London and the steam engine. Part 1: The engines

by David Perrett

Since 1726 London has been the home of working reciprocating steam engines, and some of the last productive engines in Britain still operate in the capital. Soon even these will cease to function usefully, and only preserved engines will remind us of the power of steam. In the stationary steam engine, this power was a major factor in both the growth and survival of London. Steam engines pumped-in London's water, pumped-out London's sewage, ground London's corn and produced the power to drive its industries. Although the great engine builders – Boulton & Watt, Harveys of Hayle, Hathorn Davey & Co. – supplied engines to the capital, London also supported a substantial engine building industry of its own. This, the first part of the article, outlines the history of the introduction of steam engines into the capital and their further application. Details of the known surviving engines are listed in the appendixes. The second part will detail the various London engine builders and their surviving products.

The early engines

The first 'fire-engine' to be erected in London was the unsuccessful water pump installed by Thomas Savery in 1710 at York Building Waterworks, Villiers Street, Strand. In 1726, this same company installed London's first true steam engine, a Newcomen atmospheric beam pumping engine on the same site.[1] Although technically successful, the low efficiency of the engine combined with the high cost of coal in London meant that it was uneconomic. It ceased operation in 1731 and in the following year its brass cylinder was sold to the Lowther Collieries in Whitehaven, a second (spare) cylinder going to the London Lead Company's engine at Trelogan. The remains of the engine lay derelict at York Buildings for at least ten years. A larger (45") Newcomen engine was installed in 1752 and continued in use until 1805. It later shared its duties with a 49" Newcomen engine. In 1777 the 49" engine was improved by John Smeaton and when finally replaced in 1813 it was, according to Farey,[2] the last Newcomen engine operating in London.

Farey[3] also states that other London water supply companies had employed atmospheric steam engines. He recorded that the ten in use in 1775 had an estimated total hp of 105. The Chelsea Waterworks had a 28" and a 32" engine at Pimlico, Shadwell had two 30" engines, Lambeth had a 24" engine, and another of 24" was at Stratford. A 34" engine was used to supplement the six waterwheel-driven pumps at London Bridge. Although none of these Newcomen engines survives, the engine house built by John Smeaton for the New River Company to house his 18" atmospheric engine in 1767 can still be seen. The structure forms part of a later building at the Thames Water Authority's (TWA) headquarters at New River Head, Rosebery Avenue, EC1 (TQ 313828).

Watt's engines

The improved steam engine incorporating the separate condenser was patented by James Watt in 1769, and production by Boulton & Watt started in 1775. However the simple, if inefficient Newcomen engine was not readily displaced from its duties throughout the country, and London was no exception. Watt's first engines were – like Newcomen's – suitable for pumping duties only. Watt's first engine in London was a small pumping engine installed at a distillery in Bow in 1776. A water pumping engine was installed at Shadwell Waterworks in 1778, and it was possibly sold with a degree of expansive working of the steam,[4] although this mode of operation was not patented until 1782. It replaced the Newcomen engine mentioned earlier and was unusual for a Boulton & Watt engine of this date in that a flywheel and crank were fitted. Additional engines were purchased by this waterworks: a 43 hp Watt engine in 1803 and a third engine in 1810.

In 1781, Boulton wrote to Watt urging him to perfect a rotative engine, saying that

> 'the people of London, Manchester and Birmingham are steam mill mad.'

The real growth of Boulton & Watt's engine business therefore came after the patenting in 1782 of the sun-and-planet mechanism for deriving rotative motion, which was designed to circumvent James Pickard's 1780 patent on the crank. Engine sales increased manyfold. The first rotative engine of this type was supplied in 1784 to Goodwyne's Brewery in East Smithfield. It was followed in 1785 by the installation in Whitbread's Brewery, Chiswell Street, of another rotative beam engine which was originally single-acting and rated at 10 hp. This engine was uprated to 20 hp by making it double-acting, and drove four pairs of stones used for grinding malt. The modified engine, complete with 20' cast-iron beam and parallel motion was removed from the brewery in 1887 and is now in the Museum of Applied Arts & Sciences in Sydney, Australia.[5] This engine (B 1)* appears to be the oldest surviving 'London' engine. Farey records that within a few years the standard type of Watt rotative engine was employed in all the large London breweries and distilleries; for example, John Calvert's, Felix Calvert's, Gyford's, Close's and Thrale's breweries all purchased engines.[6] The engine installed at Barclay & Perkins (formerly Thrale's) Brewery, Southwark Bridge Road, in 1786, worked until 1885 when it was presented to the Royal Scottish Museum, Edinburgh. It (B 2) still possesses the original wooden beam and sun-and-planet gearing. Another similar engine (B 3) dating from 1797 can be seen in the Science Museum, London. It was originally supplied to a chemist and druggist in Aldersgate, London EC, where it worked until 1885.

The main manufacturing areas in London, such as Southwark and Shoreditch, were distant from rivers like the Wandle or the tidal creeks of the Thames, which were sources of natural power. In these areas the new rotative engine proved economically attractive, and Watt's rotative engines were installed prior to 1800 in a variety of industries. In 1787 a forge in Rotherhithe fitted a rotative engine for rolling iron.

* References in brackets refer to engine details listed in the appendixes.

Dyes were crushed at Goodhew, Platt & Goodwin's works in Southwark by engines installed in 1786 and 1792. The most significant advance came with the employment of Watt engines in the ill-fated Albion Mill. The Albion Mill Company was founded in 1784 by Samuel Wyatt with the intention of applying rotative steam power to grinding corn; the aim was to drive thirty pairs of stones in one building compared to the one or two pairs in a wind or watermill. The mill was built at the south-eastern end of Blackfriars Bridge, and production started in 1786 with a 50 hp double-acting engine driving six of the ten pairs of stones. Two years later a further engine was installed to drive another ten pairs. The final engine was not installed because on the 2nd March 1791 an accidental fire completely destroyed the building.[7] But the mill, the largest works of its kind in England, proved to be a major shop window for Boulton & Watt.

The nineteenth century

Farey made an apparently comprehensive survey of the steam engines at work in London in 1805, five years after the expiry of Watt's original patent. He found 112 steam engines at work, with a total horsepower of 1,355. The trades in which they were employed are detailed in Table 1.

Farey found that 46 of these engines (totalling 648 hp) were made by Boulton & Watt at Soho, Birmingham. However a recent analysis of the comprehensive Boulton & Watt archives by Dr Jennifer Tann[9] has produced the following numbers of engines delivered in the period 1775 to 1805 to the home counties (it is reasonable to suppose that Farey covered a similar area):

Essex	2
Kent	5
Middlesex and Surrey	97
Total	104

Some of the engines delivered to London could have been resold outside, some like the Albion Mill engines were destroyed prior to 1805, and others may have been supplied to firms with office addresses but not works in London. The discrepancies between the two lists require investigation. Similarly, although Farey's total includes a few surviving Newcomen engines, the sources and locations of the 66 engines not by Boulton & Watt require further research.

When Farey's Treatise was published in 1827, he estimated the number of engines in London to have increased to about 290. These were installed in waterworks, small manufactories and steam boats, with a total of 5,460 hp.[10] During the first twenty years of the 19th century, the market for steam engines in London probably matched that of the mining areas of the south-west or the textile districts of the north, which were still predominantly water-powered.

Survivals from the first half of the 19th century are relatively rare; engines still at work are scarcer still. The two beam engines at Young's Ram Brewery, Wandsworth, were supplied by the local firm of Wentworth & Sons in 1835 and 1867. Both engines still perform their original duties and are believed to be the last beam engines still working in that manner in Britain. The earlier engine is also probably the oldest steam engine still earning its keep (Aa 1, 2).

Although a number of other engine builders began supplying the London market, Boulton & Watt continued to be the premier company, winning in particular government orders such as those for the supply of engines to Woolwich Dockyard. Four engines were supplied in 1814-15 to the Dockyard's new smithery, and in 1819 a pumping engine was installed.[11] During the next period of expansion at the Dockyard in the 1840s Boulton & Watt still successfully tendered to supply a pumping engine.

In terms of design and standard of engineering other firms began to rival and eventually surpass Boulton & Watt. In particular the importance of the Thames as a centre of ship building produced many companies that derived much of their expertise from marine engine building, whilst also building numbers of land-based engines. John Penn of Greenwich, John and George Rennie, and particularly Maudslay, Sons & Field maintained this dual presence. The only surviving example of a Maudslay beam engine in Britain is the 1838 engine at Kew Bridge (Ab 17), although an example from 1837 survives in Australia. Maudslay also introduced in 1807 his famous table engine design, particularly suited to workshops. An example of 1840 from Springfield Hospital, Tooting, which worked until 1949, is now in the Science Museum, South Kensington (B 5); the Henry Ford Museum in the USA possesses earlier examples.

The later years

By the second half of Victoria's reign the true age of steam had arrived.[12] In 1870 steam engines supplied the country with approximately one million horsepower, compared to less than 60,000 hp from water power. The northern textile industries used about half this capacity, whilst the counties of Essex, Kent, Middlesex and Surrey only generated some 36,000 hp by steam and 1,200 hp by water. Compared to the beginning of the century, London was no longer a major user of steam power. Numerically the principal users of steam power in the London area in 1870 were letterpress printers (628 firms) and machinery manufacturers (145), although these two groups only used ten per cent of the power capacity. However the factory inspectors' returns on which these figures are based did not include government establishments, which were major users of steam power.[13]

Table 1. *Steam engines working in London in 1805.*[8]

	Engines	hp
Public waterworks	10	270
Docks for shipping	6	150
Temporary public works	7	68
Public baths	2	8
Power for pumping water	25	496
Breweries	17	250
Distilleries	8	111
Vinegar makers	3	20
Dyehouses	8	80
Woollen cloth dresser	1	21
Tanneries	2	8
Cotton mills	2	12
Calenders and packers	2	22
Calico printers	4	20
Sail-cloth weaving	1	14
Flour mills	6	52
Oil mills	3	20
Mustard mills	2	12
Drug mills	3	28
Paper mills	2	20
Colour makers	3	26
Starch maker	1	10
Roperies	3	24
Iron forge	1	40
Foundries & machine makers	10	42
Cutlers	2	3
Glass cutter	1	6
Diamond cutter	1	4
Silversmiths	1	8

The immense growth of population in London during the 19th century placed pressures on public utilities which were solved only by the extensive employment of steam power. Although both Newcomen's and Watt's engines had been used by the commercial water companies supplying London, it was only following the visit of Thomas Wicksteed (1806-71) of the East London Waterworks Co. (ELWW) to Cornwall that efficient pumping engines appeared in London. In 1837 Wicksteed inspected the highly developed beam engines used to drain the mines in Cornwall. The high cost of fuel plus competition between the mine engineers had made the Cornish engine the most efficient in the world. High pressure steam generated in efficient boilers supplied beam engines with large diameter cylinders operating with a high degree of expansion and controlled by Cornish cycle valve gear. The overall efficiency was also increased by efficient insulation of the cylinders and steam pipes. The best of these engines was Austen's 80" engine at Fowey Consols mine, and Wicksteed supervised the redesign and erection of a near-replica at the Old Ford Waterworks in 1838. This engine had originally been built by Harvey & Co. in 1835 for the East Cornwall Silver Mine Co. and was purchased from them by the ELWW. The success of the Wicksteed engine on water supply duties led to the adoption of the Cornish engine by other London water companies. In 1845 Sandys, Carne & Vivian of the Copperhouse Foundry, Hayle, supplied a 90" engine designed by Wicksteed to the Grand Junction Water Company's works at Kew. This massive beam engine was set to work in the following year and steamed until 1943. It survived to be resteamed by the Kew Bridge Engines Trust in July 1976 (Ab 18). Between 1846 and 1848 Wicksteed also converted the two earlier engines at Kew to the Cornish cycle: the 1820 Boulton & Watt engine, which had been moved there in 1839 from Chelsea Waterworks (Ab 16), and the 1838 Maudslay engine (Ab 17). These engines, together with the 1859 70" Bull engine (Ab 19) and the 1871 100" engine (Ab 20) – both by Harveys of Hayle – survive in the care of the Kew Bridge Engines Trust and form the best group of Cornish engines in the world. Harvey & Co. built a total of 36 waterworks engines for the London area between 1838 and 1874.[14] In 1862, of the 115 million gallons of water consumed per day in London, 70 per cent was pumped by engines built by Harveys. The largest engine they constructed for the capital was a 112" engine for Battersea Waterworks in 1858, which was scrapped in the 1920s.

Kew Bridge and most other water supply stations obtained their water from the Thames or other surface sources. Currently (1978) some 15 per cent of London's water is extracted from the water-bearing strata below ground by the TWA. In the past many firms, hospitals, public baths, etc. pumped water by engines on their own wells, and some,

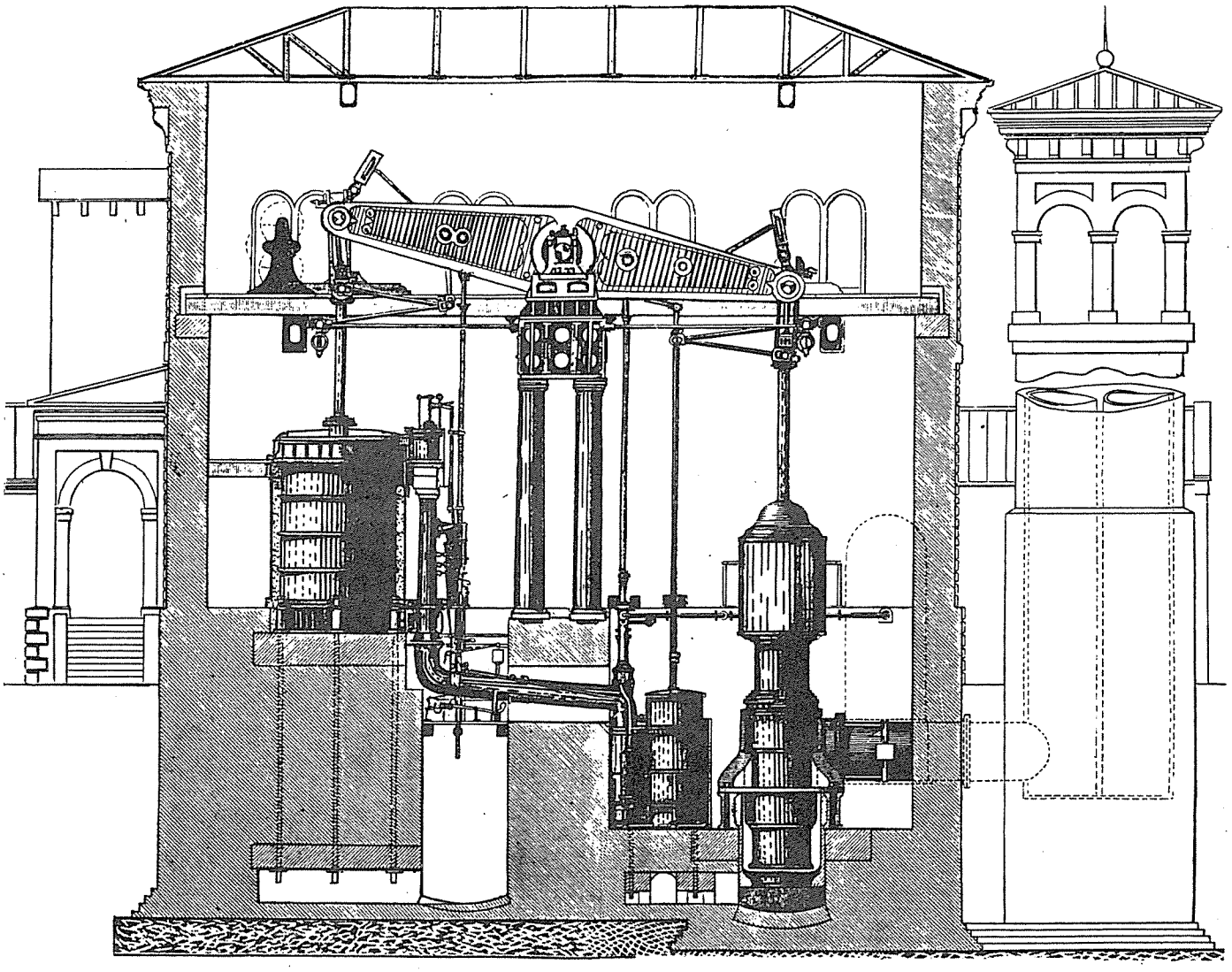

Fig.1. *Section through a typical mid 19th century London water supply pumping station: the 100" Cornish beam engine by Messrs Harvey & Co., Hayle, erected at East London Waterworks, Lea Bridge in 1866 (The Engineer, 1866,* **22**, *p.399)*

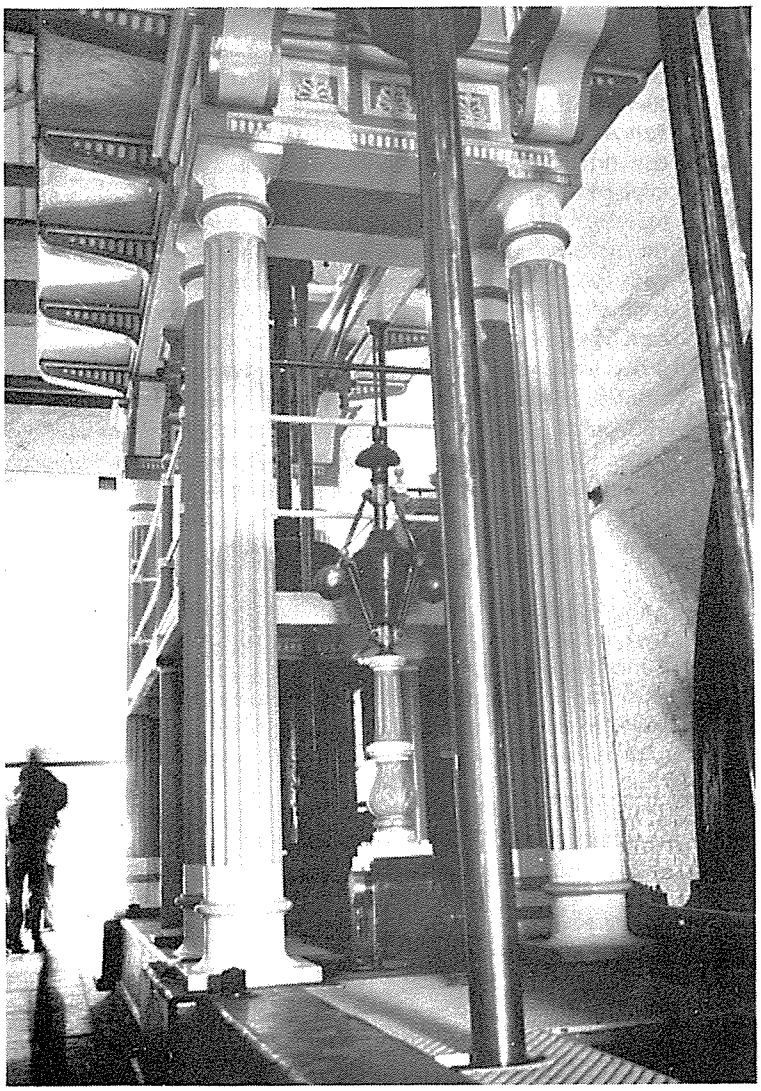

Plate 1. *Typical of the large beam engines employed in London. The 1886 engine (Ab 25) by Wood Brothers of Sowerby, Yorkshire, preserved at Markfield Rd, N15* *(Photo David Perrett, 1978)*

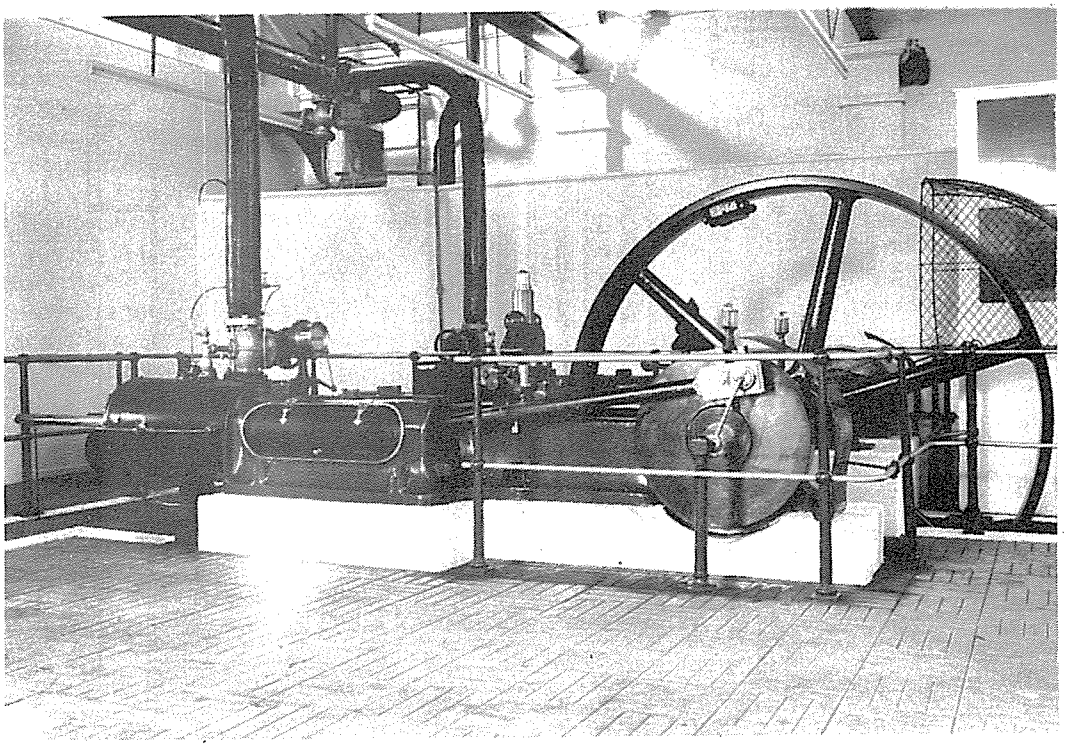

Plate 2. *The pair of preserved 1896 horizontal engines (Ab 23,24) by Marshall Sons & Co. at Low Hall Farm Depot, Walthamstow* *(Photo David Perrett, 1978)*

e.g. Harrods, still do. Two beam engines continued to pump water in this manner at Addington Well Pumping Station, Croydon, until 1975. The engine installed there was an A-framed Woolf compound rotative built by Easton & Anderson of Erith in 1887 (Ab 1). A second identical engine by Glenfield & Kennedy was added in 1893 (Ab 2), and it was this engine that was the last to work on 29th June 1975. These engines were the last beam engines in public service in Britain. Following listed building consent to demolish the engine house at Addington, the fate of these two fine engines is still uncertain. Another Easton engine over a well that can still be steamed, survives at Banstead Hospital (Ab 5).

By 1869 the eight London water companies operated 93 steam pumping engines with an average horsepower of over 100 (Table 2).

Table 2. *Works and engines of the London water supply companies in 1869.*[15]

Company	No. of works	No. of engines	Total hp
Chelsea	1	8	1,025
West Middlesex	4	10	1,201
Grand Junction	3	8	1,180
Southwark & Vauxhall	3	11	1,765
Lambeth	2	12	1,180
New River	9	19	1,700
East London	3	11	1,340
Kent	6	14	1,175

At the end of the century when the role of the private water companies was under review, the number of engines had more than doubled. In 1893, the New River Company had 24 engines whilst the East London Company operated 26 engines, mainly triple expansion engines. The Metropolitan Water Board (MWB) was formed in 1903 by amalgamating the private companies supplying the capital under public control. In June 1904 the MWB possessed 235 steam engines with a total power of 32,177 hp. But the steam engine's reign as the supreme water pumping prime mover was now being challenged. In 1905/6 the first steam turbine was installed at Hampton Pumping Station by W B Bryan.

The beam engine was also extensively employed on the sewage system designed by Sir Joseph Bazalgette for the Metropolitan Board of Works in the 1860s. Large concentrations of pumping power were required at the intermediate lift stations at Deptford and Abbey Mills and the outfall stations at Beckton and Crossness. The steam plant was removed from the first three of these stations in the 1920s and 30s but at Crossness replacement pumps were installed in a new building and the beam engines still remain. The four 125 hp single-cylinder rotative beam engines discharged the effluent from the Southern Outfall sewer into the Thames. They were supplied by James Watt & Sons in 1865 but were compounded in 1891. They continued in service until just after the second world war, but one engine is believed to have remained in working order until 1953. Now they and their magnificent cast-iron engine house slowly rust away (Ab 8-11). A later pair of rotative beam engines (1895) worked until 1967 in the municipal sewage pumping station at West Ham. These engines by the Lilleshall Company of Shropshire are disused but 'preserved' (Ab 29,30). The 1886 sewage pumping engine by Wood Brothers of Sowerby Bridge, Yorkshire at Markfield Road, Tottenham is more fortunate, having been restored by a group of enthusiasts on behalf of the Lea Valley Park Authority (Ab 25).

Of the thousands of engines which powered the workshops, factories, gasworks etc. of Victorian London little detail is known. Only a handful of these engines survive, with even fewer still at work or remaining on their original site. The small single-cylinder horizontal engine still working in Stoke Newington (Aa 4) and the similar engines which drove the washing machines at Cheshire Street public baths and wash-house (Ab 6,7) are rare survivals. Most of the small engines that remain are to be found in museums because such engines were the ones most easily replaced by gas engines or electric motors. Only when steam was produced for some other purpose was it economic to retain a small steam engine in a workshop or factory. At Tower Bridge a small donkey engine by Tangyes of Birmingham drove the line shafting in the workshops until regular steam generation ceased around 1972.[16] The engine was removed in 1977 and its present whereabouts are unknown. Hundreds of small engines were employed in the capital's many gasworks but most were scrapped when coal gas production ceased in the 1960s. Gasworks engines dating from *c.* 1900 have been preserved at Wendron Forge (B 18) and Forncett St Marys (B 16,17).

The twentieth century

The reciprocating steam engine was the initial prime mover for the new power sources developed after the 1880s. For electricity generation slow speed engines coupled to dynamos or alternators were not ideal. A Ransome, Sims & Head two-cylinder engine powered the demonstration of electric lighting on the Embankment in December 1878. Much larger engines were used in the later central supply stations. Two 1,250 hp engines by Hick, Hargreaves & Company Ltd. drove alternators supplying initially 5,000V, later 10,000V at Ferranti's Deptford Power Station in 1889. By the time high speed engines (such as Willans and Belliss & Morcom types) could be directly coupled to the generators, the infant steam turbine was ready to completely supersede the steam engine. Reciprocating steam engines presented less problems when the power generated was used for traction, as voltage stability was relatively unimportant. In 1906 slow speed 'Manhattan' engines at Greenwich Power Station, which supplied the LCC tramways, were to form the last major installation of steam engines in a British power station.[17] None of these important early engines from the London area appears to have survived.

The earliest commercial means of transmitting power was via hydraulic mains, and steam engines drove the pumps which pressurised the water. The London Hydraulic Power Company provided a public supply whilst private systems existed in the docks, railway depots etc. The total number of such hydraulic pumping stations was large, but the only steam engines to survive in London are the two beautiful 1894 horizontal engines by Sir W G Armstrong, Mitchell & Company Ltd. at Tower Bridge (Ab 26,27). January 1978 saw the last steaming of these engines, which had ceased active service in 1972. They survive preserved; one engine has recently been offered for sale but without any successful bidders. The smaller relief engine installed at Tower Bridge in 1941 is now in private preservation in Norfolk (B 21).

Other public utilities, in particular water supply, continued to install steam plant during the first 30 years of the present century. The MWB replaced many beam engines with triple expansion engines. These engines were land based versions of the high efficiency marine power units developed by firms like Penns of Greenwich and Hathorn Davey. In 1949, of the 65,800 hp capable of being generated by the MWB, about 70

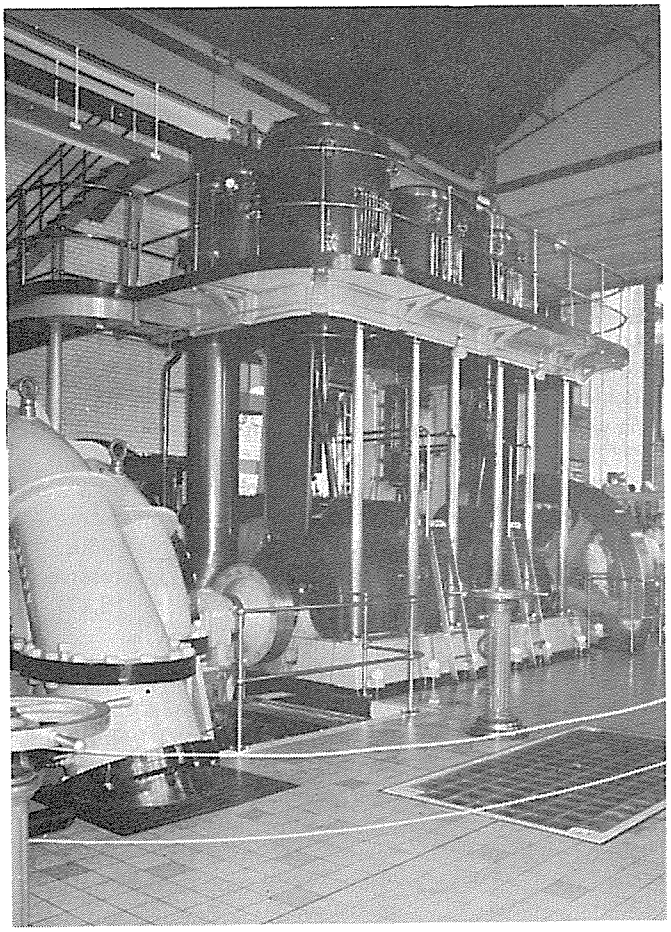

Plate 3. *The Thames Ironworks triple expansion engine at Walton-on-Thames pumping station (Ab 28)*
(Photo Malcolm Tucker, 1976)

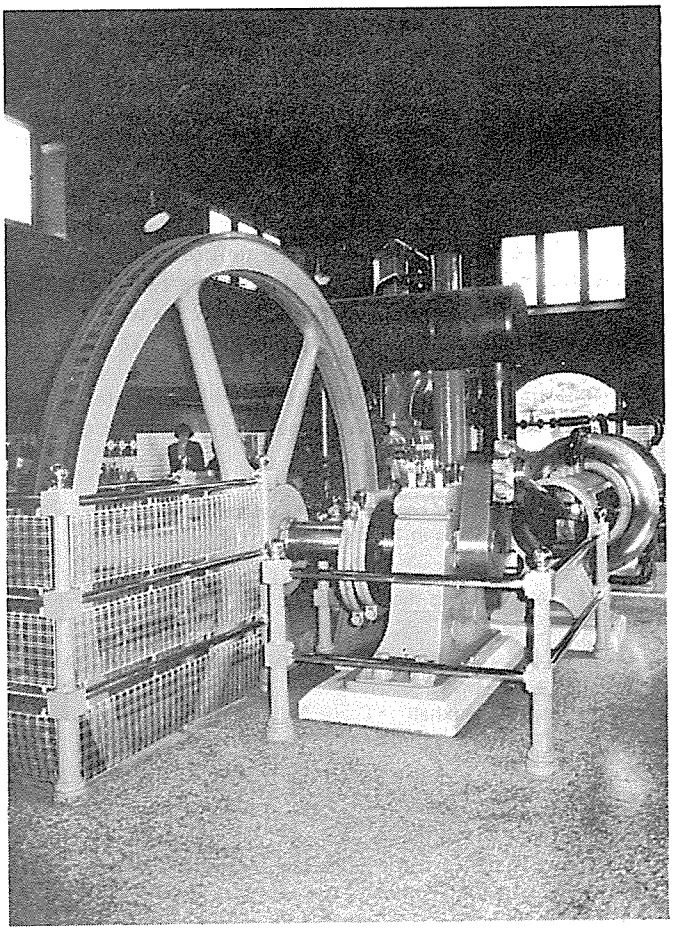

Plate 4. *Still at work; one of the pair of horizontal engines (Aa 6,7) by Simpson at the TWA's Waddon pumping station, Croydon* *(photo Malcolm Tucker, 1976)*

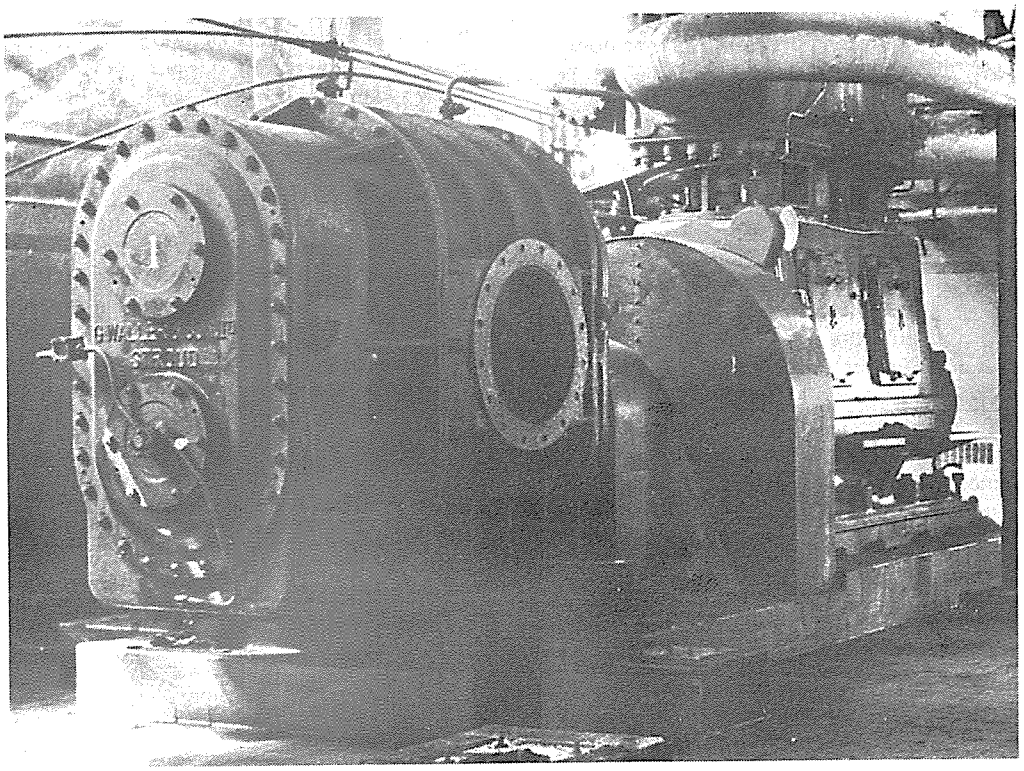

Plate 5. *Prior to scrapping; on the right one of the enclosed engines (Ab 12,13,14) by Ashworth & Parker at Ford's Dagenham. The engine is coupled to a compressor by Waller & Son (left)*
(photo Bob Carr, 1978)

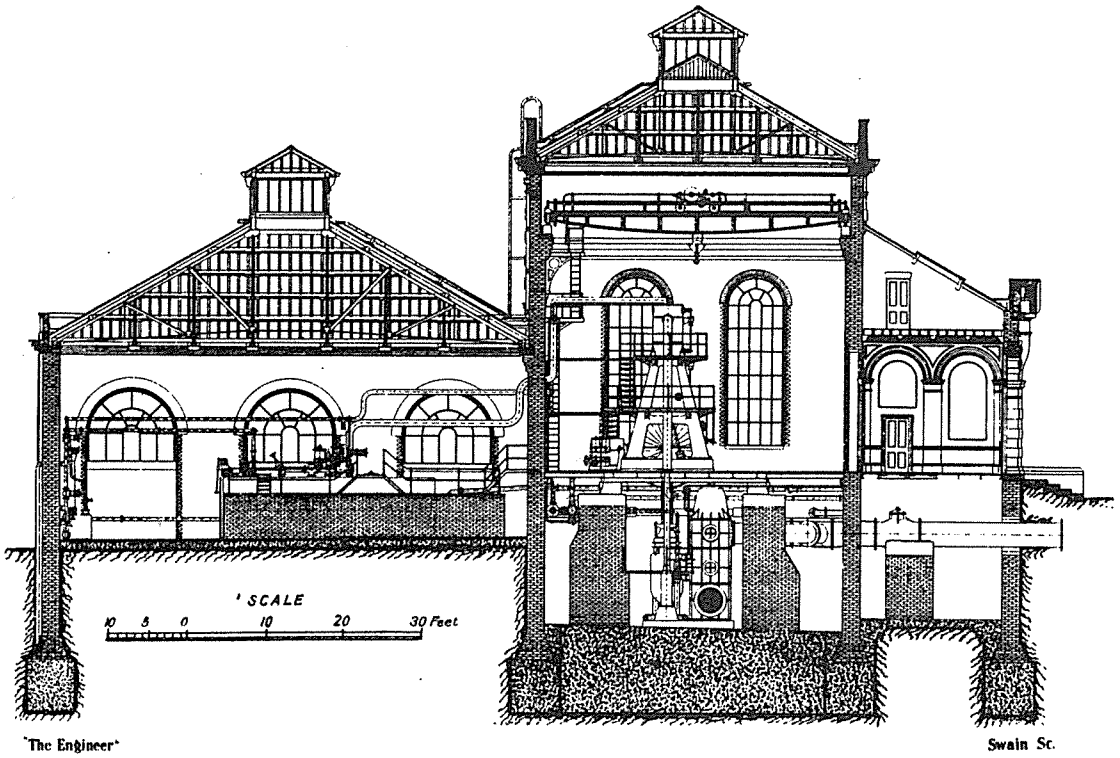

Fig.2. *Section through typical early 20th century pumping station: Kempton Park which housed five Lilleshall triple expansion engines, installed 1908, scrapped 1973 (The Engineer, 1908,* **106**, *p.424)*

per cent still came from steam engines. The last big steam engines employed in the capital pump water. At Waddon pumping station, Croydon, two horizontal engines by James Simpson are kept on standby but work frequently in summer (Aa 6,7). At Kempton Park pumping station adjoining the M3, probably the most spectacular sight of steam still at work can be obtained. The two Worthington Simpson triple expansion engines, built in 1928, are still pumping some 19 million gallons of water per day to the East End and the City (Aa 9,10). These engines are believed to be the largest land based steam engines to work anywhere in the world. They will continue in service for about another year until electric pumps are installed. It is hoped that these magnificent engines will be preserved in working order as a memorial to 250 years of steam power in London.

Footnote

This article cannot be a full account of London and the steam engine. The chronology is incomplete, the numbers and locations of steam-employing industries need much more investigation, and the industrial archaeology of the surviving engines requires further research both at home and abroad. The author would be pleased to learn of additional unrecorded engines. However, the importance of the stationary steam engine to London is clear.

Acknowledgements

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Appendix A

Known locations in Greater London with steam engines still believed *in situ* (1978).

(a) Engines still in use

Ram Brewery (Young & Co.), Wandsworth High St, SW18 **TQ 256747**

1. 1835. Wentworth & Sons, Wandsworth
   A-frame rotative compound beam engine
   * 9" x 2'6" & 15" x 3'6". 12hp increased to 16hp in 1863. 32 rpm. Standby.
2. 1867. Wentworth & Sons, Wandsworth
   A-frame rotative compound beam engine
   9" x 2'6" & 15" x 3'6". 32 rpm. Working.

Houses of Parliament, Westminster, SW1 **TQ 303795**

3. c. 1880. Marshall Sons & Co. Ltd, Gainsborough
   Horizontal duplex air compressor engine
   Approx. 10" x 14". 90psi. Standby.

Politi & Sons (Turkish Delight Mfr), 10 Manor Road, Stoke Newington, N16. **TQ 335870**

4. 1901. Marshall Sons & Co. Ltd, Gainsborough
   Horizontal single-cylinder engine. Working.
5. *c.* 1950. W. Sisson & Co. Ltd, Gloucester
   Inverted vertical single-cylinder enclosed engine. Standby.

Waddon pumping station (T.W.A.), Waddon Way, Croydon **TQ 313639**

6. 1910. James Simpson & Co. Ltd, Newark
   Horizontal cross-compound engine
   24" & 42" x 3'. 120hp. 120 psi. Working.
7. 1915. James Simpson & Co. Ltd, Newark
   As No. 6. Working.
8. Not dated. E. Green & Son Ltd, Wakefield
   Small horizontal single-cylinder economiser engine. Working.

Kempton Park pumping station (T.W.A.), Hanworth, Middx. **TQ 111706**

9. 1928. Worthington Simpson Ltd, Newark
10. Two inverted vertical triple-expansion engines *Sir William Prescott* & *Lady Bessie Prescott*, inaugurated 24.10.1929.
    These engines pump 19 mgd against 200' head and are believed to be the largest steam engines still at work anywhere.
    29" & 54" & 86" x 66". 1008hp. 200psi.
    25 rpm. Two 17' flywheels of 32 tons.

* Engine particulars, where known, are listed in the following order: Cylinder diameter(s) x stroke(s). Horsepower. Working steam pressure. Speed.

(b) Other engines still on original site

Addington Well pumping station (T.W.A.), Featherbed Lane, Croydon **TQ 371627**

1. 1888. Easton & Anderson, Erith
   Woolf compound rotative A-frame beam engine
   20" x 4' & 20" x 6'. 125hp. 100 psi. 16–20 rpm.
   Stopped June 1975; preserved but to be removed from site.
2. 1893. Glenfield & Kennedy, Kilmarnock
   Woolf compound rotative A-frame beam engine
   20" x 4' & 20" x 6'. 125hp. 100 psi. 16–20 rpm.
   Stopped 29 June 1975; to be removed for preservation.

Albion Brewery (Watney Mann), Whitechapel Rd, E1. **TQ 349819**

3. 1867. Kittoe & Brotherhood, London
   Single-cylinder rotative beam engine with 16' flywheel shared with No. 4.
   28" x 4'6". 90 hp. Being dismantled (Sept. 1978) for preservation in Somerset.
4. 1872. Robert Morton, Stockton-on-Tees
   Single-cylinder horizontal engine
   24" x 4'. Disused, probably to be scrapped.

Banstead Hospital (Kensington, Chelsea, Westminster A.H.A.), Sutton Lane, Banstead, Surrey **TQ 262612**

5. 1875. Easton & Anderson, Erith
   Small single-cylinder rotative beam engine
   Pumped water from well. Disused but workable.

Cheshire Street public baths (L.B. of Tower Hamlets), Cheshire St, E2 **TQ 343823**

6. 1899. Marshall Sons & Co. Ltd, Gainsborough
   Horizontal single-cylinder engine
   Drove two washing machines and two hydro-extractors via belts.
   10" x 14". Ceased work *c.* 1963; disused.
7. 1899. Tangyes Ltd, Birmingham
   Horizontal single-cylinder engine
   Drove pumps on well
   8" x 16". 40–80 psi. 125 rpm.
   Ceased work *c.* 1966; disused

Crossness sewage treatment works (T.W.A.), Belvedere Rd, Thamesmead, SE2. **TQ 484811**

8. 1865. James Watt & Sons, Soho & London
9. Four identical single-cylinder rotative beam
10. engines originally 125hp, converted to triple
11. expansion working in 1891 by Benjamin Goodfellow of Hyde. *Victoria, Prince Consort, Alexandra & Albert Edward.*
    19" & 32" x 6'10½" & 44" x 9'. 10½ rpm.
    30 psi. 210hp.
    Last worked *c.* 1945; standby until 1953; preserved but dilapidated.

Ford Motor Co. Ltd, Dagenham, Essex (Coke ovens by-product plant) TQ 499817

12. 1957. Ashworth & Parker, Bury
13. Three two-cylinder enclosed compound engines
14. Drove compressors by Geo. Waller & Son Ltd, Stroud
24" & 16" x 10". Disused, being scrapped.

Goodmayes Hospital, Barley Lane, Goodmayes, Essex TQ 465884

15. *c.* 1900. Thames Ironworks
Engine driving dynamo

Kew Bridge pumping station (Kew Engines Trust/ T.W.A.), Kew Bridge Rd, Brentford, Middx. TQ 188780

16. 1820. Boulton Watt & Co., Soho, Birmingham
Single-cylinder beam pumping engine converted to Cornish cycle 1846–48. *The West Cornish Engine.* Originally erected at Chelsea Waterworks, moved to Kew 1839.
64" x 8'. 90hp. 40 psi. 8–10 spm.
Last worked 1943; resteamed Oct. 1975; restored in steam.

17. 1838. Maudslay Sons & Field, Lambeth
Single-cylinder beam engine converted to Cornish cycle 1846–48.
65" x 8'. 125hp. 40psi. 8–10 spm.
Beam strapped 1862 but fractured 1888 and replaced with new beam by Hunter & English of Bow in 1889.
Last worked 1944; preserved.

18. 1845. Sandys, Carne & Vivian, Copperhouse Foundry
Cornish beam pumping engine. *The Grand Junction Engine.*
90" x 11'. 400hp. 40 psi. 8 spm.
Last worked 1943; resteamed 19 July 1976; restored in steam.

19. 1859. Harvey & Co., Hayle
Cornish Bull pumping engine
70" x 10'. 160hp. 40psi. 8–10 spm.
Last worked 1944; preserved.

20. 1869. Harvey & Co., Hayle
Cornish beam pumping engine
100" x 11'. 411hp. 50 psi. 6–8 spm.
Beam cracked 1879; James Simpson fixed wrought iron straps.
Last worked 1944; preserved.

21. 1863. Easton, Amos & Sons
Compound rotative beam pumping engine
Originally at Cliftonville Waterworks, Northampton
16" x 41" & 30" x 60". 50–60 psi.
Preserved; workable from 1978.

Littleton pumping station (T.W.A.), Staines, Middx. TQ 060696

22. 1924. Worthington Simpson Ltd
Uniflow engine driving centrifugal pump
28" x 39". 750hp. 195 psi. 140 spm.
Stopped 1970; preserved, possibly to be removed to Kempton Park.

Low Hall Depot (L.B. of Waltham Forest), Markhouse Ave, Walthamstow, E17 TQ 363883

23. *c.* 1896. Marshall Sons & Co. Ltd, Gainsborough
24. Two horizontal single-cylinder engines with common flywheel.
Steam originally supplied from refuse destructor; engines drove centrifugal sewage pumps.
14" & 24" dia. cylinders. Preserved.

Markfield Road sewage pumping station (Lea Valley Regional Park Authority), Markfield Rd, Tottenham, N15 TQ 344888

25. 1886. Wood Bros, Sowerby Bridge
Free-standing Woolf compound rotative beam engine
21" x 52" & 36" x 6'. 100hp. 120 psi. 18 rpm.
Preserved and restored by members of RLIAS on behalf of the Park Authority.

Tower Bridge (Corporation of London), SE1 TQ 337802

26. 1894. Sir W.G. Armstrong Mitchell & Co. Ltd,
27. Elswick
Two horizontal twin-tandem cross-compound engines driving hydraulic pumps.
18" & 30" x 3'. 360hp. 80 psi. 50 rpm.
Stopped 1972; last steamed Jan. 1978; one (or both) to be preserved.

Walton-on-Thames pumping station (T.W.A.), Surrey TQ 118684

28. 1911. Thames Ironworks Shipbuilding & Engineering Co. Ltd, Greenwich
Inverted vertical marine-type triple-expansion engine
14" & 23" & 38" x 30". 600hp. 200 psi.
120 rpm.

West Ham sewage pumping station (T.W.A.), Abbey Lane, West Ham, E15 TQ 389833

29. 1895. Lilleshall Co. Ltd, Oakengates
30. Two compound rotative beam engines
Stopped 1972; preserved for time being.

Appendix B

Steam engines formerly in London but now known to be preserved elsewhere.

1. 1785. Boulton & Watt, Soho
Rotative beam engine with sun-and-planet motion and cast-iron beam. 35hp increased to 70hp in 1795.
ex Whitbread's brewery, Chiswell St; removed 1887.
Present location: Museum of Applied Arts & Sciences, Sydney, Australia.

2. 1786. Boulton & Watt, Soho
Rotative beam engine with sun-and-planet motion and wooden beam. 25" x 4'.
ex Barclay & Perkins brewery, Southwark; removed 1885.
Present location: Royal Scottish Museum, Edinburgh

3. 1797. Boulton & Watt, Soho
Rotative beam engine with sun-and-planet motion. 16" x 4'. 8hp original but increased to 19¼" x 4', 12hp in 1806.
ex Maud's Chemist (later Atkinson Chemical Works), Aldersgate EC; removed 1885.
Present location: Science Museum, South Kensington, London.

4. *c.* 1825. John Braithwaite, London
Geared table engine, power taken off by bevel wheels.
ex Stanmore Brewery, Watford, Herts.
Present location: Henry Ford Museum, Dearborn, Michigan, USA.

5. 1840. Maudslay Sons & Field, Lambeth
Table engine. 12" x 24". 7hp. 60-80 rpm.
ex Springfield Hospital, Tooting SW17.
Present location Science Museum, South Kensington, London

6. 1840. Maker unknown
Grasshopper beam engine
ex 1840–1870 Royal Horticultural Gardens, on well; 1870–1921 Royal Albert Hall, on well.
Present location: Science Museum, South Kensington, London

7. *c.* 1850. John Rennie & Co., Blackfriars (?)
Oscillating marine engine. 24" x 30".
ex Thames Paddle Steamer *Albert Victor*; scrapped 1931.
Present location: Henry Ford Museum, Dearborn Michigan, USA.

8. *c.* 1855. Thomas Horn, Westminster
Medium sized Woolf compound beam engine
ex Britannia Lead Mills, Battersea; worked hydraulic pumps; removed 1930.
Present location: Henry Ford Museum, Dearborn, Michigan, USA.

9. *c.* 1860. Thomas Horn, Westminster
Present location: Science Museum, South Kensington, London.

10. 1862. Maudslay Sons & Field, Lambeth
Single-cylinder vertical engine; drove the firm's exhibits at the 1862 International Exhibition.
Present location: Science Museum, South Kensington, London.

11. 1864. Easton Amos & Sons, Southwark
Woolf compound rotative beam engine
10" x 25" & 17" x 36". 14' diameter flywheel.
ex Battersea Gas Works
Present location: Science Museum, Newhall St, Birmingham.

12. 1870. Harvey & Co., Hayle
Oscillating cylinder vertical engine
ex Metropolitan Water Board
Present location: Science Museum, South Kensington, London.

13. 1879. John Penn & Son, Greenwich
Oscillating marine engine. 30" x 33". 30 psi.
ex P.S. *Empress*, built Samuda & Co. Millwall; scrapped *c.* 1956.
Present location: Maritime Museum, Southampton.

14. 1891. Marshall, Sons & Co., Ltd, Gainsborough
Vertical single-cylinder engine. 6½" x 10". 14hp. 100 psi. 210 rpm.
ex 1891–1903 Imperial Institute, South Kensington. 1903–1932 Kew Gardens, driving dynamo.
Present location: Science Museum, South Kensington, London.

15. 1897. Jessop & Appleby
Single-cylinder horizontal engine. 9hp.
ex Sarsons Vinegar Works
Present location: Forncett Steam Museum, Forncett St Mary, Norfolk.

16. 1900. Hunter & English, Bow
17. Two single-cylinder vertical engines. 45hp.
ex Poplar Gas Works
Present location: Forncett Steam Museum, Forncett St Mary, Norfolk.

18. *c.* 1900. G. Waller & Co., Stroud
Horizontal tandem compound engine
ex Croydon Gas Works
Present location: Wendron Forge, nr Helston, Cornwall.

19. 1927. Ashworth & Parker, Bury
Small engine with direct drive onto dynamo
ex Kempton Park pumping station (M.W.B.)
Present location: Wendron Forge, nr Helston, Cornwall.

20. *c.* 1935. E. Reader & Co., Nottingham
Enclosed self-lubricating vertical engine; drove machinery
ex Paddington Technical College
Present location: Wendron Forge, nr Helston, Cornwall.

21. 1941. Vickers-Armstrong, Newcastle
Horizontal cross-compound pumping engine
18" & 30" x 27". 150hp. 80 psi. 50 rpm.
ex Tower Bridge, SE1; on standby until 1971; removed 1975.
Present location: Forncett Steam Museum, Forncett St Mary, Norfolk

22. Not dated. Belliss & Morcom.
23. Two high-speed vertical engines
ex Lyons Corner House
Present location: Forncett Steam Museum, Forncett St Mary, Norfolk.