is cut in half instead, but this may have been modified for the museum installation. It is likely that the scroll that supported each large baluster was cast in an open sand mould. A dovetail tenon on the other end of the scroll was embedded into an extension of the brick wall on which the rest of the railings stood.

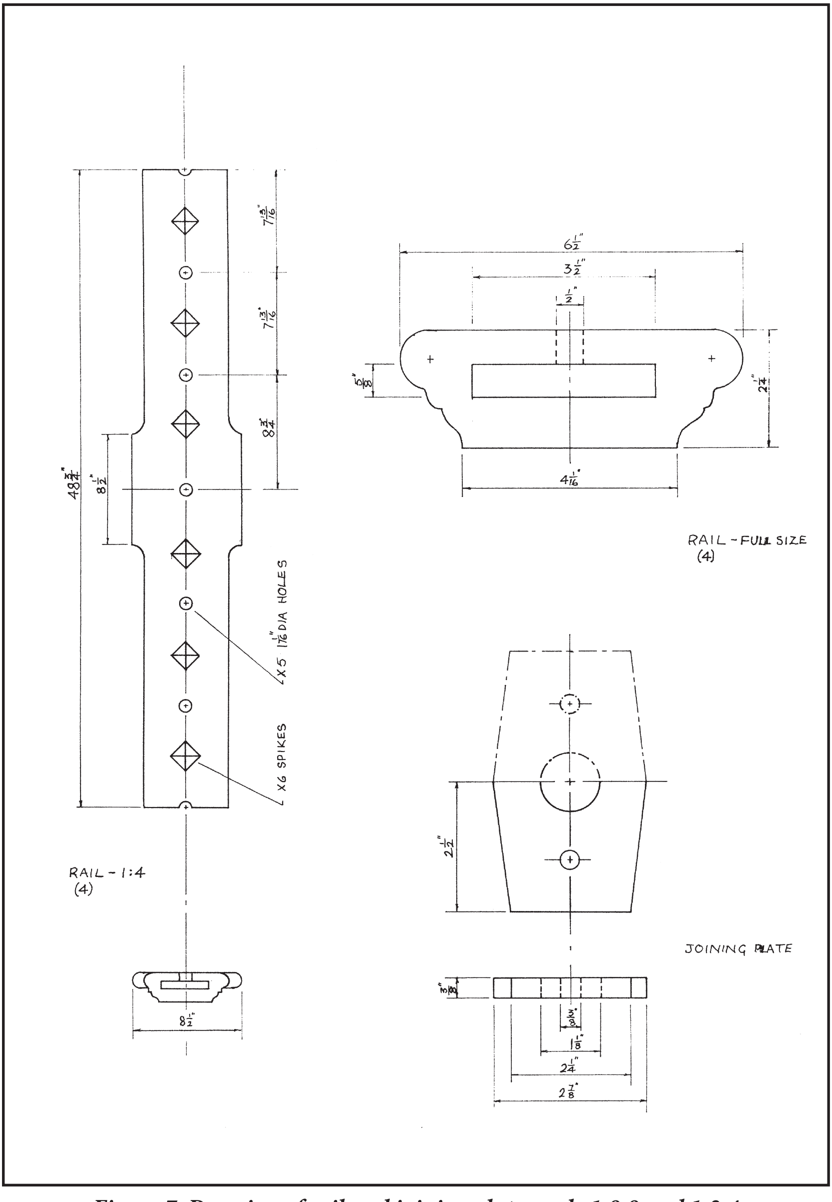

Figure 7. Drawing of rail and joining plate; scale 1:8·8 and 1:3·4 (R. Houghton).

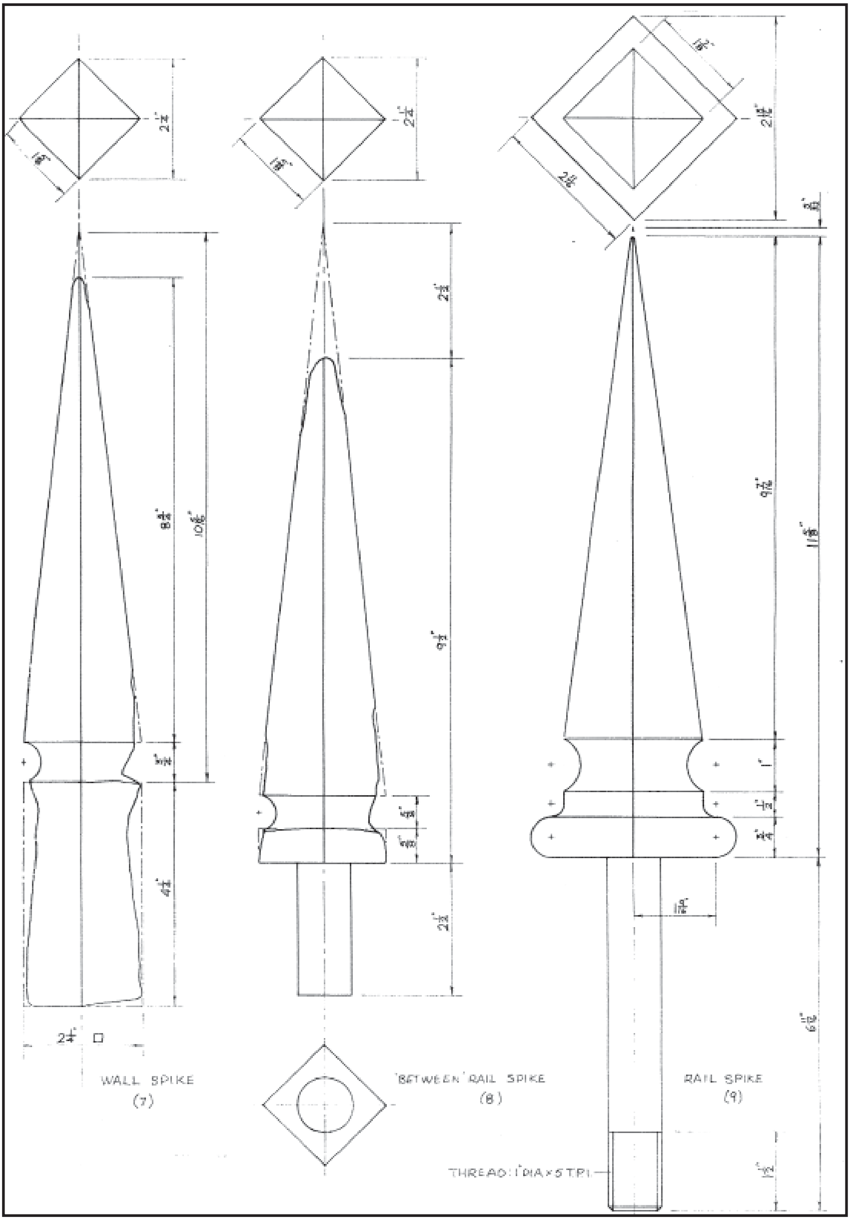

Figure 8. Drawing of baluster, rail and wall spikes; scale 1:3·4 (R. Houghton).

Small baluster spikes (Fig. 8)

Made of wrought iron with a wrought iron threaded shank that screwed at 45° in plan, via a collar, through the rail into the top of the small baluster. With the collar, the spike stood 1ft 3³⁄₁₆in (385.76mm) above the rail.

Collars (Fig. 9)

Made of turned cast iron, these are probably the 'baies for spikes' mentioned in the original inventory. They fitted between the rail and the squared flange of the small baluster spike.

Vase-shaped finials (Fig. 9)

Made of cast iron in two parts with a wrought-iron threaded shank at the base for screwing through the rail and the scroll plate into a nut in the top of the large baluster. On top, a wrought-iron shank fitted into a separate ball and acorn finial.

The extant railings around St Paul's Cathedral have a large spike above each of the large balusters. However, among the components that comprise the sections acquired by the Victoria and Albert Museum, the Museum of London, the village of Lamberhurst and the Wealden Iron Research Group is a vase-shaped finial that was attached, above the rail, to the top of each large baluster. It seems likely that this feature formed part of the original design, but that either a decision must have been made to replace some of them with a larger version of the spikes that were fixed to the top of each of the smaller balusters, or that the vase finials were only intended for specific locations. A photograph taken before the railings were removed from the western approach to the cathedral, and six years before Penrose's alterations to the remainder of the railings had begun, clearly shows large spikes above the large balusters (Figs. 10 and 11). The reasoning behind the replacement of the vase finials can only be guessed at, but it is significant that only on the section at Lamberhurst has the finial survived in a complete form, surmounted by a ball and acorn (Fig. 12). This must have presented a tempting target for vandals, and photographs dating to the late 1950s or early 60s of a small section of railings in the south-west corner of the cathedral, that had not been subject to the otherwise wholesale repositioning under Penrose, show

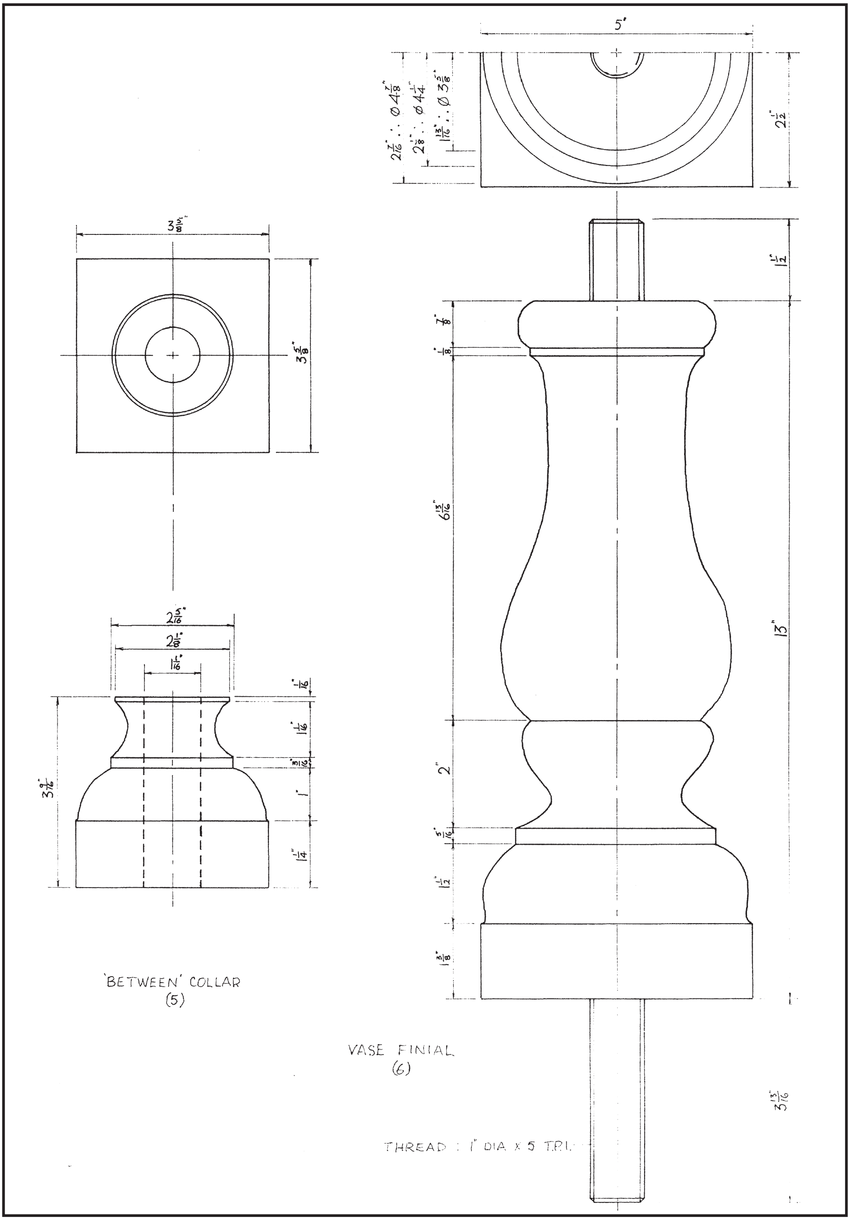

Figure 9. Drawing of baluster, rail and wall spikes; scale 1:3·4 (R. Houghton).

a vase-shaped finial still in position but missing its ball and acorn (Fig. 13). The survival of this section strengthens the case for the vase finials being part of the original design. Schofield states that the section was removed in 1984.[31] Unlike the balusters and the collars for the threaded spikes, the vase finial was not turned. Possible reasons for this might be that this component was cast by a sub-contractor, or that it was delivered late and turning would have delayed the completion of the contract.

Wall spikes (Fig. 8)

Made of wrought iron with a dovetail tenon for setting at 45° into the supporting wall; 10½in (266·7mm) high proud of the wall.

Missing from the components examined was the wrought-iron, tanged plate that was located between the top of the large baluster and the rail, and to which the supporting scroll was fixed with a pin (Fig. 14). Apart from the spikes, all of the main components were made of cast iron. A description of the general principles of casting such objects can be found in Raymond Lister's *Decorative Cast Ironwork in Great Britain*.[32]

Machining the parts

All the cast iron components required some machining so as to be ready for assembly. Holes had to be drilled in the tops of the balusters, which were then tapped, i.e. given a female thread, and the balusters had to be turned.

The Commissioners had specified in 1710 that 'the fence around the church be of cast and turned iron work'. Similar railings at St Leonard's Church, Shoreditch, London, which were made in 1740, are not turned although the balusters are very similar; the parting lines resulting from their being cast in a split mould may be felt and seen but only with close examination as they were dressed well. The St Paul's balusters were indeed turned since where they have not suffered from rusting the turning marks may be seen and they are circular by

31. J. Schofield, St Paul's Cathedral south-west churchyard, unpublished report, 2005, 8-9.

32. Lister, *Decorative Cast Ironwork*, 10-57.

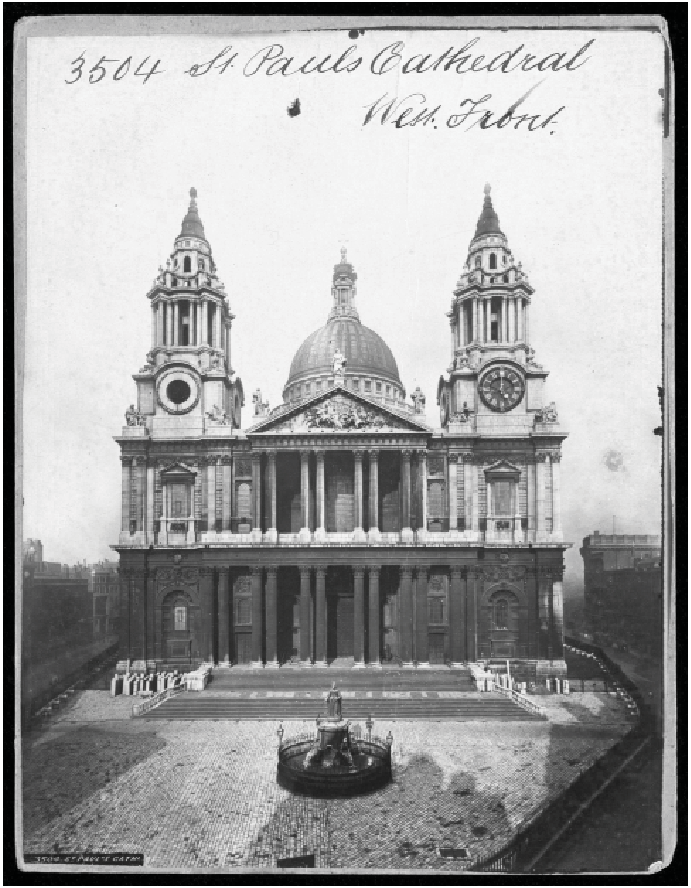

Figure 10 (left). Photograph of the west end of St Paul's Cathedral pre. 1873. A lamp attached to the railings can just be seen on the far right (Francis Frith and Co.); ©Victoria and Albert Museum, London.

Figure 11 (below). Detail of the bottom right corner showing the large baluster spikes.

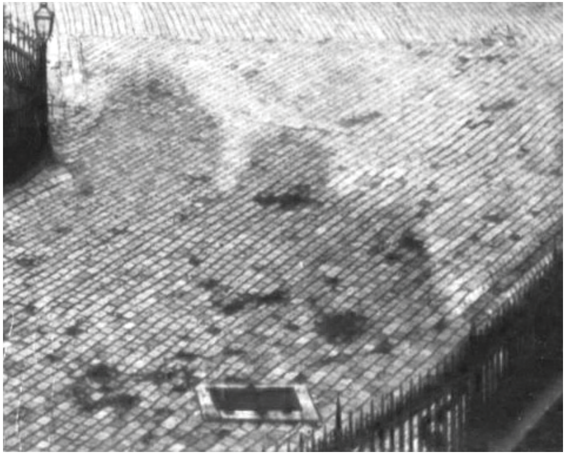

Figure 12. Ball and acorn finial, Lamberhurst War Memorial Hall, Kent (photo: J. Hodgkinson).

Figure 13. Photograph of railings at the south-west corner of St Paul's Cathedral c. late 1950s-early 1960s; ©National Monuments Record EH 3137-15.

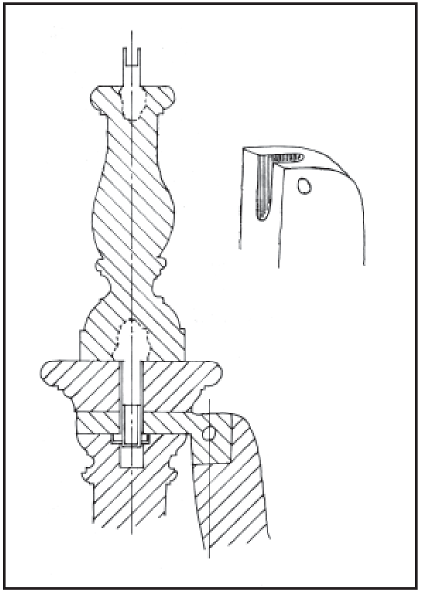

Figure 14. Sketch drawings of the vase finial and scroll assembly (J. Collett).

measurement within quite close limits.

In order to turn the balusters, firstly they would need to be centered carefully so that the shaft would run as truly as possible when mounted in a lathe. Since there were many to be done no doubt one of several possible methods evolved as best. Thus a central, conical hole was drilled in the lower end and a hole, large enough to be threaded later, in the top end.

The Wealden furnaces that produced cannon also in most cases also reamed and finished their bore but this was not done using a lathe. Stone masons who produced balusters did however use lathes to turn them and would have developed methods of copying the profile for many parts so it seems likely that their experience was called on to develop machines to turn the cast-iron balusters.

A possible arrangement would be to have a lathe with a cross slide, able to move at 90° to the axis of the lathe, with a tool mounted on it, perhaps controlled by a lever. This would be fitted with a finger that stopped the inwards traverse when it contacted a bar fixed to the lathe bed and this bar would have the profile required along its length. The cross slide would need to be so arranged that it could be moved along the lathe bed in small increments, say ¼in, re-secured to the bed each time, thus allowing a series of radial cuts to be made into the casting. The tool would need to be carefully set in relation to the stop finger, and tool changes made to deal with the various changes of profile. Once this had been done along the length of a baluster the profile would be turned all along but with a ridged surface, this could then be finished to give a smooth surface with a hand held tool using a tee-rest as wood turners do.

How long it might take to carry out the above would depend on the set up of the lathe and tooling, also on the skill of the operator. Since there were several thousand to do no doubt this was developed to a fine art.

Gates

The earliest surviving plan of the layout of the railings confirms that there were originally six entrances, for each of which there must have been a pair of gates corresponding with the 12 listed in the accounts. The work carried out in the 1870s by Penrose involved replacing and repositioning the gates. One of the original gates has survived, and was donated to Hastings Museum and Art Gallery in 1898 (Fig. 15). It comprises a horizontal arrangement of two raised and fielded panels with ovolo-moulded profiles, in imitation

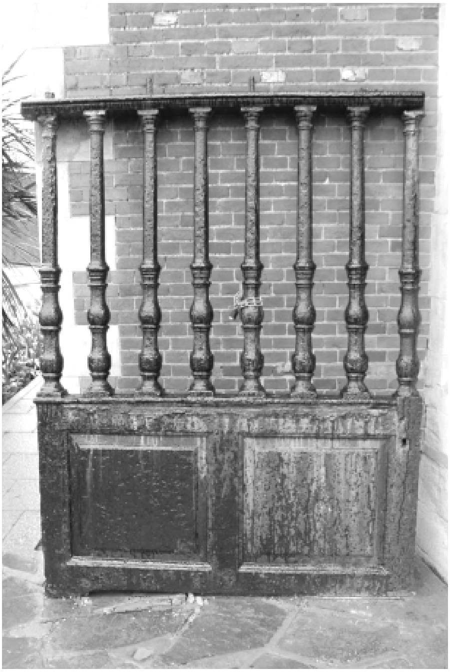

Figure 14. Gate from St Paul's Cathedral pre. 1879; Hastings Museum and Art Gallery (photo: J. Hodgkinson).

of wooden joinery, with eight small balusters above, interspaced with seven spikes. The balusters are attached to a rail above by a corresponding number of spikes screwed to the balusters, and seven interspaced spikes set into the rail. Each gate was 1.62m wide with the bottom panels 91cm high at the hinge stile, where the gate pivoted in a plate set into the ground. Above the top rail of the bottom section of the gate, below the balusters, is a plate moulded into the top rail. This does not extend to the lock stile which is extended above this plate. Accordingly, the baluster above the lock stile does not have a square plate beneath it while the other seven do.

Conclusion

There seems little doubt that the complexity of the construction of the railings represented an advance in the application of cast-iron for public use, and that previous writers on the use of cast iron in architecture have been unaware of the degree of sophistication that the railings represent. The use of threaded components, and of turning to achieve a higher standard of finish, was to set a standard that was not be equalled for some time. The authors are conscious that their interpretation of the materials and of the methods used to manufacture the railings could be a matter for some debate.

Acknowledgements

The authors are most grateful to Roger Houghton for his scaled drawings of the components, and to John Schofield for making available some of his extensive knowledge of the cathedral as well as commenting on a draft of this article. They are also grateful to the staff at Cole Ironcraft, St Paul's Cathedral Library, the Guildhall Library, the Victoria and Albert Museum and the Museum of London for their assistance.

Sadly, John Collett passed away before this article was published. His training in engineering enabled him to carry out the detailed inspection of the railings without which this article would not have been possible.

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