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The availability of sufficient fresh water to support human habitation is fundamental to our existence; it was commonly sourced from rivers, springs, wells, rainwater cisterns, ponds and lakes. However, with increasing populations in towns and cities, the demand often outstripped supply, and water storage ponds fed from distant sources by man made water courses were constructed. By the late 18th C. the industrial development of many manufacturing towns drew in an increasing population from the country and water provision by conduits and wooden pipes to fountain heads was found inadequate. Distribution systems were built from new reservoirs and distributed to houses and stand pipes by underground elm and cast iron pipes. These often rotted and rusted respectively, producing brown, contaminated water unfit for consumption. An alternative system using stone pipes was developed to provide 'a source of pure, soft, spring water'.(a)

#### THE STONE PIPE COMPANY:

In 1805, Mr. George Ernest Wright patented a machine for sawing long pipes out of single blocks of stone(1). A notice was placed in the Morning Chronicle (1806) reporting pressure tests on the '**new stone pipes**'..... '*Eminent Engineer, Mr Mylne, of the New River and London Bridge Water Works Companies, stated that they are the best contrivances for water, stone being the purest, cheapest and most durable of all materials*'.(2) **The Stone Pipe Company (SPC)**, established 1806, employed this technique at their 'stone pipe manufactory' in Charles Street, Hampstead Road, London.

The quality of the pipes produced were inconsistent, many with irregular bores and varying wall thickness. They originally used Portland stone from The Crown Estates but George III objected to the use of valuable, architectural stone for water pipes.(b) In a quest for an alternative stone source, the **SPC** established a **Stone Pipe Works** on Fox Hill in the Parish of Guiting Power in Gloucestershire in about 1809. Here, they quarried the soft, yellow, oolitic limestone known as *Guiting Stone*, using Wright's Patented stone saws. Similar in density to Portland Stone at 16 cu ft per ton, Guiting Stone weighed 17 cu ft per ton and was readily quarried in 8 foot blocks and was easy to work when freshly quarried. (3)

In the Morning Post of 8th July 1809, the **SPC** advertised that they '*had ready for delivery at their Manufactory in Charles St., Hampstead Road, London, **STONE PIPES** for the use of **WATER WORKS**.....*' (4)

The manufacturing process was modified in 1810 when **William Murdock**, chief engineer at the **Boulton & Watt (B&W) Soho Foundry** in Staffordshire, was granted **Patent 3292** ..... '*An Improved Method or Process for Boring and Forming Pipes.....out of Solid Blocks of Stone of Any Description*' using long, vertical, cylinder saws. It was immediately sold to The Stone Pipe Company (5). Employing this method, several pipes of diminishing, concentric diameters could be cut from one block of stone. Using flowing water to facilitate the passage of the cylindrical saws through the stone blocks, their production of pipes increased with reduced waste.

Samuel Hill, a proprietor of the SPC, subsequently patented a technique for joining the stone pipes with cemented stone collars; Patent 3355 1810 (6).

Mr. John Rennie, FRS, eminent mechanical engineer (Kennet & Avon Canal (1809-1813) London Docks, Hull Docks, Albion Corn Mills, Bell Rock Lighthouse ), was appointed as Chief Engineer to oversee the construction of the new works (d). A large engine shed was built at the bottom of Fox Hill above the Hawling Brook to house two, 15 horse power, B&W rotary, steam engines and two vertical sawing machines. A conduit to carry water from springs on Cloud Hill was ordered to be constructed to supplement the meagre supply.....

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from a spring for use in the sawing process. On a later visit, he instructed Mr. Jones, clerk of works, to construct a reservoir to augment the flow. He noted that the quarry had an abundance of available stone and admonished the quarrymen for extracting the stone blocks in a brutal manner thereby damaging their inherent strength (7). A substantial terrace block of eight, stone, **back to back houses** for skilled workers and an engineer's cottage were constructed adjacent to the works. A manager's villa was built in the Gothic Revival Style in a nearby meadow. Mr. Fox, a wood merchant from Bourton on the Water, was engaged to construct the engine shed roof and to build wooden huts to house manual workers. (8)

In a letter (April 9th 1810) to Mr. Murdock, Chief Engineer, at the Boulton & Watt (B&W) Engineering Works, Soho, a Mr. J T Walker, on behalf of Rennie, ordered a pump to *'through up water sufficient for 28 boring tubes for the Stone pipe Co'y at Guiting...'* The stroke was to be alterable to 4 differing lengths(9). Mr Thomas Pearson, millwright of Lower Guiting, the resident engineer, was instructed to advise Murdock of the required dimensions... *'A pump was required for each engine and one as soon as was possible'*. Walker, in a further B&W letter (April 23rd 1810), understood that the first engine was ready for use (10). In early September 1810, both Rennie and Murdock visited the Fox Hill Stone Pipe works to monitor its production.(11)

Advertisements were placed in the Cheltenham Chronicle of June 7th.1810, for Stone Masons, Labourers and *'scablers'* (dressers) promising *'liberal wages and constant employ at the Stone Pipe Quarries in Lower Guiting'*. They were to apply to Mr. Jones (12). From the above, we can deduce that stone pipe production began at this time.

This new industrialisation had an impact on the parish. The 1801 Parish Census Return recorded 430 residents. In 1811, this rose by 183 to 613, including 42 males employed in the Manufacturing Trades.(13) There were also fatalities and evidence of child labour. The Cheltenham Chronicle (May 3rd.1811) recorded the death of a 9 year old boy, Mark Walker from Bisley, Glos. He *'fell into the works, got entangled in the machinery and was crushed'*. Mr. William Cooke of Lower Guiting was killed on February 12th 1812 at the Hill & Co Works. (14)

The works were situated at the foot of a steep hill with no easy access for coal and building materials or the passage out of heavy loads of finished pipes other than through the steep, narrow lanes. There remains physical evidence of embankments and cuttings around the site which took horse drawn quarry wagons on iron rails. Rennie mentions a *'formation line of railway extending nearly to the quarry..'*(15) The ledgers of the Butterley Furnace Company indicate that 15 stone carrying tramway wagons were ordered by Mr Rennie of the *'Patent Stone Pipe Co.'* in 1810 (16) Rennie also advised the management to buy used iron rails from Welsh slate mines as they would be cheaper(17). Small embankments cross the valley bottom from the Gazeley Wood Quarry towards the works area. Two straight, gradual inclines go from the valley bottom: one East and upwards to Tally Ho (The Tally House) Gate and the other, south westward through metaled embankments and cuttings, to the Cheltenham Turnpike Road, a rise of some 275 feet. With increasing demand, carts of heavy stone pipes were sent via the Dowdeswell Turnpike, through Cheltenham Town and onto the Gloucester Docks. This caused much *'injury to the roads'* and many complaints in the local press(18).

To facilitate stone pipe transport out to London and the provinces, Rennie proposed that a 60 mile **Central Junction Canal** be constructed to link the Berks & Wilts with The

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Stratford canals costing £470,000 with a £30,000 *'Collateral Branch to the Quarries of Lower Guiting of the Greatest Magnitude'*.(20) A Mr. Bartley completed the Survey Map in 1810.(map A).The Central Junction Canal Bill failed to receive backing in Parliament with fervent opposition from the Oxford Canal and the Thames Navigation Companies (& their shareholding MPs) fearing crippling coal carrying competition from The Midlands to London (d).

As a result of the failure of the canal, Rennie employed Mr.Trinder, a surveyor, to plot a 12 mile horse tram road to connect with the existing Leckhampton Quarry Tram Road. It included a half mile of tunnel under Hawling village joining the Coln and Windrush valleys (Maps B & C). The SPC, with the support of major and influential land owner, Lord Sherborne, brought a Railway Bill to Parliament. It failed at the third reading in 1811 with strong opposition from the Charlton Kings land owners over who's land it was to travel (c).

The Sharp practices of Mr. Samuel Hill and the SPC were emerging. In April 1811 John Rennie wrote to James Watt junior at the Soho Works expressing his frustration with the **SPC's** poor record of paying bills. He related that he had little doubt that the management of the **SPC**, the **Manchester and Salford Water works Company (M&SWWC)** and the **Grand Junction Water Works Company (GJWWC)** were, *'so far as the principal people are concerned, one and the same company....and amongst these, there are many men of undoubted propriety...and that amidst this irregularity, the money will ultimately be got..... however it is certainly a very unpleasant mode of getting it....my having recourse to law'*; they owed him £2,300 (19). The Butterley Furnace Company's account of £469-8s-2d. for the wagons was still unpaid in 1811 and later written off as a bad debt (16); Fox, the local wood merchant and builder, largely went unpaid (8).

LONDON:

A Bill was brought before Parliament in 1810 for sanction to supply water to Paddington and parishes up to St Mary le Bone with 'good and wholesome' water sourced from the 'Grand Junction Canal, Cuts & Reservoirs' using stone pipes. In a Parliamentary cross examination of the **GJWW Bill (1810)**, Mr. Walker, consultant engineer for the rival **West Middlesex Water Works Company (WMWWC)**, stated, that the cost to lay a water main of two and a half miles from Paddington to St Mary le Bone using **iron pipes** of 18" diameter would be about £2,500 per mile. When asked the cost of laying **stone pipes**, he said he would **never use them** in any engineering project of his. The WMWWC had tried them before his appointment but they had not "answer there"(20). Thomas Telford, engineer, had also tried stone pipes from the Rotherglen Quarry in The Glasgow Water Works in 1806. He found their performance to be 'variable' and advised the use of iron pipes.(e)

Despite the findings of other eminent engineers,The Grand Junction Water Works Company Act (June 1811) gave Samuel Hill and other proprietors (18 of whom were also proprietors of the **M&SWWC** and 7 of whom were named **Hill** and 4 were the directors of **the SPC**) the powers under the Act to supply water to Paddington and parishes up to St Mary le Bone with 'good and wholesome' water sourced from the 'Grand Junction Canal, Cuts & Reservoirs'. They had the powers to lay pipes in any streets and to 'break up pavements and grounds as they think fit'.They were given authority to raise up to £150,000, issuing 3,000, £50 shares.(21) Mr. Samuel Hill took the Chair, Richard Hill, his brother, elected as Superintendent & Clerk of Works and John Rennie was appointed their chief engineer. A system of water distribution through stone pipes was recommended and The Stone Pipe Wharf was built at Paddington on the Grand Junction Canal to receive the pipes.

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In Rennie's report to the General Assembly the **GJWWC**, Dec 11th 1811, he outlined the state of the project and 'flattered' himself on the 'gratifying progress'. The large reservoirs at Ruislip and Paddington had been finished and filled without leakage; the steam pump installed and ready for use by March 1812; one and a half miles of the large iron main had been laid from Paddington down Oxford Street and four and a quarter miles of the subsidiary stone pipe mains and service pipes were in the process of installation and a further mile of stone pipe were also on site (22).

On 3rd June 1812, Rennie wrote again reporting a further 6409 yards of stone pipes had been laid in the streets including Baker, Orchard, Wimpole and St Mary Le Bone streets. However the progress had been slow due to delays of land purchases between the reservoirs and failures of both large iron main and stone distribution pipes. (23)

Investors were impatient and wanted what the promotional newspaper notices promised: '*an abundance of pure and excellent soft water, even in the upper stories of the houses...*' (13) which demanded a Boulton & Watt, steam-pumped supply.

The newly installed pumping engine in Paddington was fired and passed pressurised water into the system. Many hundreds of the stone pipes burst. Further tests carried out at the SPC yard found that the stone pipes weakened with increasing use and burst at ever decreasing pressures.

On July 2nd 1812, Rennie reported the catastrophic failure of the stone pipes, the severe damage to the streets and flooding of numerous subscribers' properties. He advised the company to replace them with the well tried and tested cast iron..... '*upon which the salvation of the company depends....otherwise the proprietors' money invested in the engines and reservoirs will be lost.....*'. (24) Despite protestations by four prominent board members (the SPC directors) that the pipes were damaged at installation and offering free replacements, a vote was cast in favour of replacing the whole of the system using iron pipes. This replacement cost was £11,000 to be at the expense the Stone Pipe Company. After a report by Anderson, Rennie's site engineer, that the SPC supplied pipes that were unfit for use, Samuel Hill and G Mainwaring (the SPC director & Merchant banker) resigned as directors of the GJWWC on Dec 3rd 1812.

### MANCHESTER:

In the latter part of 18th century, the wells, springs and a medieval conduit terminating in the Market Place could not keep pace with the demand for fresh water from this expanding, industrial town. The Lord of the Manor of Manchester, Sir Oswald Moseley, who had the manorial rights to supply the town with water, built a system whereby water was pumped from the River Medlock, stored in ponds and distributed in wooden pipes. This proved inadequate and in 1808 a communal consortium led by Robert Peel Jnr. and business associates, vied for Parliamentary approval to build a new water works with the rival scheme of Samuel Hill & the Stone Pipe Company. Moseley sold his rights to the SPC for an annual rent of £640-10s-0d and backed the Stone Pipe Company against the wishes of the townspeople. Despite resolutions at public meetings of the Borough Reeves and Police Commissioners of Manchester and Salford against this massive undertaking, an Act of Parliament to supply fresh water to the growing towns of Manchester and Salford was awarded to the **Manchester and Salford Water Works Company (M&SWWC)** in 1809 (25 & D). Hill and his Stone Pipe Company partners, became the principal directors of this new company. John Rennie was appointed as consultant engineer. Money was raised by public subscription and the original (SPC) proprietors sold their shares to Manchester people at a great profit.(f). Construction began by enlarging Moseley's works, laying stone pipes and building feeder tunnels from the River Medlock.

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Rennie wrote to the M&SWWC in May 1810 outlining their need to raise a further £50,000 as authorised by the Act of Parliament for establishing the water works over and above £60,000 already subscribed. He indicated that the abstraction from the River Medlock had been restricted by the local parish authorities which necessitated further reservoir construction in the adjacent parish with a lower poor rate and the installation of massive B&W steam pumps to satisfy water demand. They also contracted with the SPC to deliver a further 60 miles of stone pipes of varying sizes costing £95,000 over the next few years (26).

In June 1810, a wharf and crane on the Ashton Canal were completed to receive the stone pipes (27). Rennie reported on July 2nd 1811, that about 1000 yards of 18" stone pipe main had been laid with many hundreds of pipes on the wharf ready for use. (28)

On Sept 11th 1812, Rennie responded to the M&SWWC's misgivings over the suitability of their choice of stone pipes for their project. His observations from the recent GJWWC stone pipe failures were that the mains fractured under sustained high pressure. He related that the M&SWWC system was a low pressure one and ... *'where the pressure does not exceed 30-40 feet...pipes should be of stone ..... and where the pressure is greater should be laid in cast Iron...'* He would *'....not advise any trials to be made with the present kind of stone where the pressure exceeds that height...'* recommending cast iron for the lower part of Manchester....and *' unless a stone of very superior strength and quality to any that has been sent to the GJWWC is not found it will not answer for these purposes...'* He also advised that *'....those pipes which are now laid down should be joined to the main and the whole be thoroughly tried before any streets are proceeded upon and more stone pipes sent to Manchester'*.

This appears to be the irresponsible response of a man with two masters and his attempt at a 'get out clause'.(29)

An account in the Manchester Times of 1891 records that despite their failure to hold water, the company continued to pay for and take delivery of large quantities of stone pipes which were laid in the streets without joints and many buried in large pits. The stone pipes were superseded by 1818 with cast iron. (30)

An Act of Parliament for the 'Better Paving, Improving and Regulating the Streets of the Metropolis .....' was passed in 1817. It included Clause XII, outlawing the *'laying down of New Mains or Pipes for conveying water or gas made of material other than of Iron'* (31). This was a response to the public's disquiet over rival water and gas companies having the lawful right to dig and destroy the paved streets at will.

### THE DEMISE of the Stone Pipe Company.

The SPC enterprise failed leaving many investors with large financial losses. In 1814, the **Mainwaring and Company Merchant Bank**, run by two partners of the SPC, had a **commission of bankruptcy** issued against them with outstanding liabilities of £81,500.... (about £4.5 million today)...(g).

Continuing reports and repercussions of the insolvency were addressed in Parliament. In a court report in the Morning Chronicle of July 9th 1822, Samuel Hill stated that ... *' he was not in partnership with his 2 brothers in the SPC ...'* distancing himself from the SPC and from the ensuing suits from disenchanted investors '. In the Court of Common Pleas, Trinity, June 19th 1824, and action against Hill by the Everett Bank, found *'no fraud'*.

A notice appeared in The Cheltenham Chronicle on Dec 21st 1815 advertising the 'sale by auction at Hawling Lodge of *'nine stone cottages, a Gentleman's Cottage and lawns in the*

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*Gothic Revival Style, cranes, stone saws, machinery and quarrying equipment etc'* formally employed by the 'Stone Pipe Company'. The two Boulton and Watt steam engines were for sale by private treaty.

The local legacy of the Stone Pipe Company includes the many waste pipe cores found in the field walls, dug up in gardens and in house foundations; the area's assumed names, *Tally Ho!*, Pipe Wood and Engine Cottage derived from the SPC's activities; some uncharacteristically wide terrace of cottages (the back to backs), stone debris at Fox Hill and Gazeley Wood Quarries and the remnants of the inclines that are the result of the industrial quarrying.

There was a temporary boost to the local population, gene pool and the economy.

The South Transept of St. Michael's church was added in 1822 with the provision of 64 seats to accommodate the burgeoning faithful. Little else survives to alert the passing visitor to Guiting Power's entry into the British Industrial Revolution.

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