Archaeologia Cantiana Vol. 84 1969

THE PUMPHOUSE ON COBHAM HALL ESTATE

By J. E. L. Caiger

At the northern or Watling Street end of the Cobham Hall Estate there are several artificial lakes, for many years known as Brewer's Ponds. Connected to the lower pond is a deep, crescent-shaped ditch bordered by banks on each side. This ditch runs in an easterly direction and then curves south for a distance of approximately 380 yards. In 1959 the Kent Archæological Society carried out certain excavation works in Cobham Park in order to determine the date of this crescentic earthwork. It had been claimed by C. Roach Smith in 1877 as being part of a British *oppidum*.[1] The excavation was directed by Mr. P. J. Tester, F.S.A., on behalf of the Society. A section was cut across the ditch and flanking banks at a position about 100 yards east of the pond.[2] Numerous fragments of thin red roofing-tile were found in the body of both banks and also sealed on the old surface below the outer bank. A clay tobacco pipe, dated between 1680 and 1720, was found poorly stratified under the tail of the outer bank. In addition to these finds further evidence was available in the form of a map of Cobham Park, dated 1718, which clearly showed the crescent-shaped ditch. Along its course were printed the significant words *Conduit Pipe*. The map also showed a *Fountain House* near the lower pond, some 90 ft. to the east of where the Cobham Hall pumphouse still stands. The archæological and map evidence brought forward in the K.A.S. reports[3] demonstrated that this earthwork was not of prehistoric origin. It was possibly medieval, but more probably was constructed at an even later date.

Further investigation over the ground in this part of the estate, together with additional documentary evidence, has led the writer to conclude that there was a direct association between the *Fountain House* and the deep crescentic earthwork marked *Conduit Pipe* on the map of 1718. From these investigations it is suggested that the two features formed part of a mid-seventeenth-century scheme devised for the sole purpose of piping water from a spring close by Brewer's Ponds to an underground cistern sited nearer to the Hall.

The accurate setting out of a curved conduit was well within the skill of a seventeenth-century surveyor. In support of this, it may be

[1] *Arch. Cant.*, xi (1877), 121.
[2] *Arch. Cant.*, lxxvi (1961), 107.
[3] *Arch. Cant.*, lxxiii (1959), 224, and lxxvi (1961), 105.

recalled that the course for the New River was surveyed, excavated and completed by 1614.[4] This ambitious project allowed spring water from Chadwell and Amwell in Hertfordshire to be brought to Clerkenwell, a distance of 40 miles. The total gradient along the entire route was only 18 ft., which necessitated the surveyor, Edward Pond, working to a fall of about 5 in. in a mile. It would appear that halls and mansions were not infrequently sited on estates where the natural water supply had to be conveyed to the kitchen quarters by artificial means. The leading gardening authorities of the early eighteenth century describe in great detail suitable methods for bringing water from afar to mansions which had been unfortunately sited relative to a water supply. Stephen Switzer[5] states: 'When water is brought from a spring in a direct line, a rough stone or brick drain is to be preferred for its cheapness, especially rough stone. A drain about 6 in. hollow is sufficient, which ought to be clayed round to prevent any waste of water. However, elm pipe is very reasonable, and upon casting up the expenses of one or the other, a gentleman may in some places rather chuse [*sic*] these wooden pipes than a drain. But where the water is brought over hills and dales, 'tis absolutely necessary to have wood or leaden pipes, the first are preferred in respect of cheapness, and indeed for goodness, tho' the other are more durable and lasting . . . The next care is to draw the spring into some reservoir, but let it not be too near the main head but rather at two or three hundred yards distance . . .' Richard Bradley,[6] writing in 1724, remarks: 'I am persuaded this chapter will not be unacceptable to such gentlemen as have their gardens remote from it (i.e. water) but especially if by the assistance of some engines, which I shall here mention, they may be taught how to bring it, with little trouble, to their houses or gardens, although they have their station upon the tops of hills, or other places remote from water . . . and that it (the house) has at present no other conveniency of water than what is brought continuously by men or horses . . .' Both these writers recommend the use of engines for forcing water up the gradient of a hill. Switzer says: 'It may not be amiss to add that about 60 or 70 pounds will purchase a very good horse engine, a small sum considering the infinite advantages that accrue to a seat nearby.'

It is quite apparent from these and other sources that landscape gardeners of this early period were always prepared to survey the land and design and install a water supply to suit the needs of a mansion. They would also order and obtain an engine from the pump-makers for the necessary pumping requirements. Since the middle of the seven-

[4] J. W. Gough, *Sir Hugh Myddleton* (1964).
[5] Stephen Switzer, *History of Gardening*, Vol. I (1718), 301.
[6] Richard Bradley, *New Improvements of Planting & Gardening both Philosophical & Practical* (1724), Ch. viii, 337.

teenth century several changes have been made to the water supply arrangements for Cobham Hall and an attempt has been made in this paper to trace them in chronological order.

The Fountain House and Conduit Pipe, Cobham

The northern end of the Cobham Hall Estate contains several fresh water springs, the nearest to the Hall, however, is at least 400 yards away. Furthermore, these springs are separated from the house by a steep natural elevation of the ground. Of the two principal springs, one flowed out beside the lower Brewer's Pond whilst the other had its source on the west side near the artificial pond in the Pleasure Ground (see Fig. 1). The distance of both these springs from the Hall must have made the transportation of water by horse a laborious undertaking during the earlier period of Cobham Hall. The writer believes that the initial water supply installation was a relatively simple one; the conduit pipe, probably made of elm-wood, was originally laid partly underground from the springhead by Brewer's Pond and then along the length of the crescentic ditch. The water finally discharged into an underground cistern sited at the south end of the ditch near the old walled garden (see Fig. 1). This early water scheme was essentially a gravity-fed one. It is to be noted that the Brewer's Pond end of the ditch and the cistern end of the earthwork both lie approximately on the 350 ft. contour. The spring had its outlet in the hillside some 8 ft. above this level and this was just enough head to keep the water flowing along the conduit pipe. The crescent-shaped route excavated for the pipeline was evidently carefully planned in order to skirt round the base of the intervening hill, which rises to a height of 390 ft. A.O.D. and separates the spring from Cobham Hall. This curved route is something of a compromise; it avoids the very high ground but as the natural contour of the land rises so the ditch sides get gradually higher through the hillside. At this point the ditch appears to be at its deepest but levels taken recently along its course show that the base of the ditch was in fact at its highest elevation. At this position a spur from the hill runs out across the conduit and an earth causeway (see Fig. 1), shown on George Russell's map of 1718, crosses the deep ditch, thus affording a carriageway to the parkland beyond. The conduit pipe is shown buried beneath the causeway. The levels taken along the conduit course show that there is about 8 ft. of silt in the ditch near the causeway. This silt decreases in depth as the ditch nears Brewer's Pond. When originally excavated the ditch probably had a fall of only a foot or so to the ponds, just enough gradient to allow any drainage water, certainly to be encountered in such a deep cutting by a hill, to be drained back into Brewer's Ponds. This meant that water was

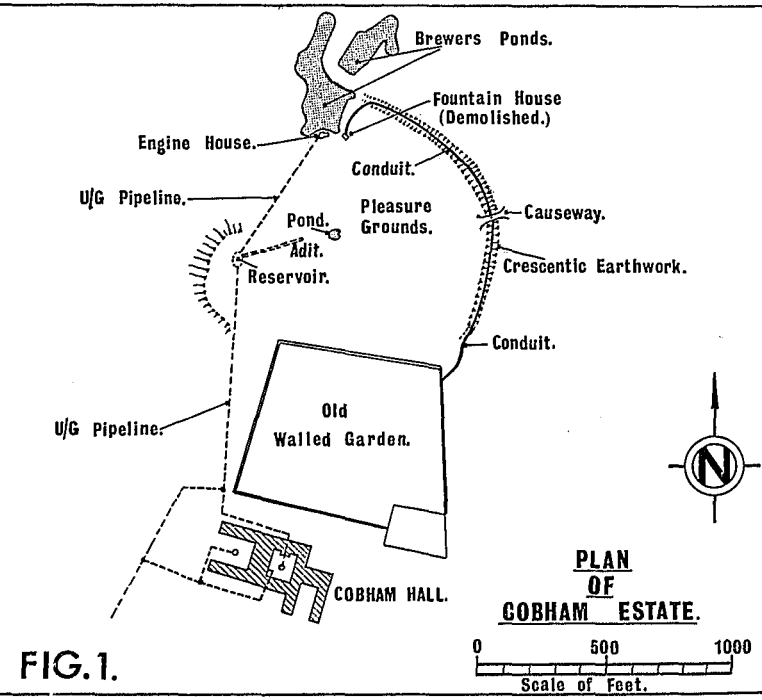

FIG. 1.

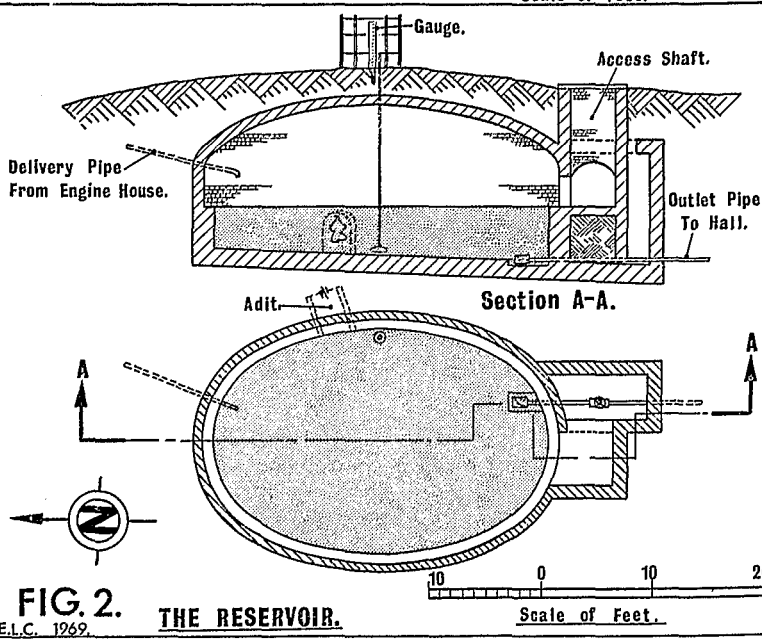

FIG. 2. THE RESERVOIR.

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literally flowing in two directions at the same time; pure water springing from its source in the hillside and enclosed within the elm-wood pipe was conducted in a southerly direction to the cistern and drainage water from the hill flowed openly along the ditch northward to the pond.

At some later date, possibly at the beginning of the eighteenth century, due to difficulties experienced through insufficient head of water being available at the springhead to meet the demands of the household, the Fountain House was built and an engine, capable of lifting the water up to a tank inside the building to maintain an ample head of water, was installed. The Fountain House is shown on the detailed map of Cobham Park made by George Russell in 1718[7] as a tall building complete with tiled roof.[8] Its position beside the pond coincides with that of a spring and the term *fountain house* implies a building erected near or over a spring. In 1749, the Cobham Hall Estate was re-surveyed by C. Price, and his large-scale plan (¼ in. = 2 chains) clearly shows the Fountain House as a rectangular building of about 20 ft. by 24 ft.[9] It also shows the conduit in dotted line following around the edge of the hillside and with its southern end terminating near the old walled garden. Spaced at somewhat irregular intervals along its route are seven small square structures with tiled roofs. The buildings are placed across the pipe and they almost certainly each housed a tank through which the conduit water flowed in turn. Their purpose along the pipe route was to act as settling tanks, a usual method of cleansing spring water of any sediment it contained. The silt would tend to sink to the bottom of the tanks nearer the spring source and the water would be relatively pure by the time it reached the last tank. It should be noted that there still remain seven rectangular pits, about 3 ft. deep, on the base of the ditch. They are sited on each side of the causeway over a distance of 400 ft. Although not strictly in accordance with C. Price's plan, it is possible that these hollows indicate the former positions of the settling tanks. Similar tanks are to be observed on the plans of the waterworks at Christ Church Priory, Canterbury.[10] Apart from the sediment being present in the spring water, another problem was the presence of entrained air which might cause air-locks in the supply. This was obviated by inserting vent pipes along the course of the conduit. It will be recalled that Mr. P. J. Tester, in his report on the cutting he made through both banks and ditch, states that he found many broken fragments of plain roof tile in the banks. It is possible that these fragments of tile may have

[7] Map in Archives Office, Maidstone.
[8] Tiles can be found on the site at the present time.
[9] Map in Archives Office, Maidstone.
[10] *Arch. Cant.*, vii (1868), 160 and fig. 33.

come from the roofs of the settling tanks and were embedded by earth movement when these small structures across the conduit were finally demolished.

The conduit course described above bears a marked resemblance to a water system devised for Sir Harry Vane of Fairlawne, Shipbourne, in about the year 1640.[11] These arrangements, consisting of a spring, two wells, conduit pipe, pumphouse and cistern are clearly shown on an estate map made by John Bowra, in 1765. Water from a wayside spring at Ivy Hatch was conducted in a conduit for a total distance of 1½ miles. The route had been skilfully laid out to skirt around the high ride of Ivy Hatch and followed a course a little below the 500 ft. contour for its first 360 yards. At this place, by Dowles Cottage, a cistern was employed for storage purposes. From the cistern onwards, the conduit pipe descended to a mansion called Fairlawne which was situated at a much lower level. A fragment of a deed, dated 1646,[12] refers to 'The Fountain, wells and springs of waters are late found and made by the said Sir Henry Vane'.

In the grounds of Over Blow House, Shorne, near Cobham, there is a curious little brick building standing on the edge of the wooded part at about 260 ft. A.O.D. It is a conduit house of the early seventeenth century. The building is 8 ft. square and contained a tank where spring water was collected and then distributed under gravity by lead conduits to a pump in the village and to another dwelling near Pipes Place. It was installed in about 1610 by Sir Roger Manwood, who at that time was a tenant of the Manor. On 24th July, 1739, a Mr. J. Lewis of Margate, wrote the following letter to the Revd. Parfect, Vicar of Shorne:

'Reverend sir,

> In answer to yours of 13th. I have not Sir John Manhoods Will but suppose it to be a mistake for Sir Roger Manwood who had a house at Shorne which by his will he gave to his Lady which is all the mention there made of Shorne. But in an inventory of his estate he takes notice of a conduit springhead conduit house & watercourse all made there at his own charge whereof he had given al waye (a waye) for the Streete neighbours & made for them a conduitt house at the Street which is all he says of that. My humble service to Dr Thorpe I am your afct friend & servant.
>
> J. Lewis.'[13]

The building is known locally as a well-house and is unfortunately now in a very derelict condition.

[11] *Arch. Cant.*, lv (1942), 8.
[12] *Ibid.*, 10.
[13] I am indebted to our member, Mr. A. F. Allen, for drawing my attention to this conduit house and supplying the copy of the letter from J. Lewis.

It is interesting to speculate on the type of engine installed in the Cobham fountain house of 1718. In order to do so with some certainty, reference must be made once again to the gardening authorities of this period. From these sources it is apparent that several types of engine were then available, the most important three being as follows:

(i) The Horse Engine. A central vertical pole, mounted with a large wooden toothed wheel and pinion to obtain a suitable driving force, was made to rotate as a horse walked round a circular track. This mechanism in turn actuated a pump.

(ii) Savory's Fire Engine, patented in 1698. This engine employed steam and a condensing vessel to draw water up from a pond or other source of supply, and could force water up to a height of nearly 100 ft. It was claimed that 3,000 gallons per hour were within its working capacity. One of these engines was in use at Camden House, near Kensington, in 1700.[14] It cost the sum of £50.

(iii) The Gerves's Multiplying Wheel Bucket Engine. This ingenious and little-known engine lifted spring water up to a header tank. Its motive power was derived from the weight of the water, much of which flowed away as waste. One such engine was installed at Sir John Chester's home at Chichley, Bucks.[15] The rectangular shape of the Cobham Hall fountain house as shown on both the George Russell and the C. Price maps rather precludes the use of a horse engine. Its size, height and position beside the spring do bear, however, a striking resemblance to the Gerves's bucket engine which had to be housed in just such a building. Fig. 3 shows this engine in a fountain house of the period. It accords well with the known details as they existed in Cobham Park in the early 1700s. A brief description of the Gerves's Multiplying Wheel Bucket Engine is as follows: Water from the springhead A is conducted by the pipe B and feeds the two centre tanks C at ground level. Assume that the two unequal capacity buckets D are at rest at floor level and are being filled from the two tanks. The quadrant-shaped counterbalance E is in the horizontal position during this operation. When the larger bucket is completely filled a catch on it releases and both buckets move away from floor level. The smaller one ascends whilst the larger one descends towards the discharge pit F where it is tilted and its contents are discharged as waste down pipe F. Meanwhile, the smaller bucket has ascended to the top staging where its water content is tipped by a mechanism into the header tank G. The two buckets then return to floor level. It will be noted that the associated hoist wheels on the top staging are so arranged as to have diameters of 3 : 1. Thus the smaller bucket is enabled to

[14] Richard Bradley, *op. cit.*, 338.
[15] Stephen Switzer, *Universal System of Water and Waterworks* (1734), 314.

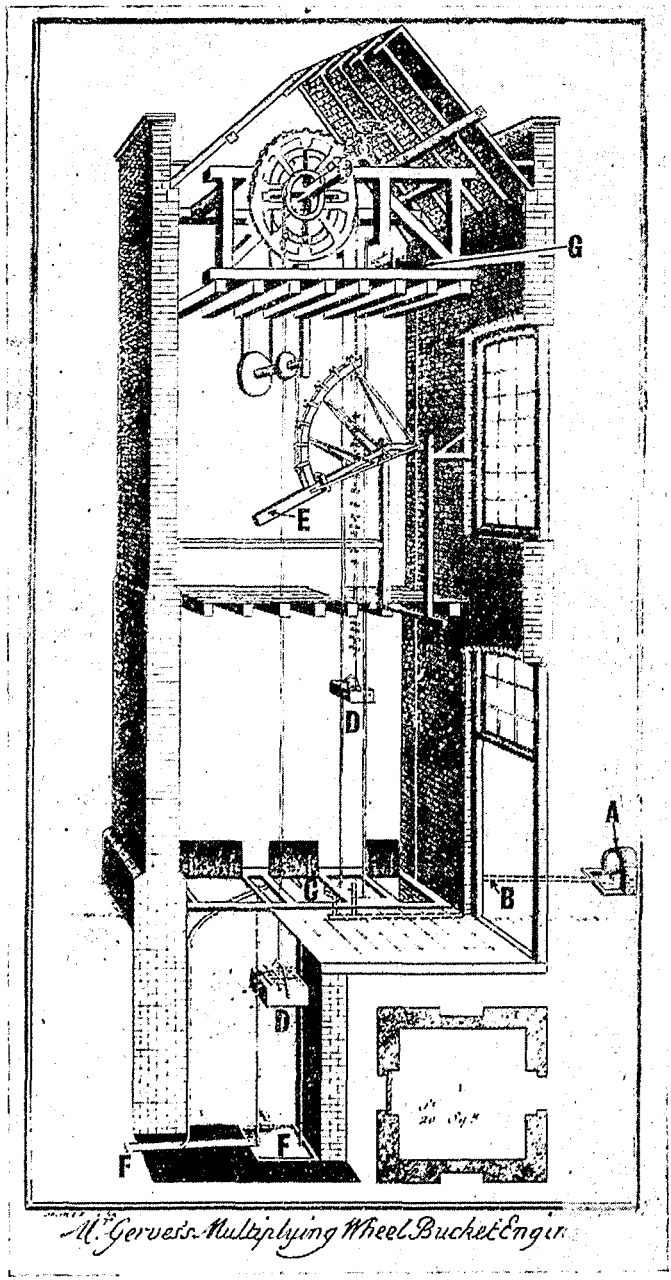


FIG. 3.

travel three times the vertical distance of the larger bucket. The curious quadrant counterbalance set on the mid-staging and driven by its own set of hoist wheels has the property of altering its mechanical momentum during its descent; this has the effect of initially assisting the buckets away from the filling position. The small bar counterbalances inserted in the small bucket chain assist the quadrant to rise to its horizontal position when the small bucket is descending.

The antiquated fountain house and its associated conduit pipe was limited in its application and reliability, with only a small amount of water kept in reserve in its storage cistern. By the late 1700s this arrangement was totally inadequate, so to meet the growing domestic demands a more modern scheme was devised which employed a horse-driven mechanical pump and a much larger capacity reservoir. As was mentioned earlier, another spring on the west side of the Pleasure Ground was available but had not been put to use. This spring supplied an oval-shaped pond which was now brought into definite service as a reservoir. Previously this spring-fed pond had been named *The Reservoir Pond*, but its water was obviously not intended for domestic consumption as it was unroofed and open to pollution by animals. No doubt it was intended as a source of water in case of fire. In 1789 the fountain house was demolished and the conduit pipe abandoned. A new building then known as the *Engine House* and later as the *Pump House* was constructed a little to the west of the site of the fountain house. At the same time, the reservoir pond was improved and roofed over with weather-boards.[16] The Steward's Account Book for 1790 contains the following entry:

Amount in the last account. Nov. 26th.	£93. 18. 11½.
By Joseph Bramah, for a Horse Engine erected in the Engine House in May and June last.	£140. 0. 0.
for 730½ feet of 2½ Inch Lead Pipe laid from the Engine House to the Reservoir Pond at 4 shillings per foot.	£146. 2. 0.
for Soldering 50 joints in the above pipes at 7s. each joint.	£17. 10. 0.
for 2,000 slates for the roof of the Engine House and expenses delivering them into the Gravesend boat at Billingsgate.	£4. 13. 6.
for a suction pipe from the Engine to the bottom of the tank, for a square lead head for top of pipe in the Reservoir Pond and for lead Pipes and Stop Cock to empty the main pipe.	£6. 8. 0.

[16] *Steward's Account Books, Cobham Hall*, Archives Office, Maidstone.

and for Mens' time putting up the Engine, laying down the pipe including their expenses from London and returning.	£13. 18. 0.
Total	£422. 10. 5½.

These accounts show that the engine house can be accurately dated to 1789/1790. It was a plain circular building of red brick with a slated roof and the tank, referred to in the above account, abuts to its east side. The tank is rectangular, with a 10 ft. deep, oak-lined water sump. It contained the two pumps which were driven from the horse engine housed in the circular part of the building. At this time, the open springhead which had formerly supplied the old fountain house was encased in a brick culvert and diverted underground so as to flow into the tank of the new engine house. When in use, the horse engine operated the pumps which forced the water in the tank uphill and along the newly-laid length of lead pipe to the storage reservoir some 700 ft. away. These much improved arrangements ensured that when necessary large quantities of water could be pumped to the reservoir. However, within a few years, even further modifications were to take place, both to the engine house and to the reservoir. In 1790, the fourth Earl of Darnley commissioned Humphry Repton to redesign the gardens and landscape the park. In all, Repton was to work there intermittently for no less than 25 years. Amongst the many changes he wrought on the estate was the obliteration of three of the four avenues of lime trees which radiated from the Hall and which had probably been planted in the 1670s. One of these, the northern avenue, had closely followed the west side of the Pleasure Ground. This was now destroyed and replaced by a curving driveway taking a more westerly route. This route had its exit on to the Watling Street through an imposing Gothic style gatehouse designed by Humphry Repton's son John. It was built in 1801 and is known as Brewer's Gate. The estate accounts[17] show that a great deal of money was spent at the turn of the century on improving and enlarging the series of ponds near Brewer's Gate. Work on the ponds went on during the years 1803, 1804 and 1805. It was during this period of improvements and additions to the grounds that the prominent round pond in the upper part of the Pleasure Grounds was made at a cost of £13 11*s*. 5*d*.[18] In the library of the Royal Institute of British Architects there are a number of original drawings by Humphry Repton and his two sons. One of the most interesting is a proposed design by John Repton for Brewer's Gate Lodge. The exterior

[17] *Ibid.*
[18] Account for 1805.

of the engine house as it remains today shows strong affinities to the architectural features in the Brewer's Gate drawing. That the two buildings were designed by the same architect seems undoubted and amongst the steward's accounts is an entry for 6th July, 1804, which states: 'By John Pattison and other bricklayers and labourers for raising the walls of the Engine House. £33. 16. 6.' This item is a most important piece of evidence, for it confirms that the engine house was in fact drastically altered at this date from a rather drab circular structure to its present-day form of octagonal upper walls raised on top of the existing low circular wall of 1789. This modification to the engine house was entirely in keeping with Repton's ideals of disguising utilitarian garden buildings. An engine house at Bayham Abbey was designed by Humphry Repton to resemble a barbican; thus, in his own words: '. . . contributing to the magnificent effect of the picture'.[19] Guests to Cobham Hall, entering via Brewer's Gate and passing along the new driveway, would see amongst the trees on the left-hand side, a red brick tower, buttressed and complete with windows; a structure which concealed from view the horse engine and pumps.

The Reservoir

The oval reservoir pond, boarded over in 1789, must have presented an ugly appearance to visitors; so it, too, was transformed by Repton. Concerning water supplies, he states: '. . . I have frequently seen large houses placed where no water can be had but by aqueduct or distant land carriage, and it is not only for the constant use of the family that water is essential, but as a security in case of fire, some great Reservoir or tank ought to be provided near the House.'[20] The oval pond was drained and a large brick-built reservoir was constructed on the site but below ground level so as to be out of view. It remains today, in an excellent state of preservation, its position clearly marked by a large grassy mound. This is the upcast soil from the excavation spread over the vault of the subterranean tank (see Fig. 2). Entry into the reservoir is by means of a 4 ft. square shaft situated at the south end of the mound and protected by a cover. The reservoir measures 30 ft. by 20 ft. with a brick vault 14 ft. above its base, which has been set to slope downwards towards its south end. Adjacent to the access shaft and below ground level there is another compartment which contains a 3 in. cast-iron outlet pipe and a stop-valve to regulate the supply of water to the Hall. Although no longer in use, and fractured in several places, this pipe is still *in situ* between the reservoir and the kitchens of the Hall, whilst a branch pipe leads

[19] H. Repton, *Theory and Practice of Landscape Gardening* (1803), 211.
[20] H. Repton, *Fragments* (1816), 201.

off to the site of the ornamental fountain inside the Kitchen Court.[21] The delivery pipe from the engine house, also 3 in. diameter cast-iron, is to be seen high up on the north wall of the reservoir. A water gauge, consisting of an iron rod, tube and internal float, indicated on a scale above ground level the depth of water inside the tank. The spring which had formerly supplied the old pond reservoir was enclosed within a brick culvert and led underground into the newly-built reservoir to augment its supply of pumped water. The arched opening of this adit is to be seen on the east wall. For some unapparent reason it was bricked up at a later date and then, at an even later period, broken open again. The work was clumsily done and the adit now bears a jagged opening into the reservoir. The Cobham Roman villa, which was discovered in 1959,[22] lies just 30 yards to the north of the brick reservoir. Amongst the many interesting features uncovered when the villa was excavated was the discovery of a bath and its associated hypocaust. There can be no doubt that this Roman bath derived its water supply from the hillside spring which, some 1,600 years later, was to be enclosed in a brick culvert and employed as an additional water supply to the Georgian reservoir. Some of the damage to the hypocaust noted in the Cobham villa report[23] must have been caused in the early nineteenth century when Repton replaced the lead pipework from the engine house to the reservoir with 3 in. diameter cast-iron piping. Its course crosses the villa at the exact position where some of the destruction occurred.

Description of the Engine House

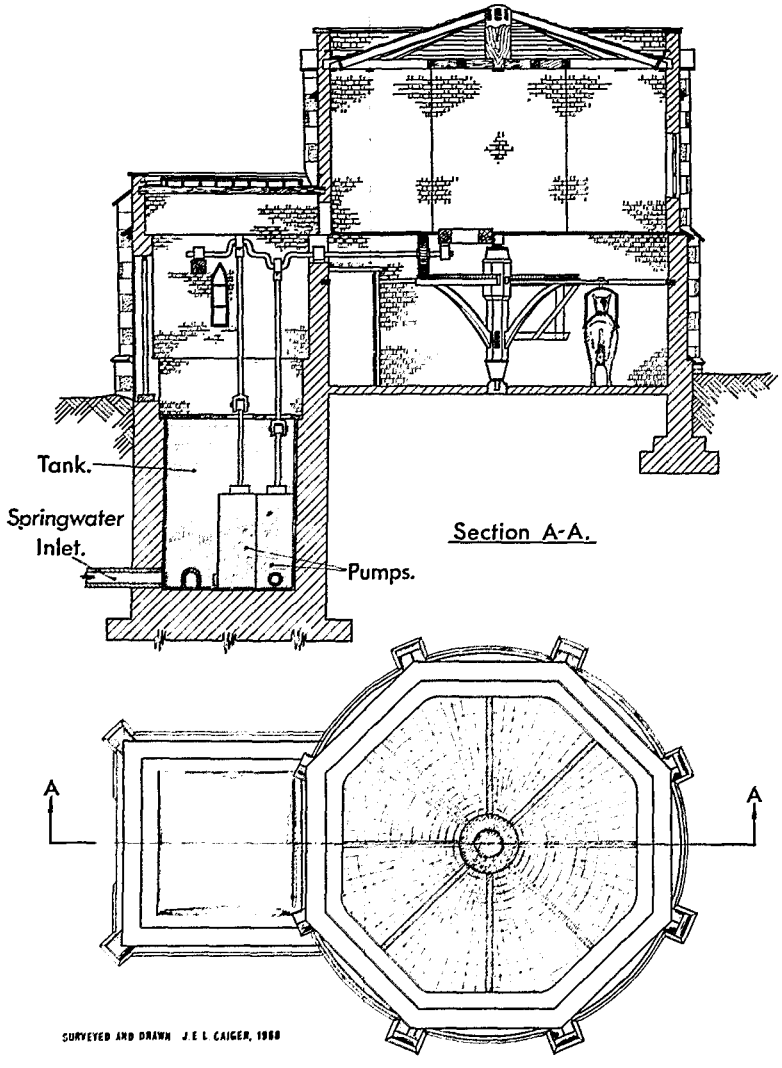
This building stands on the south bank of the lower Brewer's Pond, just a few feet back from the water's edge. From the rear of the engine house the ground rises steeply to the Pleasure Ground. The structure is comprised of two separate functional compartments (see Fig. 4).

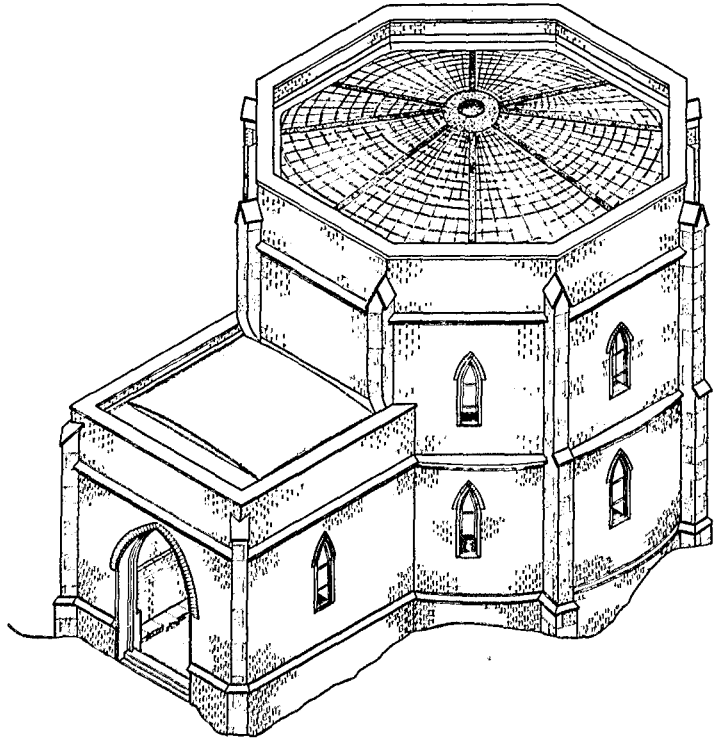
(i) The circular part housed the horse engine with its central revolving axle beam and gear wheels.

(ii) The rectangular part contained the water storage tank and the pumps.

The lower part of the horse engine compartment is sturdily constructed in 17 in. brickwork of a mellow red colour and the internal diameter measures 20 ft. 6 in. At 9 ft. above the inside floor level there is a conspicuous wooden insert let into the brickwork. Above this insert the brickwork changes into an octagonal shape which rests somewhat incongruously on the circular structure. This obviously

[21] M.O.W. Plans and Correspondence.
[22] *Arch. Cant.*, lxxvi (1961), 88.
[23] *Ibid.*, 90.





ENGINE HOUSE.
COBHAM HALL ESTATE.

5 0 5 10 15 20
Scale in Feet

FIG. 4.

[*face p.* 178

is the later addition of 1804; the bricks are of lighter colour and the bricklaying lacks the workmanship imparted to the earlier circular base. These upper octagonal walls are the work of John Pattison and his labourers. The tower rises to a height of 21 ft. 6 in. above ground level and formerly had a slated roof. The remains of the lead flashing for the internal gutter can still be seen. The external angles of the tower are strengthened with stepped buttresses which extend almost to the top coping of the tower. The brickwork of the buttresses has been rendered in a lime, sand mortar and tooled to convey the impression of ashlar work. The apex of each buttress is covered with a neat saddle-back coping (see isometric view, Fig. 4). Three prominent horizontal and moulded string-courses serve as cover fillets for the changes in wall thickness. The centre moulding covers the odd transition between circular and octagonal coursing. On the south-east side there is a doorway to admit the horse when pumping work was necessary. On the east wall of the engine house there was an arched opening, now blocked up, through which the connecting rods passed to operate the pumps in the adjoining tank compartment. Six small pointed windows are set into the walls on the north aspect only; it is this side which is visible to visitors passing by on the driveway. The rectangular part of the building is raised over the 10 ft. deep brick tank, which was oak-lined and caulked to keep out seepage from the nearby pond. Provision was made for this deep tank to be covered over with boards for the sake of safety. Spring water is fed into this tank at its base through several arched openings which branch out from the main feed culvert (Section A-A, Fig. 4). Excess water was conducted away to the pond by means of an overflow pipe set high up on the right-hand side of the tank. The delivery pipe from the pumps is still *in situ* on the rear wall and it passes under the engine house floor and uphill to the distant reservoir. Two windows, similar to those in the engine house, are set in the two side walls of this tank compartment. Although the engine house building is now roofless and in a ruinous condition, sufficient evidence remains in the fallen débris to enable a reconstruction of the type of roof form and also the internal workings of the horse engine[24] to be reasonably determined (see plan and sections, Fig. 4). The original horse engine was removed many years ago but certain fitments and recesses remain to indicate broadly the type of engine that could have been installed by Joseph Bramah.[25] Fortunately, a similar horse engine still remains at Earlham Hall, Norwich, and although the pump has not been used for many years it is still in fairly good condition and could be said to be in working order.[26]

[24] *Transactions of the Newcomen Society*, viii, 34.

[25] Joseph Bramah, 1748–1814, inventor and engineer, Patent Engine Maker of 14, Piccadilly and Pimlico.

[26] The City Engineer, Norwich.

DESCRIPTION OF A HORSE ENGINE

The main wheel would be made of oak, fitted with perhaps about 125 wooden teeth and set on to a vertical axle beam capable of revolving on its two iron gudgeons; one mounted in a floor bearing whilst the upper one would be in a plummer block secured to a large transverse beam which spanned the engine house. This main wheel bore six spokes between the outer rim and axle, whilst each spoke bore a curved strut from the rim to brace it back to a lower position on the axle beam. One of the horizontal spokes would be especially strengthened with a timber frame to accommodate the necessary iron yoke fitting for attaching the horse. A small pinion, containing possibly 25 teeth, would engage with the main wheel. This pinion drove the two-throw crankshaft which, via connecting rods, worked the pumps in the adjoining tank compartment. An engine of this description, although rather primitive, was no doubt capable of pumping a considerable volume of water for a few hours' work by the horse.

The engine house at Cobham continued in working order for the domestic water supply until 1905/1906 when the Hall was put on the Company mains supply. The horse engine and pumps were dismantled in 1932 by the order of the ninth Earl of Darnley, who also had certain internal structural changes made at that time. It was thought that the old engine house might be suitably converted, by the addition of a centre floor, staircase and other modifications, into a dwelling for one of his estate workers. However, due to its damp and mosquito-ridden position it was never used as such and through the passing of time has fallen into a ruinous condition. The tower portion of the building has deteriorated rapidly during recent years. The upper octagonal walling was severely damaged when a heavy tree branch crashed upon it, and acts of vandalism have accentuated this damage.