THE EXCAVATION OF A TRIAL TRENCH ACROSS THE MOAT AT HAMPTON COURT PALACE

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SUMMARY

The Historic Royal Palaces Agency (HRPA) commissioned the Oxford Archaeological Unit (OAU) to excavate a trial trench in the north arm of the Tudor moat at Hampton Court Palace. The excavation provided a 12.5m-wide section through the north side of the moat. The full width could not be established as the southern edge of the moat lay beyond the area available for excavation. The northern edge had a stepped, then gradually sloping edge which had no revetment wall at this point. The bottom of the ditch was located 4.2m below the present ground surface at the south end of the evaluation trench.

Study of the environmental samples taken from the bottom of the ditch suggest that common lime, horse chestnut and box were being grown in the vicinity of the moat in the early post-medieval period. The finds retrieved from the layers of backfill consisted mostly of 18th and 19th-century pottery, glass and clay pipe fragments; a small quantity of earlier post-medieval pottery and clay pipe was also found.

A narrow brick wall was found c.1.5m below the present ground surface. The wall had a gravel path running parallet to its north; a layer of loamy (?garden) soil was associated with these features, which appear to represent a 19th-century garden layout or border along the line of the moat. The foundations of a number of 19th-century brick structures were also found. These can be related to buildings shown on contemporary maps. The walls were left in situ.

INTRODUCTION

A trial trench was excavated across the north arm of the moat at Hampton Court Palace (NGR TQ 15776862) in June 1994. The site lies to the south of the 17th-century Royal Tennis Court and lies within the width of the backfilled moat. The aims of the excavation were to establish the construction techniques and (as far as possible) dimensions of the Tudor moat, and to characterise its backfill. Documentary sources attest to the use of parts of the moat as a dumping ground for demolition material from Tudor lodgings and other buildings during the 17th and 18th centuries. The trench was thus also intended to determine whether architectural fragments relating to these early buildings had been dumped in the north arm of the moat.

ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

Hampton Court began its life as a small, moated site owned by the Order of St John of Jerusalem, generally known as the Knights Hospitallers. The Knights held the site from the 12th century until 1505, when they leased it to Giles, Lord Daubeny, Chamberlain to Henry VIII. Daubeny died in 1508, and the site was subsequently leased to Thomas, Cardinal Wolsey, in 1514. Daubeny had probably begun to develop the site, but Wolsey was responsible for building many of the Tudor buildings seen today.

Wolsey built extensive lodgings for Henry VIII at Hampton Court. These were completed in 1525, but by 1528 Wolsey had fallen from favour. The king himself took over Hampton Court and

continued to develop it (Thurley 1988). Henry made extensive use of the palace and it continued to be favoured as a royal residence for several centuries. William and Mary were responsible for extensive rebuilding works in the late 17th century, during which time most of the Henrician royal lodgings were demolished. George II was the last monarch to live at the palace, and it was increasingly used for 'grace and favour' apartments from the middle 18th century onwards. The palace was opened to the public by Queen Victoria in 1838.

Wolsey probably began the excavation of the moat around Hampton Court during his tenure. The moat appears to have been a continuous feature around the whole of the palace in the Tudor period, when its function would have been as much sanitary as defensive. It must have been dry in places, as there was a pheasant yard in the moat. There were several bridges, the principal one being on the west side to coincide with the Great Gatehouse. The moat was already being filled in during the 17th century (Colvin *et al* 1976, 160), and the bridge in front of the Great Gatehouse was buried at this time. Late 17th and early 18th-century plans show that only the north half of the west arm and the north arm of the moat were still open, and even these had been filled in by the middle of the 19th century. The moat at the west front was re-excavated in 1910 (Chettle *et al* 1982, 6).

SITE TOPOGRAPHY

Hampton Court lies on Thames terrace gravels. Alluvial deposits are present on the floodplain. The trench site is part of the southern border of an area of extensive gardens known as the Wilderness. The border contains mature trees, saplings and shrubs, and landscaping has completely obscured the position of the moat on the ground. Some buildings which lie on the line of the moat, however, have suffered serious problems of subsidence, most noticeably in a post-medieval brick tower attached to the mason's yard at the north-west corner.

The trench falls partly within the open moat shown on John Rocque's map of 1736. A mid 18th-century plan does not positively depict the moat, but neither does it show any other buildings in the area (PRO Works 34/44). Brick buildings and structures are shown here, however, on maps of 1841 (PRO Works 34/1349) and 1851 (Map of the Royal Parks of Hampton Court and Bushy). It is assumed that they were built in the early 19th century, but most of them had been demolished by 1912, by which time the existing greenhouse and office had been built (see Fig 1).

METHODOLOGY

A single trial trench measuring 14m long and 4m wide was excavated at right-angles across the moat. The position and size of the trench was dictated by several physical constraints. These included the avoidance of Tudor and later masonry and modern services, and the position of mature trees. The site of the trench, on an area of managed rough grass, presented the only possible location for a trench wide enough to allow stepping in of the sides. This was necessary so that excavation could proceed to the bottom of the moat in at least one area.

The trench was excavated to a depth of *c.*1.2m using a JCB mechanical excavator equipped with a toothless ditching bucket. The first undisturbed moat fills, and structures/features cutting them, were observed at this level. The trench was then stepped in to a width of 1.7m. Deeper excavation continued by hand up to a depth of 2.4m below the surface, whereupon further work was concentrated in two selected areas where shoring was used to secure the trench sides.

All deposits, structures and features were assigned a unique context number in a continuous sequence. The various phases of deposits and structures were described, planned and photographed as excavation proceeded, using standard OAU methods and formats (Wilkinson 1992). Finds were collected by context, and environmental samples were taken from deposits of potential interest.

ARCHAEOLOGICAL DESCRIPTION

The moat

The natural sandy gravel was overlain by a 0.7m-thick deposit of light brown silty sand [121] in the first 1.5m at the north end of the trench. Layer [121] was then cut away by the north edge of the moat ditch, which had two steep steps at its north end before assuming a more gradual slope to the south.

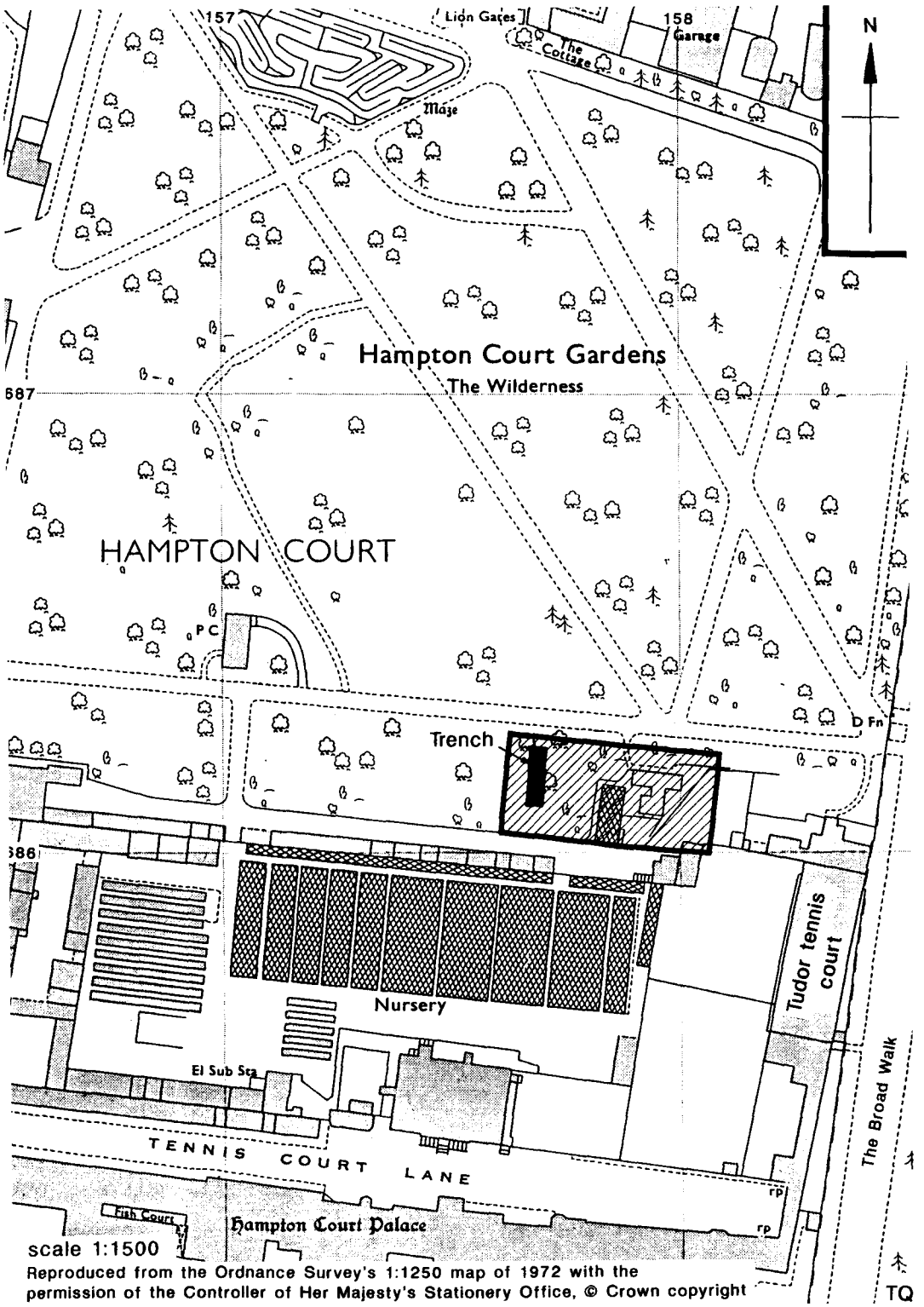

Fig 1. Hampton Court Palace moat trench: location plan

A 5.5m long × 1.7m wide segment was excavated through the moat backfill at its north end. The bottom of the moat was 3m below the present ground surface (or 7m above Ordnance Datum) at the southern end of this segment, and it continued to slope down to the south. A further segment was excavated to the bottom of the moat near the south end of the trench. The undisturbed natural sand was found at a depth of 4.2m below the present ground surface (or 5.8m above OD). The base had flattened out by this point. The considerable depth meant that the area of excavation had to be stepped in three times. Only a 0.5m x 0.4m slot could be excavated to the very bottom of the moat.

The moat backfill

The primary fill of the moat was only found in the base of the southern segment, and consisted of dark grey, organic, fibrous loam [181]. This visibly contained macroscopic plant remains, including horse chestnut seeds. The only find was a large, undiagnostic fragment of ceramic roof tile. The organic layer was sealed by a sequence of layers containing variable proportions of sand, clay and silt [177–80], the latter containing lenses of organic material). The layers sloped in from the north, but it was noticeable that they levelled off at a consistent point (see Fig 2). The layers were between 0.08m and 0.28m thick. Layers [177] and [178] contained pottery and clay pipes suggesting a deposition date in the late 17th or early 18th century.

The primary deposits in the southern segment were sealed by a sequence of predominantly sandy or silty layers with a variable gravel fraction [160, 166–7, 172–6]. Pottery, glass and clay pipes dating from the 17th to 19th centuries were found in these layers. A few sherds of 16th-century pottery were also found, but these were residual. The layers all sloped in from the north, but again they mostly levelled off at the same point as the primary deposits. The only exceptions to this were [160] and [166–7] (see Fig 2). These might represent a slightly later episode of filling, although the pottery from layers [160] and [172] has a very similar date range. The top of these deposits lay 1.8m-2.15m below the present ground surface (or at 8.15m–7.8m above OD).

The moat backfill in the northern segment consisted of layers of sandy silt and deposits of sand and gravel, all tipping down to the south [119, 151–2, 161–2, 164–5, 174]. Pottery, glass and clay pipes dating from the 18th and 19th centuries were retrieved from these deposits, along with a few residual pot sherds of 16th and 17th-century date. No architectural fragments other than roof tile were retrieved from this segment. The only unusual find was that of an articulated horse skeleton [153], comprising the back half of the horse with the hind legs missing. The remainder of the torso lay beyond the limit of excavation. A single posthole [158] was found towards the north edge of the moat (Fig 3a). The posthole cut through [156], and was in turn sealed by [125], showing that the feature was not part of the primary moat construction.

Section 1 (composite)

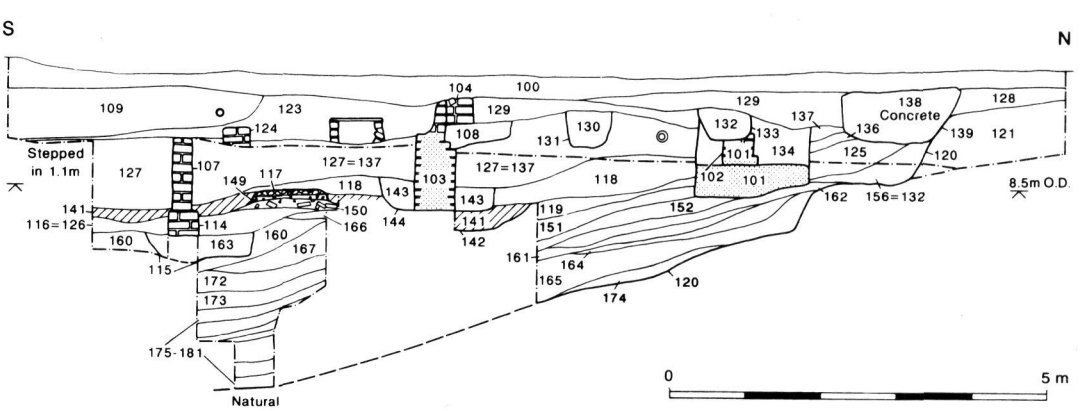

Fig 2. Hampton Court Palace moat trench: section of the trench (scale 1:75)

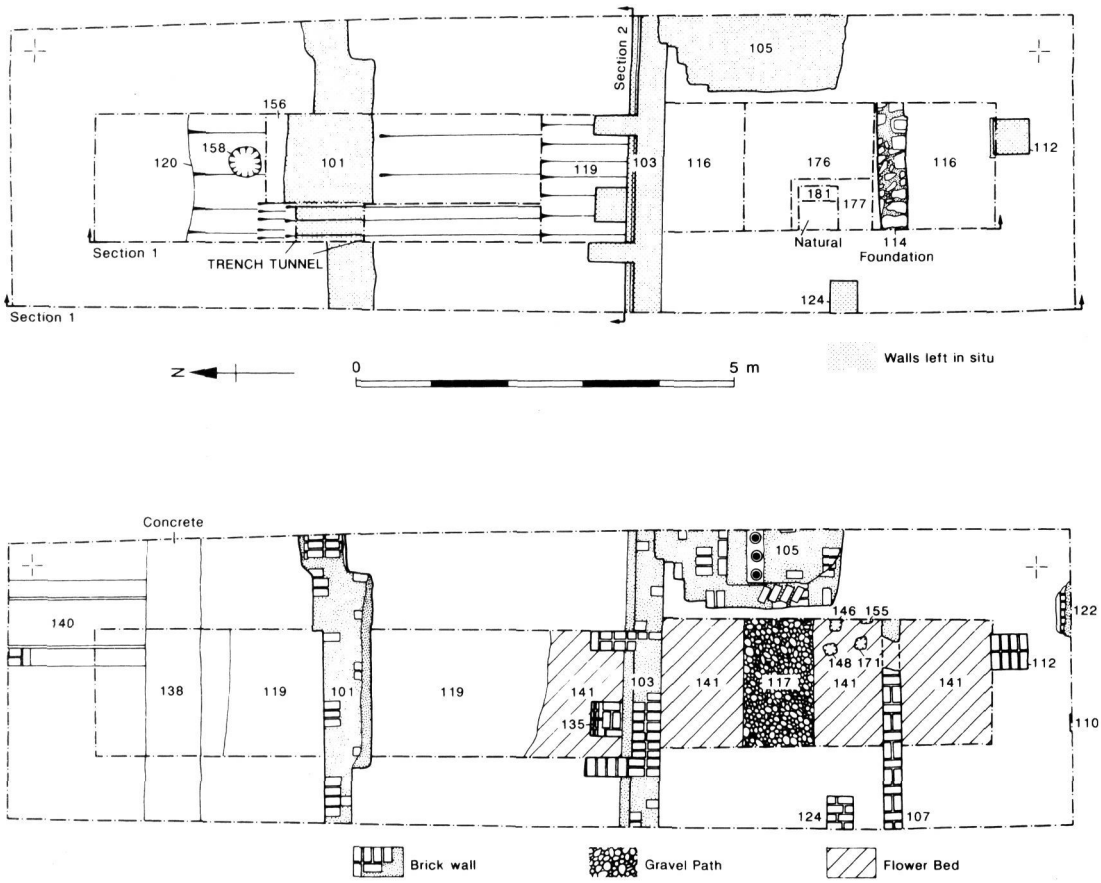

Fig 3. a) Hampton Court Palace moat trench: plan showing north edge of moat (scale 1:75); b) Hampton Court Palace moat trench: plan showing principal 19th-century contexts (scale 1:75)

Victorian structures, features and associated deposits

An east-west foundation trench [115], some 1.4m wide and 0.3m deep, cut the top of the moat backfill layers close to the south end of the trench. The trench was filled with clinker and brick hardcore, and contained 19th-century pottery. It represented the foundation for wall [114/107]. The offset base courses [114] were 0.4m wide and 0.35m high, and were built from reused pieces of Reigate stone (including one moulded fragment) and early post-medieval bricks. The upper part of the wall [107] was 0.22m wide, and was made of 19th-century bricks. The top of the wall lay 0.85m below the modern ground surface.

A layer of loam [116/126] containing fragments of post-medieval bricks abutted wall [114]. A 1.35m-wide linear deposit of densely-packed post-medieval brick rubble [150] overlay the loam approximately 0.8m to the north of wall [114]. The rubble formed the base for a narrower (1.1m wide) layer of sand containing crushed mortar and brick [149]; this was in turn overlain by compacted sand and gravel [117]. The top of this surface lay 1.5m below the current ground level. A deposit of grey brown loamy soil [141] abutted both the linear feature and wall [114/107] (see Figs 2 and 3). Four closely-spaced post-voids [146, 148, 155, 171] were visible from the top of layer [141], in the area immediately to the north of wall [107] (Fig 3b). The post-voids were at least 1.6m deep; they still contained fragments of the decayed posts.

A deposit of silty loam [118] overlay the linear gravel strip and layer [141], and extended throughout the central area of the trench. An east-west foundation trench [144] cut this layer and contained brick wall [103]. The wall had an

open relieving arch springing from the top of the foundation, and two buttresses on the north side. A further buttress [135] had been inserted on the north side to underpin the arch, which had a large crack at the crown.

A number of other brick structures lay partly within the trench [105, 112, 122, 124]; Fig 3b). The stratigraphic relationship between these structures and wall [103] could not be determined, but they appeared to have been built from the same level. They are therefore considered to be at least broadly contemporary. Structure [105] appeared to abut wall [103], and consisted of a brick vault containing a metal tank. A similar feature could be seen in the east face of the trench, where soil had fallen away from the section to reveal a brick void immediately to the north of wall [103].

Modern features

A series of dump layers [109, 123, 127, 128, 129, 137] abutted and/or overlay the brick structures. The dumps were truncated by concrete foundations, drains, and other modern disturbances.

THE POTTERY

Lucy Whittingham

A small assemblage of pottery (126 sherds, 3.997kg) was recovered during the excavation. The sherds were catalogued by context, using standard fabric codes based on the Museum of London's recording system. The earliest red earthenwares present are 16th century (or possibly late 15th century) in date, but they always occur with wares of a later date and are probably residual. The assemblage as a whole dates from the 16th to early 20th centuries.

The majority of the pottery (65 sherds) consisted of glazed red earthenwares. There were three distinct types: Tudor Brown (TUDB), Red Borderware (RBOR), and glazed/unglazed red earthenwares (GREW/REW). The Tudor Brown wares are the earliest of these fabrics found in the London region, characterised by their reduced external surface and dated as late 15th to 16th century. The ten sherds include three rims from a cooking pot, a jar, and a large storage jar. Red Borderware is a distinctive product of the Surrey-Hampshire Borderware industry and appears to be a slightly later product than the more common Surrey White wares, beginning in the 17th century and continuing into the 18th century. It is characterised by well-made finely thrown forms and glossy lead glaze. The nine sherds here include seven from one 17th-century bowl/porringer. The remaining 46 red earthenware sherds are found in both the coarse and fine quartz-gritted fabrics which began to dominate the London market in the early 17th century and continued into the 19th century.

One handle and 21 sherds from an imported Rhenish Westerwald Seltzer bottle (WEST) are of 18th-century date and represent the only import in the collection. The bottle is stamped with the letters 'SELT ...' around a central cross and further blurred letters. The stamp is ringed in blue cobalt.

Nine sherds of tin-glazed ware (TGW) include one with a mixed lead and tin glaze which can be dated from early to mid 17th century, while the others have a distinctive blue glaze which is characteristic of the 18th century. The 18th century vessels include the rim of a drug jar, a shallow open bowl, and the footring from a large dish/charger. Seven sherds of Staffordshire white salt-glazed ware (SWSG) include two moulded plates with decorated rims of 'dot, diaper and basket' and 'seed or barley' designs, and one thin-walled bowl. These vessels date from 1720 to 1770. Creamwares (CREA), comprising nine undiagnostic sherds and one footring base from a bowl, are a late 18th to 19th-century introduction to the site.

The rest of the assemblage comprises one or two sherds of the following fabrics: English stoneware and London stoneware (ENGS & LONS); English porcelain (ENPO); Staffordshire press-moulded slipware (STAFFS); Pearlware (PEAR); Mocha Ware; transfer-printed ware (TPW); and Red Basalt (RBAS).

CLAY PIPES

Dr David Higgins

Fifty-six fragments of pipe were recovered, comprising seven bowl, 46 stem and three mouthpiece fragments. The earliest bowl is a variant of a London type 19 bowl from context 119 (Atkinson & Oswald 1969). This style was very common south of London during the late

17th and early 18th century but they were almost always unmarked, making it impossible to identify the individuals who made them.

Two London type 25 bowls, a form current from *c.*1700–70, were recovered. The example from [151] has a quite chunky, 'heavy' feel to it, with thick walls. These features suggest that it is an early form, probably dating from the first 30 or 40 years of the 18th century. The heel is marked with the moulded initials RT. In a study of Surrey pipes, five examples of 18th-century bowls marked RT were recorded (Higgins 1981, 226–238). There were single examples from Nonsuch Palace, Epsom and Ewell and two examples from Kingston. The RT pipe from Epsom was recovered from a pit group dated to *c.*1714–20 (Higgins 1987, 416). This supports the earlier 18th-century date suggested for the Hampton Court example. The identity of the RT maker is not known although the marked cluster of these pipes in north Surrey is significant. This strongly suggests that the maker worked in this area, perhaps in Kingston where the pipemaking industry has been little studied.

Another marked pipe came from [141]. This has a damaged heel so that only the christian name initial R is intact although the lower part of the surname initial survives, showing that it had a single vertical stroke to it. This can only have been an F, I, P or T suggesting that this may also have been an RT pipe. This example is of a slightly later form, having a thinner stem, bowl walls and heel and with later finishing techniques, such as the lack of trimming to the base of the heel. This pipe is particularly interesting since it is decorated with the Prince of Wales feathers and motto and therefore belongs to a class of armorial designs first produced in London during the early 18th century and which continued to be produced, in various forms, until the demise of the industry in the 20th century (Le Cheminant 1981a, 1981b). Armorial pipes were never particularly common outside London although they were copied in some parts of Britain and quite large numbers were exported from London to America (Noël Hume 1970). The large, simple feathers and bold open leaves on the seam of this example are both characteristic of pipes produced from the 1740s to 70s (Atkinson & Oswald, 1980). This is in keeping with the form of the bowl and a date of *c.*1740–80 is suggested for this piece.

There do not appear to be any 'RT' armorial pipes documented from London, which might support a local origin for this piece. This suggestion is supported by the fact that the N of the motto 'ICH DIEN' has been cut in reverse. A small Prince of Wales bowl fragment with similar feathers, leaves and motto with a reversed N has been found at Kingston (Higgins 1981, Fig 44.2) and it seems highly probable that these two examples are from the same mould. Given the distribution of RT pipes in Surrey and the matching armorial bowl fragment there is no reason why all of the marked pipes from this excavation could not have been made by an 'RT' maker working in or near Kingston from *c.*1710–50.

The final bowl fragment from the excavation came from [175] and consists of a fine spur from a London type 26 pipe of *c.*1740–1800. This was never a common form of pipe, the type 25 being much more common. This example has quite a narrow bore and the base of the spur has not been trimmed. Both these tend to be later features and suggest a date in the second half of the century for this piece. There are slight undulations in the bowl surface which suggest that the pipe may have had a decorated bowl.

The stems recovered from the excavation are almost all of a medium or thin diameter with a medium sized stem bore and a strongly cylindrical, neatly finished form. These features are all characteristic of 18th-century groups. One notable exception is a very thick stem from [175] with a bore of 8/64″ and diameter of 11mm. It is made of a soft fabric with a finely burnished surface, the only piece to be so treated from the excavation. This unusual piece may well represent a very early and well finished pipe, but it came from an 18th-century deposit where it was clearly residual.

MACROSCOPIC PLANT AND INVERTEBRATE REMAINS

Dr Mark Robinson

Two samples, each of 0.5kg, were studied for macroscopic plant and invertebrate remains from the lowest fills of the Hampton Court Palace moat. One sample came from layer [181], a black organic detrital sandy silt at the base of the moat; the other from [177], a dark brown humic sandy silt including mollusc shells.

The sample from [181] contained much waterlogged plant material such as deciduous

Table 1. Waterlogged macroscopic plant remains from [181] (seeds unless specified)

Ranunculus sceleratus L.	Celery-leaved crowfoot	1
Tilia cf. x *europaea* L.	Common lime	53
Aesculus cf. *hippocastanum* L.	Horse chestnut	1
Buxus sempervirens L. – leaf frag.	Box	2
Aphanes microcarpa (B.& R.) Roth.	Parsley-piert	1
Bellis perennis L.	Daisy	1
Leontodon sp.	Hawkbit	5
deciduous leaf fragments		+

tree leaf fragments, and was gently broken up in water; the lighter fraction was washed over onto a 0.2mm mesh. All waterlogged macroscopic plant remains are listed in Table 1. The heavier material was checked for mollusc shells, which were absent.

The organic component of the other sample was very humified and the only waterlogged macroscopic plant remains to survive were seeds of *Sambucus nigra* (elder), which are particularly resistant to decay. The mollusc shells in this sample proved to be very fragile and could not be extracted by sieving. Shells were therefore dissected from the broken up sample, a total of eight specimens of *Valvata piscinalis* (Müll.) being recovered.

The most numerous plant remains from [181] were seeds (fruits) of *Tilia* sp., lime. Some resembled the fruits of *Tilia platyphyllos*, being pyriform with five oblong ribs, but the majority were more elongate, with less well-developed ribs. They fell within the range of variation of fruits of *Tilia* x *europaea*, common lime. This is a hybrid of *T. cordata* Mill. (small-leaved lime) and *T. platyphyllos* Scop. (large-leaved lime) and is regarded as introduced or very doubtfully native to the British Isles (Clapham *et al* 1987, 165). It is a large, long-lived tree well-suited to parkland or avenue planting, and was first recorded as being cultivated in Britain during the early 17th century (Krüssmann 1986, 395; Mitchell 1981, 140).

A single seed (conker) of *Aesculus* sp., horse chestnut or buckeye, was recovered from [181], and others were noted by the excavators. It could be closely matched with seeds of *Aesculus hippocastanum*, horse chestnut, but it was not possible to compare it with seeds of all the North American and Asian species of *Aesculus* that are now grown as ornamental trees. *A. hippocastanum* is native to the mountains of Northern Greece and Albania. It was not known in Western Europe until 1576 when seeds were sent to the botanist Clusius in Vienna from Constantinople (Bean 1914, 170; Krüssmann 1984, 120). It makes a spectacular large specimen or avenue tree unlike any other European tree when in flower and was rapidly distributed after its introduction to Vienna. The tree was first grown in England in about 1616 and a few trees known to date back to 1662 are still in full health (Mitchell 1981, 67). The North American species of *Aesculus* started to arrive in Britain in the 18th century and the Asian species were not introduced until the 19th century (Hillier's 1977, 28–9).

These remains suggest that common lime and horse chestnut were being grown as ornamental trees in the vicinity of the moat. The leaf fragments of *Buxus sempervirens* (box), although a native evergreen shrub, are also likely to have been derived from shrubs grown for ornament in the garden. *Leontodon* sp. (hawkbit) and *Bellis perennis* (daisy) seeds from the moat suggest the proximity of grassland. Both species would have been favoured by the conditions of scythe-mown lawns. The botanical remains give little evidence for the state of the moat other than that there must have been waterlogging for their survival. Seeds of aquatic and marginal plants that readily colonise bodies of stagnant water were absent from [181] apart from a single seed of *Ranunculus sceleratus*, an annual weed of nutrient-rich mud.

The documented dates of introduction of *Aesculus* species to Western Europe mean that it is very unlikely that the lowest fills of the moat are early 16th century, when it is assumed that the moat was constructed. It is probable that they accumulated at an early 17th- century or more recent date following refurbishment of the moat.

Valvata piscinalis, the mollusc identified in [177], is a flowing water species which does not live in closed ponds (Boycott 1936, 140). However, if a source of flowing water were used to feed the moat, this would have been sufficiently slow to allow the colonisation of various species of *Lymnaea* and the Planorbidae in addition to *V. piscinalis*. In the absence of these species, it seems

more likely that the clay represents the dumping of calcareous alluvial sediments in what was an otherwise non-calcareous environment, perhaps in order to seal the bottom of the moat.

POLLEN SAMPLES

Dr Robert Scaife

Pollen analysis was carried out on organic deposits from the basal context [181] of the Hampton Court moat. A single sample of *c.*500ml was examined, comprising highly organic material which contained amorphous, detrital and fibrous plant matter. Three sub-samples of this material were analysed using standard procedures for extraction of the sub-fossil pollen and spores (Moore *et al* 1991). Identification and counting was carried out using an Olympus biological research microscope with phase contrast facility at magnifications of ×400 and ×1000. Pollen sums of between 250 and 400 grains were counted for the three sub-samples. The raw data from these counts are presented in Table 2. The pollen has also been calculated as a percentage of the total pollen and the spores as a percentage of the total pollen plus spores. These data are given in Table 3. One sample was also examined prior to acetolysis for the presence of cysts of human intestinal parasites.

The depositional environment in moats can be extremely favourable for preservation of plant material and this is the case here. Moats were a readily accessible area for disposing of domestic refuse, including ordure, and it was felt that the pollen spectra from [181] might contain a component derived from human faecal material, *ie* containing a substantial cereal and associated weed component (Greig 1981; Scaife 1986). This appears not to be the case. Samples were examined for the cysts of human intestinal parasites (*Trichuris* and *Ascaris*) but none were found. Furthermore, the pollen component does not contain assemblages typically associated with a high faecal component or large numbers of grasses from floor coverings. It is, therefore, considered that the pollen recorded derives predominantly from the vegetation which grew locally to the site.

Tilia (lime) dominates the tree pollen, while *Betula* (birch), *Pinus* (pine), *Quercus* (oak), *Ulmus* (elm), *Acer* (field maple) and *Carpinus* (hornbeam) occur sporadically. Shrubs are represented by small numbers of *Corylus* (hazel) and a single *Cornus* (dogwood). The herb spectra are dominant (72–93% of the samples) with 28 taxa identified. The plantains are important with *Plantago lanceolata* type (ribwort plantain), *P. media/major* and *P. coronopus* present. The former is particularly important with values of 28% of total pollen in sample 2. Asteraceae are similarly important comprising *Bidens* type (a large pollen group including daisies), *Anthemis* type (a large pollen

Table 2. Pollen counts obtained from [181]

Sample	**1**	**2**	**3**
TREES			
Betula	1	—	1
Pinus	4	3	2
Acer	0	1	1
Ulmus	2	3	9
Quercus	9	3	—
Tilia	55	59	11
Carpinus	0	1	3
SHRUBS			
Cornus	1	—	—
Corylus type	4	1	—
Erica	—	—	1
Calluna	—	1	—
Hedera	1	—	—
HERBS			
Ranunculaceae undiff.	1	—	1
Ranunculus type	1	—	—
Papaver	1	—	—
Dianthus type	1	—	—
Spergula type	—	1	—
Chenopodium type	1	1	—
Papilionaceae undiff.	—	1	1
Trifolium type	—	—	1
Filipendula ulmaria	1	1	—
Apiaceae	—	1	—
Polygonaceae undiff.	1	—	—
Polygonum aviculare	—	1	—
Fallopia convolvulus	1	—	—
Convolvulus	1	—	1
Odontites type	1	—	—
Plantago media/major	1	1	1
Plantago lanceolata	68	71	64
Plantago coronopus type	5	2	16
Bidens type	8	5	3
Anthemis type	3	—	—
Centaurea nigra type	1	—	—
Centaurea cyanus	1	—	—
Liguliflorae	84	62	258
Poaceae	23	27	13
Cereal type	1	4	1
Cyperaceae	—	—	1
Unidentified	3	3	3
Pollen sum	287	253	392
SPORES			
Pteridium aquilinum	3	6	—
Dryopteris type	1	1	1

Table 3. Pollen percentages obtained from [181]

Sample	1	2	3
TREES			
Betula	0.3	1.2	0.3
Pinus	1.4	0.4	0.5
Acer	—	0.4	0.3
Ulmus	0.7	1.2	2.3
Quercus	3.1	1.2	—
Tilia	19.2	23.3	2.8
Carpinus	—	0.4	0.8
SHRUBS			
Cornus	0.3	—	—
Corylus type	1.4	0.4	—
Erica	—	—	0.3
Calluna	—	0.4	—
Hedera	0.3	—	—
HERBS			
Ranunculaceae undiff.	0.3	—	0.3
Ranunculus type	0.3	—	—
Papaver	0.3	—	—
Dianthus type	0.3	—	—
Spergula type	—	0.4	—
Chenopodium type	0.3	0.4	—
Papilionaceae undiff.	—	0.4	—
Trifolium type	—	—	0.3
Filipendula ulmaria	0.3	0.4	—
Apiaceae	—	0.4	—
Polygonaceae undiff.	0.3	—	—
Polygonum aviculare	—	0.4	—
Fallopia convolvulus	0.3	—	—
Convolvulus	0.3	—	—
Odontites type	0.3	—	—
Plantago media/major	0.3	0.3	0.3
Plantago lanceolata	23.7	28.1	16.3
Plantago coronopus type	1.7	0.8	4.7
Bidens type	2.8	2.0	0.8
Anthemis type	1.0	—	—
Centaurea nigra type	0.3	—	—
Centurea cyanus	0.3	—	—
Liguliflorae	29.3	24.5	65.8
Poaceae	8.0	10.7	3.3
Cereal type	1.0	1.6	0.3
Cyperaccae	—	—	0.3
Unidentified	1.0	1.2	0.8
SPORES			
Pteridium aquilinum	1.0	2.3	—
Dryopteris type	0.3	0.4	0.3

group containing chamomiles), *Centaurea nigra* type (knapweed) and particularly Liguliflorae. The latter comprise *Taraxacum* (including dandelion, hawk's-beard and hawkweeds). Other herbs include a range of taxa (including the Poaceae) typical of grassland and pasture habitats. A small number of cereal pollen grains and some possible segetals (*Centaurea cyanus* and *Spergula* type) were recorded. The range of herb taxa present therefore indicates that the local area consisted of grassland and associated weeds.

The tree taxa *Betula, Pinus, Quercus* and *Ulmus* are considered to be the background component, *ie* pollen derived from longer distances by wind pollination. *Tilia* contrasts with these taxa, and attains relatively high values. This is particularly so considering the entomophily and consequent small pollen production of lime. This usually results in its marked under-representation in pollen spectra. Where it does occur in quantity, it is usually regarded as being from a source close by. Furthermore, *Tilia* is a relatively rare occurrence in deposits of later prehistoric and historic date. Although it was a dominant element of the 'natural' woodland of southern and eastern England, prehistoric clearances caused its demise from the late Neolithic onwards and the last recorded natural or semi-natural woodland existed in Epping Forest during the Saxon period (Baker *et al* 1978). It is postulated, therefore, that limes were deliberately planted at Hampton Court and were growing in close proximity to the moat. They may have been planted in an avenue typical of stately homes (Wilson 1991). Examination of the pollen grains was carried out in an attempt to determine the species of *Tilia* found. Unfortunately, no conclusive determination was made (*ie T. cordata* or *T. platyphyllos*) and it is possible that the tree was an introduced exotic or a hybrid form.

Carpinus betulus (hornbeam) and *Acer* sp. (maple) are more enigmatic since both could have been planted trees but could also have been part of the background floral component. *Acer*, however, is not frequently encountered in pollen analysis because of its poor pollen production, and therefore it is likely that this was also growing close to the moat.

With regard to the character of the moat, it appears that there was no permanent standing water with aquatic and/or marginal plants growing, at least during the earliest phase. Certainly, no pollen of such plants was found. This may have changed subsequently since the ditch environment must have remained wet for such fine preservation of organic material to have occurred.

DISCUSSION

The gradually-sloping character of the north edge of the moat, and the lack of any masonry, suggests that a revetting wall (equivalent to that on the approach to the Great Gatehouse) was not required along this part of the moat. The north edge was stepped in, but there was no

evidence either for a wall or that such a feature had been robbed out. The ditch itself (and its fills) sloped gradually for approximately 7m from the stepped edge and bottomed out at 5.8m above OD *c.*2.5m from the south end of the trench. The width of the flat bottom cannot be determined on the evidence available. Nevertheless the ditch would probably have been more than 20m wide if its profile was broadly symmetrical. No direct evidence for the date of the moat's construction was recovered, but a Tudor date still seems most appropriate on the basis of documentary and cartographic evidence.

The primary moat fill [181] consisted of organic debris which had been preserved by waterlogged conditions within the moat. Unfortunately the environmental analysis provides little evidence for the state of the moat except for a single seed of *Ranunculus sceleratus*, which might suggest that conditions were not especially wet. The environmental remains included seeds and pollen of lime, seeds of horse chestnut, and leaf fragments of box. These probably represent species which were present, and had been deliberately planted, in the immediate vicinity of the moat. Limes were used extensively in the late 17th-century layout of the park and gardens at Hampton Court, especially in the great avenues which radiate away from the east façade (Chettle *et al* 1982, 30–2). Limes may well have been the principal species used in the lines of trees which flank the north arm of the moat in Leonard Knyff's early 18th-century paintings of the palace (and Johanes Kip's contemporary engravings from them). Horse chestnuts may also have been used, and box hedges were probably present. Other seeds and pollen indicate the presence of grassland managed with scythes.

Layer [177] also provided useful environmental evidence. Dr Robinson suggests that the layer represents dumped alluvial sediments rather than a water-lain deposit. This would fit in with the general character of the contexts above the primary fill. It would suggest that the conditions of waterlogging which preserved the seeds *etc* in [181] were only prevalent for a relatively short time. The backfill layers above [177] were generally of similar character. The small quantities of finds recovered are notable, showing that domestic rubbish was not a significant element in the backfill. The fairly consistent thickness of most of the layers is notable, and they all maintain the slope of the bottom of the moat ditch. The layers were probably dumped at fairly regular intervals.

No Tudor architectural fragments such as terracottas were found in the layers of backfill. The north arm of the moat is in fact at the furthest remove from the Henrician domestic ranges which were demolished in the late 17th century. Moreover surviving Tudor ranges lie in between the demolition site and the north arm of the moat. Economy of effort alone would suggest that material would be dumped at the nearest possible locations, either in the moat or elsewhere. Indeed terracotta fragments have recently been found on the Privy Garden excavations, in a deposit very close to the palace (I am very grateful to Steve Parry of Northamptonshire Archaeology for this information).

The dating of the fills is difficult because of the small quantities of finds. The single find of undiagnostic tile from the primary fill, for instance, is of little use. The seeds of horse chestnut and lime from the same context are unlikely to have been deposited before the early 17th century. This suggests that the moat was kept meticulously clean in the second half of the 16th century if a Tudor date for the moat's construction is accepted. Layer [178] is the earliest one containing datable finds in the sequence of fills. A single sherd of early-mid 17th- century tin-glazed ware was found. This fits well with the suggested dating of the primary fill. The possibility that the sherd is residual cannot be discounted, however, and the deposit could be later in date. The pottery and clay pipes suggest that the remaining layers of backfill were deposited during the late 17th, 18th and 19th centuries.

The final fills of the moat date to the 19th century (*ie* [119, 150–1, 160], and perhaps [125]). The moat therefore contained about 2.2m of backfill by the time Victorian landscaping took place. The ditch must have been an obvious and still quite deeply-hollowed feature.

The narrowness of brick wall [107] suggests that it was a boundary wall. None of the other walls was definitely contemporary with it stratigraphically, and most were in fact clearly later (*eg* the foundation trench for wall [103] cut a layer which was stratigraphically later than [107]). It is notable that wall [107] lies several metres to the south of the building shown on maps of 1841 and 1851 (respectively PRO Works 34/1349, and Map of the Royal Parks of Hampton Court and Bushy). The strip of gravel [117] running parallel and to the north of wall [107] is interpreted as a path, while the loamy soil [141] to either side was a garden soil. It is most likely that these contexts were part of a

garden layout or border along the line of the partially backfilled moat. Wall [103] is stratigraphically later than [107/141] and appears to coincide with the south wall of the building shown on the 1841 and 1851 maps. Brick structure [105] is not shown on the maps, but appears to be a liquid fuel store. The building was probably a hothouse.

CONCLUSIONS

The trial trench represents the first modern excavation in the Henrician moat at Hampton Court Palace, and the data retrieved are therefore of considerable interest. Evidence for the construction, maintenance and filling of the moat was recovered, and the environmental analyses will be of lasting value not only for studies of Hampton Court but also for research into late medieval and post-medieval moats and palaces in general. The site was landscaped for gardens in the 19th century, and structures associated with this phase still survive below ground. The excavation left these buildings intact.

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