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Hampshire Industrial Archaeology Society

Hampshire Industrial Archaeology Society was founded as the Southampton University Industrial Archaeology Group in the 1960s from members of the University Extra-Mural classes who wished to continue their studies in industrial archaeology. Recording has included surveys of mills, breweries, brickworks, roads and farm buildings. Restoration work is undertaken by associated groups such as the Tram 57 Project, the Hampshire Mills Group and the Twyford Waterworks Trust. In addition to the *Journal*, the Society publishes a newsletter (*Focus*) twice a year and lecture meetings are held every month throughout the year.

To join, contact the Membership Secretary: Keith Andrews, 13 Ashley Close, Winchester, Hampshire, SO22 6LR.

Front cover picture: An early photograph of Floating Bridge No. 8 at the Southampton hard. The presence of electric lighting indicates it is from the twentieth century (see page 16). (Clive Sweetingham Collection)

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(formerly Southampton University Industrial Archaeology Group)

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Editorial

Welcome to issue **32** of our *Journal*, which contains three articles. Last year, we changed our printer, so that we could have colour pictures throughout. Although many old illustrations are in black-and-white, we have found many more colour illustrations for this issue.

In our first article, your Editor reviews the history of the Clark process of bulk water softening in Hampshire. The Hampshire chalk, with its famous chalk streams has proved an excellent source of drinking water. However, the water is 'hard', and thus, the local water companies were early investors in the Clark water softening process and used it longer than most.

Jim Beckett tells the story of a remarkably long-lived member of the fleet of Floating Bridges which crossed the river Itchen in Southampton between 1836 and 1977. Built in Southampton in 1896, Floating Bridge No. 8 was in service until 1961 and her hull still serves as offices in a marina at Bursledon in 2024!

Andy Fish relates the history of another steam flour mill in Southampton; that in Melbourne Street, Chapel. Like the Northam Steam Mill story (see *HIAS Journal* **31**, 2023), the Melbourne Street Steam Mill was owned by the Hague family in its early years. Once again, the author has delved into newspaper cuttings for much of his material, and, for this one, we have a photograph of the mill.

Martin Gregory
May 2024

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Edited and produced by Martin Gregory

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The Contributors

Jim Beckett
Jim Beckett has been interested in Industrial Archaeology for most of his life. He uses his hobby of photography to record disappearing industrial heritage. Past projects of this nature have included mechanical railway signals in Southern Hampshire and Southampton Docks. More recently, he has turned his attention to brick manufacturing, and is a volunteer at Bursledon Brickworks Museum. He is the current Vice Chairman of HIAS.

Andy Fish
Andy Fish was born in Southampton and has lived there all his life. He was educated at Richard Taunton's College, and worked in construction for most of his working life until he retired. He is currently researching the Steam Mills of Hampshire, and Mills on the River Wey in Dorset. His first article was published in the *Southern Evening Echo* back in 1966. He is a past chairman of Hampshire Mills Group, was editor of the Dorset Industrial Archaeology Society newsletter from 2011-2019, and is a Committee Member of HIAS.

Martin Gregory
Martin Gregory is a retired schoolmaster. His interest in the history of industry and technology goes back over sixty years. He has researched full sized steam and Stirling engines, built models of them, and is *Honorary President* of Twyford Waterworks Trust. He also works on the history of the sewing machine. He has been a member of HIAS and its predecessor for over fifty years and has served as Secretary and Chairman. He is the current Editor of the *Journal*.

Acknowledgements

My thanks are due to all who have contributed to this edition of the *HIAS Journal*. In particular, I wish to thank Howard Sprenger for help with illustrations and the set-up for the printer. Acknowledgements and thanks for the provision of illustrations are made as follows:

Jim Beckett, (Figures 27, 33-40); Grace's Guide to British Industrial History, (Figures 24, 25, 26, 28, 29, 30); Martin Gregory, (Figures 3, 31, 32[back cover]); Dave Marden Collection, (Figure 42); Minutes of the Proceedings of the Institution of Civil Engineers, (Figures 5, 6); National Library of Scotland, (Figures 22, 23, 41); Romsey Local History Society, Picture Archive, (Figure 2); Science Museum Collection, (Figure 1); Southampton City Library, (Figure 43); Southampton Archives, (Figures 44-46); Clive Sweetingham Collection, (Front cover); Twyford Waterworks Trust, (Figures 4, 7-21[back cover]).

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The Clark Process of Water Softening, as Practised in Hampshire

Martin Gregory

Soap for washing was written about by both the Greeks and the Romans, as was the treatment of some waters with alkali to enable the soap to 'cleanse' more effectively. The Roman historian Pliny recommended soap made with 'tallow (from goat's suet) and ashes (from beechwood)'.

Whilst many recipes for saving soap and 'purifying' the water appear in the literature from then on, it was not until the nineteenth century that, with the advent of public water supplies, a formal study of the removal of the salts of metals from water supplies led to chemical methods of 'purifying' water in bulk. In the common terminology, water is termed 'hard' when it contains metal ions in solution, the most common ions being calcium, magnesium, and iron. 'Soft' water may have few metals ions present, or they may be held in solution by the presence of sodium or potassium ions. Hard water may have 'temporary' hardness or 'permanent' hardness; the former occurs when the anions are hydrogen carbonate ions and the latter where the anions are sulphate ions.

Water pumped out of aquifers in chalk or limestone rock (calcium carbonate) areas possesses temporary hardness. Calcium carbonate is very insoluble in water. However, dissolved CO_2 in rainwater leads to the formation of carbonic acid (H_2CO_3) and hydrogen carbonate (HCO_3^-) ions in the aquifer. So, the raw water from the chalk is a very dilute solution of calcium hydrogen carbonate, which is soluble in water. This is the most common situation encountered in British waterworks. When (1) the raw water is heated, the dissolved CO_2 is driven off and the calcium carbonate is precipitated out as limescale in your kettle, boiler or heating pipes. Also, (2) when soap made from tallow or vegetable oils, is added to this raw hard water, the polar carboxylate ions in the soap bind to the calcium (Ca^{2+}) ions in the water to form a sludge instead of a lather; in fact, no lather is formed until all the calcium ions have been removed (this is the basis of Clark's hardness test). It was to cure these two problems that water softening became popular.

The first person to describe and patent a process for softening water was **Thomas Clark.** Clark (1801-1867) was born and educated in Ayr. Leaving school, he went to Glasgow where he worked in Charles Tennant's St. Rollox chemical works. He completed his M.D. at Glasgow University in 1831 and, in 1836, he was appointed Professor of Chemistry at Marischal College and University, Aberdeen, a post he held until his retirement in 1860.



Figure 1. Portrait of Thomas Clark by Alexander Craig, 1856. (Science Museum Collection)

In 1841, Clark took out a patent for his "well known and beautiful process for softening water." Alongside this, Clark gave us his 'soap test' for measuring hardness, and his scale of hardness, in which one Clark degree equates to one grain of calcium carbonate precipitated from each gallon of water. The process works with 'temporary' hardness caused primarily by calcium salts, such as the water in limestone and chalk areas.

How did it work?

When alkali is added to the raw hard water, the hydroxyl (OH^-) ions react with the hydrogen carbonate (HCO_3^-) ions to precipitate the calcium carbonate, which can then be removed by settling and filtration at the water works. Usually, the alkali used was an aqueous solution of calcium hydroxide

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(lime water). Often, this was produced on site, using lime kilns to produce calcium oxide (quicklime) which was converted to calcium hydroxide (slaked lime) with excess water, and further diluted to give the lime water for softening. The beauty of Clark's process is that, when the added alkali used is calcium hydroxide, the only waste product is calcium carbonate which is removed at the waterworks. The softened water does not have anything added! All chemical reactions are examples of chemical equilibria, so the removal of calcium ions is not complete. In practice, it was found that around 70% of the hardness was removed so that the water sent to the customer was technically 'moderately soft'.

Clark's process was first used in 1854, by the Woolwich and Plumstead Waterworks Co. where, on the Clark scale, the hardness was reduced from 23º to 7º. Clark's own forecast was that "The process is of such utility and such necessity to London that it will be in operation as long as London last." The main practical problems for the water companies centred around removing the precipitated calcium carbonate. If it were just allowed to settle in the softening tank and then decanted off, the process was very slow and the tanks had to be drained, and the sludge removed, after each charge. Using filters allowed the water to be kept moving, but introduced complications as the filters had to be cleaned and sterilised regularly.

In the years following Clark's work on his process, over 30 English patents were taken out for improvements. The process will precipitate out metals other than calcium, such as magnesium, and including some heavy metals, as carbonates. Also, the precipitation process will trap organic material in the solid waste and remove it thereby. Since the waste sludge is calcium carbonate, it is tempting to suggest it could be recycled. No practical way of doing this was ever found: at Twyford, some was sold for agricultural use and some was sold to a toothpaste manufacturer (Eucryl) as a mild inert abrasive filler to polish your teeth!

The use of sodium carbonate (Na_2CO_3) was tried and ruled out as too expensive in the nineteenth century. Sodium carbonate would also precipitate calcium as the carbonate from water with permanent hardness. The problem incurred was that sodium ions were left in the softened water; a problem which affects ion-exchange water softeners still.

Commercial applications.

The water companies which installed Cark's lime softening process were those in chalk and limestone areas. Sadly, uptake of his process was well below his initial hopes. Most users were strung out along the south coast Counties.

Table 1.

Some Water Companies which used the Clark process, in basic or improved form:

The basic Clark process using open sedimentation tanks with no filtration:

The East Surrey Co. (Caterham & Kenley) from 1861	Capacity 500,000	galls day^{-1}
The Canterbury Co. (Canterbury) from 1869 . .	Capacity 400,000	galls day^{-1}
The Colne Valley Co. (Bushey) from 1876 . .	Capacity 900,000	galls day^{-1}
The South Hants Co. (Timsbury) from 1879 . .	Capacity 360,000	galls day^{-1}
The Stroud (Gloucester) Co. (Stroud) from 1890 . .	Capacity 300,000	galls day^{-1}

The Clark process using Atkins' patent improvements (a small softening tank followed by rotating filters):

The Henley Co. (Henley) from 1882 . . .	Capacity 180,000	galls day^{-1}
Wellingborough Local Board (Wellingborough) . .	Capacity 166,000	galls day^{-1}
Southampton Corporation (Southampton) . .	Capacity 2,250,000	galls day^{-1}
Saffron Walden Corporation (Saffron Walden) . .	Capacity 80,000	galls day^{-1}

Matthews' paper includes details of twenty other installations with other patented 'improved' versions of the Clark process, operating before 1890.

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One group of users was in the south of Hampshire, and included Southampton Corporation (one site at Otterbourne, which softened its water from 1888) and the South Hants Waterworks Co. (two sites, at Timsbury, where water was softened from 1879, and at Twyford where water was softened from 1902). All three sites had both the chalk quarry and the lime kilns with slaking plant, on site. All the lime kilns were of the 'flare' or 'bottle' pattern and were fired intermittently. Thus, the only extra material to import was coal for the kilns.

Typical hardness of the raw water from the Hampshire chalk is 19-21 Clark degrees of hardness (250-300 mg l^{-1} of $CaCO_3$). The hardness of the softened water was measured every day for the water supplied to the Southampton area, with the average hardness, in Clark degrees, being 8.6 for water supplied from Timsbury, 6.0 from Otterbourne and 7.4 from Twyford, in June 1904 (the weekly averages were published).

The three sites clearly showed the evolution of the Clark process well. The first site, Timsbury, started in 1876 to supply Romsey and the lower Test Valley, supplied softened water from 1879. It was powered by two small beam engines, each of which drove two sets of three-throw pumps: well pumps to raise water from the well to the surface, to feed the softening plant, and force pumps to deliver softened water to the service reservoir a mile away on the top of a hill. A pair of small 'flare' kilns provided the supply of lime for mixing with the raw well water in shallow open tanks. A minimum of 16 hours was allowed for the precipitates to settle, before the softened water was decanted to feed the force pumps for delivery to the reservoir. The calcium carbonate sludge was then dug out before the tank could be refilled.

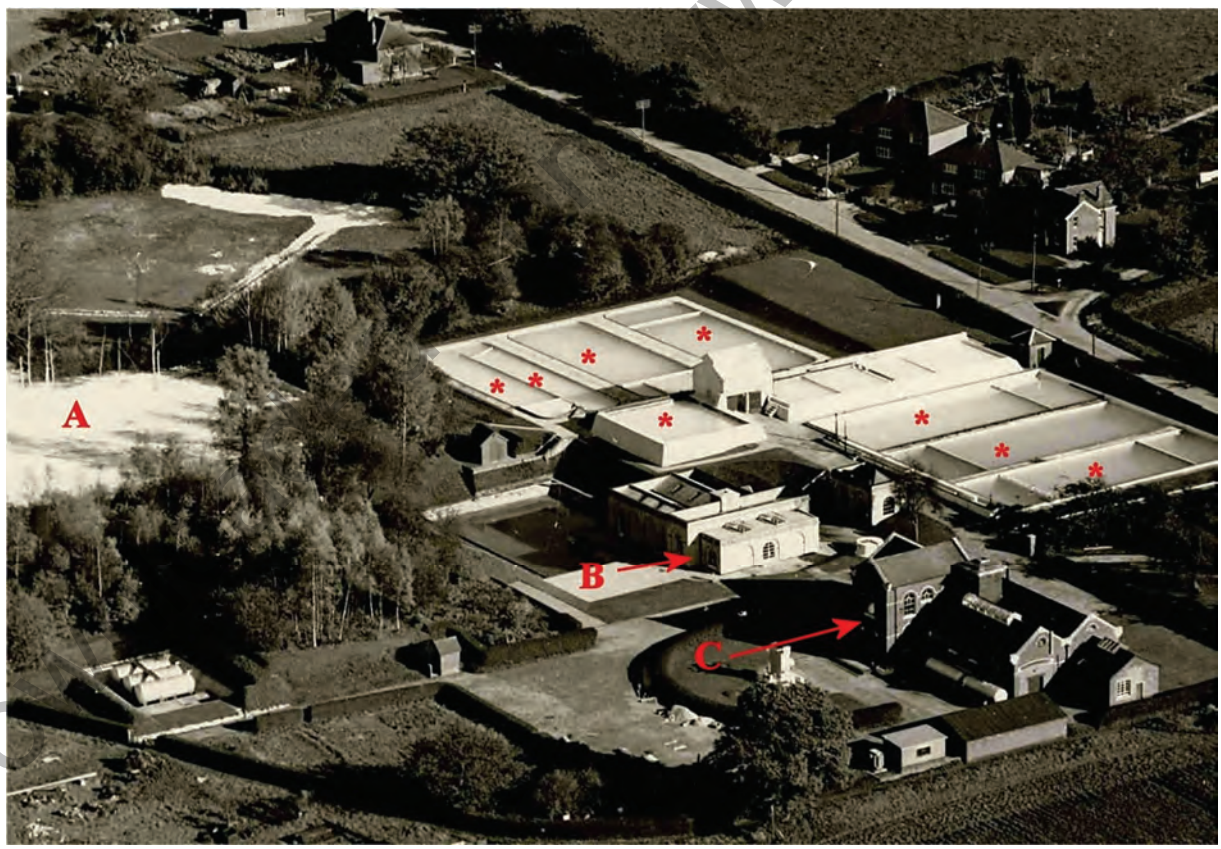


Figure 2. An aerial view of Timsbury Waterworks in the early 1960s, (Romsey Local History Society). The shallow open settling tanks, with their bright white chalk linings, are very obvious features of the installation. Both chimneys have been demolished down to roof level, as both steam plants had been scrapped by the time of this photograph. This was probably the last surviving example of Clark's original arrangement of plant. A is the site of the chalk quarry, B is the original pump house of 1876, C is the 1897 pump house, ***** are some of the large open settling tanks for softening.***

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This initial plant had a maximum output of 250,000 gallons per day. As demand for water increased at the end of the nineteenth century, a much larger beam engine was added in 1897, to raise the output to over 1 million gallons per day. The only change to the softening plant was to build extra shallow precipitation settling tanks (Figure 2).

Figure 3. Timsbury Waterworks, the 1876 engine and pump house, viewed from the terrace alongside the settling tanks. (Martin Gregory)

The second site, Otterbourne Waterworks, was started by Southampton Corporation in 1884 and supplying softened water from 1888. It had two much larger beam engines which, like Timsbury, drove both well pumps and delivery pumps. The plant was doubled in size with two further large beam engines, in 1896. Two larger 'flare' kilns provided the lime from a chalk quarry on site. For this much larger site, a more compact softening plant was necessary. The choice made was for the Atkins' version (patented 1881): The lime water and raw hard water were mixed vigorously in a relatively small softening tank, to initiate the precipitation, and then transferred to a battery of cloth filters which removed the calcium carbonate precipitate to give clear water for the customer. The filters were cloth covered hollow cylindrical disc-like boxes. Water entered a tank containing a bank of filters, deposited the precipitate on the cloth cover, as it entered the cylindrical boxes and exited via a hollow shaft on which the cylindrical boxes were mounted. The cloth covered cylindrical boxes were rotated continuously so that an arrangement of stationary brushes could remove the precipitate from the cloth, leaving it to collect in the bottom of the tank (Figures 5 & 6). This compact arrangement, and the steam engine to drive it, was sited in a relatively small building attached to the end of the boiler house. When completed in 1888, it was claimed to be the first Clark lime softening plant to soften over two million gallons per day. In 1892, William Matthews, the Engineer to Southampton Corporation Waterworks, published two papers in the *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol **108** part 2, pp 285-303, (1892) (see Figures 5 & 6) on the cost of softening at Otterbourne. This worked out at one farthing (¼ old penny) per 1000 gallons, which accounted for 17% of the cost of the water supplied.

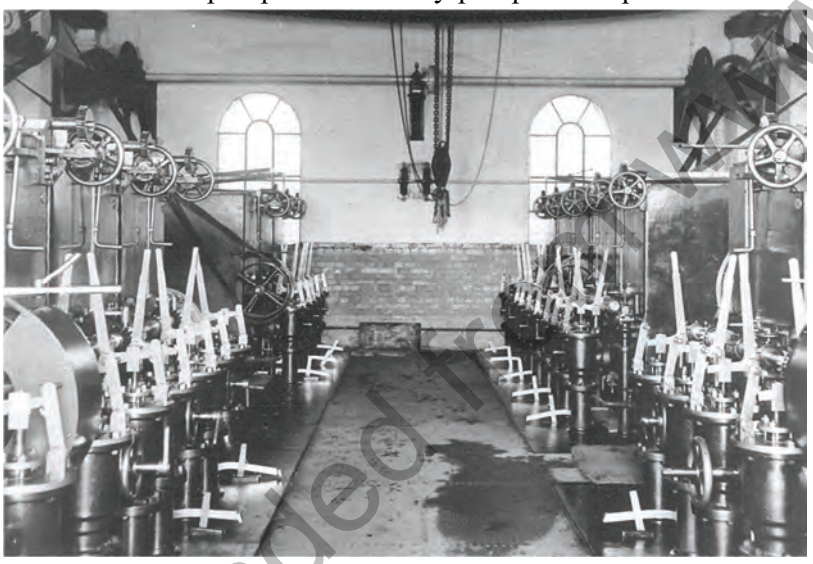


Figure 4. The filter house at Otterbourne showing the two facing rows of Atkins rotary filters as originally installed. Note the line-shafting and belt drives, high up on the far wall. (TWT)

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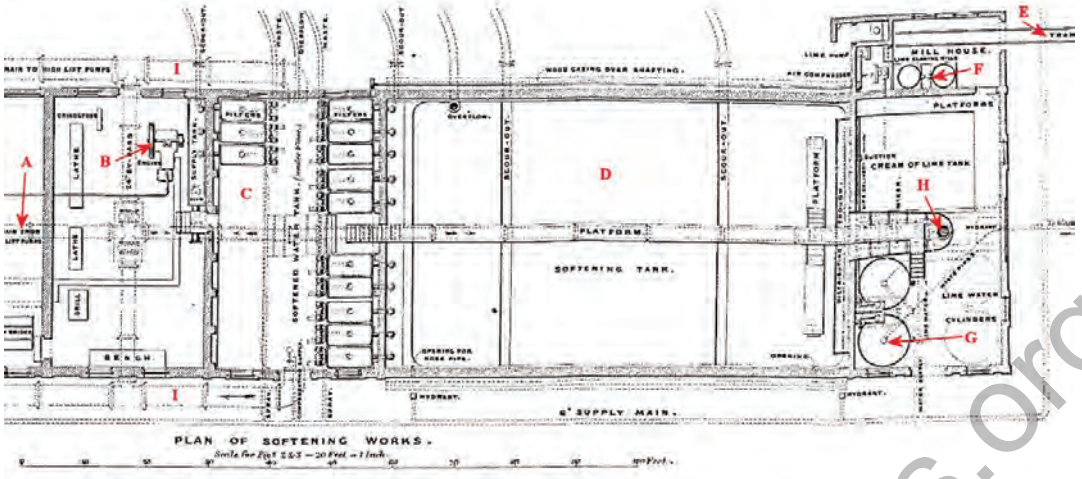


Figure 5. Plan of the softening plant at Otterbourne in operation in 1888 and designed for 3 million gall day^{-1}. It was connected to the pumping plant through the boiler house, the rising main from the wells (A) running under the boilers. The next building was a maintenance workshop with a steam engine (B) which drove the Atkins' filters (C) and the lime slaking mill (F), through overhead line-shafting. D was the softening tank in which the raw well water was mixed with lime-water and the softening initiated. Quicklime, from the kilns, entered the slaking mill on a tramway (E), was mixed with water (F) to give 'cream of lime' (a saturated solution of slaked lime) which was diluted with excess water to form lime-water and stored in the cylinders (G). Raw well water entered the system at (H). After softening and filtering, the softened water returned to the pumping plant by pipes (I,I).

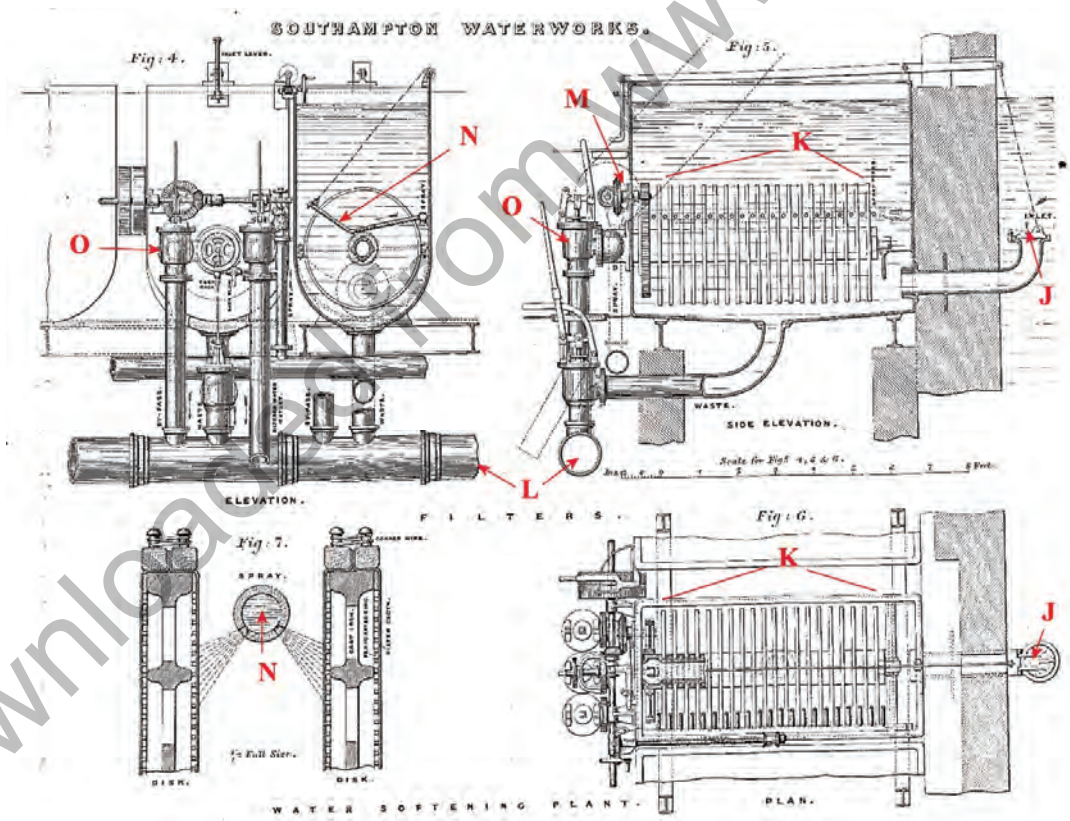


Figure 6. The Otterbourne filter house when fitted with Atkins filters. Water enters the filter tanks through flap valves (J) in the end wall of the softening tank. The filters consist of 20 disc-like cloth covered boxes (K), mounted on a hollow shaft. The water is filtered in passing through the cloth, and exits via the hollow shaft on which the boxes are mounted. The softened water is collected by pipework (L) and flows to the delivery pumps in the steam engine house. M is the gear train, driven from the overhead line-shafting, which rotates the filters. N are the stationary brushes which remove the chalk sludge from the outside of the filters, and O the 'back-flushing' valves to force water in the reverse direction, through the filters for cleaning.

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Table 2.
Selected data on water softening, from:
William Matthews "The Southampton Waterworks and Softening Plant (Paper 2521) in the Minutes of the Proceedings of the Institution of Civil Engineers (1892).

The Otterbourne plant was started in 1884 and started supplying Southampton in 1888. It was designed to supply 3 million gallons per day and, in 1891, averaged 2,250,000 gallons per day.

The total cost of the new works was £65,000 out of a capital expenditure for the Borough of Southampton of £202,000 on water supply. The cost of the softening works, including plant and kilns was £10,500, amounting to 16% of the expenditure of building the Otterbourne Works.

In 1891, the cost of the water supplied by Otterbourne averaged 1.44d (240 old pence [d] = £1) per 1000 gallons. This was made up from the costs, in old pence per 1000 gallons, of: pumping [0.54], softening [0.25], distribution mains [0.30], management expenses [0.28] and rates and taxes, [0.08]. Thus, softening the water resulted in a cost increase 17% in the cost of water delivered to the customers.

The actual average cost of softening the water in 1891, breaks down into:

Lime, including all costs of labour, fuel and repairs to kilns	£379
Wages of attendants	£156
Labour, cleaning out waste-pits and deposits	£150
Filter-cloth, oil, stores, tools and repairs	£104
Steam power to operate the filter plant (estimated)	£53

Which adds up to the 0.25 pence per 1000 gallons quoted above.

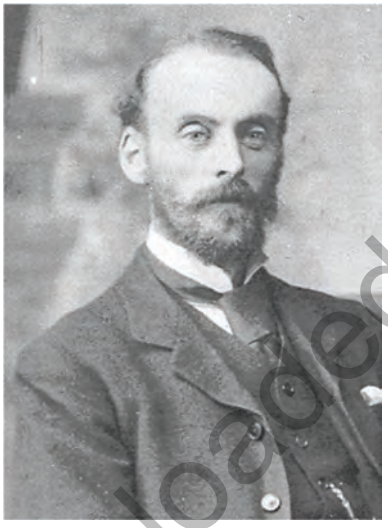


Figure 7. William R. Matthews, Engineer to Southampton Corporation Waterworks from 1880, retired 1908, and became Engineer to the South Hants Waterworks Co. 1908-1921.



Figure 8. Charles Haines, Superintendent of Otterbourne Waterworks in the 1890s and 1900s.



Figure 9. Baldwin Latham (1836-1917), Engineer to the South Hants Waterworks Co. for Twyford Waterworks, 1895-1908.

There must have been problems with the Atkins system. Less than 20 years later, the Southampton Engineer then in charge at Otterbourne, Charles Haines, had patented his own improvements to Clark's process, and Haines' filters replaced the Atkins system at Otterbourne and, in 1902-03, were fitted as original equipment at Twyford Waterworks. Haines' patent filters were similar cloth filters stretched over perforated metal boxes, but had no moving parts, with their associated leakage and wear. The Haines' system remained in use at Otterbourne and Twyford until the end of water softening in the 1960s.

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The third site, Twyford Waterworks, was the second site owned by the South Hants Waterworks Co. It started pumping water in 1900 and followed the same principles as the other two stations. Its softening plant came on stream in 1902. The original two compound steam engines were soon replaced with two inverted vertical triple expansion steam engines, driving the well pumps from a crank on one end of the crankshaft, and the delivery pumps directly from the cylinder crossheads. Once again, chalk was quarried on site and the lime made in two 'flare' kilns on site. As the demand for water increased in the 1920s and 1930s, pumping capacity was supplemented by two large diesel engines driving centrifugal pumps from 1935. Three extra lime kilns plus six extra tanks of Haines' filters were constructed to increase the capacity to soften water.

In the twentieth century, the population of the area increased greatly. Southampton Corporation, being the largest component, sought to unify and co-ordinate the water supply to the area. It promoted a Bill in Parliament to compulsorily purchase the South Hants Waterworks Co. before the First World War, and achieved this in 1921. During the inter-war period, all three of the waterworks were enlarged and interconnected. As long as water softening continued, pumping had to be split between well pumps to raise raw water to the surface, and force pumps to deliver softened water to the reservoir.

Implementation of the Clark process was labour intensive: quarrying the chalk, operating the lime kilns, making the lime water, disposing of the waste sludge, sterilising the cloth filters regularly, in addition to the normal pumping duties. Twyford Waterworks, with a workforce of over twenty on a three-shift pattern in the inter-war years, was the largest employer in Twyford village. With the cessation of water softening, the payroll of Twyford was rapidly reduced.

The Clark softening plant at Twyford Waterworks, (1) the lime kilns and lime slaking mill



Figure 10. Twyford Waterworks, the five 'flare' lime kilns. The left-most two date from 1902 and the other three from 1930.

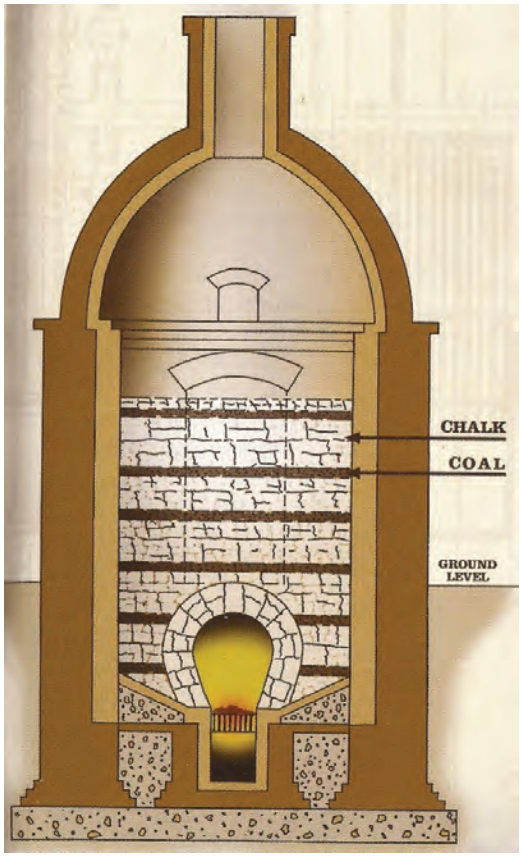


Figure 11. A cross-section of a Twyford Waterworks lime kiln showing the loading arrangement. An arch of chalk blocks was built over the grate to create a firebox. The interior of the kiln was then filled with alternate layers of chalk and coal. Only lumps of chalk and hard, low-ash, coal (culm) were used, to ensure a good airflow when burning, and so that, on unloading the kiln, lumps of quicklime were easily separated from unburnt fuel and ash.

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Figure 12. (left) Twyford Waterworks. The lime kiln loading floor. As the kiln was filled, the loading doorway was bricked up and sealed. Note the thickness of the kiln walls. Only the innermost layer of the kiln was firebrick.

Figure 13. (right) Twyford Waterworks. The interior of a lime kiln showing the stokehole and fire bars of the grate at the base.





Figure 14. (left) Twyford Waterworks. The stokehole and firing aisle of the lime kilns. Note the iron straps to improve the stability of the brickwork.

Figure 15. (right) Twyford Waterworks. The lime slaking mill driven by a 3-cylinder water hydraulic engine. Lumps of quicklime, from the kilns, were loaded into the drum, and water was added through the pipe at the left side of the drum. Slaking lime is a very exothermic process, so that the cream-of-lime formed would be at, or near, its boiling point. The cream-of-lime was run out into a concrete-lined pit through the tap at the far right of the drum. It was then diluted with excess water to form 'lime water' which was stored in cylindrical tanks in the Filter House.
The hydraulic engine drove the stirrer/crusher in the mixing drum.

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The Clark softening plant at Twyford Waterworks, (2) the softening tank and Haines' filters

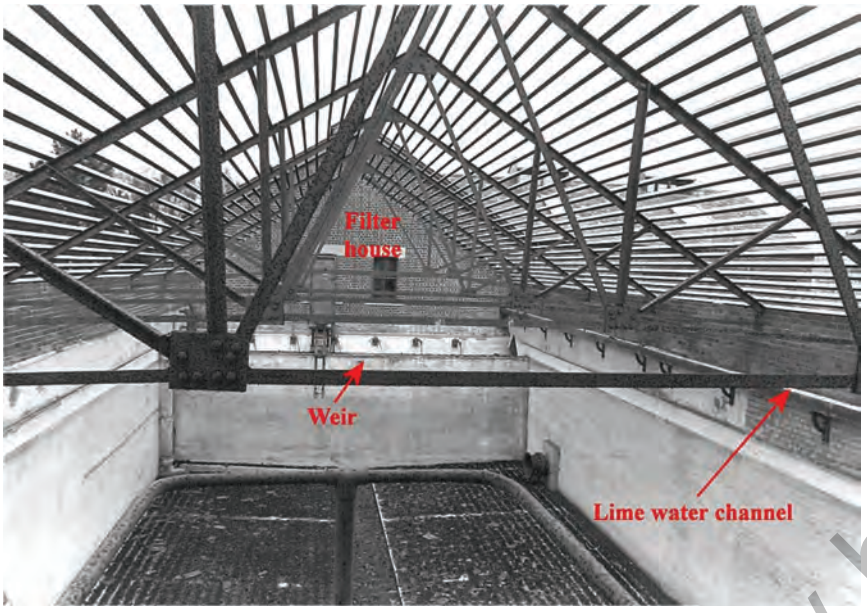




Figure 16. (left) Twyford Waterworks, the softening tank (photograph taken during roof repairs).
Raw well water entered the tank through a cast iron bell housing at the south end of the tank (behind the photographer). Here it was mixed with lime water (supplied from tanks in the filter house, along the channel seen on the right side of the tank at roof level). The softened water flowed through a baffle wall and down the tank, depositing most of the calcium carbonate sludge as it did so, and exiting over the weir wall seen at the end. Above the weir can be seen the operating rods for the flap valves to admit softened water to the Haines' filter tanks.
The bottom of the tank is V-shaped so that, when softening is stopped and the tank emptied, sludge can be swept into a culvert in the centre of the tank, and flow to a sludge pit across Hazeley road.

Figure 17. (right) Twyford Waterworks, a sectioned single Haines' filter element mounted on a section of tank showing the cast iron manifold along the base of the tank with slots to drain each filter box.
Softened water flows into the filter tank, through the cloth sleeve (depositing any remaining sludge), and drains out through the slot in the base, into the manifold along the bottom of the tank. For cleaning and sterilisation, the elements are lifted out of the tank and cleaned by a steam lance fed from the boiler house.

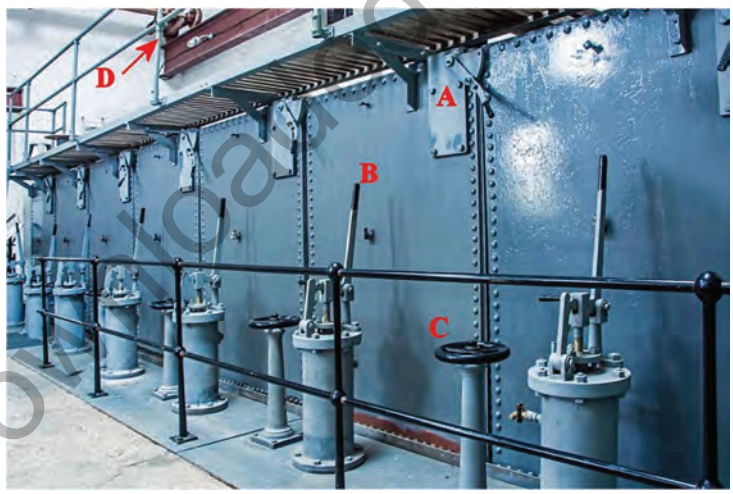




Figure 18. (left) The row of Haines' patent filter tanks in the Twyford Waterworks filter house.
(A) Is the lever admitting water to the filter tank, (B) is the lever releasing filtered water from the manifold to the clear water tank, (C) is the back-flushing valve to force water back through the filter cloth for cleaning. (D) is the travelling crane to lift the filter elements out for sterilising.

Figure 19. (right) Twyford Waterworks, the interior of a Haines' filter tank showing a set of filter elements installed.

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Water softening ceased at Twyford in 1969, by which time modern detergents could cope with the soap sludge problem, and water conditioners mitigated the effects of limescale. In particular, steam power was no longer dominant in the ships using Southampton, so one of the main reasons for softening the water had vanished. The medical and dental professions had never liked soft water, and were happy that the water drunk by their customers was hard and thereby better for their cardio-vascular systems.

Nevertheless, the Clark degree scale of hardness (Table 3 compares Clark's scale with modern measurements) and Clark's soap test for measuring the hardness of water continued in common use for many years. You can still get the reactants for his soap test today!

The cessation of water softening in Hampshire came before the formation of the Southern Water Authority in 1974. This new regional Authority wished to demolish all the old redundant plant and construct an all-electric pumping system. Timsbury and Otterbourne Wells stations were demolished and electric pumps are now used in their associated wells. Twyford Waterworks was listed as a Scheduled Ancient Monument (HA501) in 1974. It contains the last remaining Clark lime softening plant in the UK. Whilst still an operational Southern Water abstraction site, with electric pumps in the wells, the 'old' parts of the site are looked after by Twyford Waterworks Trust (a Registered Charity, No. 291720) and are open to the public on the Trust's Open Days. (www.twyfordwaterworks.co.uk)

Further reading

Gregory, Martin, *The Works,* Twyford Waterworks Trust guidebook, (2017)
Latham, Baldwin, *Softening of Water,* Journal of the Society of Arts, Vol **32**, pp 910-918, (1884)
Latham, Baldwin, *Papers upon the Supply of Water to Towns,* E. & F. N. Spon, London, (1865)



Figure 20. Twyford Waterworks in 1909, showing the 1905 pumping engine house. At the right can be seen part of the chalk quarry. The red dotted line shows the position of the rope worked railway incline to take chalk and coal up to the lime kilns. (For Figure 21, see back cover.)

Table 3

Hardness as $CaCO_3$ mg/l	Hardness as Clark degrees	Hardness Level
0 – 50	0 – 3.5	Soft
51 – 100	3.6 – 7.0	Moderately soft
101 – 150	7.1 – 10.5	Slightly hard
151 - 200	10.6 – 14.0	Moderately hard
201 - 300	14.1 – 21	Hard
Over 300	Over 21	Very hard

Clark's 'soap test' for the hardness of water:

A standard solution is made up of pure soap flakes (e.g. "Lux" or "Dreft") dissolved in ethanol. A commercial example of this is Wanklyn's solution, where 1 cm^3 of solution will remove 1 mg of $CaCO_3$ from a sample of hard water.

Take a sample of hard water, say 20 cm^3, and add 1 cm^3 of Wanklyn's solution. Shake vigorously for several seconds and note whether any lather is produced. If not, add further 1 cm^3 portions of Wanklyn's solution followed by vigorous shaking until a lather is produced which lasts for 30 s or more. Calculate the mass of $CaCO_3$ in your sample of hard water and hence the 'hardness' of the water sample.

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SOUTHAMPTON FLOATING BRIDGE No. 8

Jim Beckett

Introduction

It is generally accepted that the floating bridge, also known as a chain ferry, was invented by James Meadows Rendel, who was born near Okehampton, Devon, in 1799.[1] The principle of propulsion must have been understood for millennia. When the first person sitting in a dugout canoe pulled on a rope, fixed to the land, and discovered that the vessel moved towards the point where the rope was tethered, the idea for the floating bridge was born. Replace the person pulling on the rope with a steam engine and a chain and the concept of a new type of ferry was waiting to be designed.

Rendel coined the name, "Floating Bridge", because horse drawn traffic, wishing to cross a river, would not have the inconvenience of using a conventional ferry, which would have involved unloading the cargo. The carter would simply drive his horse and cart up a gently sloping ramp onto Rendell's invention, and then down another ramp at the far end of the vessel onto a hard, or inclined plane, and then onto a road, where the carter could continue his journey having crossed the water with almost the same ease as crossing a bridge. The really clever part of the inventor's design was the way he raised and lowered the ramps, or prows, at each end of the floating bridge. Both ramps were connected by cables which ran the length of the vessel and allowed the weight of one to be balanced by that of the other, so that the ramps could be raised and lowered manually, by just one man. This surely was the original roll on, roll off ferry. Another great advantage of the floating bridge over conventional boats was the fact that at the end of each crossing it did not have to dock and tie up, the chains would hold the vessel in place when the engine was not in motion.

The first of Rendel's floating bridges entered service at Dartmouth in 1831, followed by two further vessels in Devon and then, in 1836, one for *The Itchen Bridge Company* to cross the river between Southampton and Woolston. This was a very different vessel to No. 8, which is the subject of this article. However, there were certain features which were included in all later floating bridges, albeit with improvements, right up to the present day.

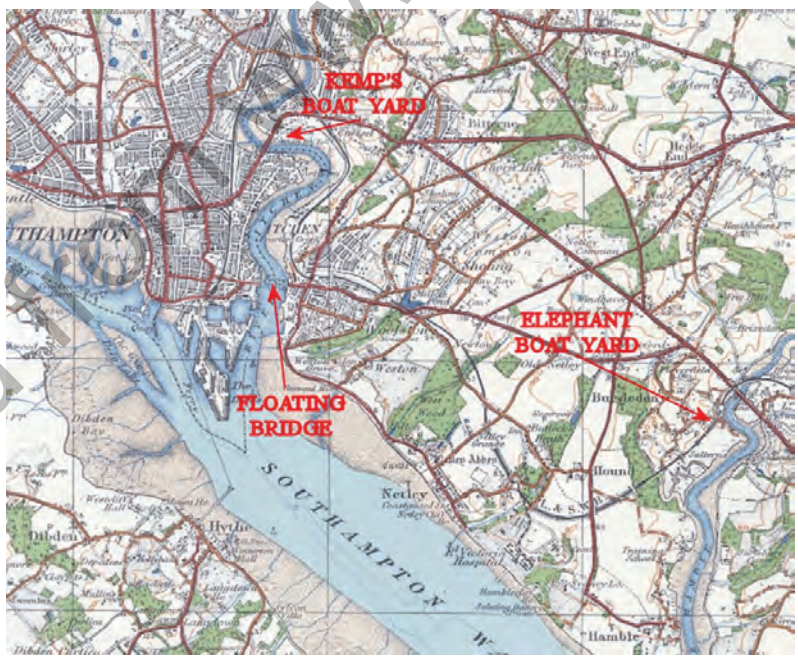


Figure 22. A map of the Southampton area showing the location of the Itchen Floating Bridge. Also shown are the locations of Kemp's Boat Yard, where Floating Bridge No. 8 was stored after being sold out of service, and The Elephant Boat Yard, where No, 8 resides in 2024.
(Reproduced with permission of The National Library of Scotland)

The Development of Southampton's Floating Bridges

Sixty years were to pass between the launch of No.1 and that of No. 8. During this period there were four design stages, but is not within the scope of this article to describe the evolution of the Southampton Floating Bridges. Table 4 overleaf, however, illustrates some of the differences between the first and seventh vessels. (No. 4 was a steam launch, not a floating bridge.)

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Table 4		
Bridge	No. 1	No. 8
Year Launched	1836	1896
Builders	Richard Hocking, Devonport (Engine built by John Mare, Plymouth)	Day Summers & Co. Southampton. Complete vessel including engine.
Hull dimensions	12.8m x 9.76m	27.06m x 11.59m (including overhang)
Hull construction	Quebec Red Pine and English Oak	Steel
Engines	Two single cylinder beam engines	One two-cylinder Grasshopper engine
Deck arrangements	Two passenger/vehicle decks on opposite sides of the central cabin.	Central passenger/vehicle deck with cabins on either side.
Ramps	4 ramps, manually operated	2 Ramps, manually operated
Boiler position	Behind engines in central engine house	On one side, in boiler house, opposite the engine
Engine position	In central engine house	On one side, in engine house, opposite the boiler
Driving mode	Two chains and gypsy wheels	Single steel cable on friction wheel
Cost	£5945	£4953
Years in service	17	65



Figure 23. Map of Southampton, c1900, showing the locations of the Floating Bridge ferry and The Day Summers & Co. shipyard where No. 8 was built.
(Reproduced with permission of The National Library of Scotland)

Floating Bridge No. 8

Floating Bridge No. 8 was designed by Charles Walter Murray. He was born in 1857, in Southampton, and served his apprenticeship at Day Summers & Co., shipbuilders based at the Northam Iron Works, Southampton. At the Day Summers shipyards they were building marine steam engines, ships, steam yachts and shear legs. They enjoyed prestigious orders from the likes of P&O, Royal Mail Line and even the Russian Government. The 1881 census shows that Charles Murray was working as a draughtsman at Day Summers. Later he spent time with P&O as a seagoing engineer and then became engineer in charge of the Hog Island Hydraulic Lift Dock in Bombay. Then, he worked as resident inspecting engineer at the building of the *S.S. Malacca* and the *S.S. Formosa* in Barrow in Furness.[2] Afterwards, he set up his own practice in Southampton, as a Consulting Engineer and Naval Architect. It can be argued that the partnership of an experienced designer with a quality ship yard should result in a successful and durable vessel. This it did, with No. 8 spending 65 years in service.

A year after No. 8 was launched a detailed description was published in the 26th

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November 1897 issue of the periodical *Engineering*.[3] The following description makes use of that article to describe the vessel.

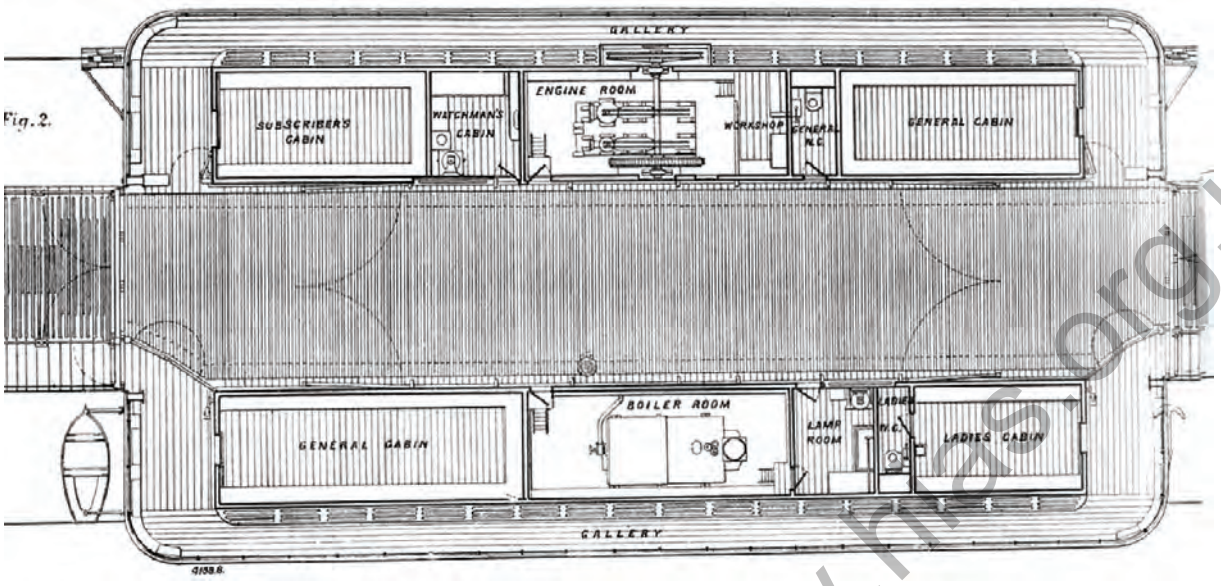


Figure 24. Plan showing carriage deck and cabins of No. 8, 1897, (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

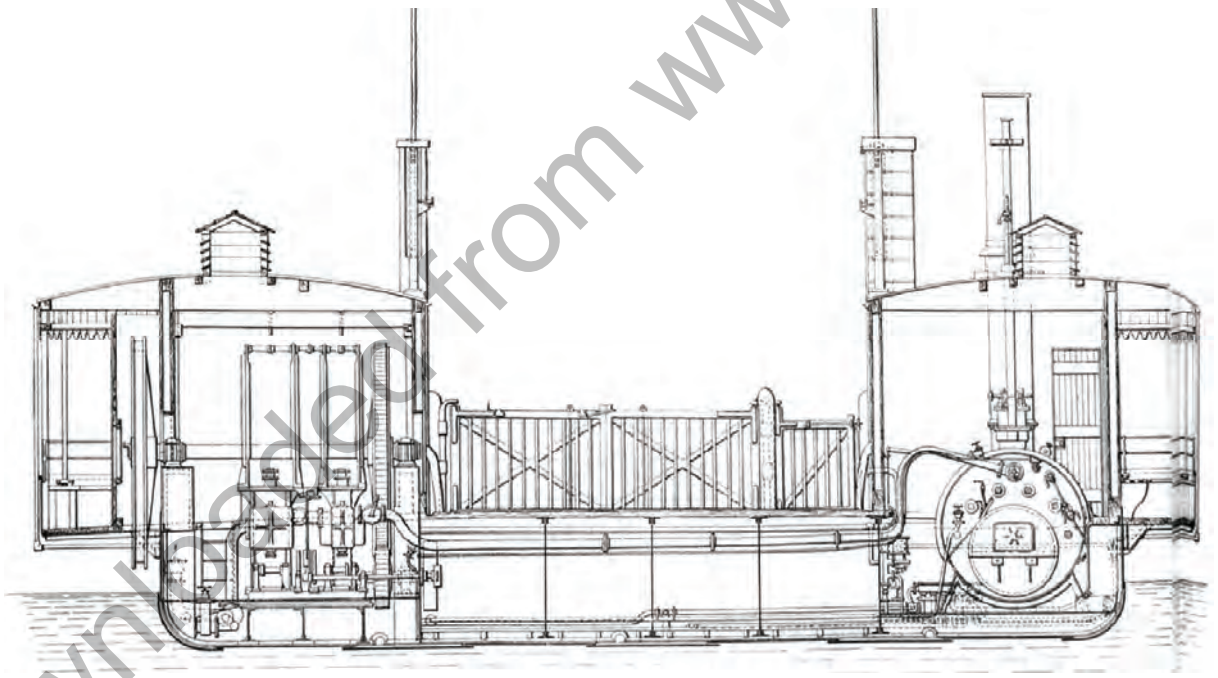


Figure 25. Transverse section of No. 8 through the engine and boiler rooms. 1897, (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

We are told that Charles Murray was not only responsible for the design but also was Superintendent of works during the build. For the hull, he specified mild steel, made by the Siemens-Martin process which was considered to produce a better quality product than the older Bessemer Converter method. The Siemens-Martin Open Hearth process would dominate steel production in the twentieth century, but in 1895 its superior quality was only then being recognised, so the choice would have been made to ensure quality over cost.

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Either side of the deck for carrying horses, carriages, carts and live stock, were erected cabins, 23.5m x 3.1m which were roofed by 16 SWG (1.63mm) thick galvanised corrugated iron sheet. These cabins provided accommodation for passengers, the engine and boiler, along with a watchman's cabin containing a bed, steam heating and a WC. (Fig. 24). Not all the passenger cabins were for everybody. There was a ladies' cabin, for women who were respectfully dressed, and a subscriber's cabin for shareholders and those with season tickets.[4] There were also two general public cabins which could accommodate 119 passengers and room for 135 outside, seated on slatted wooden bench seats, facing the river. The cabins were wood panelled but all seating lacked cushions or upholstery, as the time on board was considered too short to warrant the luxury. More importantly, with regard to safety, the hull was divided into 5 watertight compartments (Fig. 25) because, despite it being only a three-minute journey, there was constant danger of collision in the busy waterway. In addition to a WC for crew use, one was also provided for the general public and one for the ladies.

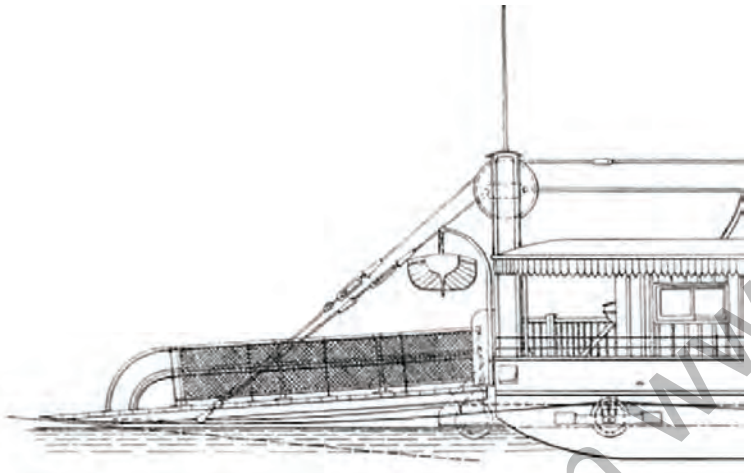


Figure 26. Part-elevation showing one of the prows or ramps, 1897, (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

The prows, or ramps, which allowed traffic and pedestrians to board the vessel, are shown in Fig. 26. They were constructed with a steel frame and surfaced with Memel Pine[5] planking. At the hards, or planes, each side of the crossing, it was necessary for the prows to be raised or lowered only a few degrees either side of horizontal to allow passengers and traffic to board or disembark. On both sides of the vessel steel cables ran from a point near the ends of the prows, up to a pulley wheel on the top of a 4m high steel stanchion, along the length of the hull and over another similar pulley wheel down to a shackle, connecting it to the prow on the opposite end. In this way the two prows, which were of almost identical mass, were held in balance in any position of elevation. Only the friction in the system appears to have prevented the prows from bouncing up and down with the motion of the river. Mid way along the length of these steel ropes there was inserted a toothed rack. Beneath these racks and on both sides of the vehicle deck was positioned a 2m diameter hand wheel, fastened to the cabin wall. A short shaft, keyed onto the hand wheel, passed through the cabin wall and connected, via a bevel gear to a vertical shaft. At the top was a pinion, which meshed with the rack. When the hand wheel was turned the pinion would rotate and make the steel rope, connected to the rack, move in the desired direction, to raise or lower the prow. The effort required to carry out this operation was easily accomplished by the deck man, alone. It is uncertain why a hand wheel was provided on both sides of the deck as it would only have been necessary for one side of the ramps to be connected to the raising/lowering mechanism. To add strength, a second steel rope or iron bar was fastened between the tops of the fore and aft stanchions and extended down to a fastening on the prows. This would also have prevented the prows from collapsing downwards, in the event of the steel cables failing.

Before going on to describe the propulsion system it may be worth briefly outlining the principles by which all similar floating bridges have been propelled from the time of Rendel's patent up until the present day. The chains, or in the case of No. 8, the steel cables, spanned the Itchen estuary from bank to bank, a distance of about 300m. The cables were not fixed tightly to the banks, but were arranged so that their mass caused them to sink to the river bottom when the floating bridge was not in motion, otherwise shipping using the waterway would have been at risk of catching the cables as they passed

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over them. The ends of the cables were attached to chains and heavy weights which were allowed to rise and fall in deep wells, according to the tension on the cables. At times when there was a strong current, causing a lateral force on the vessel, the two cables would be the only thing preventing the floating bridge from being washed away. (Fig. 27)

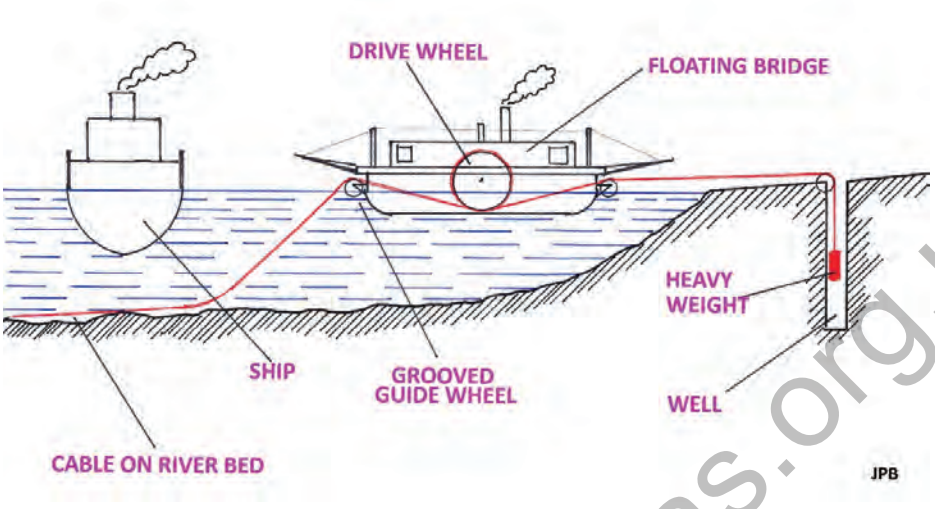


Figure 27. The principle of operation of the cables to avoid interference with shipping on the river.
(Jim Beckett)

The two steel wire cables ran along the length of the vessel on opposite sides. The one on the boiler side was only required as a guide, the engine room side having the cable that propelled the craft. On both sides the cables approached and left the hull, over grooved pulleys, one at each corner. The driven cable passed one complete revolution around a 2.67m grooved wheel, and it was the rotation of this wheel, and the friction which prevented slipping, that drove the vessel forward. The cable did not move, the ferry moved because the force required to overcome the drag exerted by the water was less than that required to pull the cables taught. In fact, when starting, the cables were rising from the river bed at an angle of about 45°, but the angle reduced as the ferry moved from one side of the river to the other.

The large grooved, 2.67m diameter, drive wheel was keyed to a shaft, on the other end of which was fixed a gear wheel of about the same diameter. (Fig. 28) This cast iron gear, or mortise wheel, was fitted with hornbeam cogs, inserted around its periphery, and meshed with a cast iron pinion, mounted on the engine crankshaft. The groove on the drive wheel was provided with soft iron inserts, which could be renewed easily as they were worn away by the rubbing of the cables. The hornbeam cogs on the large gearwheel were provided for similar reasons, i.e. to reduce the cost of maintenance and to reduce noise.

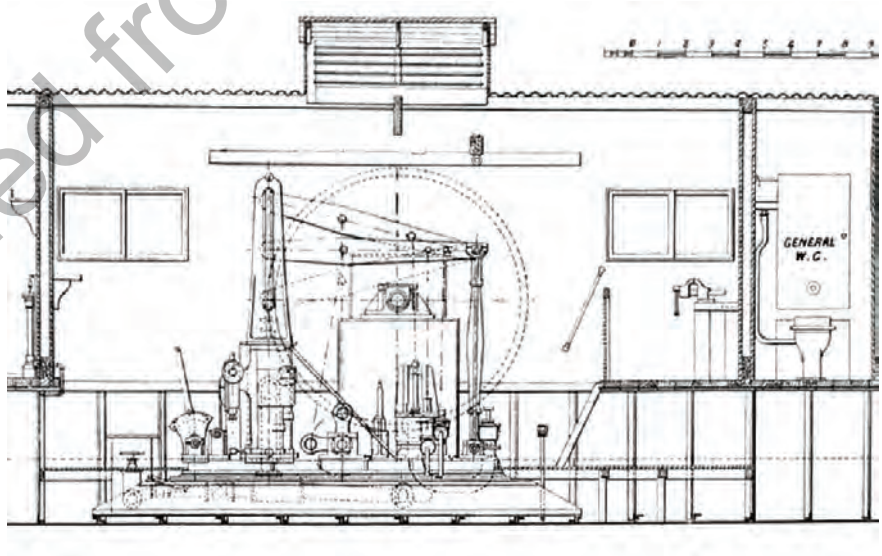


Figure 28. Elevation of the steam engine. (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

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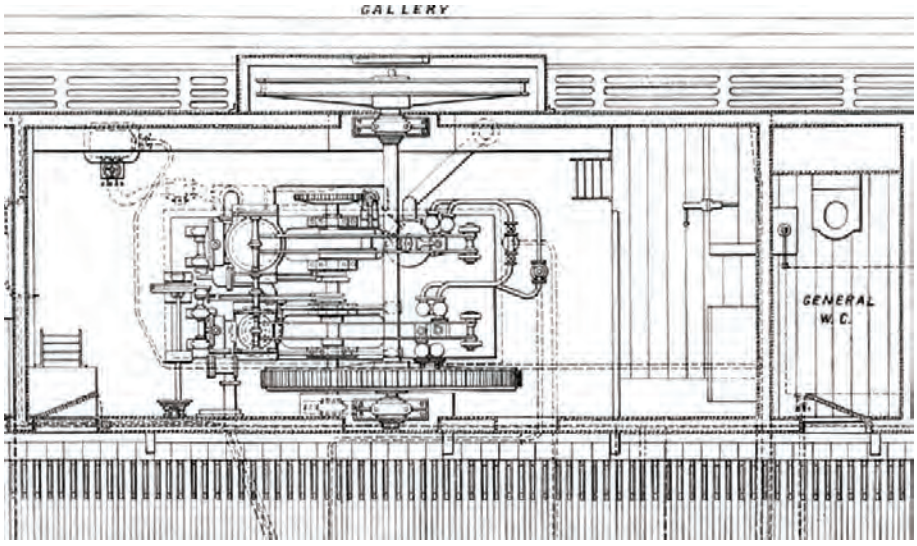


Figure 29. Plan of the steam engine, showing the large driving wheel for the cable. (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

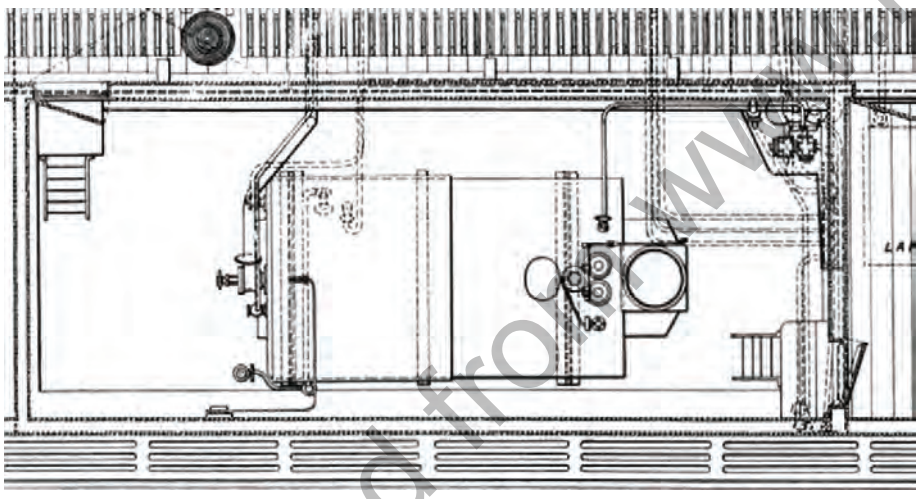


Figure 30. Plan of the boiler room. (Engineering, 26/Nov/1897), (Grace's Guide to British Industrial History)

Installed on No. 8 was a beam engine, of the grasshopper type, (Fig. 28 & 29) often favoured for marine applications, because of its low centre of gravity. It was a two-cylinder compound, with a jet condenser. He designed two further floating bridges for the operating company but chose standard two-cylinder compound beam engines for those. The grasshopper design pivots the beam at one end, with the piston rod at the opposite end, and the connecting rod near the centre. A normal rotative beam engine has the beam pivoted in the centre with the connecting rod and piston rod at opposite ends. The high pressure steam from the boiler, which was generated at 75 lbs in^{-2} (5.2 bar), was fed firstly into the high pressure cylinder, 24cm in diameter, and then into the low pressure cylinder, with a bore of 42cm. The stroke was approximately 1m. The overhead beams operated connecting rods to two cranks on a common shaft and these were positioned at an angle of 90° to one another. In addition, the motion of the beams worked the wet air pump, and three additional pumps, all connected by rods. One of these small pumps supplied water to the high level W.C. cisterns and the other two were boiler feed pumps. Water for the jet condenser was drawn in from a pocket in the hull, as was the water for the W.C. flush. This was salt water, because the River Itchen was fully tidal at this point. As auxiliaries we are told there was a duplex donkey pump, manufactured by Clarke-Chapman, in the boiler room (Fig. 30). This had connections to the fresh water tanks, sanitary pipe-work, bilges, fire hydrant and hose. This last feature could also be used for washing the decks. Whether the boiler feed was from the main engine or donkey pump, or probably both, is not stated.[6] Fresh water, to supply the boiler, was carried in tanks under the cabin floors, and this amounted to ten tonnes when full. The boiler was of the fire tube type, about 3m long by 1.8m in diameter. Almost half the length comprised the firebox, with the other half containing 48 fire tubes, each with an external diameter of 76mm. These ran straight through the pressure vessel containing the water, to the flue and chimney. It was the engine driver's job to stoke and mind the boiler, which he did when the floating bridge was stationary between crossings.

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There was a telegraph fitted at both ends of the floating bridge which allowed the deck man to communicate with the engine driver. The apparatus was made by William Hornsey, brass founder, of 17 Bernard Street, Southampton.

The article in *Engineering* ends with a few statistics. We are told that the approximate displacement of the vessel was 205 tonnes and that it made about 700 crossings per week, burning about 2 tonnes of coal per week. Apparently, this was a saving in fuel of 44% compared to previous floating bridges operating the same route.

Operation of the Floating Bridge, 1896-1961[7]

Throughout its long years of service No. 8 was joined by floating bridges Nos. 7 and 9, so that passengers would enjoy an uninterrupted timetable, provided by two working vessels. There would always be one available to step in should there be a breakdown or when regular maintenance was required. In fact, No. 7 sank after a collision in 1928, but she was quickly replaced by No. 10, the last steam floating bridge to be built.

Passenger lighting was always an issue with the floating bridges, which operated well into the night and No. 8 was initially fitted with oil lamps. When No. 9 was built in 1900, it was lit by electricity and, sometime later, No. 8 was fitted with a small steam dynamo for electric lighting, and eventually, in 1949, this was replaced by a diesel generating set made by Lister.

In 1946, J. I. Thornycroft & Co., at Woolston, carried out a major overhaul to No. 8's engine, and at the same time replaced the original main shaft and the cogs on the large mortise wheel. The cogs were originally carved from hornbeam and held in place with brass pins. Thornycroft's ship repairers experimented with a synthetic alternative to wood, and as this was successful, the cogs were replaced on all three floating bridges with the new material. At the same time some seats and partitions were removed from No.8 to allow more space for standing passengers, as the ferry was often very crowded at peak times. In 1958 the boiler was taken out for overhaul, by Husbands Shipyard in Marchwood, Southampton.

Time was not on the boiler's side, as No. 8 was now over 60 years old, and in 1961 it was withdrawn from service after being declared unsafe. A new chapter was about to begin in the life of this interesting vessel.



Figure 31, The steam engine of No. 8 photographed when displayed at the Wendron Forge Museum in Helston, Cornwall, in 1979. It was displayed in the open air and was considerably more complete than the engine now stored in Southampton. See, also, Figure 32, on the back cover. (both Martin Gregory)

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Floating Bridge No. 8, 1961-2023

The owners sold No.8 to Mr. Kemp, who towed the floating bridge to his boat yard at Bitterne Manor, about a mile upstream from Woolston, and almost opposite where she had been built in 1896. Here he used the hull as office accommodation and as a fuelling pontoon. It was still there in 1977, but at some time much later, it was sold to *The Elephant Boatyard*, on the River Hamble. Mr. Kemp had removed the engine, and believing it to be of historic importance, in 1962, it was offered to Southampton Art Gallery and Museums. Initially the offer was accepted, but the transfer never took place. In 1974 the engine was reported to have been acquired by Wendron Forge Museum near Helston in Cornwall, now part of the Poldark Mine Museum[8]. It was in a very poor state, having been left out in the open at Bitterne.[9] Figures 31 & 32 (back cover) show the engine when in Cornwall.

In April 2001, HIAS members Nigel and Angela Smith visited the Poldark Mine Museum to view the engine and were told it had been sold to someone in Kent. However, they then discovered that the sale had fallen through and the engine was found in a nearby car park. On return to Southampton they contacted Alastair Arnott, at Southampton Cultural Services, and he obtained an emergency grant from The Science Museum so that the engine from Floating Bridge No. 8, along with the compound beam engine from Floating Bridge No. 10, which was also no longer wanted by the Poldark Mine Museum, could be repatriated to Southampton. They were placed in store, and at the time of writing, have not been put on display to the public. *The author is grateful to Maria Newbery at Southampton Museums for access to the store and permission to take photographs of the engines, in particular, the engine from Floating Bridge No. 8.*



Figure 33. The steam engine from Floating Bridge No. 8, now resting in store in Southampton. It can be seen that the engine is now much less complete than it was at Wendron Forge Museum in 1979. (Jim Beckett)

The Engine

Fig. 33 shows the first of four views of the engine in the Southampton Museums store. It will be seen that only one connecting rod is present and this hangs loose, not attached to the crank shaft. The connecting rod to the wet-air pump is present but two further rods to auxiliary feed pumps and several brasses are also missing. The domed ends of the pins can be seen in the beam, as can the studs and nuts in the bedplate, where these pumps would have been fitted. The fluted and decorative columns, or pivot arms, on the right supported the end of the beams and it can be seen how they were pivoted at both top and bottom so in motion the tops would have moved backward and forward as the opposite end of the beams would have moved up and down. (The name "grasshopper engine" was given to this design because the motion described above, when the engine was running, was said to give the impression of the back legs of a grasshopper.) The red pinion with black teeth would have meshed with the teeth (cogs) in the large mortise wheel. If this wheel had been present in the photograph, its top would have been level with the top of the slide bars. The shaft to the drive wheel would have passed through the gap between the

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beams and the crankshaft. The drive wheel was out of sight, on the outside of the cabin wall, in a boxed enclosure (See Fig. 29). The cylinder closest to the viewer is the high pressure one. The steam inlet from the boiler, and its stop-valve, can be seen on the side of the high pressure valve chest, painted in black. This is shown more clearly in Fig. 34, which also shows the full extent of the slide bars. The cylinders were originally insulated with vertical wooden slats.

Fig. 35 shows the crankshaft and the eccentrics, and just visible, the rods that operated the valve gear. Fig. 36 shows the wet-air pump, which would have been part of the jet condensing system. It also shows a worm and gear, which would have been disengaged when the engine was in use, but enabled the engine to be barred manually for maintenance; for example, to replace one of the cogs on the mortise wheel. It is a great shame that neither the mortise wheel, with its synthetic cogs, nor the drive wheel with its soft iron inserts, appear to have survived.

Figure 34. The engine of No. 8 showing the slide bars and cylinders.
(Jim Beckett)



Figure 35. The engine of No. 8 showing the crankshaft with its two throws at 90º, and with the four eccentrics in between.
(Jim Beckett)

Figure 36. The engine of No. 8 showing the wet-air pump of the jet condenser, and the worm-and-wheel barring mechanism.
(Jim Beckett)



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The Hull and Superstructure

From Kemp's boat yard in 1977, where we know that the hull was being used as an office and pontoon, we next learn that in the early part of the present century, a floating bridge hull was being used as a restaurant, moored at Bursledon, on the River Hamble, about five miles away. Enquiries made by the author confirmed that this was the hull of No. 8, and that it had left Kemp's boat yard, and had been towed to its new home, in *The Elephant Boatyard*. The boatyard is named after *HMS Elephant* which was built here in 1786[10]. This ship became Nelson's flagship at The Battle of Copenhagen in 1801.



Figure 37. Floating Bridge No. 8 in its present location at The Elephant Boatyard in Bursledon. (Jim Beckett)

The restaurant suffered a fire in 2009, but appears not to have been badly damaged[11]. It continued trading until 2020, when it ceased operation during the covid pandemic. Rumours at the beginning of 2023 suggested the floating bridge had been scrapped, but enquires to *The Elephant Boatyard* confirmed that it was currently in use as their administration office. They kindly allowed access for the author to visit, and take some photographs.

Fig. 37 shows No. 8 in its present home in 2023. The prows have been removed and the car deck, between the cabins, is now covered by a roof. Otherwise, apart from the missing funnel and louvre above the boiler room, the floating bridge exterior looks remarkably little altered from when it was first built, 128 years ago. From the other end of the hull, however, it is seen that the original sheet steel sides of the overhanging gallery have been replaced with plywood. (Fig. 38) The wood panelling above the inserted UPVC corner windows appears original as does the roof and wooden door with the circular window. A narrow bench would have been fitted along the full length of the walkway for passengers to sit on and enjoy views of the river. Fig. 39 is taken from the same position but across the beam, showing the short extension of the deck, and the studs on which the prows, or ramps, would have been hinged. The large hand wheel for raising or lowering the prows has been removed from its shaft and can be seen here. The mechanism which connected this hand wheel to the prows can be

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partially seen in Fig. 40. The steel wire rope passes over the pulley wheel and is fastened to the toothed rack which can just be seen protruding from the box, which was provided to offer protection from the rain. The steel rod below the wire rope has rigging screws for adjustment to keep the stanchions vertical and stop the hull hogging or sagging.

Figure 38. Floating Bridge No. 8 today. A view along the side gallery where passengers could have sat on long benches, now removed. (Jim Beckett)

Figure 39, Floating Bridge No. 8 today. *At the right is the car deck, where the prow would have been hinged. (Jim Beckett)*



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Figure 40. Floating Bridge No. 8 today.
The upper steel wire rope connected the two prows together so that, as one was raised, the other was lowered. The small wooden tower contained a vertical shaft driving, through a pair of bevel gears, a rack & pinion mechanism to move the rope and operate the prows.
(Jim Beckett)

Conclusion

The reader may have wondered why No. 8 was selected as the subject for this article, out of a total of 12 floating bridges[12] which were built to cross the River Itchen. The reason is because of a set of three coincidences. These are the survival of: 1) the hull; 2) the engine; and 3) the detailed description of No. 8, published in *Engineering* in 1897. On a personal level, the author's grandfather was employed by Day Summers & Co. at the time when No. 8 was being built. He would have been 18 years old, and may even have worked on her!

With thanks for assistance from:
The staff at Southampton City Library and Archives.
Maria Newbery at Southampton City Museums.
The owners and staff at *The Elephant Boatyard*, Bursledon.
Angela and Nigel Smith (HIAS)
Clive Sweetingham for the beautifully colourised image of No.8

References

1. Graces Guide https://www.gracesguide.co.uk/James_Meadows_Rendel
2. Graces Guide, "Who's Who in Engineering" 1922
3. Graces Guide, *Engineering*, p 648, 26/11/1897
4. Horne, John, *Farewell to the Floating Bridges*, Southampton City Transport/SUIAG 1977
5. Imported from the Baltic and almost certainly landed in the Itchen Docks, close to the shipyard.
6. On salt water and feed pumps. https://navalmarinearchive.com/research/docs/salt_in_marine_boilers.html
7. Horne, John, *Farewell to the Floating Bridges*, Southampton City Transport/SUIAG 1977
8. The history of this museum is described in Wikipedia. https://en.wikipedia.org/wiki/Poldark_Mine
9. *FOCUS* (Newsletter of HIAS) Issue 3, Report by John Horne, October 1974
10. About the shipyard's origins. https://www.wikiwand.com/en/George_Parsons_(shipbuilder)
11. *Daily Echo* report from 02/01/2009
12. Fleet numbers 1 to 14, except, No. 4 was a steam launch (not a ferry) and the Number 13 was not used

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The Melbourne Street Steam Flour Mill

Andy Fish

The Melbourne Steam Flour Mill was situated on the corner of Melbourne Street and Princess Street, Southampton, adjacent to "The Chapel Tramway" and the Gas works. It was shown on the large scale Ordnance Survey map surveyed in 1868.

The first reference to Melbourne steam mill is in the ''Southampton Street Directory" published by Forbes in 1859, showing the owners to be the Hague Brothers. Then, in the 1871 Cox's directory, the listing shows Hague's Steam Flour Mill situated at 36 Melbourne Street. After extensive searches, no definitive schedule of the machinery in the mill has been found. In the Street Directories published between 1884 and 1904, the mill is shown as vacant. However, the building is shown on the Goad Insurance

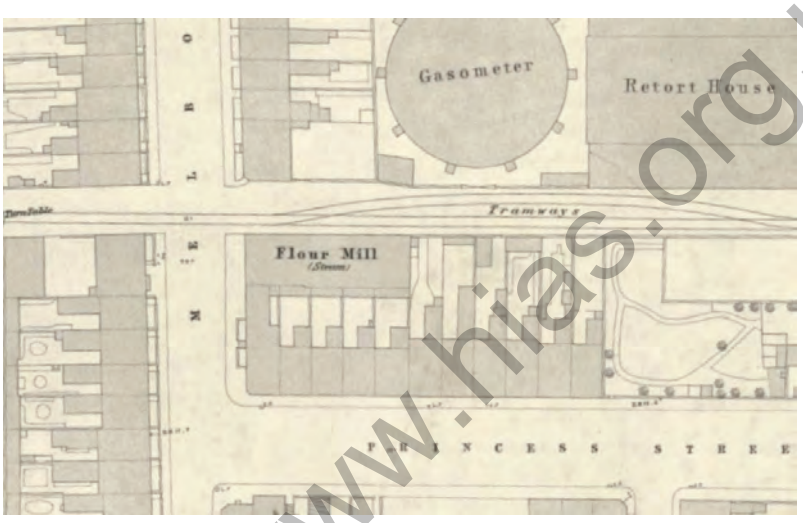


Figure 41. The location of the Melbourne Street Steam Flour Mill shown on an O.S. map surveyed in 1868.
(Reproduced with permission of The National Library of Scotland)



Figure 42. A photograph of the mill in 1907, when in use as a warehouse. Behind the mill can be seen part of the frame of a gasholder and one of the chimneys of the gasworks. The shop on the corner is branch No. 1 of the Southampton Co-op, with its bakery alongside.
(Dave Marden Collection)

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Map of 1893, as a Fodder Warehouse. The next reference to the building is when it was advertised for sale by auction in 1899. It is still there on the O.S. map of 1933.

After the Second World War, the area became very run-down. The building was purchased, on the 27th of January 1966 by the local authority, under a compulsory purchase order for the redevelopment of the property. The whole area was later demolished, and the site was redeveloped to form the Central Trading Estate and St, Mary's Stadium, the home of Souuthampton Football Club.

Figure 43. Goad's Insurance Map of Southampton (1893) showing the mill as a Fodder Warehouse. (Southampton City Library)

So, here are some glimpses of its past, seen in reports published in the local newspapers:

This is the earliest entry found.

Published in the *HAMPSHIRE ADVERTISER* dated 19th December 1863

A MAN CHARGED WITH THROWING HOT ASHES AMONG CHILDREN

On Saturday, at the Southampton Guildhall, before Alderman Palk, Mr J. H. Cooksey, and Mr T. Hill, magistrates,

Thomas Humphrys, a middle-aged man, was summoned for assaulting a little boy, Edward Newman who was 5 years of age, the son of Emma Newman.

It appeared from a statement made by a little girl (Miss Andrews) that she went with the complainant and two other children to the tramway alongside the steam flour mills in Melbourne Street on Thursday to pick up some cinders thrown out there. They looked in the door and saw the defendant taking some fire out of the furnace with a shovel. He said to them, "go on, I want more air" and they walked on some distance. They returned to the door about quarter of an hour later, they looked in the door and the defendant took a shovel full of red-hot coals and threw it amongst the children. It set the little girls dress alight and burnt Edward's face very much.

In defence Humphrys said he was very sorry at what had happened, but he was firing at the time and found a clinker. He had to keep the road by the side of the mill in repair, and he turned the ashes out on it to use for the repair.

When he threw out the clinker, he didn't know the children were at the door, and soon as he found out that they had been burned he sent a man out to see if they had been much injured. The bench considered it a very injudicious act on the part of the defendant to throw those red hot cinders into the road and fined him 5 shillings and costs, which he paid.

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Falling into debt was as common then as now.
Published in the *HAMPSHIRE INDEPENDENT* dated 9th March 1867

MR THOMAS HALL 'MILLER' OWED MONEY

In the public notices published in the *HAMPSHIRE INDEPENDNT* dated 9th March 1867, William Simpson of Commercial Road, Bitterne, a Baker, came up before The County Court for his last examination, with debts of £102 3s 7p. He stated the cause of the failure being, "Me being unable to get debts owed to me, and pressure of my creditors" The furniture and effects were sold off by the official assignee, and after the payment of expenses there was a surplus of just £17 11s 3p. The *Bankruptcy Returns* records 68 persons as debtors to his estate and owing £110 10s 5p. But as they are all poor Persons, a long time will elapse before the debts can by collected.
Mr Thomas Hall of Melbourne Street Northam, Miller, a creditor owed £67 14s 7p has been chosen as assignee.
Mr Marshall, a London Solicitor, supported the Bankrupt who was opposed on behalf of the creditors assigned by Mr Mackey. Who, in reply, denied he had ever had the sum of £50 payable to him each year. His wife had £40 a year payable to her by a gentleman now dead and the payment stopped upon his death. On the 23rd July last, his wife had no money saved up. never represented that she had to his creditors Mr Hall or Mr Douglas. The £40 was a gift not made under Will, Deed or Settlement. Mrs Simpson said she had ordered goods from both Mr Hall and Mr Douglas, she told them at that time she believed, that she had an annuity. But since the death of the donor, has found it was a gift. But did not tell either of them that she had £300 put by.
The Registrar said he believed that the estate would pay a dividend of 10s or 12s in the pound. The Court granted the discharge forthwith.

Embezzlement of goods from one's employer was a major problem in poor areas.
Published in the *HAMPSHIRE ADVERTISER* in July 1867

CHARGED WITH ROBBING HIS EMPLOYER

It was reported in the *HAMPSHIRE ADVERTISER* that, at the Southampton Guildhall on Saturday, before Mr J. H. Cooksey and Mr J. Clark, magistrates, James Gamble and Thomas Humphries were charged with stealing 64 lb of flour, the property of Mr Thomas Hall, miller of the Melbourne Steam Flour Mill. The prisoners were in the employ of the prosecutor, Gamble as a carter and Humphries as Mill Engine Driver, the latter keeping the keys of the mill so that he might go of an evening and bank up the fires. The men left at 7 o'clock on Friday evening, and while standing at the door of his residence, 51 Melbourne Street, Mr. Hall, about 9 o'clock, saw Gamble walk past with a sack containing something on his back. He stopped him and asked him what he had there, to which he replied it was a little chaff, and was going on, but he went after him and insisted on seeing what he had. Prisoner then said, "I know I have done wrong; this is the first time I have done so, and I hope you'll forgive me." He told him he must bring it back and deposit it in his house, which he did. He continually asked him to forgive him, and ongoing into the house he saw it was flour. While he was gone to look at it the prisoner ran away; he was caught, brought back, and given into the charge of a policeman. who then said to him " How did you get the flour?" to which he replied " Jack (meaning Humphries) gave it to me, and I took it away." Upon this they went to the mill and to Humphries house but could not find him. That morning, he came to his work, and he told him he had caught Gamble taking away the flour, adding "You had the keys of the mill, and be could not have taken it away without your knowledge. What was the latest time you saw Gamble last night?" to which he replied "When he was taking the pony out of your cart at half past." He denied that he was drinking with Gamble at a later hour in the evening at a beer-shop. The flour, which was worth 12s, had apparently been taken from a heap. Humphries was also given into custody. Mr Monk, with whom Mr Hall lodges in Melbourne Street, deposed that when he went into the Mill Tavern for his supper beer, about half-past 8 o'clock on Friday evening, he saw Gamble and Humphries drinking together. When charged with the offence by the police constable (Gulliver) Gamble said he was not the only

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rogue about, and that Jack gave him the flour and he took it away. Mrs Evans, mother of Mr Monk, deposed that while Mr Hall and Mr Monk were running after Gamble she saw Humphries come out of the side door of the mill and go across to the beer-shop. Gamble pleaded guilty and Humphries not guilty, and the magistrates committed them for trial at the sessions.

It was further reported in the *HAMPSHIRE ADVERTISER* on the 27th July 1867 that James Gamble and Thomas Humphries, labourers, had appeared at the sessions and were both found guilty but recommended for mercy, both sentenced to 12 months' imprisonment.

Published in the *HAMPSHIRE INDEPENDENT* dated 11th January 1868

In an advertisement in the *HAMPSHIRE INDEPENDENT*, James Powell the miller at the time was advertising, wheat, barley, oats, beans, peas, and malt ground or crushed, at the lowest prices and delivered within 3 miles of his mill at Melbourne St. Southampton, which was late in the occupation of Thomas Hall.

Published in the *HAMPSHIRE INDEPENDENT* dated 5th September 1868

Melbourne Street Steam Flour Mill, Southampton

Barley ground, beans split, and oats crushed at the above Mill, usual charges. Large quantities contracted for.

Boiler explosions were common in the mid-nineteenth century. The Manchester Steam Users Association was set up in 1854 to advise owners of mills and engines, and to provide a system of inspection of boilers owned by members. In 1869, the year of the incident at the Melbourne Street Flour Mill, there were 60 reported boiler explosions, resulting in 86 deaths. Parliament's first Boiler Explosions Act did not come until 1882, long after this failure in Southampton. The article provides a good description of the legal procedure following a fatal accident, at that time.

Published in the *HAMPSHIRE ADVERTISER* dated (Wednesday) 8th December 1869

THE FATAL EXPLOSION AT SOUTHAMPTON STEAM FLOUR MILLS

It was reported in the HAMPSHIRE ADVERTISER that a miller was scolded to death when the boiler exploded.

An inquiry into the circumstances connected with the death of Horace Bishop Hammond, a miller aged 48 years, commenced at the Apollo Inn, Grove Street, on Saturday 11th December afternoon by Mr. Edward Coxwell, the borough coroner. The jury having been sworn in. The coroner said he did not propose to go fully into the inquiry that day, but only open it in order that the deceased might be buried, He would then adjourn until a future date when they could enquire at length as to the cause of this lamentable occurrence. It is probable that it would turn out that it was the result of deceased's own negligence, or of those with whom he had the same employer at the time. The coroner would accompany them to view the body, and he also suggested that they should inspect the place where the accident occurred, as probably they would then be better able to understand how it had happened.

The next day the Jury proceeded to view the body, which was lying at the deceased's residence in Melbourne Street, and afterwards inspected the engine house at the mill. On the return of the jury, the following evidence was given by Henry Small, who deposed that he was a miller and employed at Mr. Hague's Steam Flour Mills in Melbourne Street. The deceased was the foreman of the mill and was working there on Wednesday morning. At half-past 6 o'clock he saw him with the engine driver (John White), and just after Mr Small had left the engine house to go to the top of the mill he heard a loud noise. On going back down he found the engine house was full of steam and he could not get inside for half an hour, neither did he see the deceased until that time had elapsed, when he saw him

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get out through a window. Mr White got out about a quarter of an hour after he heard the report, through the door leading to the Gas house. Both men were badly scalded. Mr White went through a house at the rear of the mill and Mr Small saw him at the corner of the mill. Both men walked home, but neither gave any account of how the accident happened.

Mr. Hague, the proprietor of the mill said the deceased's general duties were not in the engine room, but as he had been some time in the mill, he had a knowledge of the working of the machinery. The engine driver was only taken on last Monday, and Mr Hague told the deceased to see that he did things properly until he was used to the place. About 11 o'clock on Wednesday morning he received a telegram from Dr Bencraft, and in consequence of that, he came to Southampton as soon as he could in the afternoon. On going into the engine house of the mill he found the door of the hot water boiler was blown off, and the stay that went through the door and the other side of the cistern had come away with it. Mr Hague attributed the accident to the boiler being too full of water, and the waste steam acting upon it caused too great a pressure, and the door, being the weakest part, consequently, gave way. If the stopcock had been kept open, which should have been done, the accident could not have occurred.

The engine had been thoroughly overhauled lately and put into good working order. He was not aware the boiler required any repairs. Mr Hague was an engineer, and when he engaged Mr White, he had good testimonials as to his capacity as an engine driver, as he had been engaged, he believed, in the Marquis of Conyngham's yacht during the past season. It would be the duty of the engine driver to see that the stop cock was kept open.

The deceased's brother was present, and said that he thought it was rather remarkable that his brother should have remained in the mill for half a hour without any assistance being rendered to him, while he himself knocked down a window partition and got out through a window.

The coroner said he thought it was rather remarkable that no assistance was rendered. Mr Small said he went for assistance, and two or three men came, one of whom drew out the fire. They could not get into the room because of the steam. In answer to a friend of the deceased, Mr. Hague said he considered the stopcock was a sufficient safety valve, but it would be better if it was larger. The same stopcock had been in use for several years. There was nothing to lead him to suppose there was the slightest probability of an accident. The deceased's friend said he did not think a stop cock was a sufficient safety valve, for any person in passing might shut it, and no one would know. At the same time, he must say, he believed Mr White was a competent man as he had known him for some time.

The coroner told this person, and also the deceased's brother, that he should be happy to hear any evidence they might wish to bring forward at the adjourned inquiry. Dr Bencraft said on Wednesday morning, about 7 o'clock, he was called to see the deceased, and found him at his own house, lying on the bed and partly undressed. He was suffering from extensive scalds, involving nearly the whole of both arms from the shoulders to the wrists, and also of the left leg, extending from the hip to the ankle. There were also some slight scalds on the chest, and on some portions of the face and forehead. He administered appropriate remedies, and was in constant attendance on him at intervals until he died at 5 o'clock on Friday morning.

Dr Wilburn also saw him on Thursday, and noted the case was almost hopeless. He concluded the cause of the accident was the boiler being too full of water and he had no doubt death was due to the shock to the system consequent on the extensive scalds. The deceased's brother said it was owing to the driver's neglect in allowing the tank to become too full of water that the accident happened. There was some evidence of an internal injury, as if caused by a blow, and there were also two cuts on both shins, probably caused by getting through the window. The inquiry was then adjourned until 4 o'clock the next day (Thursday) afternoon.

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The other unfortunate man, John White, aged 48, having died on Sunday, an inquest was held at the Royal South Hants Infirmary last evening, on his body, before the borough coroner, Mr. E. Coxwell. Dr Short gave evidence to the effect, that the deceased was brought to the Infirmary on Wednesday last. The poor fellow was suffering from scalds and had also inhaled a quantity of steam. He was properly attended to, and notwithstanding the efforts of Dr Short and his staff, he died on Sunday from the effects of the injury received. The same evidence was given as was given on Saturday at the inquest on the other man Mr Hammond, and a verdict was returned that deceased met his death accidentally, the opinion being also expressed that the accident was caused by the stop cock not being left open, and too much water being in the boiler.

A letter to the Editor of the *HAMPSHIRE INDPENDENT* dated 15th December 1869

A SAD CASE OF DISTRESS

Sir, you have been kind enough to introduce my name into a paragraph in your paper, as being ready to receive any contributions towards the relief of the widow and of the poor Mr White, who died in consequence of injuries he received by the explosion of a boiler at Mr Hague's Steam Flour Mill in Melbourne St. As a consequence, I have received from Mr Baker, Millbrook, £2/2s and from Mr R. H. Perkins £1 and a few smaller subscriptions, with which I have redeemed all the articles which had been pledged to procure bread for the family during the nine mouths the poor fellow was out of work, part of which time he was too ill to work, even if he could have found it. It will with difficulty be believed that for more than once the family got up in the morning and went to bed at night without one morsel of anything to eat. This was not known to us, or it would not have been allowed upon application to the Relieving Officer, He was engaged to work in the labour yard. and at that time was unequal to the task due to his illness.

So, the family had to suffer hunger in consequence as they had, before applying for relief, got rid of every available article to procure the necessaries of life, and were left with only a sufficiency of wearing apparel to enable them to go about decently. This will readily be accounted for when, for nine months, the bread earner was out of work, and although they were assisted in a slight degree by their two sons, one on board the *Monarch* and the other on the *Dane*, as well as by their daughter in service, still 14 mouths to feed daily soon swallowed up all his savings and they were thus left perfectly destitute There relates to this sad tale, evidence that all true nobility has not died out in this world. The daughter is engaged to a young man, and was to have been married at Christmas, for which purpose he had saved a few pounds, but being present when coffin was sent for from the Infirmary, the widow who was in a state of great distress, addressing her by the affectionate appellation of mother, she said "It's all right; I have taken some of the money I put by, and settled all with Mr Beeston, who will undertake the funeral." There is a most painful and heart-rending circumstance yet to be mentioned. White had only been at work two days, and, consequently, had not received any money, and on the evening before the accident she said to him, "My dear, I do not know what to do about our breakfast to-morrow." as she had nothing left to eat in the house and he gave her his boots from his feet, which she says, with tears in her eyes, to pawn, to get a breakfast, of which he never partook. I need add nothing to this pitiable tale, except that I shall be most happy to assist in alleviating, in however slight a degree, the sorrow of this poor afflicted family, and any amount of money or articles of cloth entrusted to me will be wisely and judiciously, administered and as there are now twelve children, and the poor widow expects to be confined in about three weeks, it will be apparent that, for some little time at least, they will require the kind sympathy of those who take interest in such cases. She resides at No. 2 Cumberland Street, just out of St. Mary Street, on the right hand, so that any lady desirous of visiting her will have no difficulty in finding her house.
I am yours, Edward Paul,
Southampton, December 15th December 1869.

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Published in the *HAMPSHIRE ADVERTISER* dated 12th November1870

Steam Flour Mill **to let** in Melbourne Street, Southampton
[Late in the occupation of Mr Hague]
Apply to Mr Henry Clarkson (Engineer), Back of the Walls, Southampton.

Published in the *HAMPSHIRE ADVERTISER* dated 8th January 1872

Oats and beans crushed and split, without the slightest dust at 8 pence per sack.
Good, Crushed Oats, 12 shillings per sack.
Barley meal 15 shillings a sack,
At this time a 'sack' of grain, meal, flour, etc contained 2 hundredweight (~100Kg)
Best flour 9 shillings per bushel, and all kinds of Blues, Beans, Pollard etc. at equally low prices.
Melbourne St. Steam Flour Mills
Adjoining The Gasworks
Melbourne St.
Southampton

Published in the *HAMPSHIRE ADVERTISER* dated 13th November 1872

Re John Hague, of Melbourne Street in St Mary's, and Ivy Mount, Blechynden, both in Southampton. Miller and corn merchant. Is in liquidation, his creditors will shortly hold their first meeting for the above purpose at the offices of Mr W. A. Lomer, solicitor at
No. 18 Portland Street,
Southampton.

Preliminary advertisement of sale. *After the bankruptcy of John Hague, it seems likely that the mill was disused, the machinery was probably removed and, for the rest of its long life, it served as a warehouse. There were several changes of ownership.*

Published in the *HAMPSHIRE ADVERTISER* dated September 1884

Sale of a variable freehold warehouse and corner shop. Messrs Francis and Company have been instructed to sell by auction at the property market Southampton on the Friday, October the 3rd at 2:00 for 3 o'clock. The lofty warehouse of four floors situated in Melbourne St. Chapel and having a frontage there of 25 feet and the frontage to the railway siding from the main line of 83 feet or there abouts, and now let to Messrs Taunton and Blake on a repairing lease of £75 per annum. The railway siding from the main line to the quays at Chapel runs by the side of the property and wagons can be loaded and unloaded on the premises. Also, the shop and premises adjoining, now let at the low rental of £30 per annum.
Full particulars next week, or in the meantime, from the auctioneers at
The Property Market,
Sussex Place,
Southampton.

Published in the *HAMPSHIRE ADVERTISER* dated 26th August 1899

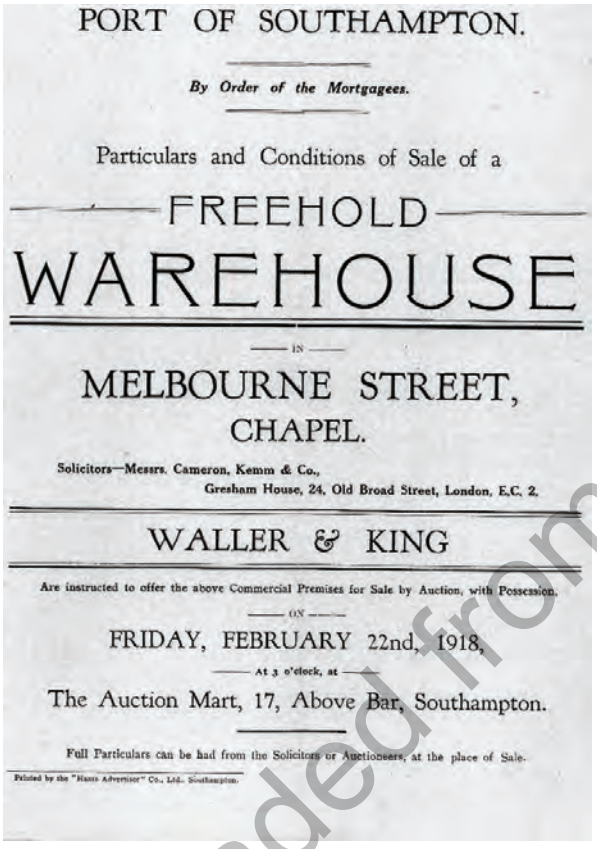
IMPORTANT SALE OF VERY VALUABLE BUSINESS PREMISES
In Southampton, the most rapidly developing Borough in the United Kingdom.

MESSRS COOKSEY and M[C]DONNELL have been favoured with instructions to sell by auction at the County Borough Auction Mart, 159, Above Bar Street, Southampton, on Tuesday the 12th day of

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September, at 3 o'clock in the afternoon punctually, all that commanding and Valuable Business Premises, having a frontage of 25 ft. to Melbourne Street, and a depth of 85 ft., consisting of a substantially built Warehouse of three floors, having an area of 7410 superficial Sq. feet, as well as the facility of a siding from the L & S W Railway, with a special cheap rate.
Solicitors: Messrs Pearce and Keele,
St. Michael's Street,
Southampton.

The next occasion on which the warehouse was offered for sale by auction occurred in 1918, a few months before the end of the First World War. Some of the paperwork for this sale has survived in the Southampton Archives:



PORT OF SOUTHAMPTON.

By Order of the Mortgagees.

Particulars and Conditions of Sale of a

FREEHOLD

WAREHOUSE

IN

MELBOURNE STREET,
CHAPEL.

Solicitors—Messrs. Cameron, Kemm & Co.,
Gresham House, 24, Old Broad Street, London, E.C. 2.

WALLER & KING

Are instructed to offer the above Commercial Premises for Sale by Auction, with Possession.

ON

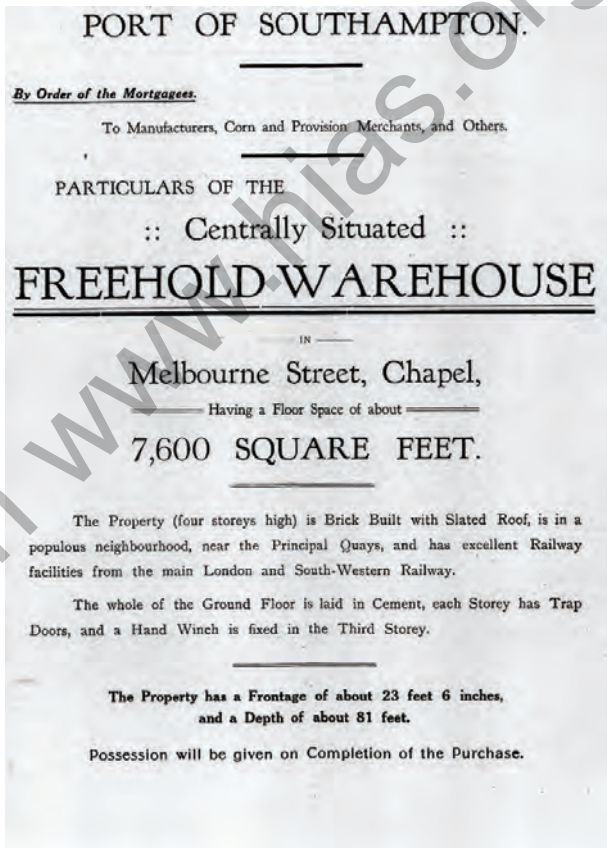
FRIDAY, FEBRUARY 22nd, 1918,

At 3 o'clock, at

The Auction Mart, 17, Above Bar, Southampton.

Full Particulars can be had from the Solicitors or Auctioneers, at the place of Sale.

Printed by the "Hants Advertiser" Co., Ltd., Southampton.



PORT OF SOUTHAMPTON.

By Order of the Mortgagees.

To Manufacturers, Corn and Provision Merchants, and Others.

PARTICULARS OF THE

:: Centrally Situated ::

FREEHOLD WAREHOUSE

IN

Melbourne Street, Chapel,

Having a Floor Space of about

7,600 SQUARE FEET.

The Property (four storeys high) is Brick Built with Slated Roof, is in a populous neighbourhood, near the Principal Quays, and has excellent Railway facilities from the main London and South-Western Railway.

The whole of the Ground Floor is laid in Cement, each Storey has Trap Doors, and a Hand Winch is fixed in the Third Storey.

The Property has a Frontage of about 23 feet 6 inches, and a Depth of about 81 feet.

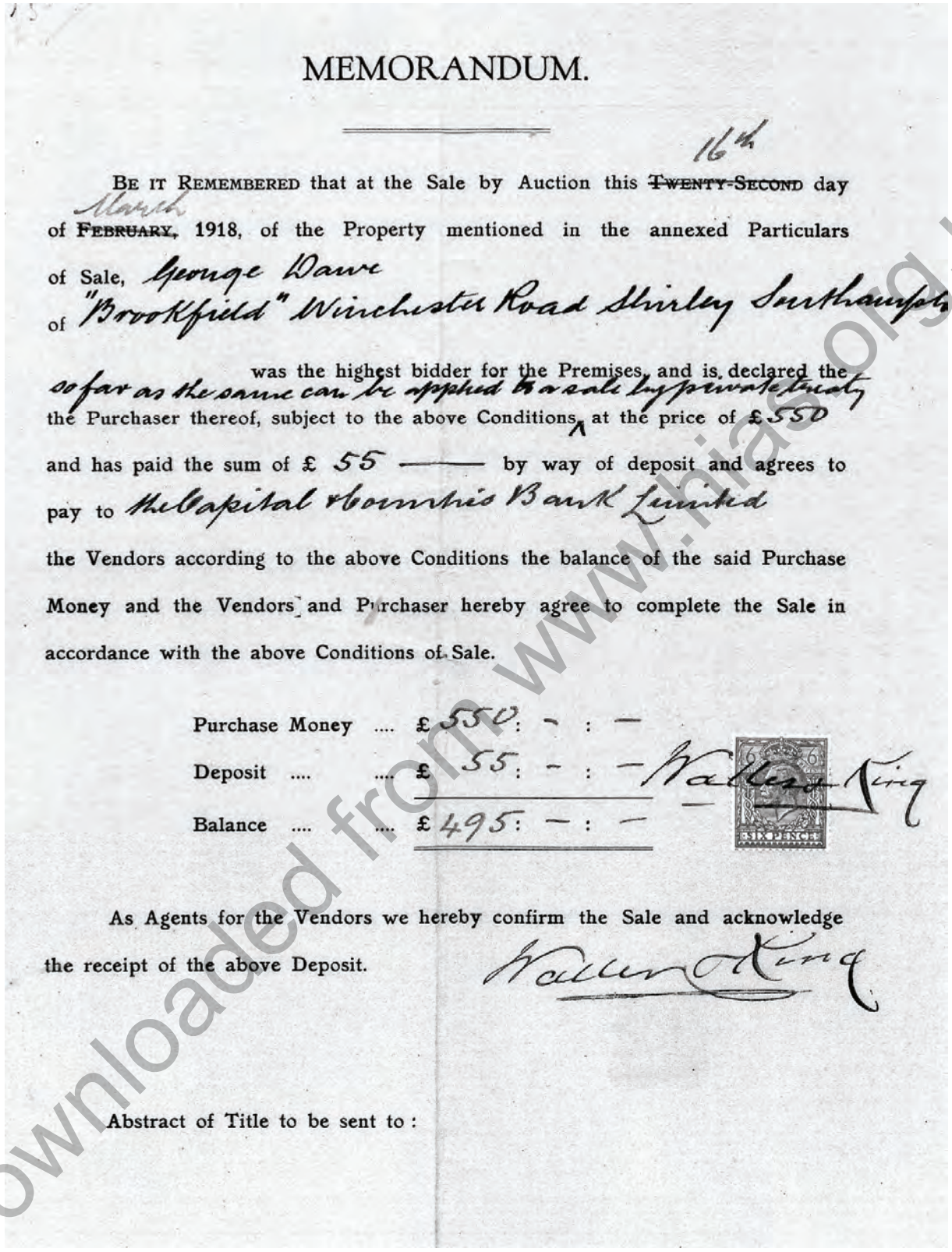
Possession will be given on Completion of the Purchase.

Figures 44 (Left) and 45 (Right). *A flyer (Left) advertising the auction, giving its time and place, and (Right) a sheet of particulars and dimensions of the warehouse.*
(Southampton Archives)

Comparing the various sales notices, and noting that accurate surveying tapes and chains were available by the start of the twentieth century, the information provided by the various auctioneers is not very precise.

For reasons now unknown, the auction was delayed for nearly a month, before being sold to a local buyer, George Dawe, of "Brookfield", Winchester Road, Shirley, Southampton, for £550.

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MEMORANDUM.

BE IT REMEMBERED that at the Sale by Auction this ~~TWENTY-SECOND~~ 16th day of ~~FEBRUARY~~, March 1918, of the Property mentioned in the annexed Particulars of Sale, George Dawe of "Brookfield" Winchester Road Shirley Southampton was the highest bidder for the Premises, and is declared the so far as the same can be applied to a sale by private treaty the Purchaser thereof, subject to the above Conditions, at the price of £550 and has paid the sum of £ 55 —— by way of deposit and agrees to pay to the Capital & Counties Bank Limited the Vendors according to the above Conditions the balance of the said Purchase Money and the Vendors and Purchaser hereby agree to complete the Sale in accordance with the above Conditions of Sale.

Purchase Money .... £550 : - : —
Deposit .... £ 55 : - : — Walter King
Balance .... £495 : — : —

As Agents for the Vendors we hereby confirm the Sale and acknowledge the receipt of the above Deposit. Walter King

Abstract of Title to be sent to :

Figure 46. Receipt and confirmation of the sale of the Melbourne Street warehouse in 1918.
(Southampton Archives)

Acknowledgements:
The British Newspaper Archive for material transcribed by the author
Cultural Services, Southampton Archives, for the 1918 Auction material

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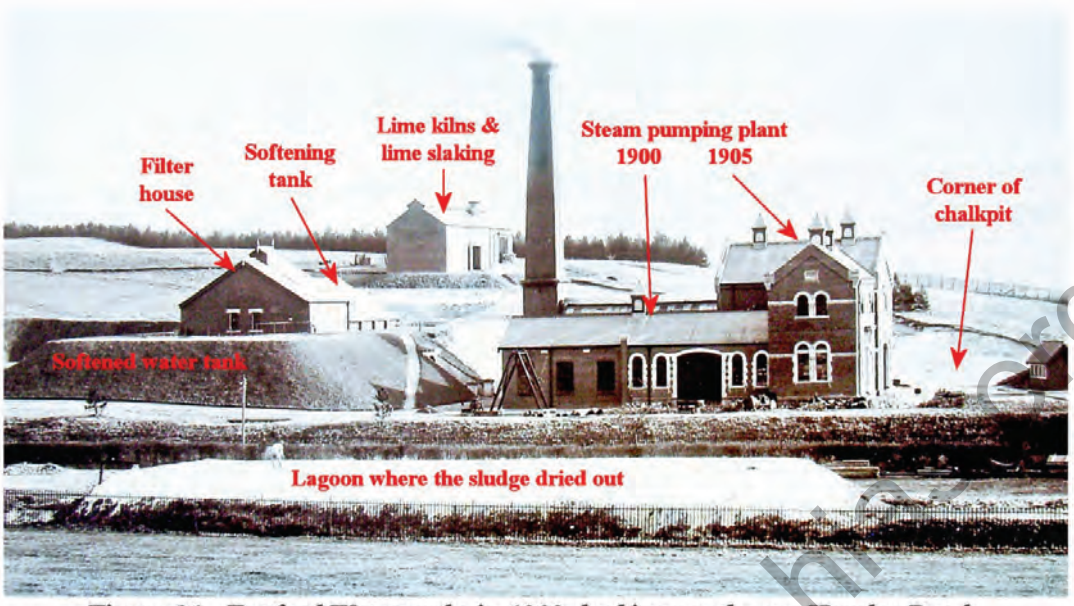


Figure 21. Twyford Waterworks in 1909, looking south over Hazeley Road. Note the skip by the lime kilns at the top of the railway incline.

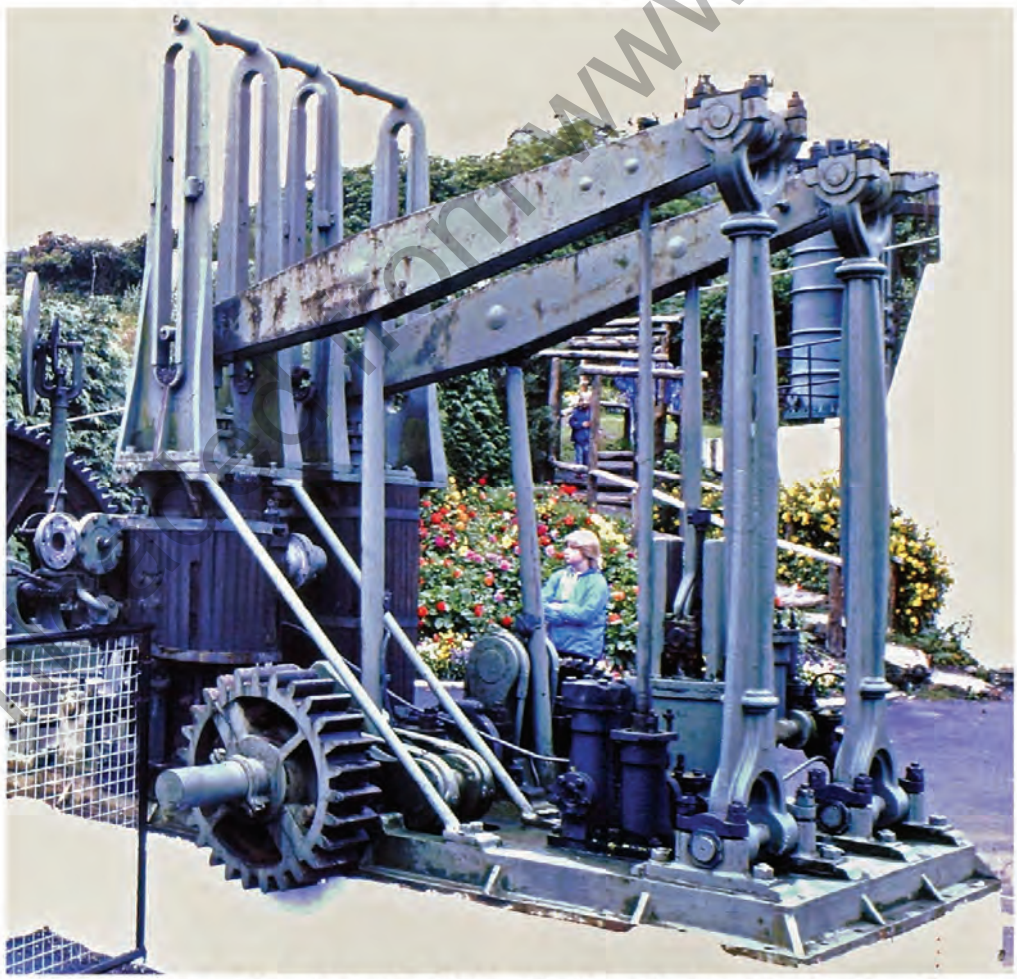


Figure 32. The engine of Floating Bridge No. 8, on display at the Wendron Forge Museum in Cornwall, in 1979. (Martin Gregory)

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