

# COOMBE HILL CONDUIT HOUSES AND THE WATER SUPPLY SYSTEM OF HAMPTON COURT PALACE

BY

J. W. LINDUS FORGE, A.R.I.B.A.

## *Introduction*

WHEN, in 1514, Thomas Wolsey leased the manor of Hampton Court from the Knights Hospitallers as a site for his new palace, one of the factors that influenced his choice was the possibility of tapping the springs on Kingston Hill for his water supply. This was because they were reputed beneficial for the Stone, from which the great chancellor suffered: but unfortunately when, nearly 400 years later, Mrs. Hwfa Williams, a noted Edwardian hostess, contemplated turning one of the sources, at her house "Coombe Springs," to financial advantage, contemporary medical opinion based on chemical analysis did not endorse the advice of the Cardinal's doctors.

The water from springs along the ridge, which is about 160 ft. above sea level, was accordingly collected by brick feeders and concentrated in conduit houses, similar to those also still extant at Greenwich and Eltham. Thence it was carried over 3 miles across country, the pipe-line swinging slightly to the south, presumably to avoid the extent of Kingston-on-Thames at that period, crossing the Hogsmill river and subsequently the Thames about 3 furlongs south of Kingston bridge, and then running through the Home Park north of the later Long Water, to the east front of the Palace. At intervals its course was punctuated by "tamkins," small brick buildings whose name, a variant of the word "tompson," still in use for the plug closing the muzzle of a gun, denoted their purpose: an access point for plugging off sections which required isolation so that repairs could be carried out.

The supply from Coombe Hill was supplemented in 1638-9, during the reign of Charles I, by the watercourse variously known as the "Queen's," "Cardinal's" and "Longford" River, which carried water from the Colne via Stanwell, Bedfont and Hanworth to Bushy Park and the Palace.

Maintenance must always have been costly, and an Account Book for Hampton Court, preserved in the archives of the Ministry

of Works and commencing in the year 1689, contains ominous entries of payments to the plumbers for "looking severall times after the Water when it was lost," followed by "binding" or "sodering" as the case might require. In 1715 it was decided that a certain Mr. Fisher should be responsible for looking after the system, and the following year his appointment was confirmed:

"Ordered that 20*l* per ann. be allowed to Charles ffisher for Watching the Conduits & Pipes at Hampton Court, together with Scowering Severall Waist Drains, Clearing the Ice from off the Pipes and Tanpin Houses by the Thames Side to commence from the First Day of April 1716."

(Minutes, Office of Works, 11.4.1716.)

The presence of a piped supply of excellent water must have been a sore temptation to some of the landowners through whose property the pipe-line ran, and there appears to have been a certain amount of tapping, unauthorized but surely only possible with the connivance of the plumbers.

"Ordered that Mr. ffort, Clerk of Hampton Court, examin the Conduit Heads, Receivers and Ducts at Comb, and open and clean such as are obstructed; and Cutt off all branches as are laid upon the Main, to private persons, having no lawfull grant of the same."

(Minutes, Office of Works, 14.3.1715/6.)

In 1794 the water was said to be "efficacious in the Gravel, excellent for drinking and washing but unfit for culinary use,"<sup>1</sup> as it turned vegetables black.

In the possession of the Ministry of Works are three plans whose style and lettering would seem to belong to the early eighteenth century. That of the complete system, hereinafter referred to as the "M.O.W. Plan," has, apart from its intrinsic beauty, considerable value as a record of what parts of the lay-out had and had not been completed at that time.

With the opening of the nineteenth century came the additional complication in the growth of the town of Kingston-on-Thames, which now overflowed across the supply route. Agreements had to be made with the Infirmary, a public water company, and finally the South Western Railway, which crossed both branches of the pipe-line on either side of Norbiton station. In 1858 there was trouble at the river crossing. Some fourteen years previously stones had been heaped over the submerged pipe to give it some protection, and now the exceptional drought had so lowered the water as to make this little shingle bank a danger to navigation. Pleasure craft grounded, "causing imminent danger to the persons therein of being upset into deep water" (Thames Conservancy), and the following year a rowing boat was stove in, followed by a successful claim for compensation. A report and an estimate, obtained from a firm of consulting engineers, advocated the replacement of the two 3 in. pipes by one 5 in. in diameter at a lower level, but by the time the quotation was approved it was judged best to postpone the work to the following

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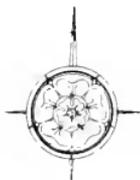
<sup>1</sup> Thacker, *Locks and Weirs*.

HAMPTON COURT

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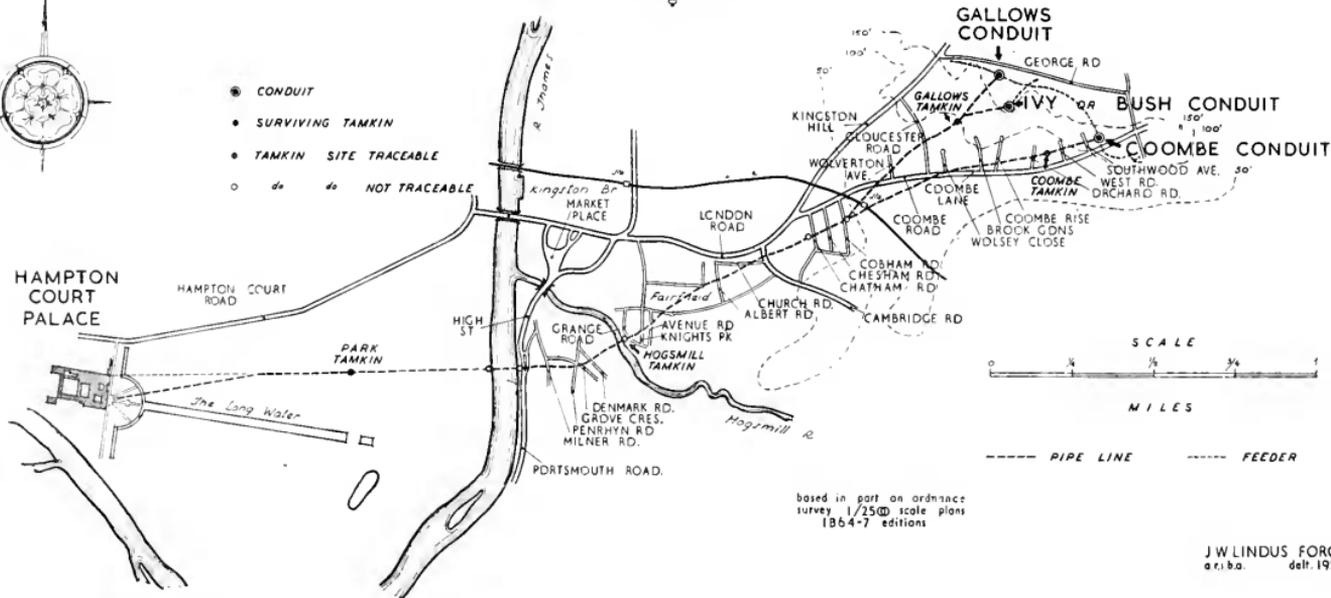
WATER

SUPPLY



- CONDUIT
- SURVIVING TANKIN
- TAMKIN SITE TRACEABLE
- do do NOT TRACEABLE

HAMPTON COURT PALACE



based in part on ordnance survey 1/25000 scale plans 1864-7 editions

J W LINDUS FORGE  
a r. b. a. delr. 1955

FIG. 1.

spring, and the records are silent as to whether it was actually carried out. This may, however, have been the occasion when this section of the pipe-line, as we shall see, was relaid in iron.

The Coombe supply does not appear to have been used after 1876, when the water is said to have become contaminated, but it was not until 1894 that the warrants for the supply of royal venison, sent to landowners in lieu of rent for the use of their subsoil, were withdrawn. The Duke of Cambridge, who at that time owned all the eastern part of the system, including the three conduit houses, was highly incensed at the loss to his game larder and threatened to divert the water for his own use. At first this was treated as merely a piece of "His Royal Highness's ebullience," but when a messenger arrived to demand the keys of the conduit houses the Commissioners realized that he meant business. Protracted negotiations followed, culminating with the sale to the Duke of the conduit houses and associated pipes, which should have been kept in the possession of the Crown and preserved as historic monuments. However, honour was deemed to be thereby satisfied.

This storm in a teacup, however, inspired an enquiry into exactly who used the water supply now it was no longer needed for the Palace. It was found that several persons paid a nominal fee for the use of Coombe water, another landowner appropriated that from Ivy Conduit without authorization, and that the supply from Gallows Conduit was running to waste. As a result, the whole system was wound up in 1900, when outstanding licences were withdrawn and agreements terminated. Some of the pipes were dug up, but in many cases they now ran under buildings or ornamental gardens, where removal would have been impracticable or too costly. Fortunately a schedule of all the properties affected was accompanied by a plan and section, obviously prepared following a very careful measured survey, by a Mr. G. H. Andrews, Civil Engineer of London, and this document (hereinafter referred to as the "Andrews Plan") has proved most helpful in the preparation of this paper, since it shows certain installations since buried or destroyed.

Finally, in 1910 the Metropolitan Water Board took over responsibility for the water supply to the Palace, and the great Italianate pumping stations of the Middlesex bank became the legitimate successors of the little conduit houses which had faithfully served Hampton Court for over three and a half centuries.

### *The Conduit Houses*

GALLOWES CONDUIT is in the grounds of "Wolsey Spring," George Road. Like Coombe Conduit, it consists of two buildings in series, but in this case the upper unit is much smaller by comparison with the lower and there is no connecting passage. Now inaccessible under a rockery, it measured, according to the Andrews plan, about 7 ft. 6 in. by 5 ft. and contained a narrow rectangular tank served by no less than five feeder pipes.

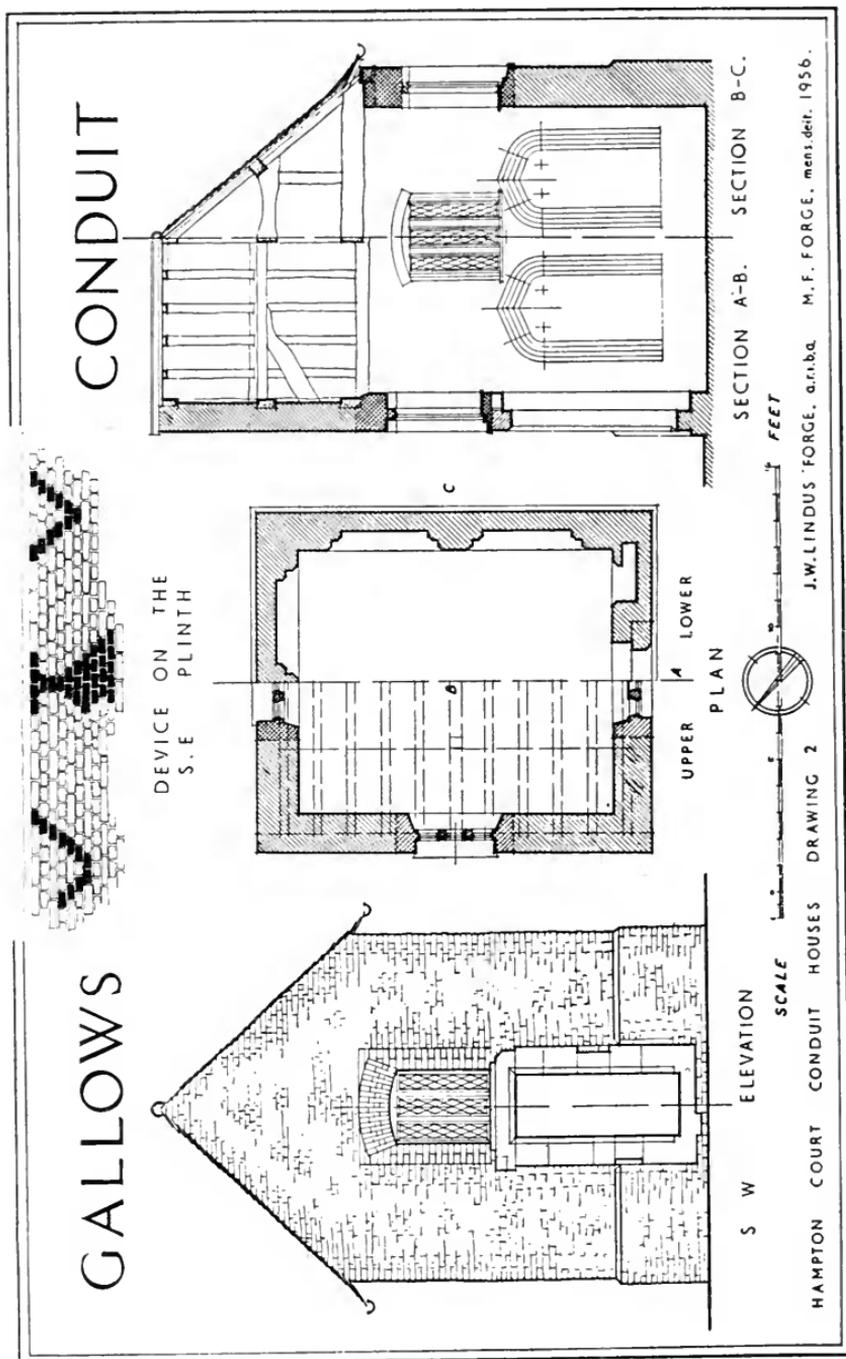


Fig. 2.

The lower chamber is the best preserved of all the Conduit Houses, though unfortunately the oval cistern, if it survives, is hidden beneath a concrete floor. A rectangle on plan, it measures approximately 10 ft. wide and 11 ft. 9 in. long within its 18 in. brick walls, which on three sides are reduced in thickness by wide internal recesses 9 in. deep and with four-centred arches in two orders over.

The bricks are of the usual plum-coloured Tudor pattern, rising nearly five courses to the foot, but the window dressings, which included gauged segmental arches, are in bright reds, rising four courses to the foot, showing that they are insertions of the early eighteenth or late seventeenth century. The doorway also, with chamfered jambs and a square chamfered head, though old, is probably not part of the original design. In the plinth on the east side is a slightly imperfect V—T—V in black headers, usually read as the Cardinal's monogram.

The roof is covered with old tiling and the framework, although much restored, obviously incorporates many of the old timbers. Its height (the wall-plate is 12 ft. 9 in. above floor level and the ridge over 7 ft. higher) presents a problem. Were it necessary for manipulation of the Tudor type of drain-rod, one might expect the tamkins to be correspondingly lofty, but, as we shall see, the sole survivor is a comparatively squat building. Another unsolved mystery is the presence of two small recesses on either side of the entrance, in a position duplicated at Coombe Conduit, L-shaped and opposite-handed on plan. The building appears to be kept in excellent repair.

IVY CONDUIT, or, as it appears on the M.O.W. map, BUSH CONDUIT, is in the grounds of the Convent of the Holy Family, which lies to the east of "Wolsey Spring." Unfortunately the whole of the front was torn out by a bomb during the last war and the interior was further damaged by thieves wrenching out the lead cisterns. Enough remains, however, to show that it differed markedly from the other two houses, so that one is tempted to ascribe a later date and perhaps see it as an addition to the system made when the Cardinal's princely household gave place to an even larger Royal establishment.

In this case the outer chamber, which is half buried in the ground, measures only 7 ft. wide by 7 ft. 6 in. long, and has at the rear a kind of annexe which, as can be seen from the measured drawing, is four-sided but very far from rectangular. This irregularity is explained by reference to the M.O.W. map, which shows that the tank it once contained followed the course of a feeder which swung away in a wide arc to the south.

While the other conduit houses have, or had, wooden roofs, Ivy Conduit was covered by a four-centred brick vault, about 8 ft. high, over which, some time in the nineteenth century, a steeply pitched brick roof had been formed, presumably so that the little building should match the new "Gothic" mansion higher up the hill. Stone seats in

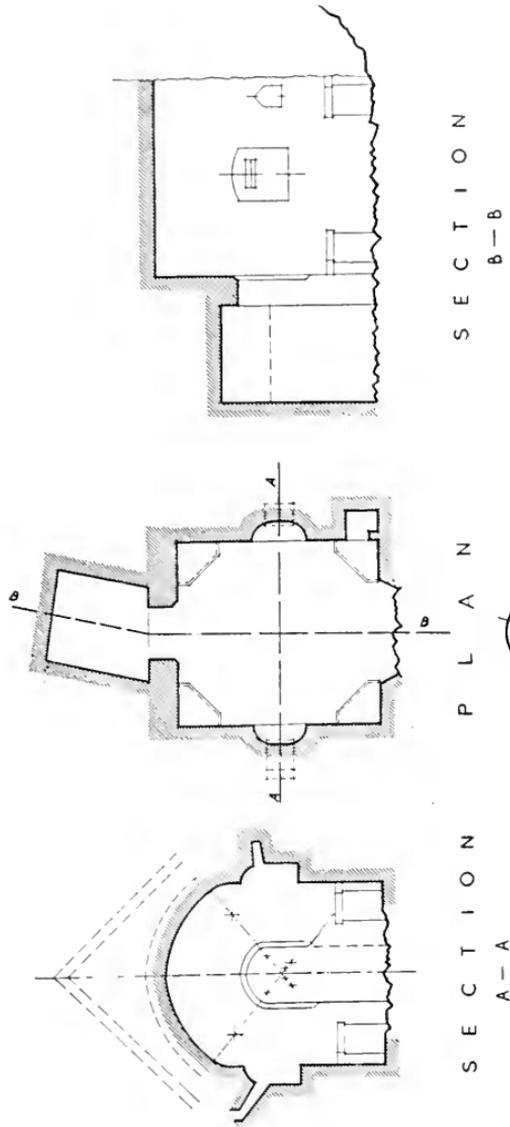


H.VIII

IVY OR BUSH

CONDUIT

SCALE 1/4" = 1' FEET



HAMPTON COURT  
CONDUIT HOUSES  
DRAWING NO. 3.

J.W. LINDUS FORGE  
a.r.l.b.a. M.F. FORGE  
mens. delt. 1936.

FIG. 3.

the angles of the main chamber are also obviously part of the same "improvements" and perhaps also the curious little segmental arched recesses in the side walls, each with a tiny flue which presumably once led to the outer air.

Apart from the fact that it has been impossible to find any photographs or drawings showing its original appearance, Ivy Conduit is plainly too much damaged to warrant restoration. It would seem desirable, however, that what is left should be preserved from further damage by the weather and also by the ubiquitous ivy which gives it a name.

COOMBE CONDUIT, which is the most elaborate and interesting of the three houses, lies some distance to the south-east of its two fellows, but as the contours bend that way its site is not appreciably lower. Like Gallows Conduit, it consists of two chambers, but in this case they are of similar size and connected by an underground passage. The higher, east, unit is largely below ground, and unfortunately the upper part has also been very badly damaged, this time by a falling tree. Judging from a sketch preserved at "Coombe Springs," the house in whose grounds the conduit stands, it closely resembled the lower chamber at Gallows Conduit. (The drawing by Ernest Coffin, cut from a glossy magazine and filed at the National Buildings Record, which purports to show this building, is really only a back view of the western chamber, wrongly captioned.)

Below ground this eastern chamber consists of three separate units in parallel. The central and original room is 10 ft. wide and just under 9 ft. long, with recesses like those at Gallows Conduit in three of the sides and the entrance to the underground passage in the fourth. Some time in the late seventeenth or early eighteenth century one of the recesses on the north side was pierced to form a doorway, giving access to a subsidiary chamber measuring about 8 ft. 9 in. by 6 ft. 9 in., and roofed by a barrel vault spanning from east to west, whose crown is only a matter of inches below ground level.

This annexe is shown on the early eighteenth-century M.O.W. plan: its counterpart to the south is not, and must therefore be of later date; indeed, the brutal way in which the Tudor recesses have been bricked up and a mean little round-headed doorway cut smacks of the utilitarian nineteenth century. This third room measures approximately 8 ft. 9 in. square, and as the floor is 3 ft. 6 in. below that of the central chamber it is usually flooded, water entering through a brick feeder 2 ft. high and wide, which leads away in the direction of Coombe Hill Farm. All three chambers have lead tanks flush with the floor; those in the annexes are in no way remarkable, but the original cistern in the central chamber is an oval measuring 2 ft. 5 in. wide, 3 ft. 6 in. long and 6 ft. deep. Surrounded by a handsome stone kerb, it was broken by a subsidence in the floor but has recently been very skilfully repaired.

The tunnel between the two sections of Coombe Conduit is 81 ft. long and 5 ft. 4 in. wide, with a fall on the floor of about 9 in. towards the south. The four-centred vault is for the most part 7 ft. 9 in. high, but 10 ft. 6 in. from the west end it inexplicably starts to rise, so that the arch to the lower chamber is nearly 10 ft. high. Anyone who has had anything to do with great Tudor houses will have met noble brick-vaulted drains, apparently built regardless of cost and a fruitful source of legends about "secret passages" to later generations, but this tunnel would seem unaccountably generous in scale if it was only intended as affording access for a plumber from one chamber to the other.

The west chamber measures about 9 ft. 10 in. wide and 11 ft. 8 in. long, with its floor 2 ft. 6 in. below ground level. The north and south walls have the usual twin recesses; the east and west walls, arches giving respectively onto the tunnel and the entrance doorway, the latter being reached by four steps. In the floor is another oval lead cistern, this time orientated east and west, and a smaller square cistern under a flagstone to the south.

Externally this western unit raises more problems. The entrance front is faced with squared, random rubble, very carefully fitted with fine joints but having the appearance of stones re-used from some other building the supply of which gave out early, so that above the window the wall continues in Tudor brickwork and finishes with a crow-stepped gable. The whole "feeling" of this picturesque elevation is that it has been doctored to provide a "feature" in a landscape garden, although the doorway, with its attractive little plinth moulding, seems to be original.

The side walls have the same inserted later windows as at Gallows Conduit, and this is curious as an Office of Works Minute, dated November 26, 1715, orders "the Windows instead of Iron Barrs to be Brickt up, leaving small narrow slitts for light." At the back is a massive brick ramp which in no way corresponds to the rise in the vault immediately below and is on the wrong side to buttress the building against slipping downhill. Taken with the thickness of the spur-walls flanking the entrance doorway, one is driven to the conclusion that provision has been made for supporting some heavy load at high level in this chamber.

The owners' resources have not permitted the reconstruction of the wrecked upper portion of the east chamber, and instead a glass roof has been inserted within the rectangle of broken walling. While this largely protects the interior and is aesthetically unobjectionable, it unfortunately affords no cover to the top of the walls and, without any coping, these must inevitably decay.

### *The Tamkins*

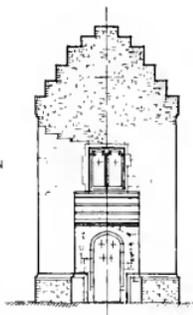
The M.O.W. map shows six tamkins: "Gallows" and "Coombe" near the conduit houses of the same name; "Hogsmill," east of the crossing of that stream; "Park," near the "Studd" House in the Home Park; and two unnamed on either bank of the Thames. The



# COOMBE

HAMPTON COURT  
CONDUIT HOUSES  
DRAWING 4

WEST  
ELEVATION



WEST  
CHAMBER

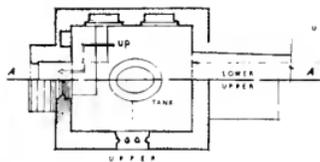
# CONDUIT



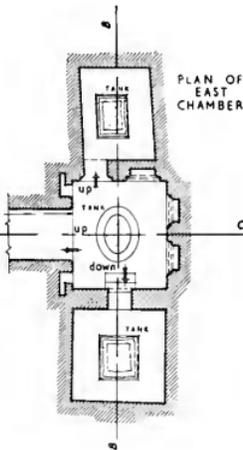
MEASURED AND DRAWN BY  
J.W LINDUS FORGE a.r.i.b.a.  
M.F. FORGE. G.R. EVANS. 1956



PLAN OF WEST CHAMBER



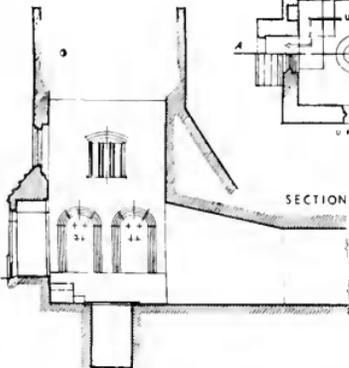
UNDERGROUND PASSAGE  
8 FT. 0" LONG



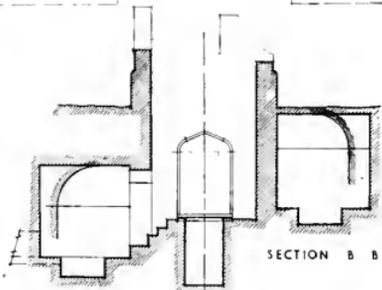
PLAN OF  
EAST  
CHAMBER



SECTION A-A



SECTION B-B



SECTION C-C

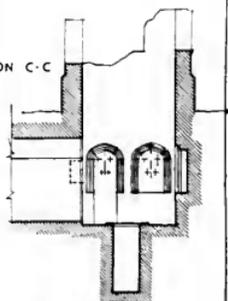


FIG. 4.

1/2500-scale Ordnance Survey maps, 1857-60 Edition, show an additional tamkin just after the junction of Gallows/Ivy and Coombe branches, which was obviously very necessary, and another only a little further along in the grounds of the now vanished Norbiton Park, whose purpose is difficult to understand.

Only one tamkin now remains above ground: "Gallows," standing lonely in the middle of Coombe Wood golf course. It is a small brick building, measuring about 9 ft. by 6 ft. 3 in. internally. Three of the walls are 14 in. brickwork, but that in which the entrance door occurs is no less than 3 ft. thick. The end walls have gables in one of which is a slit window, and the door has a modern "Tudor" arch and stone dressings. Five steps lead down to a sandy floor across which meanders a little stream; all the leadwork has disappeared. This building has been carefully but injudiciously restored; when inspected in 1956 the roof was again in disrepair.

Coombe Tamkin is represented by a sinking in the lawn and discolouration of the turf at No. 8, Orchard Rise. As far as can be judged it appears to have been rather larger than Gallows Tamkin.

Park Tamkin is probably responsible for an area of sunk ground and poor grass just west of the avenue which runs north and south across the Home Park (the cross-stroke of the "T" of which the Long Water is the stem.) This is the position shown on the M.O.W. map.

The remaining tamkins have all disappeared. That on the east bank of the Thames may be responsible for the doubling of the Portsmouth Road at this point, the carriage-way being diverted inland and then taking the shorter route once the tamkin had been demolished.

The only record of the lay-out of a tamkin appears on the Andrews plan, where, in a detail drawing of Hogsmill Tamkin, the twin pipes are shown separating to by-pass it on either side and then closing again, with cleaning eyes running back into the building. This arrangement surely cannot have been typical, since it would only have been useful for rodding in one direction and would only have allowed plugging-off with great difficulty, while there seems no obvious position for the stop-cocks which, as we know from the plumbers' records, were customarily fitted in these structures.

### *The Pipe-line*

Although the Gallows/Ivy and Coombe branches of the line met, they were not combined in a single pipe but ran side by side, obviously with the intention of providing alternative supplies in case of blockage. All trace has now been lost of where they entered the Palace; both the M.O.W. and Andrews plans show them terminating between two of the radiating avenues east of the semicircular canal, although the latter adds an "old route" leading directly towards the Great Kitchen.

The pipes on the main line were about 3 in. in diameter; within the Palace itself they were both smaller and larger, with a maximum bore

of 7 in. They appear to have been of lead throughout, except that by 1852, according to Mr. W. D. Bide (The History and Antiquities of the Ancient and Royal Town of Kingston Upon Thames), the river crossing had been renewed in iron, presumably owing to the difficulty which had been experienced from barges picking up the more flexible material with their anchors. There are records of elm pipes being supplied from time to time to Hampton Court, but these were probably for the Longford river system, which also served the Park and Gardens.

As will be appreciated, by 1876 the pipe-line was a patchwork of many different periods. In 1956, for example, when it was exposed during the laying of a new sewer across the Fairfield, a seventeenth-century section was found wiped to a nineteenth-century length. At least four different types of pipe manufacture have been encountered:

1. Wolsey's original pipe was of a pattern introduced by the Romans and consisted of a narrow sheet of cast lead, bent round a mandrill into the form of a tube and burned along its entire length. According to Ernest Law (The History of Hampton Court Palace), the pipes were laid in 25 ft. lengths and, although it has not been possible to verify this, the dimension represents the maximum length of a casting trough on to one end of which the molten lead was tipped and quickly struck off level with the sides. The remains of such a trough have been discovered at Winchester. It is tempting, incidentally, to see in the curious arrangement at Coombe Conduit the remains of a pipe foundry, with the cauldron supported at high level in the heavily buttressed lower chamber and the casting table in the tunnel. Tempting, but probably quite unjustifiable, because a less central position could scarcely have been found for the production of heavy and unwieldy units. Nevertheless, of course, it was no worse situated in this respect than the "Plombery" that certainly existed at the Palace itself.

The thickness of the metal varies. Edward Jesse, Surveyor of H.M. Parks, Palaces, etc. (Gleanings in Natural History, 1835), and others have calculated astronomical figures for the total weight of lead, based on  $\frac{1}{2}$  in., but examination of numerous specimens has convinced the author that this is exceptional and that  $\frac{3}{8}$  in. is a fairer average figure. Even this reduction makes the pipe, which is slightly flattened into an oval 3 in. high and  $3\frac{1}{4}$  in wide, weigh about 19-20 lb per foot run. Experiments made at the time of the Hampton Court Pageant in 1951, which incorporated a pipe-laying episode, showed that at least six men were required to carry a standard 25 ft. length. The laying of the Thames crossing must have presented a problem; presumably it was soldered up and lowered complete from a bridge of boats.

Joints were wiped with a 1 : 2 tin/lead solder and afterwards "overcast" or "grozed," i.e. rubbed with a hot iron to close the pores. The faceted appearance given to the wiping is quite unmistakable; with the improvement in solder this process is of course no longer necessary.

The pipes were laid about 6 ft. below present ground level, well clear of deep cultivation and the effects of frost. Anyone who contemplates digging up the remaining lengths, tempted by the traditional high silver content, is warned that the lead is singularly pure (99.99 per cent.), and that the proportion of the more precious metal is only twenty-five parts in ten thousand.

2. Certain of the smaller distribution pipes in the Palace were of the type invented by Robert Brocke about 1539. In this process molten lead was poured between an iron mould, formed by the two halves of a cylinder, and a vertical iron mandril about 3 ft. high, half an inch less in diameter than the mould and slightly tapered. When the lead had set, the mould was unclamped and the mandril freed by a light hammer blow. These were the first seamless pipes and were only made in small diameters, while the maximum length of 3 ft. meant numerous cast lead collar-joints.

3. By the seventeenth century pipes were cast horizontally in hinged wooden moulds around a sand core. Such a pipe was exposed in the Fairfield in 1956 and showed a scar on its outer surface: either the "runner" through which the molten lead was poured, or the "riser" which allowed air to escape.

This process was succeeded by one in which a short, thick-walled tube of lead was forcibly drawn out until it was of the required thickness, becoming, of course, considerably elongated. Although no specimen of drawn pipe has been encountered, it must certainly be represented in the system, as this method of manufacture was in use throughout the eighteenth century.

4. Finally, in the last half-century of use the pipe-line was patched with pipes made very much as they are today, *i.e.* extruded under hydraulic pressure through a die.

Specimens of pipe from the system can be seen at Hampton Court and in Kingston-on-Thames Museum, but the best examples, illustrating jointing, etc. are in the Science Museum, South Kensington, where unfortunately they are not at present on public display. At the Science Museum also are some interesting early draw-off and stop cocks from the Palace. Made of bronze, they consist of a socket in the form of a section of tapered tube, with two holes or "ways" corresponding to the shanks on to which the pipes were wiped. Into this socket fits a hollow plug with two holes, which can be turned by a crutch key at the top to correspond with the holes in the socket whenever the passage of water is desired.

### Conclusion

From the foregoing account, it will be seen that there are a number of unsolved problems in connection with the Coombe Hill Conduit System. Unfortunately it has been found impossible to trace any works by Tudor writers on Water Supply which might throw light on the theories behind the lay-out, and during its three and a half centuries of use no one apparently bothered to write a description of so purely utilitarian a concern. Some of the answers may be buried



among the accounts for the building of the Palace, preserved at the Public Record Office, and it is to be hoped that one day someone with the requisite knowledge may have the time and patience to seek them out.

#### ACKNOWLEDGMENTS

The Author's thanks are due to:

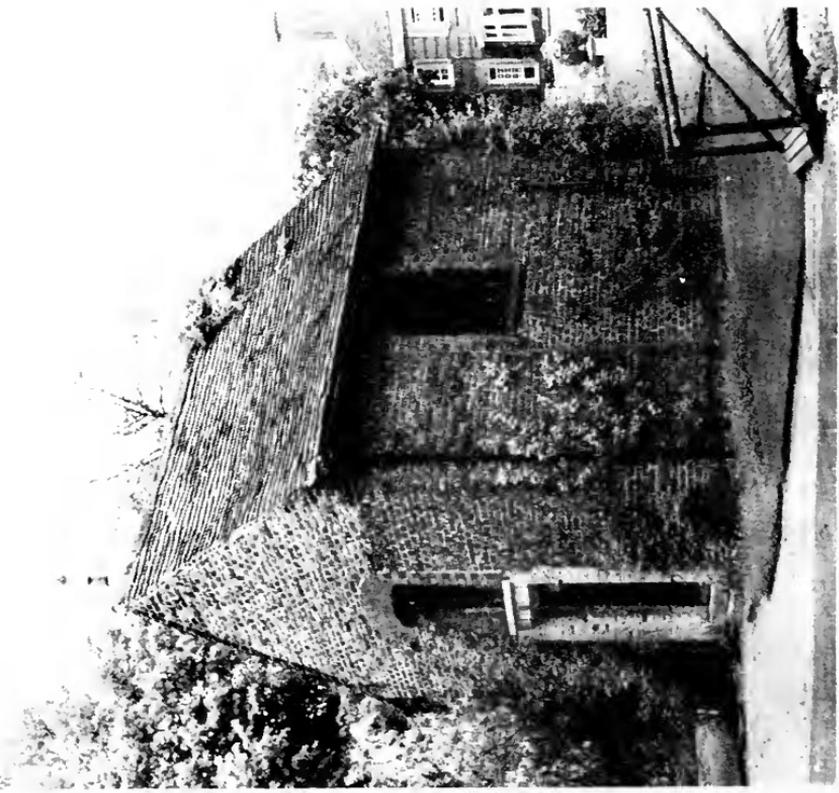
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b. COOMBE CONDUIT: WEST HOUSE.



a. GALLOW'S CONDUIT



*a.* COOMBE CONDUIT. CISTERN IN EAST HOUSE



*b.* COOMBE CONDUIT: UNDERGROUND PASSAGE LOOKING WEST.



*a.* GALLOWS CONDUIT, INTERIOR.



*b.* IVY CONDUIT, INTERIOR.



*a.* GALLOWS TAMKIN.



*b.* WOLSEY'S MAIN, SHOWING A GROZED JOINT.