Steam power in Bristol

George Watkins

In recent years new information has gradually augmented our knowledge of early steam power in Bristol, revealing a far greater involvement than previously had been suspected. A surprising number of atmospheric 'fire engines' pumping in local collieries was listed by Kenneth Rogers in The Newcomen Engine in the West of England. The series of Newcomen engines installed from 1748 at Warmley for recycling the tailwater of Champion's numerous waterwheels at his brass and copper works comprise the earliest-known use of steam in Bristol's manufacturing processes. Matthew Wasborough's later contributions in Bristol to rotative power, following his patent of 1779, have yet to be fully explored and assessed but, when his ideas were combined with those of Pickard in Birmingham, James Watt was forced to develop the sun and planet gear as an alternative means of achieving the same end. A Wasborough engine was seen working in 1783 at Young's corn mills in Lewins Mead. Described as uneconomic in the 1790s it was, nevertheless, worth modifying with Watt's separate condenser when converting the mill to roll lead, brass and iron. Recent work by Hugh Torrens has referred to other engines installed by John Jones at Bristol, including one sited at Bedminster Mill, and by Winwood at his Cheese Lane Foundry where his engine was used for boring cannon. Jennifer Tann also draws attention to these late 18th-century installations in a recent paper for Newcomen Society. In addition, she also notes briefly that the Scots engine builder Hately was in partnership with 'one Hanson or Hancocks', at Bristol and responsible for an engine at a Bristol colour grinder's concern, amongst others, whilst G Evans in Bristol was noted as an engine pirate of Watt's patents. Such sparse details serve to indicate the pressing need for research to locate more solid local information for, as Dr Tann states, Bristol was a major centre for engine development in the late 18th century. BIAS Journal is pleased, therefore, to publish this account by George Watkins, resulting from his long-standing interest in steam power in the city. He starts here with the new phase of rotative power in Bristol made possible by the innovations of James Watt.

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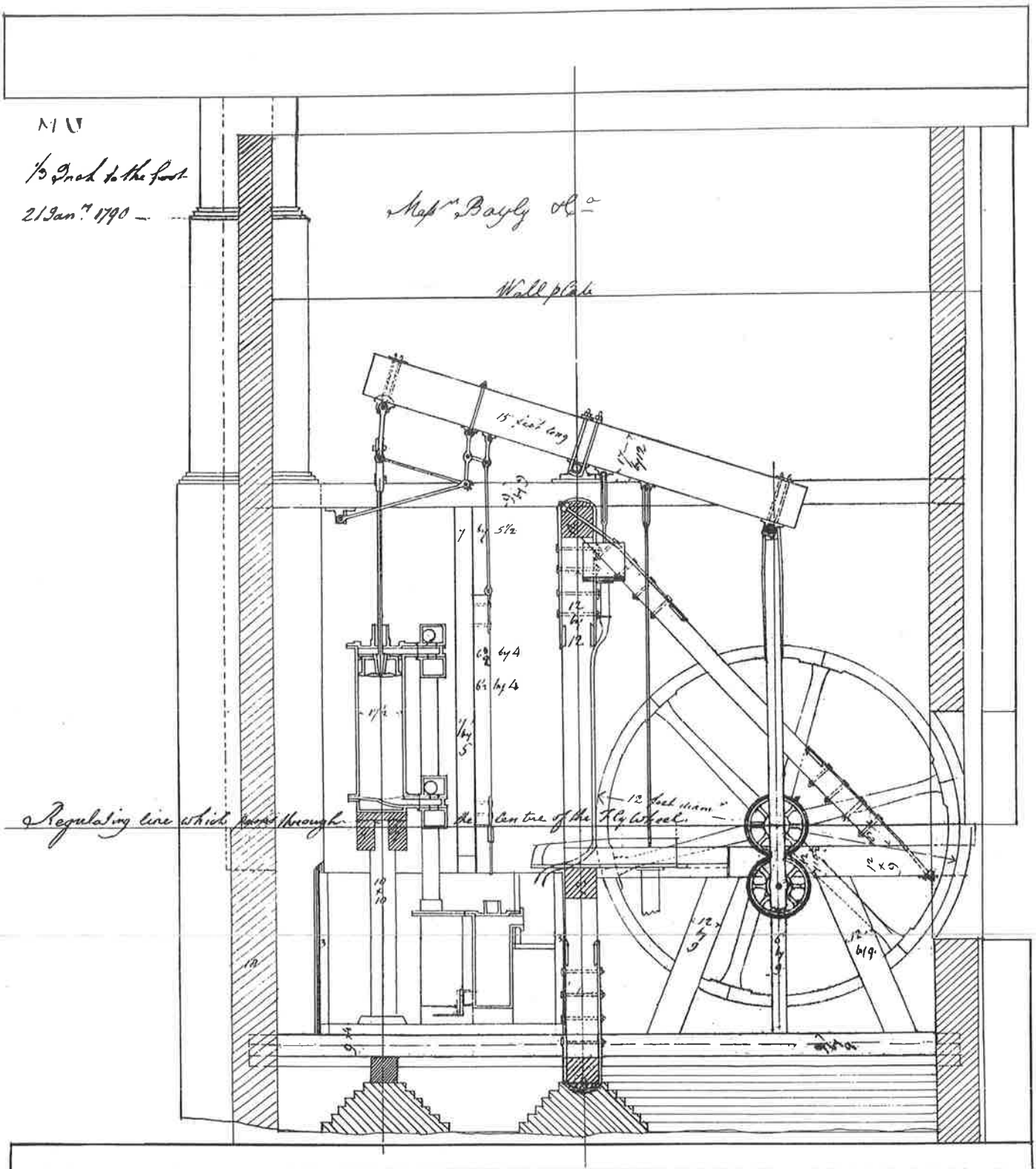
Bristol industry has always been broadly based with small concerns operating in most spheres of activity. The city, therefore, has escaped the main peaks of prosperity and depression experienced in areas of concentrated industry, such as textiles or the iron and steel trades but, for the same reason, also lacked the textile-mill and rolling-mill engines which often could be seen working from the streets in the North. In Bristol's manufacturing industry the largest engine was the 1400 hp spinning-mill engine of 1886 at the Great Western Cotton Factory. Small steam plants were ultimately seen to be wasteful of fuel and local firms turned to gas engines for power from the 1870s. From about 1895, the energetic policy of the Bristol Corporation electricity department led to even wider use of electrical power. Despite this, steam power continued to be installed well into the present century, especially where exhaust steam could be used, or by-product waste was available as fuel.

Bristol was early in using the new technology of James Watt. The earliest record found so far of his factory engines installed in the city was at the lead works of Robert Bayly and Company at Lawrence Hill, probably for their lead-rolling mill. Folio 50 in the Boulton and Watt Catalogue of Old Engines at Birmingham Reference Library contains 14 drawings of this engine, dated 1790, some coloured, with valve gear details. Originally of 10 hp, it had a cylinder of 17½ ins dia bore and 4 ft stroke, and the general layout shows it in a space of 23 ft sq, including a 3 ft dia cold-water well and the circular boiler of 5 ft 9 ins dia which was about 7 ft 6 ins high. The structural parts of the engine were of oak or deal, with vertical members 12 ins by 12 ins and 9 ins by 9 ins horizontals. A minimum of metal was used for such parts as the cylinder, crankshaft and sun and planet gearing, flywheel and strapping. Payment for the use of Watt's patents was £50 per annum as the engine was rated to develop 10 hp (equal to a load of 33,000 lbs lifted 10 ft) but was uprated to 13 hp not long after it was installed.

The next Bristol engine to be found in the folio was ordered in 1793 by Naylor Castle, or Castle and Ames at the Bristol Distillery. Of 18 hp, with a cylinder of 22¾ ins dia by 5 ft, this engine was similar to the previous design, with a 14 ft flywheel, a beam 21 ins deep by 18 ft in length, specified to be of young straight-grained oak and an 8 ins sq timber connecting rod. The boiler, again circular, was 8 ft dia. The engine required payment for patent fees of £90 per annum and ran until replaced in 1821.

Another early engine was supplied to Anthony Ammatt and Company at the corner of Thomas Street and Portwall Lane in 1799. They occupied the site of a glassmaker's tall furnace cone and when the engine was installed for the manufacture of woollen goods the brick settings and chimney for the boilers were actually built on to the furnace cone. Identical to Bayly's engine, it developed 12 hp with a timber beam 15 ft long. As an indication of the cost of early steam power plants, the castings here cost £146, the blacksmith's forgings £74 and the copper and brasswork £44. Fitting it together on site cost a further £53. With two boilers and sundry small charges the cost amounted to £407, a large sum by any standards then.

The Cotton Factory When the Watt patents expired in 1800, engine building developed over a wide area, but the Lancashire technicians who laid out the Great Western Cotton Factory in Bristol in 1837, specified the use of Boulton and Watt's engines as used in Mr Clarke's (the first manager) own family factory in Manchester. These engines were made almost entirely of the cast iron that steam power had made more widely available. Altogether, four were needed to operate the plant which made finished, baled calico from fine

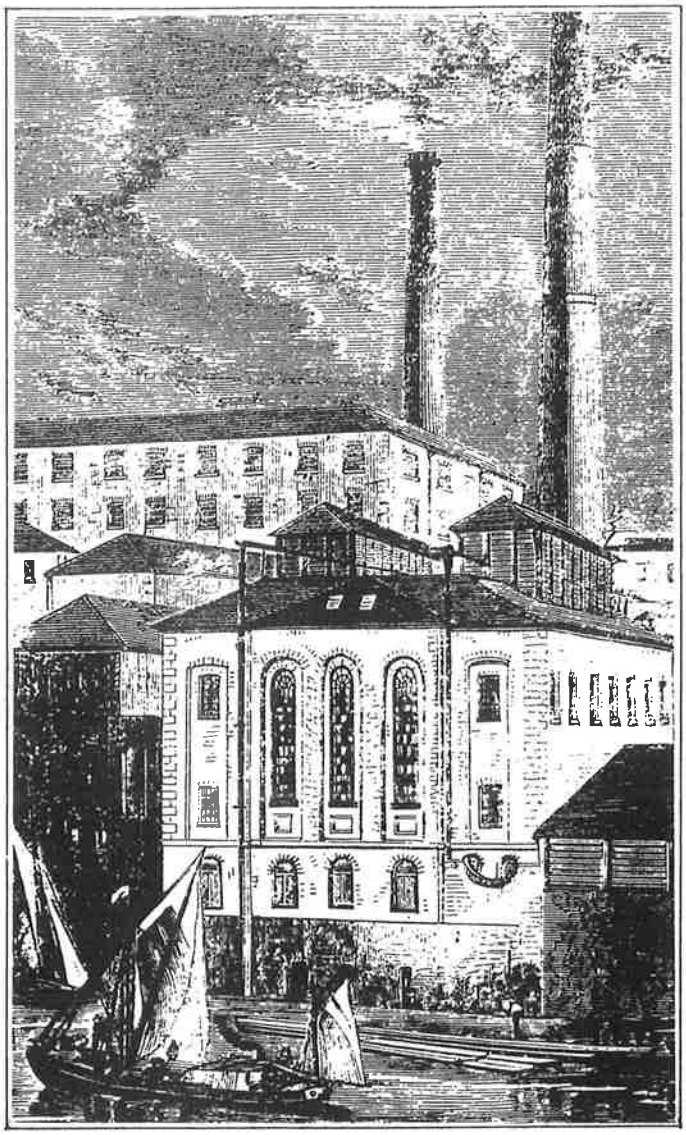


Drawing of 10 hp engine supplied by Boulton and Watt to the Lead Works of Robert Bayly and Company of Lawrence Hill in 1790

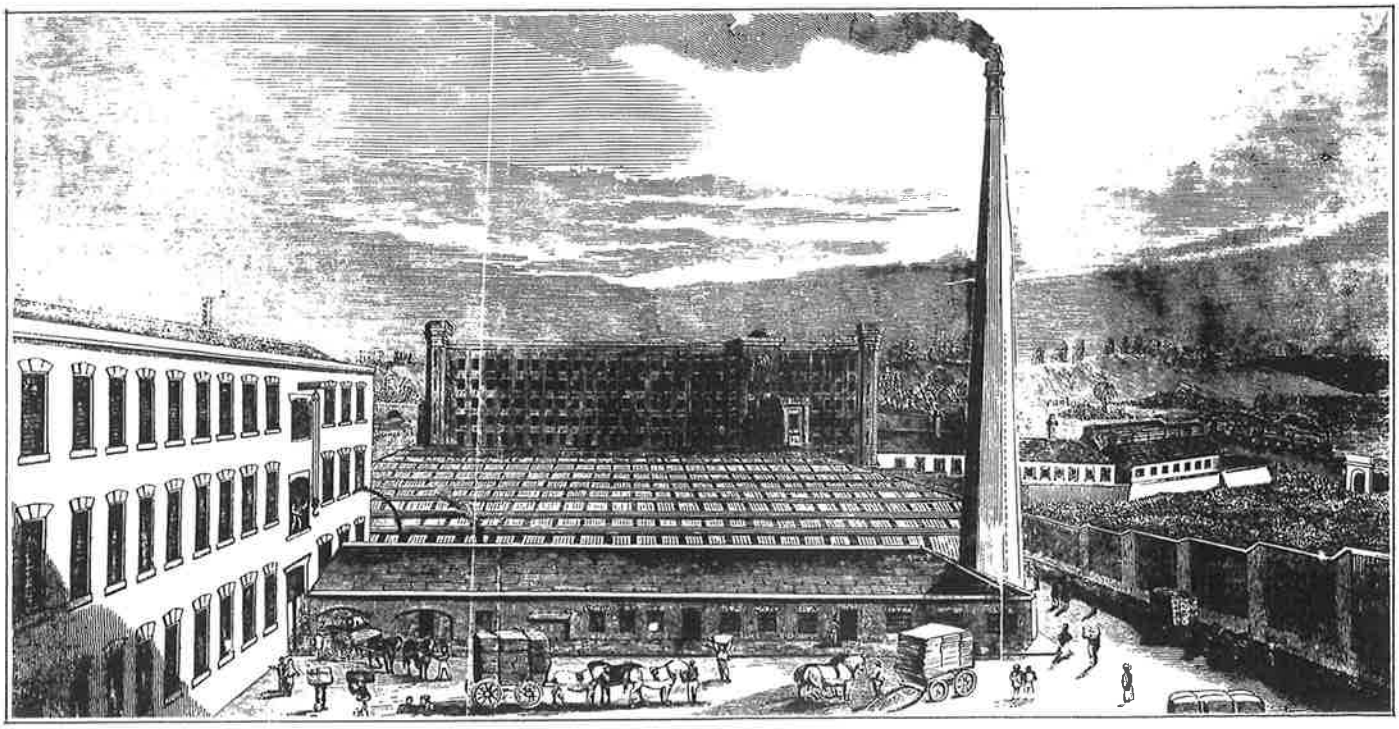
Drawing from the Boulton and Watt Collection. Birmingham Central Reference Library

American Sea Island Cotton, sold for about 2d per yard at 40 ins in width. Three of the engines were large. The two 80hp coupled together in the long spinning mill facing the Feeder Canal are believed to have been, at the time, the largest power plant in the country of a single cotton mill. Another 80hp engine drove the one-acre weaving shed behind it. Bleaching and dyeing was completed in a small separate part with a 27hp engine of a different design which was supplied about 1840. The American Civil War had tragic results for the mill and its people. Cotton soon became unobtainable, and the factory closed, making whatever provision it could for the 1200 operatives. New capital provided modernisation of the old engines and plant with new boilers in 1866. The last phase with more new capital followed in 1886 when a new engine house, installed with a 1400hp engine by Yates of Blackburn, and rope drive was added at the Western end of the complex which, with twelve boilers, ran it until closure in 1924.

Sugar Refining The clarification and whitening of the raw brown sugar was an extensive local industry. It used a great deal of steam for processing, but in a large house, such as Finzels on the Counterslip, much power was also required. The crystallizing of the sugar was carried out in closed pans under vacuum in later years, and this required air-extraction pumps to reduce the pressure within the vessels. Finzels vacuum-pumping engines were as large as those of a cotton mill and were very well kept, with carpeted walkways. The two engines of unknown make, were quite separate, their main load being to drive large air pumps near the flywheel. They are believed to have been situated in the stone building with tall windows, with remains still visible from the riverside in the brick complex of Courage's Brewery. With these, and many small engines about the works, in addition to the vacuum pans all demanding steam, the load was very heavy at times, producing lively scenes in the boiler houses as shown by the illustration. It is gratifying that this record does exist, as there appears to be very little information of the Bristol sugar-refining plant.

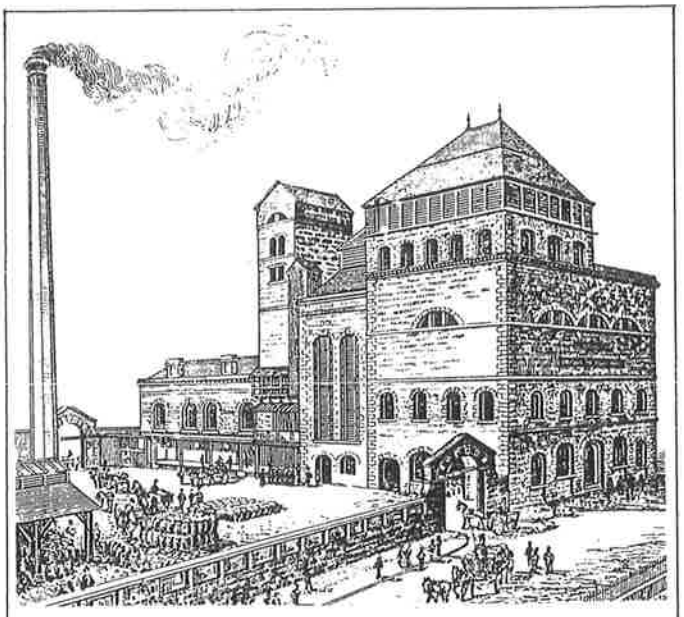


The building (now part of Courage's brewery) which housed the steam engines at Finzels sugar-refinery



The Great Western Cotton Factory on the northern side of the Feeder Canal. This drawing from a book published in 1849 shows, on the left, the Fitting Shop, in the middle-ground the Weaving Room and in the background the Spinning Mill.

Distilling, Brewing and Vinegar Although in London the great breweries led in the use of steam power, it seems that in Bristol it was the distillery that was more to the forefront by 1793 as already noted. The engine then installed was successful in keeping the plant operating until, in 1821, Boulton & Watt supplied a 40hp engine that was to run for a century. The cylinder was 24 ins bore x 6 ft stroke and it worked at 18 to 20 rpm. The walkways were carpetted for many years. The two wagon boilers worked for half a century before replacement with circular types in 1871. Barnard, visiting the distilleries of the British Isles about 1888, noted this latter main engine, but saw that the disused 1793 engine still remained in another part of the works. The 1821 engine ran with only two major repairs until the plant and processes were completely changed. During the last twelve years of its life, it ran for 120 hours per week.



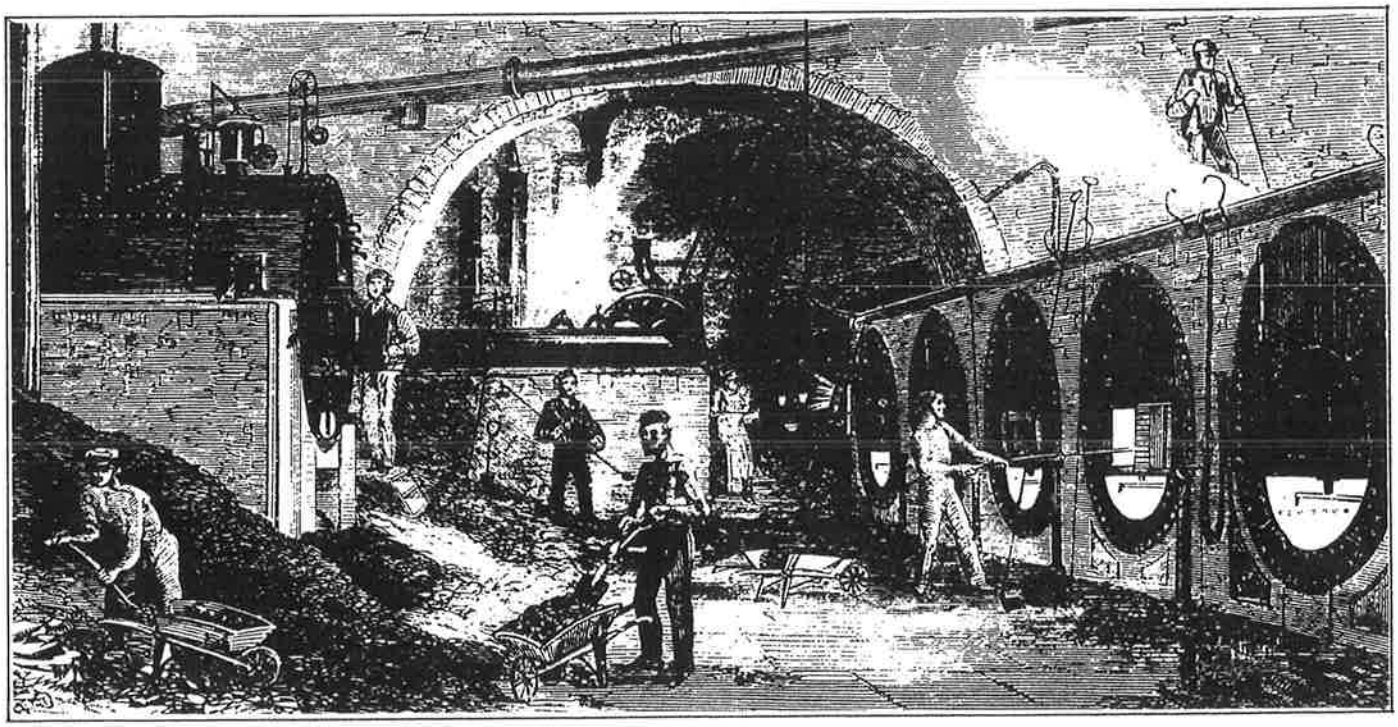
Jacob Street brewery, part of which still survives, housed a 30 hp horizontal pumping engine in 1889.

Bristol breweries, except for George's great porter plant, were mostly small, and probably had little steam power, but the city later made a considerable contribution to the industry with the plant manufactured by George Adlam. This comprised brewing coppers, coolers, pumps, malt conveyors and engines.

It may seem odd to place vinegar-making with distilling yet they were akin, as true malt vinegar is beer intentionally soured to acidity. Purnell and Panter were long noted for their products, and processed their vinegar solely from malt. Malt was at first ground in a works still standing in Meadow Street, but only the small beam engine remained in the 1920s (now stored for the Museum I believe). Its maker was unknown but it was a very attractive, although plain engine probably of the 1840s.

The vinegar-making was carried out at Holton Street with the brewery on the corner of Holton and Newfoundland Streets having a complete beer plant. This had a horizontal engine made by W Bond of Bristol, which drove pumps conveyors and the rousers for the mash tuns. The beer was pumped to the acetifier room with numerous vats in which it was circulated, through layers of broom twigs, to expose it to the air to sour it. The pumps were of elm and were driven by a beam engine, 7 ft high, of unknown make.

Chocolate Manufacture Started in Bristol by Walter Churchman in 1728, the chocolate industry developed when his patent was acquired by Joseph Fry, who had established a factory in Union Street by the mid-1700s. These premises, together with the extensions in Pithay behind it, remained



Inside the boiler-house at Finzels sugar-refinery

the centre of the industry until the move to Somerdale, Keynsham, in the 1920s. By that time the works occupied the whole Pithay area, with three factories elsewhere in Bristol. The firm adopted steam power quite early, probably in 1797, when a Mr James installed an engine. From 1875 to 1903 they used engines made by Bryan Donkin of London. The finest of these were for No 3 factory in Duck Lane, in 1879 and 1881, and No 4 factory in 1889 and 1891, superb engines which were modelled by Mr Payne. Both plants comprised a double engine, the outer one in each case being coupled by a drag link and shaft, some two years after the first installations were made. No 1 factory behind Union Street had its own small engine. The chocolate business continued to grow and around 1900 box and packaging factories were built at Wapping and Canon's Marsh, again with Donkin engines but of their latest drop valve design. There was also steam power at Quay Street. About this time too, the last of the Pithay extensions were built, factories Nos 7-11, which were always electrically driven, by current from their own generators and the Corporation. The boiler plant was extensive, as will be noted later, served by a 120ft square chimney with two others both circular and 200ft high.

Refrigeration is very important for the rapid processing of chocolate, No 3 factory having had an early plant in the 1890s if not before, with modern plant added later. Factories Nos 7-11 had similar modern plant by different makers, which could be seen from All Saints Street, of which the boilers, generators and refrigerator plants occupied nearly a half of the ground floor.

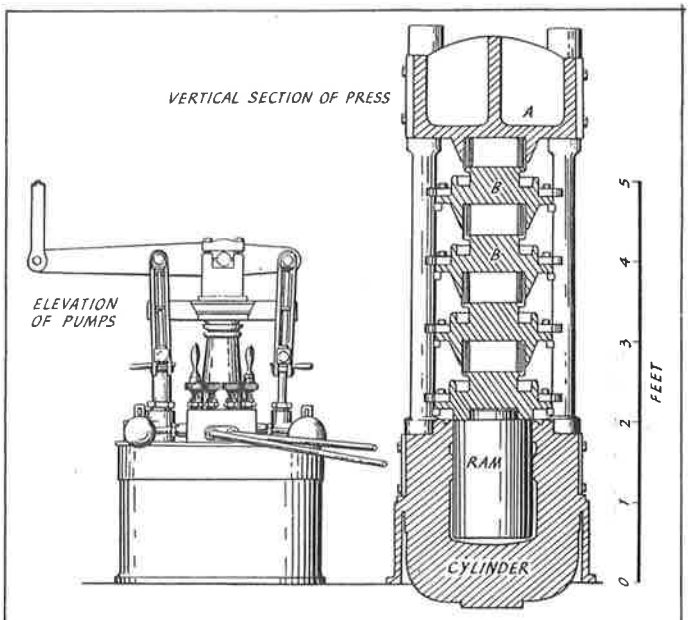
Packers chocolate factory also used steam power, their first engine (a table engine) being installed in Stapleton Road with later plant at Greenbank. Webers factory on Fishponds Causeway was probably always driven by electric motors but, also had some steam plant, whilst Carsons works at Shortwood was also electrically driven, and later installed diesel generators.

Seed Oil and Cake Milling Prior to the use of mineral oils the production of vegetable oils for lighting, paint and putty making, was very important. Oil milling was one of several trades often practised with others in a single establishment. Some of these were objectionable or noxious and as the city expanded in the 19th century, they developed in the out-skirts as in the St Philip Marsh area, with oil-seed milling, drysalting, tanning and the production of artificial manure. Messrs Home & Company started at Avonside Mills in 1838, at Feeder Road opposite the Gas Works. Homes occupied the premises until 1863 when John Robinson took over, to continue at the same place until 1926 when the trade went to Avonmouth. Robinsons were still oil millers and makers of chemical fertiliser in 1902. A brief description of the process, as illustrated by a small plant, may be of interest. The seed was first screened to remove stones and dirt, then crushed between rollers to break the husk and finally mashed in large edge-runner mills. The mash was heated in steam-jacketted pans fitted with stirrers and loaded into small sacks each containing enough to make a rich cattle-feed cake when the oil was pressed out. The sacks were then placed one above another with metal plates between hydraulic presses which expressed the oil through gutters to underground tanks. It was hot work with the men working in shirts and bare feet even in Winter. It could all be seen from the street at Robinson's later premises by Bathurst Wharf in the 1920s. Robinson's Feeder Road engine was a small tandem driving the machinery by belts with a single boiler.

The fine mill, recently demolished at Bathurst Wharf, had power provided by a 450hp engine made by Greenwood & Batley of Leeds, which drove to a mainshaft by ten or twelve cotton ropes. Steam was supplied by three boilers in a house outside, one, new in the 1920s did very little work. The fine octagonal brick chimney, reduced in height could still be seen until recently. The economics of bulk cargoes led to the more recent mill at Avonmouth, again with a Greenwood & Batley engine drive but later electric motors were installed there.

Messrs Curtis also had an oil-seed mill in Chapel Street St Philip Marsh from 1896 until it was destroyed in the air raids of the 1940s. The product was similar to Robinsons but expensive modernisation in the 1920s led to new uniflow engines being installed and probably different processes using expeller mills.

Potteries The small potteries managed with little or no power although working the clay into an air-free mass must have been laborious. At Moorse's little Albert Pottery off Feeder Road in 1920, the pots were thrown on the traditional foot-turned wheel, with the smaller ones being hand-formed very rapidly as the prices were very low. The larger ones, up to 10-12ins dia, needed a neatly formed rim for strength, and were shaped with a strickle or mould. The larger potteries needed power, such as Prices & Powell who made a wide range of heavy stoneware, near St Thomas Church, probably on the site of Amatt's Works to which I have referred. They may have used Amatt's glass-furnace cone. It was a very compact plant completely surrounded by other buildings. The heavy plant was driven latterly by a vertical engine of unknown make, coupled directly to the mainshaft for the clay-preparation plant and forming



A hydraulic press and pumps used in the 1850s to express seed oil from linseed or rape. It was very closely related to Bramah's famous design.

machinery. This engine was substantial, standing some 9ft high and able to develop up to 50hp but required care in loading the raw clay which was very heavy to work. It may well have been made by Lewellyn & James of Castle Green, who also sold Weights engines. A smaller horizontal engine there was made by J Weight of Bristol which, when I first saw it was buried in rubble from wartime bombing. I had police authority to enter in 1941 but it was too dangerous to penetrate further than the engine room. There were two boilers of 1901 and 1910.

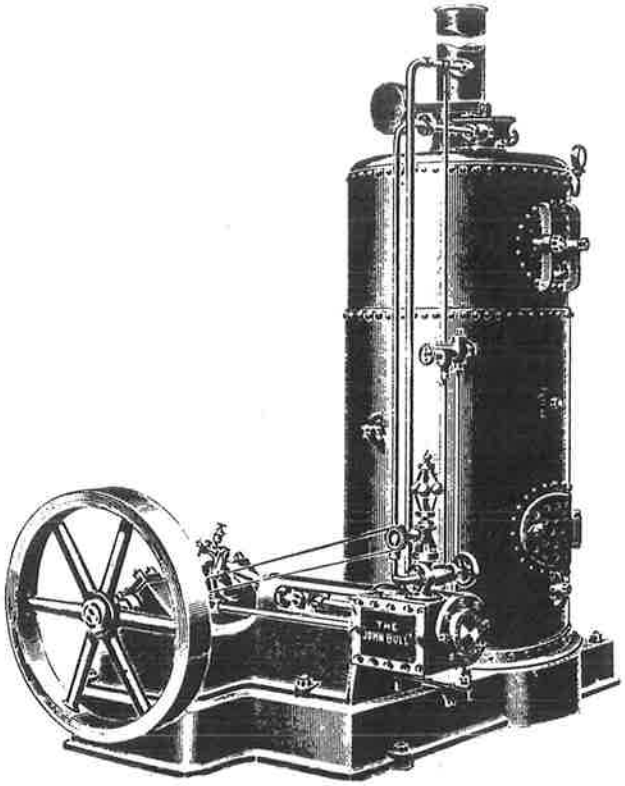
Pountney's works at Fishponds was very different, a spacious site with several furnace cones. The clay needed much mixing and preparation to make the fine chinaware. For many years the plant was grouped together and driven by two Davey Paxmans slide-valved engines, with belts to the mainshaft. These drove edge runners and, later, ball-type clay-mixing machines, in addition to the throwing wheels and presses for plate and saucer making. Later, the extension of power needed throughout the works led to direct current being produced from their own dynamos, driving motors scattered about the premises. A high speed engine and generator was eventually installed about 1936. There were two Lancashire boilers. Finally the company moved to Cornwall when all on the site was scrapped.

Chemicals The Bristol chemical industry was extensive with the great Alkali Works and its 300ft fume chimneys long prominent on the skyline. In the last century there were many small engines scattered about the works as the site was too extensive for mechanical drive from a central power source until electricity came into use. The rotary roasting furnaces were driven by engines, some of which remained in position although replaced by motor drive by 1914.

Alum, an important chemical for many trades, was made at Temple Back for over a century. The process involved chemical mixing, evaporating and cutting the concentrated clay-like product. Power was provided for nearly 90 years by plain horizontal engine with a single boiler of unknown make. The use of equal-sized gear wheels for the drive was unusual, but it ran continuously and economically as the exhaust steam was used for drying the mixed materials. This engine was removed when electric driving was installed in the 1960s.

Another small steam plant, but very different, was used for many years at the Anti-Lithon Boiler Composition Company opposite the Llandoger Trow in King Street. Again, power and heat were required for mixing and making up the liquid product to soften the scale deposited in steam boilers. Power and heat were provided by a plant probably made by Turners, Robeys or Marshalls.

Bone charcoal was much used for the clarification of sugar and water filtering, and Messrs Lockyers were a leading supplier of granulated and powdered charcoal. George Lockyer started at the Avonside Charcoal mills in Victoria Road St Philip Marsh in 1858, and George Lockyer & Son continued there for some 70 years. They made animal charcoal, ivory black sulphate of ammonia and artificial manure. The bones were first charred in simple brick ovens, and then crushed between spiked rollers. These were small units, driven by their own engines, with cylinders about 3ins bore, three or four sets in all. Thick



E R & F Turner built this vertical boiler and horizontal engine as used at Ferris & Company

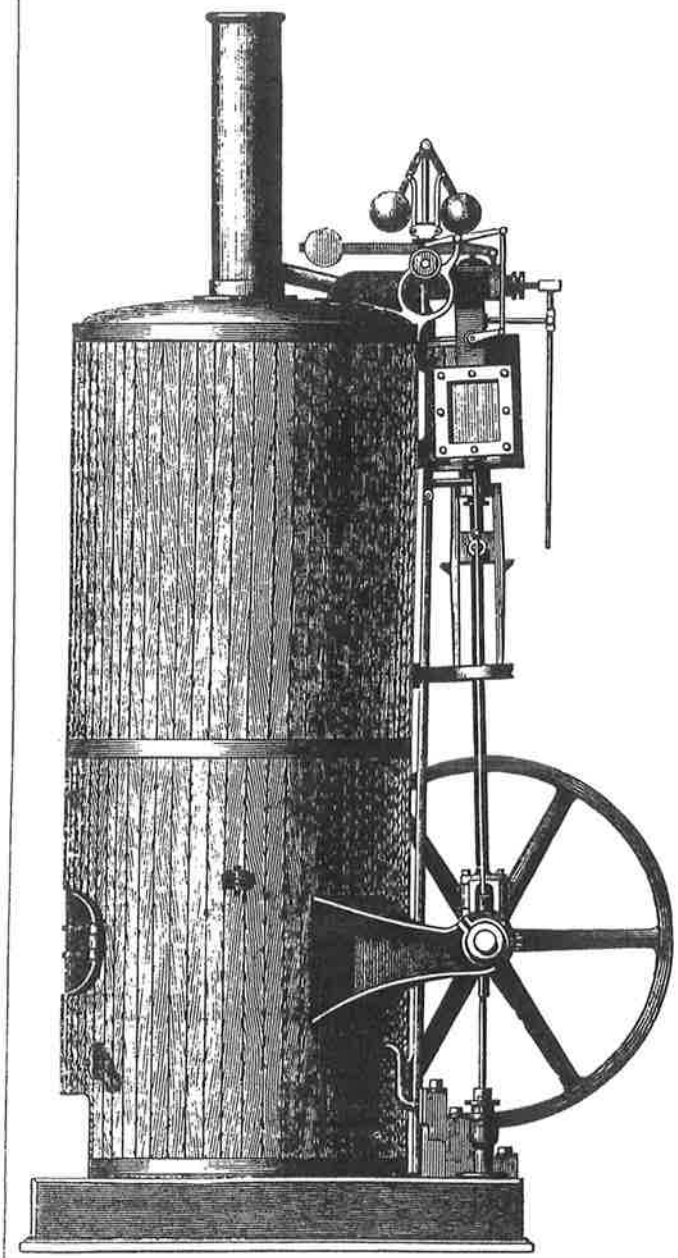
layers of fine-grain charcoal were once widely used in an attempt to purify water in the tall earthenware filtering units that have now become vintage pieces. It was considered that muddy river water became crystal clear if passed very slowly up through a thick layer of coarse charcoal. Much of Lockyer's output was ground to powder for ivory black between millstones, of which they had two sets, five pairs driven by a beam engine, with a further three pairs driven by a horizontal engine. These engines were all non-condensing and of unknown make. The works ran on long after sugar refining ceased in Bristol, the old boilers being replaced by a large Cochran vertical boiler in the 1920s but it was closed by 1933.

Ferris & Co of Union Street and Pithay were mainly pharmaceutical chemists who had a maid-of-all-work plant to sterilise bottles and containers, mix drugs and solutions, and operate powder crushers. It could be seen from the busy backwater at the end of Pithay as one passed by, and it was always working. Small, with a vertical boiler and horizontal engine it developed about 10hp and was in full use until the Blitz of 1941 when it was burned out.

Bristol Built Engines Steam plant was made, as well as used in Bristol, before the local introduction of the Watt engine, but the trend continued into the 19th century. Acramans at St Phillips Ironworks made engines until 1842 on the present Rheem Lysaght site on the Feeder Canal. Among these were two A-frame beam engines made about 1836 for the Gosport chain ferry. A large beam engine for John Hare's White Lead works in Avon Street was installed in 1832 and ran until 1927 when white-lead making ceased.

A small engine for Stephens & Martins flax mill in Horton Street nearby was installed in 1836. This ran the plant, after compounding in 1866, until a new mill was added in 1906, when a new engine with double the power was installed. This ran for some 60 years. No illustrations of their mill engines are known to exist.

Stothert & Slaughter in Avon Street built locomotives from the 1840s and in 1863-4 made four very fine beam pumping engines which worked for over 60 years for the Deptford pumping station as part of the London Main Drainage scheme. They also made marine engines, including two pairs for the British Navy in 1870-72, and in 1877 a fine mill engine, developing 250hp which was ready for despatch when the Institution of Mechanical Engineers visited the works during a conference.



A Cambridge, Parham and Webb vertical engine.

W Cambridge was in business as an agricultural engineer at Market Lavington near Devizes in the 1840s. He did much to develop portable engines, showing at the Royal Agricultural show at Derby in 1843. By 1847 he was one of seven competitors for a £50 prize in the Northampton Show. The Cambridge engine was an advanced design using steam at 68psi at 250rpm with a feed-water heater, but it did not get the prize. By 1850 the firm had moved to Lavington Ironworks at Cathay, Redcliffe in Bristol but seemed to be restless. By 1858 they were at both Cathay and Barton Road, in 1862 at Barton Road and Temple, and 1875 saw them in Albert Road, after a brief spell in Silverthorne Lane. They remained as Cambridge Parham and Webb in Albert Road and exhibited a neat 3hp engine and boiler in the Royal Show of 1876, before selling to Newell and Company at the site in 1879. Newells developed to make sizeable marine engines prior to their closure in 1897.

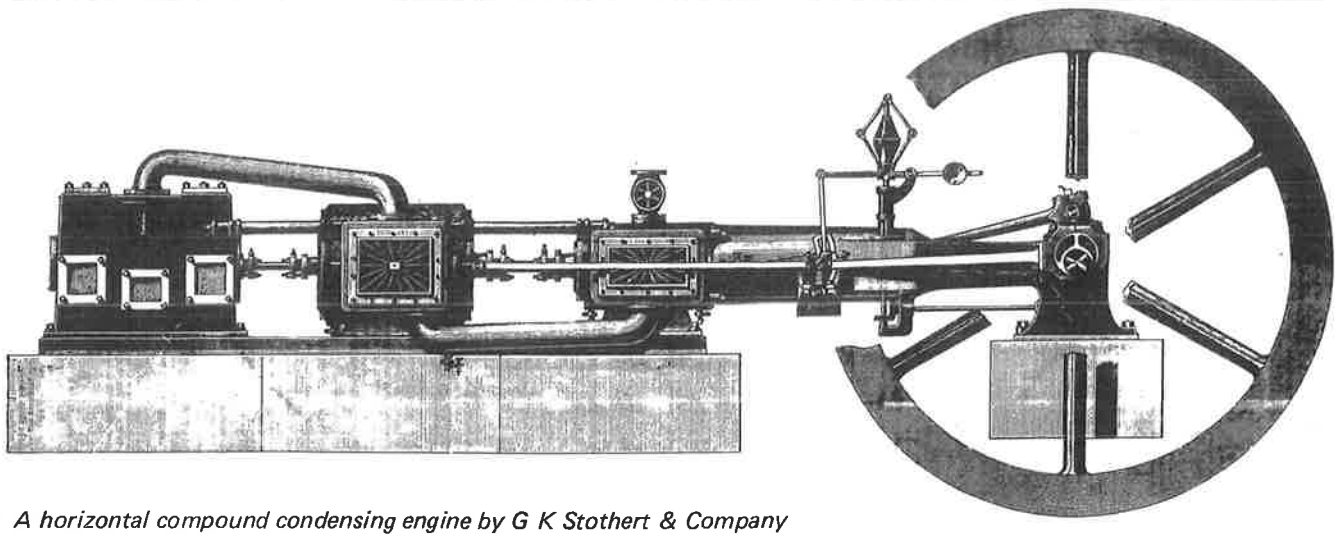
G K Stothert & Co of The Steamship Works, Hotwells, were engineers, shipbuilders and boilermakers. Their designs were plain and substantial and in addition to the engines and boilers for the boats they built, they made numerous mill engines. Among these were two for Bristol works, and one for Wookey Hole paper mill which was heavily loaded for some 70 years but gave little trouble. After being very well kept during this time it was scrapped in the 1960s.

Several small engineers made steam engines, including W Bond who installed one for Purnells, and it is most likely that some of the unidentified beam and horizontal engines at other local works were made in the city. Farvis's off Temple Street advertised small engines of most types as complete and for sale in the 1880s. Established in 1871, they continued until the 1950s, George Adlam, beside brewery plant, also made a number of engines – I saw three in widely scattered breweries that were plain, simple, and well made horizontal single-cylinder machines. J Weight, an engineer in Victoria Road, St Philip made steam engines from about 1890 to 1905. In nearby Albert Road, W Miles the Albert Ironworks and the Vulcan Ironworks were close together near Cambridge's site. All were near the railway bridge crossing Victoria and Albert Roads.

Electricity Supply

Steam engines provided the power for the first ten years of the city's current supply, after which turbines had to be adopted to meet the increasing demand. The engines were all of the, then popular, Willans type as illustrated in *The Engineer* in 1894, and there were finally eighteen units at Temple Back, with a capacity of about 3000kv. Established, as the name carved on the front still records, as the Central Electric Lighting Company, nevertheless, it was soon supplying current for motors, which kept the plant busy by day as well as night, so greatly increasing its efficiency. Fuel was taken from boats directly to the front of the twelve boilers, draught being provided by the two 150ft chimneys that gave the station its name of 'The Twin Stacks'. The engines provided local supply in the early 1920s and again as mentioned at other sites, could be seen working from the street.

The other large Bristol electrical plant was the Bristol Tramways power station of 1900 in the Counterslip nearby.



A horizontal compound condensing engine by G K Stothert & Company

This occupied part of the site of Finzels large refinery building referred to earlier and may well have been unique as the only American-type power station in the UK. Despite the fact that the site required extensive pile driving, it was built in twelve months with much American plant. Designed as a five unit station, four engines of 800hp each, made by the Allis Chalmers Company of Milwaukee USA, were installed at first, with dynamos on the engine shaft. The boilers were on the top floor, with the 230ft high steel chimney set on the top of the brick coal bunker at one end. Coal was taken from the boats into the bunker, from which it was delivered over the ten boilers by a travelling belt which returned carrying the ash to the bunker. A larger set, of 1200 hp engines, was probably installed at the end by 1908. The system of placing the boilers above and condensers below the engines, was adopted in USA where inner-city land values were very high.

That stretch of Bristol riverside is certainly unique in having a typical English single-floor station, and a storied American-type power station side-by-side.

The Port of Bristol Authority

The Authority had a large amount of steam plant in the 1920s. The city docks, with its water supplied by the River Avon, had none of the usual low-lift impounding pumps to maintain dock levels as Avonmouth did. There, there were three large pumps made by Tangyes of Birmingham installed in a low-level engine house. Two were for dock-level maintenance, and one for pumping out the dry dock, with two sets of boilers at road level, all near to the entry locks from the Channel.

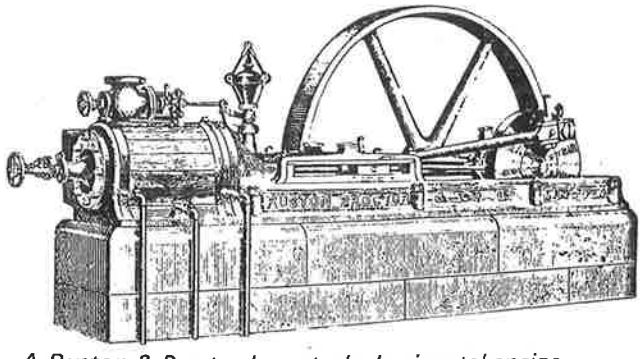
In the City Docks, there were numerous travelling steam cranes with good enclosure for the drivers and there were two large fixed cranes.

There was also an extensive high pressure hydraulic service at both docks. The first of these installations, at the North Engine House at Hotwells were probably of the type used extensively in the 1860s – 1880s by Armstrong and others, some of which remained in use at Ellesmere Port in the 1950s. Hydraulic power worked the lockgates, capstans, bridges, and fixed and movable cranes. The increasing loads soon required more capacity and in 1887 two Worthington engines were installed at the Underfall Yard, followed by similar engines at Avonmouth in 1888. The existing electric pumps at Underfall yard were installed in 1909, but steam pumps were used at Avonmouth until complete electrification of all services there about 1928-30.

Two other steam units in the City Docks deserve notice, the bascule bridge at Bathurst Basin, and the scraper dredger BD6, both having their engines preserved.

BD6 of 1843 was in use for over a century, pulling mud away from the side for removal by dredging or scouring. Comprising a scow hull fitted with powerful hauling gear, and a broad scraper about 6ft wide by 4ft deep, she was anchored to the quay by a massive chain attached to the hauling gear drum, which was driven from the engine by gearing. The engine, made by Bush & Beddoes, Bristol (the name is cast on the flywheel rim) ran non-condensing at about 18-20rpm. Simple and sturdy, it gave little trouble, other than chain breakages.

The bascule bridge of the 1870s carried the mixed-gauge railway line, from Temple Meads over the waterway that



A Ruston & Proctor long-stroke horizontal engine, as installed (second-hand) at the Winford Red Company

connected Bathurst Basin with the Floating Harbour. The bridge engine, now exhibited at the new museum, is a simple twin-cylinder type which, with the boiler, may have been made at Swindon. Always beautifully kept, it made about 110rpm to open or close the bridge under steam power being so well designed and counterbalanced that it required almost the same effort to raise or lower the span. The engine room was neat, with the boiler in one corner. The engine drove, through cast iron vee-grooved friction pulleys and gearing, to twin chains attached to the counterbalance weight. The chain ran on guide pulleys on a cast-iron frame underground. At one time the engine had also driven capstans on the quayside by belts from the engine and an underground shaft.

The 20th Century

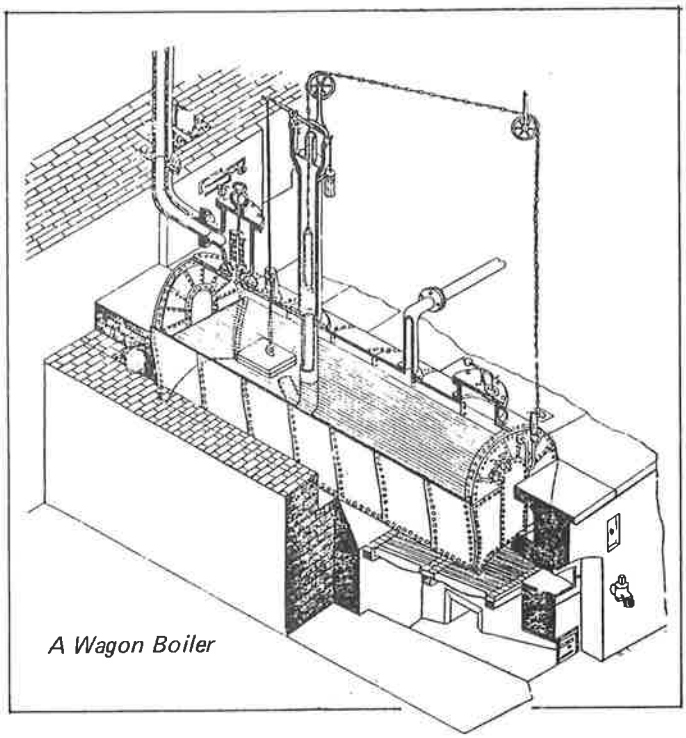
Despite the growth of other forms of powers, the large industrial plants continued to use steam for independence or economy. One installation still using steam at the turn of the century was at J Robinson's oil and cake mill at Bathurst Wharf. This had a Leeds-built engine with three boilers in an outside house, which ran the plant until concentration at Avonmouth in 1930s.

J S Fry's Nos 7–11 factories were in All Saints Lane with a power station behind the boiler plant. It contained two or three fine horizontal Davey Paxman engines, of about 700hp, driving generators, as Nos 7 –11 factories were always motor driven. Installed in 1907, one of these Fry's engines purchased by McCalls at Trowbridge in 1931 ran there for some 40 years until they closed. Another steam plant was that at the Douglas Motor Cycle works at Kingswood which was powered by engines similar to those at Fry's No 7 plant. They are believed to have been running until the 1930s. The tobacco factories also installed steam generators as they turned to electric drives after 1900. Using Bellis & Morcom engines in two or three power stations, they provided power, and heating from the exhaust steam.

A Marshall drop-valve engine at Robbins Sawmills in Cumberland Road in the 1950s steamed largely on waste wood. It was economical and developed about 150hp, driving by ropes down to an underground shaft, with belts up through the floor to the machines. It ran for nearly half a century.

Bristol soon adopted the latest design of the pure power-producing engine, the Uniflow. Two of these, of Swiss manufacture, were installed at Carson's chocolate factory at Mangotsfield in 1912-13. They were efficient and very reliable. Two were also installed at Curtis's oil and cake mill in St Philip Marsh. Probably made by Robeys of Lincoln, they gave good service with economy on a variable load until the works were destroyed in the air raids of 1940-41.

In common with the general trend, little new plant was installed during the depressed period of the 1920-30s but at least two new installations of steam plant did occur after 1930. One was for the colour-grinding mill for the Winford Red Company in Sheen Road, Bedminster. Two engines were supplied secondhand by Messrs Pugsleys of Lawrence Hill which drove crushing plant making fine colour powder from Winford ore. They probably ran through the war, making camouflage colour tint, but closed about 1950 I believe. They were the quietest engines I met; even with the two working they were scarcely audible, a tribute to the Pugsley engineers. It is interesting that probably the last steam engine to be installed was connected with an early Bristol industry – the sugar trade. This was when Messrs Dutton & Knight, who made brewers' invert sugar, proposed to move to Grace's old flour mill on Welsh Back, and installed there two Lancashire boilers and pipework, with an engine. Sadly the project did not mature and the plant was probably never used.



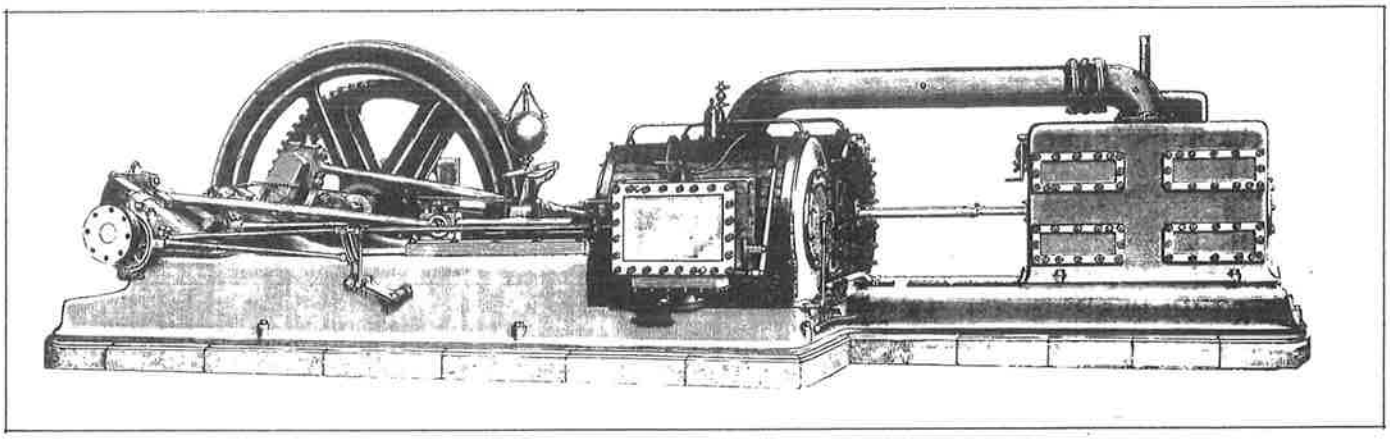
A Wagon Boiler

The Boilers

Without the boilers there could have been no steam power. The early engines required only low steam pressures, the engines gaining as much power from the vacuum as from the steam pressure. James Watt introduced the so-called wagon boiler about 1785 which resembled a wagon in shape. This varied in size, the largest being 18ft long x 8ft 6ins high and was made everywhere. Acramans of Bristol must have supplied them for the engines installed in John Hare's works in 1832 and those of Stephens and Martin in 1836. Two sold to the distillery in 1821 gave half a century of service and Boulton & Watt supplied up to a dozen to the Cotton Factory in 1837-40.

By 1845, better tools, larger plates and improved techniques led to the manufacture of cylindrical boilers with twin furnaces. These became the main factory steam generators for over a century and in the early 1920s there were over a hundred serving Bristol industry.

The largest Bristol sets were the twelve in a row already referred to at the Temple Back Power Station (largely disused by 1920). In industry there were also twelve at the Great Western Cotton Factory and eight at the Christopher Thomas Soap Works on Broad Plain and a similar set of eight at the Alkali Works beside the great chimney in Netham Lane.



A horizontal compound engine by the Avonside Engine Company

The last new range of boilers in Bristol was probably a set of six for Fry's who had previously adopted the Paxman Economic type from about 1876-1903. The next expansion scheme between 1900-11 of Nos 7 - 11 factories in All Saints Street was not so cramped for space and so was fitted with six Lancashire boilers. These were converted to oil firing during the 1921 coal strike, but reverted to coal soon afterwards. This plant dating from 1907 had two interesting features. Firstly, the whole set, each boiler weighing some 45 tons with water and brick settings, was placed upon a massive concrete raft over the cellar. Secondly, the plant had no chimney of its own, being connected to the No 4 plant chimney of 1889 by a flue 9ft deep under All Saints Street.

Boiler houses were usually on, or below, street level for ease of fuel delivery. Many could be seen from the street and were fascinating places to watch with their brightly polished fronts and fittings and the gleaming fires and constant activity. There was a boiler opposite each of the eight openings at the Broad Plain soap works served by the 200ft high brick chimney. Each large boiler used about 3½ tons of coal per day, usually delivered by horse and two-wheeled tip carts. It is difficult to imagine such scenes today but a little of the atmosphere can be gathered from the illustration of 1850 at Finzels refinery. The demand for steam was often very heavy in such plants. This series of boilers was connected to the 203ft high chimney noted earlier which was built in 1849.

The chimneys were a feature of the age of steam and one could probably see 30 or so of all shapes and sizes from St Michaels Hill. The tallest were the two 300 ft high fume stacks at Netham, the more imposing since they were on the hill. Within the city, the tallest was at the tramways power station. This, the only large steel chimney we had , was American built, brick lined, and 10ft dia inside at the top and was in itself, 200ft high and made the more imposing since it was set upon the top of the 65ft high circular brick coal-and-ash bunker at the end of the station.

The factory steam whistles or hooters were a delight we cannot imagine now. As varied as the chimneys, they signalled the periods of activity at each works. The only time they sounded together was to welcome in the New Year, when, backed up by the whistles of every ship in harbour, and the locomotives one might be forgiven for thinking that George Riseley and the immense Colston Hall organ was sounding within our City.

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