George Sorocold, of Derby.

A PIONEER OF WATER SUPPLY.

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IT is remarkable that a man of such high ability as George Sorocold is not mentioned in the *Dictionary of National Biography*, or, indeed in any other biographical dictionary, yet he was the first man outside of London to install ' house to house ' water supply, and in his time had a great reputation as an engineer.

The family of Sorocold was widely spread in Lancashire at an early date, but information is not available as to where precisely the family originated, or as to the derivation of the name. The latter appears in various forms which need not be enumerated here. If the name is divided into two syllables, the first may appear as Sar, Ser, Sor or Sur, and the ' r ' may be doubled, the second is -cole, -coale, -call, -cale, -cold, etc., with a connective, o, a, e or i. Experts on surnames and place-names whom I have consulted can throw no light on the etymology of the name. It may possibly be connected with some such place-name as *Saurescales*, mentioned by Ekwall in his *Place-names of Lancashire*, but the middle ' s ' does not occur in any form of the surname so far discovered.

The family was evidently fairly well-to-do, possibly of yeoman stock, some of them being landowners and armigerous. In 1633 Thomas Sorocole contributed his pedigree at the Herald's Visitation of London 1633-4,[1] he was a son of Ralph Sorocole, of Manchester; and Thomas Sorocold, of Barton, near Manchester, registered his pedigree at the Herald's Visitation of Lancashire in 1664.[2]

[1] *Harleian Soc.*, vol. 17, 1883. [2] *Chetham Soc.*, vol. 88, p. 176.

From Thomas Sorocole, of London, mercer, two lines descended whose pedigrees are given in Burke's *Landed Gentry*, 1937, under Serocold and Skeels. Unfortunately with regard to George Sorocold we have no information whatever as to his parentage, or the date and place of his birth, and we can only surmise that he may have been born in 1668, the son of James Sorocold, of Ashton, Lancs, who died in 1675. This James, at the same time as his brother George, was admitted scholar at Gonville and Caius, Cambridge, 9 May, 1645, when they were aged respectively 18 and 17. Their father was George Sorocold, gent, of Ashton in Makerfield, Lancs. 1668 was not too late a date for the birth of our subject as we shall see later.

George Sorocold is first encountered on his marriage with Mary Francis at All Saints', Derby on 7 Dec., 1684, and I think he must have been a stranger to Derby at the time of his marriage as the parish clerk made a hopeless mess of his name, entering it in the register as "Souerould," whereas in later entries we find normal spellings. Whatever credence we attach to the statement of Ralph Thoresby, the Yorkshire historian, who was personally acquainted with Sorocold, it is safe to say that George was very young at the time of his marriage, and if Thoresby is correct he cannot have been more than sixteen. This is the extraordinary statement he makes: "our ingenious hydrographer, Mr. George Sorocold has already had thirteen children (of whom eight were living at the same time) all single births, and all nursed by his wife, before he was twenty-eight years of age."[1] I leave my medical readers to discuss the probabilities of this, which I have not been able to verify by the corroboration of parish registers.

It seems obvious that at the time of his marriage he was not living in All Saint's parish, although he may have been in one of the other four Derby parishes, because the

[1] Thoresby, *Ducatus Leodiensis*, 1715.

first baptism of one of his children at All Saint's was on 20 April, 1691 whereas if there were any semblance of truth in Thoresby's statement, this should be Sorocold's sixth child at least. There were other children of his baptized and buried at All Saint's, and his wife was buried at the same church, on 13th April, 1728. The date of Sorocold's death is a complete blank, and we cannot be sure whether he survived his wife or not. In the registers she is simply described as Mrs. Mary Sorocold, neither wife or widow. Sorocold's wife was the daughter of Henry Francis, apothecary, one of the most respected men in Derby. His house has just been pulled down, 1936. That something untoward happened to Sorocold is clear from the letter dated 2 March, 1717[1] written by the Mayor of Derby to Baron Parker, with reference to the navigation of the Derwent, where he refers to Sorocold as "the ingenious, unfortunate, mathematician." Defoe[2] tells a story of Sorocold falling under the big waterwheel at the Silk Mill but concludes by saying he suffered no hurt at all. Perhaps at the time Defoe wrote this may have been the case, yet there may have been unfortunate after effects of which Defoe was ignorant. He gives no dates to assist in arriving at an opinion.

By the testimony of his contemporaries best able to judge Sorocold was looked upon as an extraordinarily good engineer. His competitor, Thomas Savory, engineer and inventor said that "in composing such sort of engines [for supplying towns with water] I think no person has excelled the ingenious Mr. George Sorocold."[3] Beighton said that the London Bridge works were better than the famous installation at Marly, France. Sir Thomas Johnson, of Liverpool, introduced him to the Corporation of Liverpool, as a very ingenious man, to advise them on the construction of their first dock. Sir Godfrey Copley,

[1] See below the account of the Derwent Navigation.
[2] See below the account of the Silk Mills, and of the Sheffield Water supply.
[3] Savory, *Miner's Friend*, 1702.

founder of the Copley Medal, said that Sorocold's engine at Marchant's London Waterworks was the best piece of work he had seen. We are told that Sorocold was one of the two millwrights of his time who never failed in what they undertook, because they considered the perfection and success of their work first and then profit afterwards. This is easy to believe as several of Sorocold's machines continued to work continuously for very long periods, in some cases for 150 years, until at last steam-engines ousted waterwheels.

Sorocold devoted most of his time to public water supplies, but this was by no means his only line. His first recorded job was the hanging of the bells of All Saint's, Derby (now the Cathedral) in 1687. He was consulting engineer for the first Liverpool Dock in 1708, and probably for the first great wet dock at Rotherhithe. His millwork at the Derby Silk Mills was one of the wonders of the century. It was more than fifty years before any other factory was built equal to the latter either in England or abroad. He was also engineer for making the Derwent navigable.

It will be seen that Sorocold has a just right to more consideration than has hitherto been accorded him and as he was generally known as George Sorocold, of Derby, during his working life-time, this seems to be an appropriate place to record, what is known of his work.

The only previous attempts at anything like an account of Sorocold are by Mr. Henry Peet,[1] and Mr. Rhys Jenkins,[2] to both of whom I am indebted.

Seeing how closely Sorocold was associated with hydraulics, it is strange that the only patent granted to him was for something entirely unconnected with water.

[1] Peet, Henry, *Thomas Steers*, engineer of Liverpool's First Dock, with an appendix on George Sorocold, in *Trans. Hist. Soc., Lancs. & Ches.*, vol. 82, 1930.

[2] Jenkins, Rhys, *George Sorocold*, in the *Engineer*, 18 Oct., 1918. Reprinted in *Collected Papers of Rhys Jenkins*.

He received letters patent, 1st Jan., 1704 (not 1703 as given in the reprint of 1857), for "a new machine for cutting and sawing all sorts of boards, timber and stone, and twisting all kinds of ropes, cords and cables by the strength of horses or water."[1] There is no specification filed with the application so that details are not known, but the patent may have had some connection with the machinery for boring elm trees for use as water-pipes, which he worked from his water-engine at Derby in 1692.

BELLS AND CHIMES. The earliest piece of engineering work carried out by Sorocold of which we have definite knowledge was in connection with the bells and chimes of All Saints' Church at Derby.

This church had five bells until 1620 when a sixth was added, and the six continued until 1677 when four more were added, these four being hung above the older six, an obviously makeshift arrangement. In the "Book of Orders," 28 July, 1687, it was recorded that "the bell work, frames, and wheeles" are decayed and out of repair and £15 is to be paid to "Mr. Sorrocolde to bee ymployed for and towards the repair of the wheeles, ironwork and frames of the bells." This was duly carried out and the fact was permanently recorded on a brass plate 6 by $5\frac{1}{4}$ inches, attached to one of the timbers of the frame. The tablet is now fixed to the panelling in the Cathedral vestry, and is a fine example of 17th century lettering. It reads as follows:—

"Anno Dni 1677 | These fower cast bells were | bought by the endeavours of Francis | Thacker of Southwood, Esq., & hung | above the rest. | Anno Domini 1687 | John Baxter of Laxton in Northamptonshire | Bellhanger built this frame and hung | the bells new. The same being undertaken | by George Sorocold, of Derby, gentleman | John Bowley, Joseph Heywood, Churchwardens."

The churchwardens' accounts show that Sorocold in

[1] *Patent of George Sorocold*, 1703, No. 369, Patent Office, 1857.

1687-8 was paid the £15 promised, and the next year he received two further payments of £6. 5s. each. Cox and Hope in their "Chronicles of All Saints'" say that Sorocold was responsible only for the payments to Barker, but it is clear that Baxter worked to Sorocold's designs, otherwise there would have been no need for him to intervene between the workmen and the churchwardens, who actually paid the costs. Further, Wolley in his manuscript account of Derby written in 1712,[1] says of All Saints, "There is in it a ring of ten as fine and tunable bells, as most in England and much repaired to for ringing and a clock with very good chimes, which the before mentioned Mr. Sorocold improved, and has hung the bells to be very much more easy both for ringers and the steeple. He also set the chimes to five tunes."

One of the bells at least was recast at this date, and the second bell bears the following inscription, which again indicates the importance of Sorocold.

"GOD SAVE HIS CHURCH 1687—F. THACKER. G. SARACOLE."

The hanging of the bells was so well designed by Sorocold and so efficiently carried out by Baxter that they continued in use until 1926, when it was found necessary to reconstruct the framework owing to the ravages of the death-watch and furniture beetles.

DERWENT NAVIGATION. This important undertaking if not conceived by Sorocold, certainly owed a lot to him, although we cannot be sure that he carried out the work. The story of this scheme has received no attention from local historians and is worthy of fuller treatment than I am able to give it here. Local historians will find a lot of information in the *House of Commons Journals*, about Bills projected with respect to the Derwent in 1664, 1675 and 1676, three abortive attempts not dealt with in this paper.

[1] Printed in Simpson's *History*, p. 178.

In the House of Commons on 12th Dec., 1695,[1] leave was given to bring in a bill for making the River Derwent navigable from Derby to its junction with the Trent, and Mr. [John] Bagnold[2] was authorized to prepare and bring in a bill, which he did on the 18th Dec., 1695, when it was read first time. It was read a second time on 3rd Jan., 1696, and sent to committee after which nothing more is recorded of it.

One of the reasons why the Bill was dropped may be found in a petition sent to Parliament 14 Feb., 1695/6.

" A petition of several Burgesses and Inhabitants of the Town of Derby, was presented to the House, and read, setting forth, that a few Maltsters and petty Chapmen in Derby, who mind more their own private gain than the general good of the town, labour in the name of the Mayor and Burgesses to procure an Act of Parliament for making the River Darwent in the co. of Derby, navigable, which if obtained, will be a great prejudice to great part of the inhabitants of Derby, who get a living by the land-carriage of commodities; and they bring . . . corn to Derby, by this navigation, at a cheaper rate than the adjacent landowners can afford them, will divert many of the farmers from that Market, to the prejudice of the Innholders of Derby; And praying that the House will prevent the passing of the said Act, That the Town of Derby may not be its own ruin."[3]

On 3rd Jan., 1698, two years later, Lord Henry Cavendish and Mr. [George] Vernon[4] were authorized to prepare another bill, which was read for the first time on 27th Jan., 1698. At the second reading, 20th Feb., 1698, it was rejected. To both these bills there had been many petitions both for and against, the latter predominating.

[1] All references are taken from the House of Commons Journal under dates mentioned.

[2] One of the M.P.'s for Derby and also Town Clerk, bur. 4th May, 1698

[3] *House of Commons Journal.*

[4] The two M.P.'s for Derby.

However, the people of Derby were not to be denied and on the 17th Nov., 1702 " a petition of the Mayor and Burgesses of the Borough of Derby was presented to the House, and read; setting forth that the said Borough is an inland town, but hath a large river (called Darwent) running into the navigable River of Trent [made navigable under Act of Parliament, 1698], within six miles distance of it; and the county of Derby abounding with great store of heavy commodities, as Lead, Iron, Marble, Plaister, Milstones, etc., the highways, especially towards the River Trent, being exceedingly deep, renders the land carriage very difficult and expensive; which John Burrows esquire, and other undertakers, have, at their own charges, proposed to remedy, by making the River Derwent navigable from Derby to the River Trent; and also to build a convenient Dock and wharfs for the benefit of the borough, and the poor thereof."

Mr. Stanhope, Mr. Harpur and Sir Thomas Davall were authorized to prepare and bring in the bill.

This passed the Commons on 9th Jan., 1703, and was sent to the Lords the same month, where Sorocold attended and gave particulars, no doubt presenting the map, which is referred to in the letter from the Mayor of Derby and others, dated 2nd March, 1717. This map is reproduced here, by kind permission of Col. O. Pearce Sorocold, who possesses the only copy known to the present writer. It shows that Sorocold contemplated making three cuts, or canals, two designed to by-pass the tortuous bends of the river, the other to pass the weir at Wilne. Eventually the two long cuts were omitted, as indicated in the letter mentioned about, but it is interesting to note that in 1934 a scheme was completed, at a cost of approximately £300,000, which cuts out the series of bends nearest the town. One cannot help thinking that it would have been better and cheaper had the work been done when first proposed by Sorocold.

A strong case was presented to the Lords, but was ejected by them, 1st Feb., 1703.[1]

Fourteen years passed by and on 28th Feb., 1717 the Mayor and Burgesses again presented a petition. On this occasion they enlisted the good offices of Baron Parker, Chief Justice of the King's Bench, and afterwards Chancellor, and Earl of Macclesfield. It will be remembered that as Thomas Parker he was M.P., for Derby from 1705 to 1710, and Recorder of Derby, ante 1698 to 1710. A letter was sent to Baron Parker, and along with it (*a*) an engraved map of Derbyshire prepared by Sorocold[2] showing the position of lead-smelting mills in the county, and how the navigation would benefit the trade; (*b*) arguments in favour of the scheme; (*c*) a copy of King John's charter of 1204. These documents and map are preserved in the British Museum,[3] and with them are notes on the case prepared by Baron Parker himself.

The letter reads as follows:—

" May it please your Lordship, I had the honour of your Lordship's commands, and have inclosed sent you the map which was done by the ingenious, unfortunate mathematician, Mr. Sorocold, by which will appear (to all unprejudiced persons) that it is morally impossible there should in the least be any prejudice to the trade at Bautrey.

We have one Mr. Alleyn concerned for us as a solicitor in town, who is a person well recommended, and we have made choice of Mr. William Parker to assist him, and have this post wrote to him to attend your Lordship with a brief, which was in the hands of Mr. Fitzherbert, who drew our bill, and has been kind in writing to his friends in the country in our favour.

I have wrote to all the most considerable gentlemen in our country, and also to all, or most, of the landowners

[1] House of Lords Journal, 1703.

[2] Reproduced here by kind permission of the Trustees of the British Museum.

[3] Stowe MSS., 818.

upon each side of the River Derwent (from the town of Derby to the River Trent) for their concurrence, favour and assistance.

Mr. Parker has a copy of a draft of the river as done by Mr. Sorocold, but we hope (if the Act passes) to navigate the course of the river without making use of the intended cuts (except one very small one from a dam at Will [Wilne] Mills.

My Lord Ferrers did us the honour upon our application, to send over his steward to let us know that his Lordship was very ready, by his good offices, to serve the Corporation and County of Derby. We had a favourable return from my Lord Chesterfield, my Lord Bishop of Lichfield and Coventry, Lord Newport, Sir Robert Corbett, and many other members of Parliament.

Our council in the navigation was formerly of the opinion that King John's Charter[1] might be useful to us in the house, to show that the River Derwent was formerly navigable, the use of which is lost for want of continuance, but have inclosed given your Lordship the double of a copy of that, to the end that Mr. Parker may know where to find the original, if there be occasion for it. Your Lordship's great goodness prompts us to be thus troublesome and do beg leave with grateful acknowledgement to subscribe ourselves, My Lord Your Lordship's most faithful and most humble servants,

John Bagnold, Mayor;
Thomas Rivett;
Fra: Cokayne;
John Holmes;
Thos. Gery;
Thomas Gisborne;
Benjamin Blundel, Junior.

Derby, 2nd March, 1716/7."

[1] Granted to the Bailiffs and Burgesses of Derby in 1204.

In spite of all their efforts, success was still denied them, but in the meantime other similar schemes were being approved, and opposition was growing less. At last a final petition was presented on 19th Dec., 1719, the bill passed the Commons on 23rd Feb., 1720, agreed to by the Lords 17th Mar., 1720, and received the Royal Assent, 7th April, 1720. The Act was printed in 1720 and a copy is in the Derby Public Library.

The undertakers named in the Act were, William Woolley, Thomas Gisborne, Benjamin Blundell, junior, Thomas Rivett, esquires, Abraham Crompton, John Chambers, Francis Cokayne, Robert Wagstaffe, Samuel Fox, and Samuel Shepperdson, gentlemen. They were given wide powers over the course of the river and its banks, and a large body of commissioners was appointed to see that holders of land and tenants along the river were treated fairly. Naturally the undertakers were authorized to collect tolls, which were not to exceed one shilling a ton for the full journey, and proportionately less for lesser distances and weights.

The work appears to have been quickly carried out, and a wharf was constructed in the Morledge at Derby. The river continued to serve a useful purpose for over seventy years, until in 1793 an Act of Parliament was obtained authorizing the construction of the Derby Canal from the Trent and Mersey Canal to Derby. An agreement was made between the new company and the old, but in a few years the Canal Co. bought out the Derwent Navigation paying £40,000 as compensation.[1]

Both the maps prepared by Sorocold were printed from copperplates and Sorocold is the sort of man who might have engraved the plates with his own hand.

LIVERPOOL'S FIRST DOCK. A full account of Sorocold's association with Liverpool's first dock is given by Mr. Henry Peet, in a paper on " Thomas Steer: the engineer

[1] Glover, I, p.269.

of Liverpool's First Dock,"[1] and extracts are given here with the author's permission.

" Thomas Johnson, knighted shortly afterwards, was Liverpool's leading man, and therefore it is not surprising to find he was the prime mover in providing Liverpool with its first dock. The following letter written by him on 27th Jan., 1707/8 from London to Richard Norris at Liverpool, indicates plainly enough a considerable amount of previous discussion.

' On Sunday night (25th Jan.), in good time, I saw Mr. Sorocold; he would gladly serve us about the Dock; he is a very ingenious man; he is of opinion it may be very well done, and the stones in the Castle will save a great deal of money. He will tell you the charge within three or four hundred [pounds], which is as near as can be computed.' "

" The ' Mr. Sorocold,' who was consulted by Thomas Johnson, was George Sorocold, a notable London engineer at that time, and the fact that he was thus selected to advise about the proposed dock at Liverpool suggests that he may have been the engineer responsible for the dock at Rotherhithe a point on which it seems impossible to obtain information."

" Having made these preliminary investigations, Johnson raised the matter in the Liverpool Town Council, but must have met with some opposition, for it was not until ten months later (3 Nov. 1708) that the Council passed this resolution:—

' That Sir Thomas Johnson and Richard Norris, Esq., the representatives in Parliament for this Corporation (being now goeing to Parliament) be desired and impowered to meet with and agree for a proper person to come to this town and view the ground and draw a plan of the intended Dock.' "

[1] In *Trans. Historic Soc. of Lancs. & Ches.*, Vol. 82, 1930, where Mr. Peet gives copious references to his authorities.

" Having now official authority, Johnson must have interviewed Sorocold again, for it is found that in the following March, Sorocold had come to Liverpool and had brought with him Henry Huss, of Derby, a surveyor, and doubtless a friend of Sorocold, who had spent most of his life in Derby, if indeed he were not a native of that place. On 7th Mar., 1708/9, both of them had the Freedom of the Town conferred upon them as a compliment. Henry Huss being thus described in the record: one Henry Huss of Derby in Derbishire who comes to survey the place where to make a dock with Mr. Sorocold and draw a plan and estimate of the charge thereof.' "

An Act for constructing a Dock at Liverpool was passed 24th Mar., 1710 and " here for the first time, appears the name of Thomas Steers, and it must be assumed that he was ' brought ' from London on account of his special knowledge and qualifications. Now experience of that kind could only have been obtained at Rotherhithe, and as it is known that Steers was an engineer and was living at Rotherhithe during the construction of the ' Great Wet Dock,' it may be presumed with considerable plausibility that if George Sorocold was the chief engineer in that work, Steer was probably his principal assistant."

" It was hardly to be expected that Sorocold would be willing to leave his London practice and become resident engineer at the Liverpool dock."

An Act for making a Wet Dock at Rotherhithe obtained Royal Assent on 10th Apr., 1696; it was not only for this purpose but also to enable the Trustees of the Marquis and Marchioness of Tavistock to raise money for the purpose of constructing the dock. These two were minors, and possibly the information given in the House of Commons during the progress of the Bill, might afford clues to further information about this pioneer undertaking.

DERBY SILK MILLS. Derby is justly celebrated as being the birth-place of silk-throwing or spinning in this

country, but little justice has been done to the part played by Sorocold and by Thomas Cotchet. John Lombe is the man who usually gets more credit than he justly merits.

Thomas Cotchet built his silk-mill in 1702, and a description of it follows later where it is described as the "old shop." There is no doubt that Sorocold constructed the mill-wheel, and carried out the mill-wright work. Wolley mentions Cotchet's mill in his manuscript history of Derby written in 1712. Whether Cotchet's mill was a failure or not we do not know for certain, but Samuel Smiles[1] tells us that John Lombe learned his trade under Cotchet, afterwards going to Italy to learn all about the Italian machines. In 1717 he was back in Derby, attracted here no doubt by the existence of Cotchet's mill, and by the prospect of having the services of such an expert mill-wright as Sorocold. He must have come to some arrangement with Cotchet because we find later that Cotchet's mill formed a part of Lombe's, which he had at once begun to erect.

The earliest description we have, presumably of Lombe's mill, occurs in Daniel Defoe's *Tour Thro' . . . Great Britain,* 1st edition published in 1727.[2] In his description of Derby he says:

"Here is a curiosity in trade worth observing, as being the only one of its kind in England, namely a throwing or throwster's mill, which performs by a wheel turned by the the water; and though it cannot perform the doubling part of a throwster's work, which can only be done by a handwheel, yet it turns the other work, and performs the labour of many hands, whether it answers the expense or not, that is not my business.

This work was erected by one Sorocole, a man expert in making mill-work, especially for raising water to supply

[1] *Men of Invention and Industry.*

[2] Vol. 3, p. 38; Reprinted in 1927, vol. 2, p. 562; Reprinted 1928, in Everymans Library, vol. 2, p. 156.

towns for family use; but he made a very odd experiment at this place; for going to show some gentlemen the curiosity, as he called it, of his mill, and crossing the planks which lay just above the mill-wheel; regarding, it seems, what he was to show his friends more than the place where he was, and too eager in describing things, keeping his eye rather upon what he pointed at with his fingers than what he stept upon with his feet, he stepped awry and slipt into the river.

He was so very close to the sluice which let the water out upon the wheel, and which was then pulled up, that tho' help was just at hand there was no taking hold of him, till by the force of the water he was carried through, and pushed under the large wheel, which was then going round at a great rate. The body being thus forced in between two of the plashers of the wheel, stopt the motion for a little while, till the water pushing hard to force its way, the plasher beyond him gave way and broke; upon which the wheel went again, and like Jonah's whale, spewed him out, not upon dry land, but into that part they call the apron, and so to the mill tail, where he was taken up, and received no hurt at all."

This incident so impressed Defoe that he mentions it again under his description of the water-works at Sheffield.

The first was the only edition of Defoe's work published in his lifetime, and whether or not he revised it himself is not known, but in the 4th edition published in 1748, we find a fuller account of Lombe's mill.

" Here is a curiosity of a very extraordinary nature and the only one of the kind in England; I mean those mills on the Derwent which work the three capital Italian machines for making Organize or thrown silk, which, before these mills were erected, was purchased by the English merchants with ready money in Italy; by which invention one hand will twist as much silk, as before could be done by fifty, and that in much truer and better manner. This

engine contains 26,586 wheels and 97,746 movements, which work 73,726 yards of silk-thread every time the water-wheel goes round, which is three times in one minute, and 317,504,960 yards in one day and night. One water-wheel gives motion to all the rest of the wheels and movements of which any one may be stopped separately. One fire-engine, likewise, conveys warm air to every individual part of the machine, and the whole work is governed by one regulator. The house which contains this engine is of a vast bulk, and five or six stories high."

"A patent passed 5 Geo. I to secure to Sir Thomas Lombe the sole property of this invention for 14 years, but the requisite buildings and engines and the instructing of proper person to work them took up so much time, and when all was completed, the King of Sardinia prohibiting the importation of the raw silk made by the said engines into his dominions, all which rendered the undertaking expensive and difficult, and the term of 14 years being near elapsed without any great benefit accruing from the useful invention, Sir Thomas applied for a consideration from the public; and the Parliament accordingly, to preserve so useful an undertaking for the benefit of the Kingdom in general, allotted 14,000£ to be paid to Sir Thomas, on condition that he should allow a perfect model to be taken of his new-invented engines, in order to secure and perpetuate the art of making the same. The preamble to this Act sets forth, That Sir Thomas Lombe did with the utmost difficulty and hazard, and at a very great expence, discover the art of making and working the three capital engines made use of by the Italians to make their organize silk, and did introduce those arts and inventions into this kingdom.

"This wonderful piece of machinery was under the direction of Sir Thomas Lombe, or, as some say, of his brother, erected by one Soracle, a man expert in making

mill-work, especially for raising water to supply towns for family use."

This account is ridiculed by William Hutton[1] who because he worked at the mill from the age of seven until he was fourteen claims to know that the exact number of wheels was 13,384, a remarkable feat of reckoning for a boy of his age. Hutton was born in Derby in 1723, so that his apprenticeship began in 1730, and immediately it was over he left the town, which does not seem to give much weight to his disparaging remarks.

In 1739 the Silk Mills passed from Lady Lombe the widow of Sir Thomas, to William Wilson, of Leeds, and Samuel Lloyd, and the former has left a description of the mills which has not hitherto been printed. It will be seen from this account that Cotchet's mill, as well as Lombe's two mills, were factories greatly in advance of their time, and that Sorocold's mill-work was really a very extraordinary achievement, which merited every praise that could be bestowed upon it, and that Hutton's disparagement was unjustified.

The manuscript from which it is taken is in the handwriting of William Wilson, joint owner with Samuel Lloyd from 1739 to 1753, and I assume it would be compiled shortly after 1739 as a sort of inventory of the buildings and their contents.

A DESCRIPTION OF THE SILK WORKS AT DERBY.

From a manuscript in the handwriting of William Wilson, of Leeds joint owner with Samuel Lloyd from 1739 to 1753.

SITUATION. These works are situated on an island in the River Derwent on the east of the town of Derby, and from the upper end of Full Street, about the middle of the said town, is a lane commonly called Silk Mill Lane, 81 yards long and 9½ broad, always clean even in the depth of

[1] *History of Derby*, 1791, p. 191 *et seq.*

winter, which leads to a bridge of three arches, built with brick and covered with plaster work in imitation of stone very hard and durable, across the mill fleam, this unites the larger island, on which the works stand with the lane aforesaid. On the second pier of the bridge from the lane stand two handsome stone pillars, 14 feet high, 3 feet square, to which are hung a pair of neat iron gates, 19 feet high and 10 feet wide, weighing 18 hundredweights. The bridge is 55 feet long, 12 broad without and 16 within the gates, and leads into a space or court-yard between two good brick buildings, which are in fresh and perfect good order. The island on which they stand is 540 feet long and 52½ broad.

DOUBLER'S SHOP. The building to the right hand of the court yard is called the Trammer's or Doubler's Shop, and stand upon piles drove into the ground of 16 to 20 feet each; it is in the form of a T. It's walls are all 14 inches thick to the battlements, which hide it's tiled roof. The upper part nearest the court-yard is 39½ feet high, 44 feet 9 inches broad, and 21 feet deep, contains two stories besides the cellars and brewhouse under it; the lower story has three sash windows to the yard of 7 feet 2 inches high and 3 feet 3 inches broad (besides the door), two windows to the east, two to the south, and two to the west, all of the same dimensions. In this part is a Compting House, which overlooks two of the doubler's shops at once, and the other conveniences for this branch of the business. The long part of this building contains three stories, is 139 feet long, 41½ feet high and 18 feet broad, being only three rooms, one in each story, which have 51 windows to the east, and the same number to the west, viz.:—102 windows in each room. These are but small sash-windows being only 3 feet 7 inches high and 20½ inches broad but being set regular cause the east and west fronts to look beautiful, each of them having 153 windows fixed in three rows, and as every one of these windows will admit a

doubler to work at it, there is sufficient room for 306 doublers in the said rooms, in all of which there are at present no more than 143 doublers wheels, with spindles and everything belonging to them 143 jacks with glass eyes thereto, and 145 boxes for doublers' works and many other necessaries for their business.

WAREHOUSE. The building on the other side of the courtyard is called the Large Building. At the end next the yard are the warehouses, sorting rooms, carpenter's room and other offices, which take up a space of 30 feet long and 26½ broad, contains three stories, and is 46½ feet high, each of which stories has three sash-windows to the court yard and two windows to the east, each of them 6 feet high and 3 feet 2 inches broad. Adjoining to the west of this east building is a staircase that goes to the aforesaid offices, and to the several stories of this great building, forming a sort of tower, has in it five sash-windows, one above another at proper distances, each 5 feet 2 inches high and 3 feet 2 inches broad through which you may look into the court-yard. The staircase is 64 feet high and 18½ by 14½ square; in its top hangs a bell for calling work people to business, the diameter of which is 14½ inches and its depth within 13 inches.

ITALIAN WORKS. From the court-yard you rise by five steps into a passage through the aforesaid offices, which leads as well to the staircase on the left, as to the Mill Room in front almost. The foundation of this building is piles doubly planked, and upon them stonework 4 feet broad, from whence are turned 13 handsome stone arches on each side of the building, and upon them stand the walls; they are 18 inches thick to the top of the second story, and from thence upwards to the battlements 14 inches thick. The roof is a strong framed flattish roof covered with lead of 10 lbs. to the foot, and is hidden by the battlements. This building is 110 feet long, 55½ high and 39 broad. It contains five stories or rooms, besides

the under-works even with the arches, is fronted east and west, and has 14 sash-windows in a row, each 6 feet high and 3 feet 2 inches broad, 70 windows in each front.

WINDING ENGINES. In the three upper stories are the Italian winding engines, 26 in each room or 78 in all, which are in a neat and regular manner across the rooms, and in each of them are 4141 swifts 4241 spindles and 45363 engines or spinning bobbins; but note there are engines for working 630 more spindles and swifts than above mentioned, all the rest of the engines have everything proper and necessary for working them in complete order.

FILATOS. In the two lower stories are 8 filatos or spinning mills, and 4 tortoes or twist mills; the filatos are built in a circular form, their diameter 12 feet 7 inches, and their height 19 feet 8 inches, which is the exact height of the two lower stories, so that the second floor has spaces through it in which the mills are built. They are all turned by upright shafts in their centres, and each of them contains 6 rounds and 575 spindles, all their wheels, boxes, and everything belonging to them being in good order. The spindles of these and the tortoes are the same, of which the whole number is 6350, and to the filatos there are 25,693 reel bobbins, 2,923 star wheels belonging to the reels besides those always on the mills; these stars are of several sizes for altering the spinning as occasion requires, and 6204 wooden leads of several size belonging to the same.

TORTOES. The four tortoes are in the same rooms with the filatos, being the same height, and are also built in a circular form; their diameters are 12 feet 11 inches. Each torto contains 4 rounds of spindles, and there are 384 in a mill, as also 64 reels, 21½ inches long, and their girth 44 inches, of these there are 400 belonging to the said tortoes, and 9,050 bobbins, 2,535 leads, 1870 star wheels of several sizes for altering the throw, as occasion requires, and all

other things useful for working them in a complete manner. These mills are also turned by upright shafts in their centres, all of which have a communication with laying shafts over the tops of the mills, and they with others from the water-wheel without-side of the building westward, which wheel is an under-shot 23 feet diameter, and has 42 ladle boards on its rims and cantells. Its shaft is 10½ feet long and 21 inches diameter. One end of this comes through a navel-hole in the middle of the building, on the west side thereof which has on it a head or crown of 4 feet 4 inches diameter, with 44 cogs therein. This turns another ditto of 4 feet 3 inches diameter with 40 cogs therein. This last is on the bottom of an upright shaft 18 inches square, which has another head or crown on its top, of the same dimensions, by which it turns the 12 mills of filatos and tortos by the laying shafts over their tops, and in the centre of this upright shaft is a large iron gudgeon that passes through the floor into the lower winding engine room, where it turns a head or crown of 6 feet 4 inches diameter, and has 48 cogs therein, by which all engines in three stories are turned.

OLD SHOP. Adjoining to the north end of this great building, is another building formerly the property of Mr. Thomas Cotchett, which is 62 feet long, 28 feet 5 inches broad, and 35 feet high, contains three stories, the upper of which is a garret made use of as a lumber room, has 6 dormant [dormer] windows in the roof, in the other two stories are 8 double Dutch mills, four in each story, all in complete working order, with 148 spindles in each mill of which there are 1340 in all, 56 reels, 69 toats, 56 lantherns, 116 stars, 8,410 bobbins, and 2340 leads. These mills are turned by another water-wheel in the same manner as the other, only the shafts and heads are under the lower floor instead of being above. This water-wheel is 13½ feet diameter, 24 ladle boards. The west front of this building is brick, and has 12 handsome windows, 6 in

each story; the east front is a studded wall, covered with plaster work, and windows in two rows, and the whole length of the building, at these formerly worked the doublers, 24 to each row of windows.

HOUSE AT THE END. At the north end of this shop is a compting house which overlooks the lower shop, and both the rows of doublers, and a dwelling house built with brick, all the windows sashed; in the lower floors are a kitchen and parlour, in the next three bed chambers and dining room, and one garret over all. The east side of the space or court-yard between the building afore-mentioned is open to a fine shute of water, being a main part of the River Derwent. From the same space by the side of the great building is a handsome gravel walk, which serves as a passage to the dwelling-house at the north end of the building, and from the said space and walk is a prospect of the weir which turns the water to the mill wheels, and forms a beautiful cascade, as also of another island belonging to the works, and made into a garden which is 124 feet long and 27 broad, on the south end of which stands a very handsome summer-house with 4 windows therein large and neat, the room within is 14 feet high by 13 feet 3 inches square.

ALLOA, 1710. As early as 1694 enquiries were being made as to the suitability of Sorocold's water-engines for pumping water from coal-mines as will be seen from a letter written by Dr. Jabez Cay, of Newcastle-upon-Tyne to Ralph Thoresby, and printed in this paper under Newcastle. I have no record as to whether or not, Sorocold's engine was used at Newcastle for this purpose, but in 1709 we find that John, Earl of Mar, sent the manager of his Clackmannanshire collieries to Newcastle to see what was being done there, and in the following year, " Sorocold, of Derby, one of the two engineers of this age who never failed in what they undertook, because they considered perfection and success of their work first,

and their profit afterwards, was engaged by the Earl to inspect his coalworks and plan machinery for drawing water, and have £50 for his pains." Sorocold advised the use of the water-wheel with crank and beam, in place of the buckets and chains then employed, but no person could be found in Scotland to carry his design of this simplest of machines into execution. Sorocold visited Alloa where he stayed for several days, and left a report as just stated.[1]

WATER SUPPLY. The most important part of Sorocold's work lay in the installation of public water supplies, in which branch of engineering he was a practical pioneer. Sorocold designed sets of pumps worked by water wheels, which forced water up to cisterns on the highest level available, from which sufficient pressure was obtained to give a supply of water direct to the houses of those who were prepared to pay for the service.

It is true that Peter Morris installed a water supply in London on similar lines, as early as 1582, but Sorocold seems to have been the first to introduce the same principle to provincial towns, beginning with Derby in 1692. Moreover, Sorocold's wheels and pumps were much superior to those of Morris, which they superseded at the London Bridge Works. The water wheels were constructed to rise and fall in accordance with the level of the stream which turned them, a principle patented by John Hadley, 3rd March, 1693,[2] exactly a year later than the lease granted to Sorocold to empower him to construct the Derby water works. There is no specification filed with Hadley's patent, which by the way claimed several different inventions, so we cannot be sure that it was exactly the same device as used by Sorocold, although it probably was, for the two men are found in collaboration on the construction of Marchant's London Water Works.

[1] Bald, *Hist. of the Coal Trade*, quoted in *Patent Office Abgts.*, The Steam Engine, Pt. 1, 1618-1859.

[2] *Abridgments of Specifications relating to Hydraulics*, 1617-1866.

Whoever was the real inventor of the rising and falling water wheel as will be seen later that Sorocold used this innovation in his first work at Derby.

Local historians generally have neglected the history of water supply, and many have scoffed at the efforts of Sorocold and his associates, but there could be little wrong with pumping systems which continued to work satisfactorily from about 1700 until 1850, when the growth of population rather than inherent defects rendered other methods necessary. It should also be remembered that by 1850 untreated river-water in industrial areas had become too impure for human consumption.

In the following pages an attempt will be made to describe the various water supplies which are known or reasonably assumed to be the work of Sorocold, and details of his methods will come out in the various accounts.

Our knowledge of the towns where Sorocold put in water supplies is due largely to Ralph Thoresby, the Yorkshire historian, who was personally acquainted with the engineer. In his *Ducatus Leodinensis*, 1715, after describing the water engine erected by Sorocold at Leeds, goes on to say that he has done the like at Macclesfield, Wirksworth, Yarmouth, Portsmouth, Norwich, King's Lynn, London Bridge, Deal, Bridgnorth, Islington New Works and Bristol. To these should, of course, be added Derby, and Exeter, (mentioned by Celia Fiennes as being similar to what she had seen at Derby and Islington), and also Sheffield where Defoe says the water-engine was constructed by Sorocold.

It will be seen that in several instances Thoresby's statement is corroborated by other evidence, but in other cases Sorocold's name does not appear in local records. Usually Sorocold did not retain any financial interest in his works once they were constructed, and leases were granted direct to those who intended to carry on as proprietors, and although there can be little doubt that Sorocold was


A Map with relation to the Navigation of the River DERWENT Shewing ye Smelting Mills in Derby Shire, and ye passages of the Lead from thence by Land & Water. by G.S. Gent.
HIGH PEAK
Chappel in the Frith
Tideswall
Hasop
Bakewell
Dronfield
SCARSDALE
Chesterfield
Chattsworth
Belay Chap
Rowsley
Balsover
DERBY SHIRE
1 Beely
2 Darly
3 Winster
Ashover
Matlock
Cromford
Low Peak
Wirkworth Wapontack
Wirksworth
Alfreton
Belper
Duffield
Ashborn
Appletree Hund
Derby
R Darwent
Wiln ferry
Nottingham
Erwash R
Trent R
Dove R
Uttoxeter
Burton sup Trent
30 Miles
Bautre
Stockwith
Gainsburgh
Blyth
Retford
Worksop
NOTTINGHAM SHIRE
Tuxford
Mansfield
Southwell
Newark
¤ Smelting Mills
From Rowsley to Wirksworth 8 Miles
thence to Derby 8
Derby to Wiln Ferry 5 Miles
Wiln Ferry to Stockwith by water 55
76
From Rowsley to Chesterfield 8 Miles
Chesterfield to Blyth 18
Blyth to Bautre 2
thence by water to Stockwith 10
From Miles
38
5 10
Miles

the man really responsible for designing and carrying out the work, his name may not appear in the records. In some instances no records remain of what actually happened beyond the bare fact that some sort of water supply was installed.

In the absence of other records I am prepared to accept Thoresby's list as entirely reliable.

DERBY, 1692. Derby seems to be the first place at which Sorocold installed a public water supply, which is what we should expect seeing that he was living in the town at this date.

It is fortunate that the terms on which Sorocold began his undertaking is preserved in abstract[1] although the original document is lost, and from it we get a clear idea of the procedure.

" Deed whereby the Mayor and Burgesses of Derby gave to George Sorocold, of Derby, gent., the mill commonly called Gunpower Mill, near St. Michael's Mills, and two sluices adjoining and the little Byflatt [island] whereon the mill stands, with free liberty to erect a water-house, a water-wheel and other engines, laying pipes for conveying water into the streets, lanes, and passages within the borough, to hold for a term of 99 years at an annual rent of £3 with certain conditions as to opening the streets, digging trenches, and repairs, etc., the said George Sorocold to begin work within three months next ensuing, and to lay pipes through the King's Streete, Iron Gate, Market Place, Rotten Roe, and the Corne Market, and to the Gaole Bridge in the said Burrough within three years next following.'

On the back of the document is a memorandum to the effect that the said George on his completion of the said waterworks may have liberty to surrender the lease, leaving the waterhouse, water-wheels, sluices, bridges, pipes, pavements, etc. in good repair.

[1] *Cal. of Ancient Records of the Borough of Derby*, 1904, p. 48, Deed No. 135.

Signed. Samuel Fletcher, Mayor, and by George Sorocold and witnessed by John Bagnold, Town Clerk, Thomas Bourne and Joshua Bourne. Dated, 5 March, 1691/2."

It is certain that Sorocold set to work immediately he got his authority, for John Houghton[1] in his *Collection* No. 38, of 21 April, 1693 says, " one Mr. George Sorocold has set up a waterhouse to convey water-pipes to all the houses in the town [Derby] that desire it, and it is likely it will be much used."

A few years later Celia Fiennes[2] visited the town and gives an account of the water-engine, which shows it could be raised and lowered like the later one at London Bridge.

" The River Derwent runs by the town and turns many mills, and the water engine which turns the water into the pipes that serves the town, the same wheels grind also, but they do it for a halfpenny a strike, which is the same measure as our bushill. At this engine they can grind if it is ever so high a flood, which hinders all the other from working at the flood, they are so choaked up, but this they can set higher or lower just as the water is. There are bays which they make with stones to keep the water to run to the mill and thence it falls againe into the Derwent; there is also a fine stone conduit in the Market Place, which is very spacious, well pitch'd, a good Market Cross." (*op. cit.* p. 140).

A fuller description is given by William Wolley in his manuscript history of Derby, printed in Simpson's History, p. 176, and written in 1712.

" St. Michael's Mills belong to the Corporation, but there is also adjoining thereto a Silk throwing mill built by Mr. Cocket [Thomas Cotchet], of great curiosity [this

[1] John Houghton, *Collection for Improvement of Husbandry and Trade.* A weekly news-letter.

[2] Celia Fiennes, *Through England on a Side Saddle in the time of William and Mary*, 1888, p. 140.

preceded Lombe's mill], and on the hither side the water-engine, invented by Mr. Sorocold with a great deal of art, which at the same time with one wheel throws up water to a cistern joining St. Michael's Church, which from thence is conducted in pipes, and supplies all parts of the town at a cheap rate, and turns a malt mill and bores elm trees for pipes, all at the same time and all managed by one man. It pays to the land tax £50. 12s. 4d. per annum."

It seems from the foregoing that the cistern or reservoir was adjoining the church, but Hutton[1] says it was " at the top of the church, ... Perhaps this is the must useful church in Derby, though preached in but once a month." Hutton is probably the most unreliable writer who ever professed to be an historian, and in this instance, he is directly contradicted by two references which carry more weight than his facetious statement. Simpson quotes an extract from the churchwarden's accounts of St. Michaels, " paid every Michaelmas by Mr. Sorocold, 5s. for *the ground* on which the cistern stands " (p. 298), although undated this is clearly during Sorocold's lifetime, and again he quotes from a terrier of lands, etc. belonging to St. Michael's delivered into the Bishop's Consistory Office in 1786 (*ibid.*, p. 391), " Item—Twenty shillings yearly to be paid to the vicar or minister as a rent for the cistern *standing in the churchyard*, to be paid by the owners of the water-works." It is certain from this that at the time Hutton was writing the cistern was in the churchyard and not *on* the church itself.

Although Sorocold carried out the installation, he appears to have been financed by the Corporation, at least to some extent, and they probably took over the management of the waterworks afterwards. At a meeting of the Derby Company of Mercers held at the house of Mr. Howel, in Derby 1st March 1691/2, it was resolved that Mr. William Franceys, apothecary should pay over to the

[1] William Hutton, *Hist. of Derby*, 1791, p. 14.

Mayor and Burgesses, the sum of £40 for carrying on the waterworks for the town, according to agreement between the Mayor and Burgesses and Mr. George Surrocold, to be lent for three years without interest.[1]

The Mercers had a great difficulty in getting their money back, and after twenty years ten pounds of the loan were still owing.

From a deed of 1738 it appears that the profits of the waterworks went toward lighting the streets.

"Counterpart of a lease made by consent of John Gisborne, mayor, from Thomas Borrow, esq., and other Trustees appointed to administer the rents, etc., arising from the Borough Waterworks, and the interest from a sum of money given by Margaret Chambers, for the support and maintenance of 80 lamps or lights for the use of the Borough, to Benjamin Grainger, Stocking frame-knitter, of Derby, of the gunpowder Mill, now used as an [water] engine house, and the malt mill, with sluices thereto belonging. Term 40 years, rent £23. 6s. 8d. Witnesses: William Bateman, Richard Whitby, 11 Apr., 1738."[2]

Before Sorocold's time there had been no direct supply of water to houses, and it had to be carried from the two rivers, various wells and conduits. The Friars had a conduit before the suppression of the lesser monasteries, there was one in the market place in 1610, and another Becket Well erected in 1652, the last being still in existence. Sorocold's system supplied only that part of the borough which lies between the River Derwent and Markeaton Brook, then called Odde Brook, at least that is the inference from the terms of the lease, and also from the topographical features of the town.

In 1829[3] the water engine was still the main source of

[1] *Derby Company of Mercers*, ed. by H. H. Arnold Bemrose, in D.A.J., vol. 15. Original minute book in Derby Pub. Lib.

[2] *Cal. of Anc. Records*, No. 285.

[3] Glover, II, p. 417.

supply to the town, but when Glover says the reservoir was on the top of St. Michael's Church, he is merely quoting Hutton's words without acknowledging the quotation.

Bagshaw[1] in 1846 adds the information that there were four miles of pipes carrying water to the consumers.

The frontispiece of Simpson's *Walks through Derby*, 1827, taken from an old picture shows Sorocold's wheel and engine house before the silk mills were erected.

BRIDGNORTH, 1706. Mentioned by Ralph Thoresby as being one of the places where Sorocold put in a water supply, and although his name has not been discovered in local records, yet the character of the waterworks indicates the hand of Sorocold, and the reference to it being the work of those who erected the new water work at London Bridge is definite proof.

The earliest description of the Bridgnorth works is in Cox's *Magna Britannia*, vol. 5, 1727, p. 676, which thus describes it.

" The water here is very good and wholesome, with which the town is plentifully supplied partly by several conduits to which it is conveyed in leaden pipes from a spring half a mile from the town. This was the noble gift of the great benefactor to this place, Sir William Whitmore Bart., created 17 Jas. I, partly by a water engine, which throws up such a quantity of water of the Severn (as is sufficient for the whole town) to the top of the Castle Hill, which is sixty yards higher than the river. This wondrous piece of art was performed by those that erected the new waterworks at London Bridge."

The water was carried through a four inch main to a cistern having a capacity of about 6,500 gallons.[2]

The wheel and pump house is figured in Buck's view of Bridgnorth, published in 1732, but there is a better picture of it in R. Godfrey's engraving after Paul Sandby,

[1] Bagshaw, S., *Hist. etc. of Derbyshire*, 1846, p. 81.
[2] Bagshaw, S., *Hist. etc. of Shropshire*, 1851, p. 618.

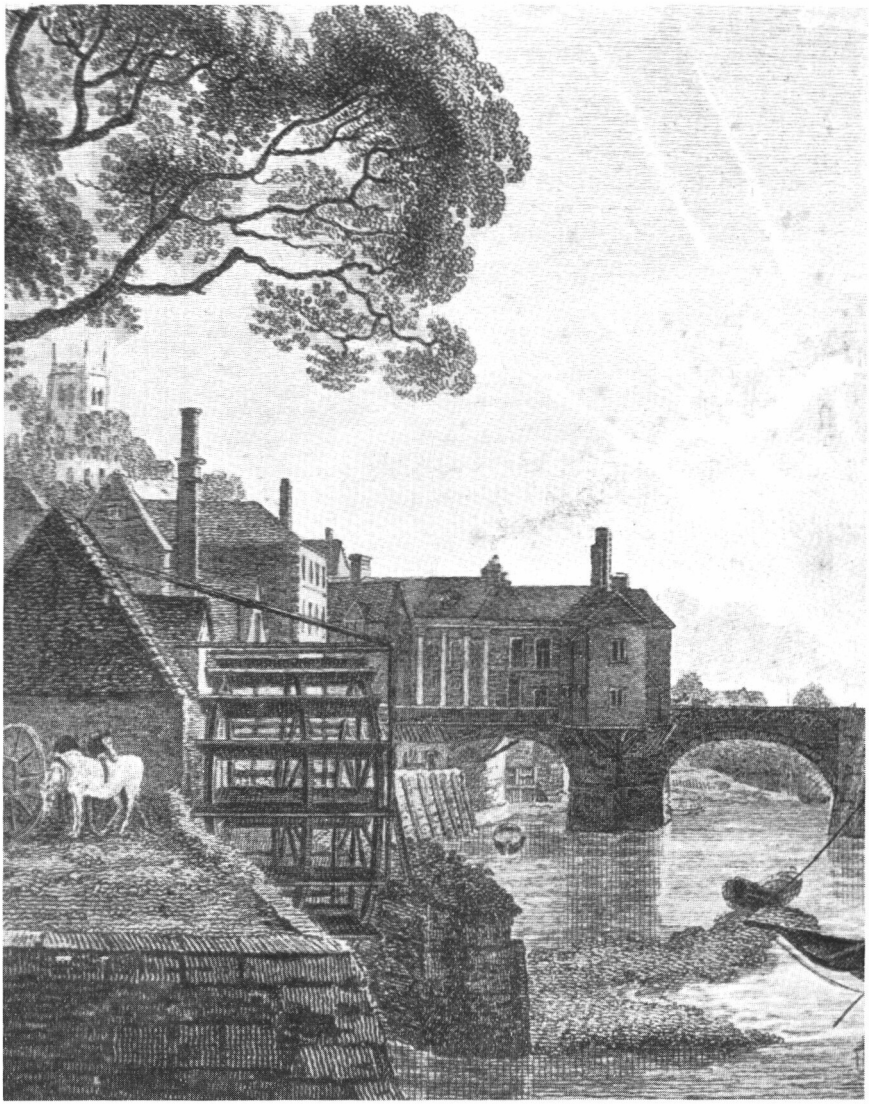
R.A., c. 1778, which through the kindness of Dr. W. Watkins-Pitchford, of Bridgnorth is reproduced to illustrate this paper. It shows the water-wheel, and the 'engine-house' adjoining, in which were housed the pumps, this arrangement being usual with Sorocold's installations.

The wheel and pumps continued to be the source of supply until 1857, a continuous life of 150 years, when a steam-engine and reservoir were constructed on the other side of the river.

BRISTOL, 1696. One of the towns where Thoresby tells us that Sorocold put in one of his installations. In 1696 an Act of Parliament[1] was obtained for supplying the City with fresh water, and a fair account is given by Barrett, in his *History of Bristol*. Although Barrett does not mention Sorocold that is no reason for doubting Thoresby's word, if Sorocold were only interested as engineer. It is curious to note a Richard Berry as one of the undertakers, who might be the Richard Barry who was associated with Sorocold in other undertakings.

"Besides these conveniences [conduits and pumps] for the supply of water, that no part of the City should be without this useful element, it was brought in elm pipes from a large pond or reservoir, a mile from Lawford's Gate, to the remote parts of the city that stand most in need of it for their families and businesses that require a great supply. This reservoir is filled by a large wheel engine, erected at a place on the bank of the Avon two miles above Bristol bridge. An Act of Parliament passed for this purpose [An Act for the better supplying the City of Bristol with Freshwater, received the Royal Assent, 10 April, 1696]; and in August 1696, Daniel Small, of London, draper, Christopher Fowler and Richard Goddard, of London, merchants, and Richard Berry and Samuel Sandford, citizens of Bristol, on behalf of themselves and

[1] *House of Commons Journals.*



Waterwheel and Engine-House at Bridgnorth constructed by George Sorocold, 1706.
From an engraving by R. Godfrey after Paul Sandby, R.A., *c.* 1778.
This is typical of many of Sorocold's installations.

others, contracted with the mayor, etc. for supplying the inhabitants with fresh water at reasonable rates."

They were allowed to bring their pipes through any person's lands (except houses, gardens and orchards) from Hanham Mills and other places, in aqueducts or pipes. "The undertaking was perfected at great expence, the whole being divided into 95 shares at £65 a share, and water brought in at the easy rate of 40s. a year to each family who reserved it."[1]

Celia Fiennes[2] who visited Bristol about 1698, describes nothing but conduits, which is rather remarkable as she seems to have been interested in water supplies.

In 1903 a number of elm-pipes were excavated, some of which had 2¼ in. plug-holes in the sides, evidently meant for service connections.[3]

DEAL. This was one of the towns where, according to Thoresby, Sorocold installed one of his water-engines, and here we discover the remarkable fact that two rival supplies were being installed at the same time and apparently both completed.

In 1688, James II granted letters patent, dated 21st July, to William Rider, and Edward Burdett,[4] giving them the sole liberty of building a conduit head, wharf, and other necessary buildings on the beach at Deal

What these two actually accomplished is not known, but 23 Jan., 1699/1700, William Warner presented a petition to the House of Commons setting forth that the town of Deal had always been short of water, and that he had found out a method "which had already cost him several hundred pounds and will do more" which the inhabitants were satisfied would effectually supply their wants, and prayed to be allowed to bring in a Bill.

[1] Barrett, W., Hist. etc. of Bristol, 1789, p 101.
[2] Op. cit.
[3] *Trans. Bristol & Glos. Arch. Soc.*, Vol. 27, p. 335.
[4] *House of Commons Journal*, 6 Feb., 1699/1700.

Leave was granted and Mr. Brewer brought in a Bill on 1st Feb. which was then read a first time.

Five days later (6 Feb. 1699/1700) William Rider presented a petition to the House, reminding the House of the Letters Patents granted to himself and Edward Burdett, and going on to say that the Patentees had been at great charges in bringing engineers from London to Deal to view the premises, and to direct what was necessary to be done (this is no doubt, where Sorocold came in), " But, the Petitioner is informed that one William Warner is endeavouring to advantage himself by the Petitioner's discovery, and for that end hath *begun* a work for bringing freshwater to Deal," prays to be heard by counsel before Warner's bill is passed.

Commons ordered the petition to lie on the table until Warner's bill was read a second time. On 14 Feb. the Bill and petition were read and the Bill negatived.

William Warner being for the moment cleared out of the way, Rider petitions again on the 16th inst., and to his preamble about his Letters Patents adds:—" But the Petitioner, who purposeth to supply water from a River called the North Stream, it being the opinion of able engineers, that it cannot be done by well-water [this sounds like Sorocold again], cannot effectually perform this undertaking without breaking up some small part of the soil of some persons, lying between the town and the river, and praying leave to bring in a Bill."

Leave was granted and Sir Robert Davers brought in a Bill on 21 Feb., 1699/1700, which was read a first time on 26 Feb., a second time on 29 Feb., and committed.

All seemed plain sailing for Mr. Rider, but Warner was by no means beaten. On the 16 Mar., 1699/1700, the Mayor, Jurats and Inhabitants of Deal presented a petition to the House in his favour, setting forth " that Mr. William Warner, about a year since, offered to erect a waterwork for supplying them with good water, and

begun the same at great expense, and hath made considerable progress therein, and the Petitioners being informed that Mr. Rider hath presented a Bill to this House to supplant Mr. Warner in his undertaking, which will be a great detriment to the Corporation, and praying that they may be heard by their Council against the Bill before the same do pass."

On the 13 Mar. the Committee having examined the Bill and heard Council, returned the Bill with some amendments, but when the question was put that the Bill be ingrossed—it passed in the negative.

A year later William Rider [spelled Ryder this time] petitioned the House again, 4 Mar., 1700/1, after introducing his Letters Patents goes on to say, " The interest of which Patent is also, by mortgage, vested in the Petitioner," he must have bought out Edward Burdett, and asks leave to bring in a Bill. This time the Marquis of Hartington and Sir Robert Davers were authorized to prepare and bring it in. It was duly presented and read a second time and committed on 20 Mar., 1700/1.

Even now Warner was not defeated and he presented another petition on 27 Mar., 1701, which provides a little more information. He states, " that having liberty from the Archbishop of Canterbury, and a lease for 99 years from the town of New Deale, to enable him to erect water works for the use, etc., hath expended about £1600 in the undertaking, which may be effectually completed within two months time; but William Ryder, esquire, hath obtained leave to bring in a Bill for supplying Deal with freshwater, notwithstanding that his Bill for that purpose the last session was rejected upon a petition of the inhabitants of the town against it, and praying that the Petitioner may be heard by his Counsel against the now Bill in this House."

The Committee examined the Bill and heard Mr. Warner, and made amendments to the Bill, which are not

recorded, and 8 May, 1701 it passed and was sent to the Lords. The Lords made amendments, striking out a paragraph referring to Rider and Burdetts letters patents, with which it passed, and on 12 June, 1701 the Act received the Royal Assent.

It might be assumed that Warner was prevented from going on with his scheme, but this was not so, as his authority did not rest on the consent of Parliament, and we learn from the *London Gazette*, 16-20 April, 1702, that "Mr. Warner and partners have actually brought very excellent water into the town of Deale."

Warner's scheme was to supply water from a well, while Rider's was to supply it from a river, and both appear to have been carried into effect and to have continued in use side by side until after the passing of the Deal Water Act in 1840.

EXETER, 1695. Exeter is not one of the towns where Sorocold is known to have acted as engineer, nor is he mentioned as one of the undertakers, but the system is so like others which he was known to have designed, that no apology is needed for mentioning it here. There is also the direct statement of Celia Fiennes that the Exeter plant was similar to those she had seen at Islington and Derby, which we know were Sorocold's.

"Behind this building [i.e. the Guild Hall which is still standing as she described it] there is a vast cistern which holds upwards of 600 hogsheads [31,500 gallons] of water which supplies by pipes the whole city. This cistern is replenished from the river, which is on purpose turned into a little channell by itself to turn the mill, and fills the engine that casts the water into the truncks which convey it to this cistern. The Water Engine is like those at Islington and at Darby as I have seen, and is what now they make use of in diverse places either to supply them with water or to draine a marsh or overplus of water."[1]

[1]Fiennes, *Op. cit.*, p. 209.

According to local historians an Act of Parliament was obtained in 1694 [there is no record of this in the House of Commons Journal], to convey water from the Exe. An engine on a very ingenious model was erected at the head of the New Leat, which notwithstanding the elevated situation of the city plentifully supplied, by wooden-pipes, such of the inhabitants, who on payment of an annual rent, are desirous of being furnished therewith.[1]

On 10 Nov., 1694, Jonathan Pyrke and Richard Lowbridge contracted with the Mayor, etc., concerning waterworks, and on 12 Feb., 1695 the Mayor, etc., made a grant to them of the waterworks of the city and several parcels of land for a term of 200 years.[2]

Oliver[3] mentions the second grant and elaborates it a little, giving the undertakers as Jonathan Pyrke, of Stowbridge, co. Worcester, gent., Richard Lowbridge and Andrew Crowley, of the same place, ironmongers, and Daniel Dennett, of Gloucester, carpenter, who agreed at their own expense to erect and maintain a water engine.

Celia Fiennes probably visited Exeter about the end of 1698, but she gives no definite dates, however, the plant was then quite newly constructed as can be inferred from letters in the City archives.

On 19 Feb., 1700 the Chamber was ordered by the House of Commons to furnish not later than 8 a.m. on 2 Mar., 1700, an account of the value of the Estate of which the City stands seized and possessed. In reply the Clerk had to say that the information could not be given as the accounts were not up to date, as " before that time expired the waterworks were taken in hand, and everyone was soe much busied thereabout that nothing could be done."[4]

[1] Jenkins, *Hist. of Exeter*, 1806, p. 193.
[2] H.M.C. *Records of Exeter*, p. 285.
[3] Oliver, *Hist. of Exeter*, 1861 ed. p. 149.
[4] H.M.C., *Records of Exeter*, p. 226.

Although, as I have said, Sorocold's name does not occur in any available record, I am certain that in 1694 there could not have been local engineers capable of designing a pumping installation similar to Sorocold's without his direct assistance.

ISLINGTON NEW WORKS. Thoresby says that Sorocold put in one of his installations at Islington New Works and Celia Fiennes tells us that the water-engine at Exeter was similar to those she had seen at Islington and Derby. Yet in all the accounts of the New River Works which I have seen, there is no mention of this. The New River was an artificial river originally 38¾ miles long (now 28), opened in 1613, and designed by Sir Hugh Myddelton to bring water from the river Lea; it is still an important source of supply for London. At various points along its length there are 13 deep wells from which water is pumped into the river, and Sorocold may have been responsible for one of these. In 1889 a founder's share was sold for £122,800.

KING'S LYNN, c. 1698. King's Lynn is one of the towns where Ralph Thoresby tells us that Sorocold put in one of his installations, and although local records do not confirm this it will be seen that a pumping system was introduced at King's Lynn about the time of Sorocold, so that there seems no reason to doubt Thoresby's statement.

Henry J. Hillen in his *History of King's Lynn*, vol. 2, p. 793 gives a fairly long and detailed account of the early water supply of the town. In early times, as was usual, water was carried in pipes to conduits, purely by gravitation, and there is no need to quote details. "In 1682 the common dike was recast and a wind-mill erected, whereby the water was raised, by means of tubs or barrels, from the river to a reservoir or 'condytt or receipt,' a wooden tank in a round tower of the town wall."

This of course was a more primitive arrangement than

Sorocold's, but " During the 18th century the water was raised thirty or forty feet either by horse-power, the wind, or a force derived from an artificial waterfall which worked a machine termed a water-engine. Horses, however, were seldom employed, unless there was an exceptionally dry season, or in case the other machinery was out of gear. The old water-engine was found to be in a hopeless condition, and as the ingenuity of the Lynn machinists was of no avail, a new engine was obtained (1780). Although the new machine, similar in type, but three times as powerful as the old one, was quite adequate to the requirements of the town, the Assembly suddenly decide to have nothing less than a Steam Engine."

A Newcomen engine was installed, but it proved so expensive in coal consumed that it was discarded and the old water-engine brought back into use.

An illuminating sentence in Hillen's book suggest that the water-engine must have been put in about 1698 or just a little earlier. " From 1686 to 1698 the expenses of maintaining the water-works exceeded the income by £288. 13s. 6d., the income being £1,338. 14s. 2d. and the disbursements £1627. 7s. 8d."

The large income seems to indicate a house to house service, although Hillen does not say so. If later accounts were available they would probably show a good profit after 1698.

LEEDS, 1694. In this undertaking Sorocold was associated with Henry Gilbert, of Netherseal (then in Leicestershire, but now in Derbyshire having been transferred in 1897), and there is a fair amount of information as to the sequence of events. Henry Gilbert may have been a surveyor, and I find that Mr. Mundy of Markeaton paid him the sum of £113. 16s. in 1686, but the entry does not say what it was for.[1]

The Corporation Minute Book of Leeds,[2] records the

[1] Mundy MSS. in Derby Pub. Lib. [2] Recently printed by the Thoresby Soc.

agreement made between the Corporation and the two engineers which is as follows.

" THE COURT of Major, Aldermen and Assistants holden for the said Burrough the third day of March in the sixth yeare of the Raigne of our Sov'aigne Lord and Lady William and Mary, by the grace of god over England, &c., King and Queene. [1694]

Whereas att a Meeting of the Major, Aldermen and Comon Councell Henry Gillert of Nether Soale in the County of Leicester, Esq., and George Sorocold of the towne of Darby, gent., have proposed and doe designe to lay an engine to convey water from the River of Aire through the streets to the sev'all houses within the towne of Leeds aforesaid or to soe many of them as shall purchase the same of them. This Corte therefore takeing the same into consideracon doe judge that it wilbe a worke of publique benefitt and deserves great encouragement, for the encouragement therefore of the said undertaking and in consideracon of the some of Forty pounds to be paid by the said Mr. Sorocold to the Treasurer of this Corporacon for the use and benefitt thereof doe order And it is hereby ordered that the said Mr. Sorocold, his heires, executors, Admi'strators and Assignes shall forever hereafter be exempted by reason of the profitts and rents which he or they shall make of the said water workes of and from all and all manner of taxes, layes and assessements to and for the poore Constable and highwayes, the Mill by which the said Mr. Sorocold conveyes the water and workes his engines onely excepted And that to be taxed and assessed att the onely usuall rate that it has bene taxed and assessed for seaven years last past."

Ralph Thoresby's diary has several entries which show that Sorocold lost no time in getting to work.

1694, July 12th. Sent for by Mr. Mayor, Mr. Recorder, and Mr. Sorocold, about waterworks.[1]

[1] Thoresby's *Diary*, vol. 1 p. 258.

1694, Aug. 22nd. Was several times with Mr. Sorocold's workmen, who this day first began in Kirk Gate to lay the lead pipes to convey water to each family.[1]

On the 1st October, 1694 the licence for laying pipes in the sheets was signed,[2] and under this date Thoresby duly records that he " dined with the Lords [of the manor] and with them subscribed Mr. Sorocold's lease for the new waterworks," although as we have seen the work was already begun. On the 17th of the same month Thoresby was " at the New Waterworks, a most ingenious contrivance." In his *Ducatus Leodiensis*, 1715, he makes further reference to the waterworks, " The engine . . . at Pitfall, is for conveying the river-water by lead-pipes to the several parts of the town, which was performed Anno, 1695, by the ingenious Mr. George Sorocold, the Great English Engineer." Further, in his museum, Thoresby had several rings of the different lead pipes used in Leeds, the gift of Sorocold.

The water-wheel was situated on the River Aire at Pitfall near the north-east end of Leeds Bridge and the reservoir was near St. John's Church at the top of Briggate, giving sufficient pressure to supply the houses. It will be seen that the Leeds installation was similar to the plants he installed at several other towns.

LONDON MARCHANT'S WATERWORKS, 1696. In 1696, Sorocold was engaged on a water supply scheme in London in association with John Hadley, the engineer who patented the rising and falling waterwheel in 1693. This we know from a letter[3] dated 3 Mar., 1696, written by Sir Godfrey Copley, Bart., of Sprotborough, Yorkshire, and M.P. for Thirsk:—

" To Thomas Kirke. I have been this day, and am to meet tomorrow, Mr. Saracole and Mr. Hadley. I have

[1] *Ibid.*, p. 261.
[2] *Manour Booke of Leeds*, Thoresby Soc., vol. 9, pt. 3, 1899, p. 281.
[3] *Cat. of Stowe* MSS., 747, f. 63.

seen his engine consisting of three mill wheeles with small cranks at each end of the axletree, which raises Tems water, and all are carried by one stream of kennel water . . . one wheel being under another, I do think the best piece of work I have seen."

This is very high praise from a man of Sir Godfrey's standing, as he was a Fellow of the Royal Society, and the Copley Medal, founded in 1736 under the terms of his will, is still the premier award of the society.

Copley was clearly referring to the installation known as Marchant's Water Works at Tom's Coffee-house in St. Martin's Lane. Hugh Marchant and others obtained letters patent in 1694 giving them the right to use all such waters as run down the common sewers within the Bill of Mortality—except those within the City and Liberties of London, and those invested in the City of London by Act of Parliament—for driving mills for raising Thames and other water for the supply of the public. Another patent in 1696 authorised them to erect over-shot wheels, lay pipes, etc., in the river, and to take Thames water for public purposes. Stephen Switzer, *Hydrostaticks and Hydraulicks*, 1729, describes the St. Martin's Lane plant as " the work of one, Mr. Sorocold, a very good engineer," and gives an illustration of the water-wheel, etc. An over-shot wheel was geared to a three-throw crank shaft, and each crank was coupled by a link to an intermediate point in an overhead lever pivoted at one end; the passage rods, three in number, were hung from the outer ends of the levers. Switzer does not mention the use of three water wheels in tandem as described by Copley.[1]

London Bridge Works, 1701. The early water supplies of London were from wells and conduits from which water was carried in buckets and carts to the consumers. Bridge water-works were developed in

[1] From a paper on Sorocold in the *Collected Papers of* Rhys Jenkins, where Switzer's illustration is reproduced.

Germany early in the 16th century, and in 1581 the Corporation of London granted a lease to Peter Morice (variously spelled Morryce, Moryce, Moris and Morris) said to have been a Dutchman or Fleming, but who none the less was a free citizen of London, to erect an engine within the first arch of London Bridge. This engine pumped the water up to a standard at the north-east corner of Leadenhall, and from thence supplied the eastern part of the City. Two years later a second arch was similarly leased. This was undoubtedly the first installation of pumping machinery in England for the supply of water for domestic purposes, and there does not seem to have been any extension of this system to the provinces until Sorocold's time. The Great Fire of 1666 seems to have quickly destroyed Morice's machinery, and in 1667 authority was given to Thomas Morris, a grandson of Peter, to rebuild his water-house adjoining London Bridge. The property remained with the Morris family until 1701, when Thomas and John Morris sold their rights to Richard Soame citizen and goldsmith, and others, for £38,000. Soame also obtained the lease of a third arch, actually the fourth arch in order from the river bank. In this arch a new machine was built to the design of George Sorocold, who was also responsible for reconstructing all the machinery.

Edward Hatton in his *New View of London*, 1708 says, "that besides the old work erected by Mr. Morris, the new, placed in the fourth arch of the Bridge, consists of two wheels with seven engines, set up about the year 1702, so there are in all thirteen engines. They are the contrivance of that great English engineer, Mr. Sorocold, whereby Thames water is raised from the north end of the Bridge to a very great altitude, by which means many parts of the city, etc., are served with Thames water. The flux and reflux of the water working the engine."

In the British Museum is a contemporary manuscript which also records Sorocold's connection with these works.

"There was an engine set up at the Bridge foot in Queen Elizabeth's time, for raising water to serve the City, and since improved. Lately they have taken in another arch of the Bridge, and the ingenious Mr. Seracoll hath contrived a most admirable machine there."[1]

Soame's company at the same time leased the City conduits for £700 a year and the company was divided into three hundred shares at £500 each, (£150,000 capital). When the company was dissolved in 1822 the shares had been increased to 1500.[2] The bridge was rebuilt at this time and the waterworks removed.

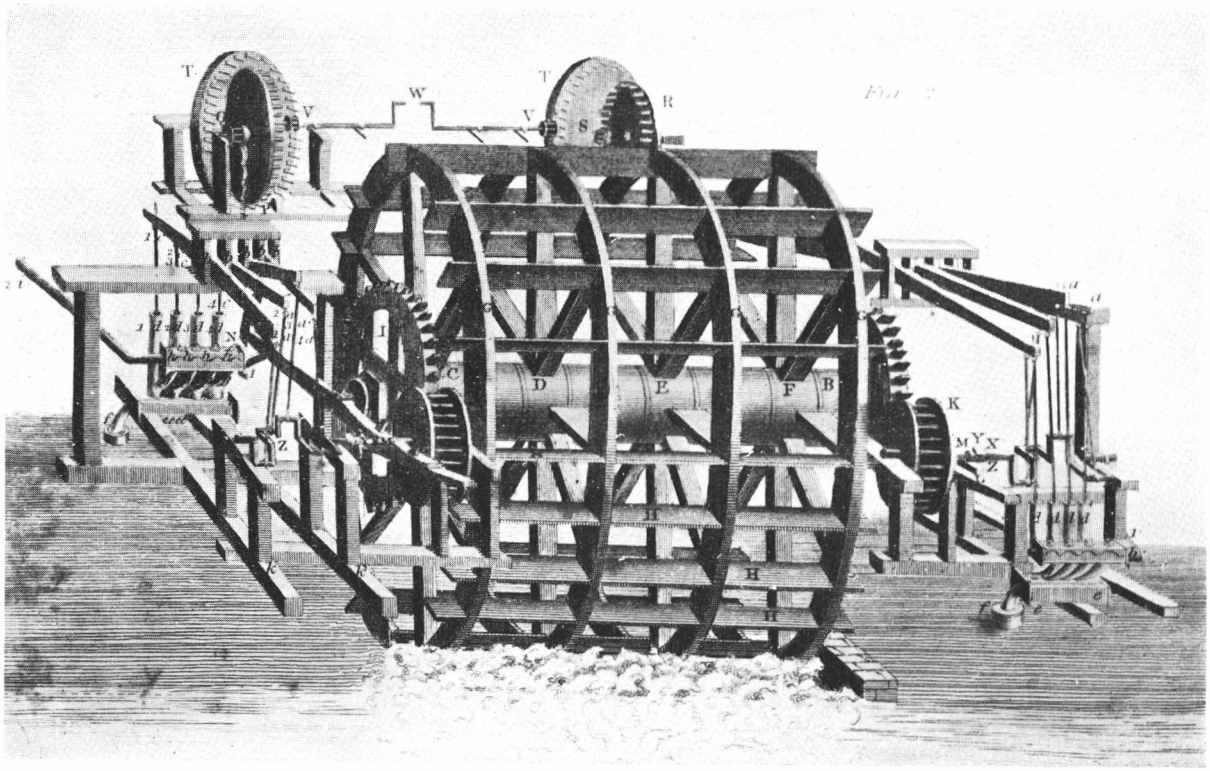
A detailed description of one section of the new works was given by Henry Beighton in the *Philosophical Transactions* 1731 together with an illustration which is reproduced with this paper (Plate VIII). Beighton's description has been briefly summarized as follows.

The waterwheel was 20 ft. diameter with floats 14 ft. long and 1.5 ft. deep. The wheel was coupled by gearing giving an increased speed in the ratio of 2.2 to 1 to two four-throw crankshafts, one on each side the waterwheel. Connecting rods from these crankshafts oscillated overhead beams, to the ends of which the pump rods were fixed, so that the one waterwheel worked 16 pumps. The pumps had bores of 7 in. and strokes of 2.5 ft. with the waterwheel turning at 6 r.p.m. the pump displacement was about 880 gals. per minute against a head of 120 feet equivalent to a h.p. of 32. The waterwheel could be raised and lowered to suit the state of the tide, a mechanism patented by John Hadley in 1693. This was found to be of little use and was seldom used.[3]

[1] Harleian MSS. 5000. Printed in the *Gentleman's Mag.*, 1807, p. 419.

[2] Foord, A. S. *Springs, streams and spas of London*, 1910.

[3] *Pumping Machinery*, vol. 2, p. 42, Science Museum Handbook; and *Collected papers of Rhys Jenkins.*



One of the Water Engines at London Bridge constructed by George Sorocold, 1701-1703. Reproduced from a drawing by Henry Beighton, 1731, in Philosophical Trans. of the Royal Society: abridged edition. Beighton shows only eight of the sixteen pumps for the sake of clearness.

The complete waterworks consisted of four waterwheels driving 52 similar pumps and it is said that 11,724 tons of water were raised per day. This is 1820 gals. per minute, and equals a water h.p. of 66.

Beighton says the machines at London Bridge were far superior to those so much famed at Marly in France which pumped water from the Seine for use at the Palace Gardens of Versailles, as the latter are very ill contrived in the cranks and some other parts.[1]

The timber-work was all admirably well executed; and the composition and contrivance, both for strength and usefulness, not exceeded by any he had seen.

Henry Beighton was in practice as a civil engineer, and a respectable member of the Royal Society, so that his account of the London Bridge Works is one to be respected.

MACCLESFIELD. One of the towns at which Sorocold installed one of his water-engines according to Ralph Thoresby, whose word we have no reason to doubt, but in this instance there is no comfirmatory evidence.

The only information available of any water supply at Macclesfield has been kindly supplied by Mr. Arthur Smith, of Gawsworth, who is engaged on a work on the Common Lands of Cheshire. He points out that Charles II in 1685 granted a charter to Macclesfield authorizing the Mayor, Aldermen and Burgesses to ' convey water in and through pipes or otherwise to the Borough of Macclesfield aforesaid from the springs in the commons or waste grounds near the borough.'

Mr. Smith says the water works established under this charter were gravitational and did not involve pumping, the commons being several feet above the level of the town. The supply thus conveyed sufficed until 1849 when it was augmented from a neighbouring valley.

[1] *Philosophical Trans. of the Royal Soc.*, abridged, vol. 7, from 1724 to 1734. London, 1809. Gives a key to the lettering on the illustration reproduced with this paper, and full extracts from Beighton's paper.

NEWCASTLE-UPON-TYNE, 1698. The work of Sorocold in relation to water supply must have aroused wide-spread interest and in 1694 we find Dr. Jabez Cay, of Newcastle-upon-Tyne writing to Ralph Thoresby, of Leeds,[1] for particulars of the water supply there.

Newcastle, 6th Nov., 1694.

Dear Sir,

Yesterday I received your kind letter enclosed in one from Whitehaven, I would beg a favour of you. I hear there is a man come to Leeds with a design to furnish the town with water, after a manner somewhat extraordinary; they say he forceth the water almost half a mile upon an ascent (the ascent being about four yards perpendicular in twenty), from the river to his conservatory [reservoir]. Now I would gladly be informed of the truth of this; and what sort of an engine it is by which he does all this, that I may know whether it be applicable to our coal works or no? and what the true height is, to which he raiseth his water? and whether his encouragement from the town be like to answer the expense of so great a work? . . . .

Sir, Your Servant,

Jabez Cay.

I have no information as to what resulted from Dr. Cay's enquiries, but on 14 Feb., 1698 a bill was promoted in Parliament "for better supplying the town of Newcastle with fresh water," and this passed the Lords, 10 June, 1698. The House of Commons Journal gives no information about the details of this scheme, but on 25 Feb., 1701, a petition was sent to Parliament by William Yarnold, gent., on behalf of himself and other proprietors and undertakers, setting forth that in pursuance of an Act passed in the 10th year of His Majesty's reign, and by a lease made by the Mayor and Burgesses, the petitioner has at great expense brought sufficient fresh water to serve

[1] *Letters of Ralph Thoresby*, vol. 1, p. 178.

the town, from a place called The Zeme, in the county of Durham, about four miles from Newcastle, and the High Sheriff had held three inquisitions to enquire what damage the owners of lands through which the water is conveyed, had sustained thereby, as the Act directs. And the petitioner asked leave to bring in a Bill to confirm the inquisitions and lease, etc.

NORWICH, 1694. One of the towns mentioned by Ralph Thoresby as having one of Sorocold's water-engines, and here we have direct confirmation of it.

As at other places the town relied on wells, ponds, streams and conduits until Sorocold came along with a direct supply to the houses.

In Sept., 1694 an agreement was made between the City of Norwich, and Richard Barry, of Westminster and George Sorocold, of Derby, gentlemen, that in consideration of £200 and a yearly rent of £25, they or their executors for 99 years should have the power to supply water and arrange for distribution " for the general use of such of the inhabitants as should at reasonable rates and rents purchase a share in the same, for the service of their respective houses or families, or for other conveniences."

Barry and Sorocold agreed to commence within nine months of the signing of the deed, and within six years to have lead, or wooden-pipes in the principal streets of the City. In case of fire the City retained the right to cut any of the pipes to obtain water to extinguish the fire.

By another agreement between the City and Richard Soame, merchant and George Sorocold they acquired a lease of the three water mills known as New Mills.[1]

Ordinarily the leases and licences granted by the City would have been sufficient, but for some reason unknown, on 14 Feb., 1700, a petition was presented to Parliament by " the Mayor, Sheriffs, Citizens, and Commonalty of the

[1] *Abstract of the several deeds . . . relating to the Water works and New Mills*, Norwich, 1786.

City of Norwich," setting forth that they had granted to Richard Barry, esquire, and George Sorocold, gentleman, several licences and privileges upon their undertaking to supply the inhabitants of Norwich with river water, and another agreement made between the petitioners and Richard Soame, merchant and George Sorocold for the same purpose.[1]

They thought it "absolutely necessary" that these indentures should be confirmed by Act of Parliament.

Leave to bring in a Bill was granted, which at the committee stage had a clause added for setting up lights within the City, and on the 21st Mar., 1700 it passed the Lords as "'An Act for confirming a Lease and certain Indentures between the City of Norwich, and Richard Barry, esquire, George Sorocold, gent., and Richard Soame, merchant; and for enlightening the streets of the said City."

Apparently Sorocold got to work before the act was passed, for when Celia Fiennes[2] visited Norwich about 1698 the work was in progress. She describes "A little building on which they were at work, design'd for a water house to supply the town by pipes into their houses with water."

NOTTINGHAM, 1696. There may have been other engineers constructing waterworks on the same principle as Sorocold, but if so we know less about their work than we do of Sorocold's. In the circumstances it may be excusable just to mention what little is known of Nottingham as the water engine there was on similar lines to the one at Derby.

The old Waterworks Company obtained a lease from the Corporation in 1696 and had a water engine on the River Leen at the bottom of Finkhill Street, and "the main wheel of the hydraulic machine set in motion a number of crank levers, and itself moved, like the great

[1] *House of Commons Journal.* [2] Op. cit., p. 120.

waterwork wheels at London Bridge, by the power of water. . . . leaden-pipes supply some of the lower parts of the town with water, while the higher parts are supplied from a cistern behind the General Hospital.[1]

This was the main source of supply until after the passing of an Act in 1822 for supplying water from the River Trent, which, of course, provided a much greater quantity of water, but this Act (p. 57) definitely prevented any interference with the old waterworks on the banks of the River Leen.

PORTSMOUTH, 1694. Another of the towns where Thoresby tells us Sorocold had erected one of his water-engines.

As usual the town relied on wells and conduits, but "there was, however, an abortive attempt to provide something better in 1694, when a lease was granted to Richard Barrey, of London, and George Surracolde, of Derby, empowering them to dig up the streets, lay pipes, and supply the town with good and wholesome spring water for a term of 99 years. There is however no record of anything being carried out, and presumably the powers lapsed."[2]

Sorocold was associated with Richard Barry at Norwich, and in view of the reliability of Thoresby as a recorder, and of Sorocold as an engineer, I am inclined to think that lack of supporting evidence does not cancel Thoresby's positive statement.

SHEFFIELD, 1697. Sheffield is not mentioned by Thoresby as one of the places where Sorocold installed a water-engine, nevertheless we have positive evidence that he did so, which out-weighs any negative assumption of local historians. Daniel Defoe in his "Tour," 1727,[3] speaking of Sheffield, says "there is a fine Engine or Mill also for raising water to supply the town, which was done

[1] Blackner, *Hist. of Nottingham*, 1815, p. 25.

[2] *Guide to Postsmouth*, prepared for the British Association meeting held there in 1911.

[3] Everyman's ed. vol. 2, p. 184.

by Mr. Seracoal, the same who fell into the River at the throwing-mill[1] at Derby."[2]

The fullest account of water supply at Sheffield is that of Mr. William Terrey,[3] formerly manager of the Corporation waterworks, unfortunately he does not give any references so his authorities cannot be followed up.

According to Mr. Terrey the first distinctly artificlal water supply in Sheffield was the construction of a reservoir by a man named Barker from whom it got the name by which it is still known, Barker Pool. The water was carried from the reservoir in pails and barrels. In 1793 it was done away with, the name only remaining.

In 1697, Peter Whalley, an engineer of Nottingham, obtained a lease from the Duke of Norfolk (Lord of the Manor) of a piece of land just above Lady's Bridge, where the exchange Brewery now (1908) stands. This piece of land was known as " The Isle of Wight " or the Island as a mill goyt surrounded it. He also obtained the lease of another piece of land near Barker Pool, with license to break up the streets for laying pipes to supply the town with water.

It was Whalley's intention to erect an engine near the river, by which he could force up the river water to the reservoir at Barker Pool, whence it was to be distributed in pipes over the town. He had the support of the inhabitants, but died when he had only made small progress.

However the scheme was taken up by five public spirited citizens who seem to have taken over Whalley's leases. Although Mr. Terry appears to think this scheme was never carried out, the direct evidence of Defoe is in my view quite conclusive that the work was completed and by Sorocold who may have been called in after Peter Whalley's death, or he may have been associated with him in the first place.

[1] Throwing-mill = silk throwing or spinning mill.
[2] See ante, p. 57. [3] *History and Desc. of the Sheffield water works*, 1908.

Mr. Terrey says,[1] " it is almost certain that the repeated failures to pump water from the river into the town were due to the fact that the only means of conveying water was by wooden pipes. . . These pipes, though strong in the body, would be excessively weak and unreliable at the joints, and, though perfectly efficacious for conveying water downwards by gravity, would not be suitable for pumping water from a lower to a higher level."

Mr. Terrey is wrong in both arguments, for lead-pipes were used by Sorocold at Leeds in 1694, and wooden pipes proved strong enough to stand the pressure at many places throughout the country.

Prior to the Sheffield Act of 1830 all the water pipes in Sheffield were of wood, and there were thirteen miles of them. When taken up some had been in a century and none for less than seventy years, yet the pipes and even the wool packing in the joints were found to be as perfect as when they were put in.[2] This is a wonderful testimony to the value of these pipes. According to Mr. Terrey the pipes were bored by hand at Sheffield, but as we have seen Sorocold was boring by machinery at Derby in 1692.

SPROTBOROUGH. This was the seat of Sir Godfrey Copley, Bart., who, as we have seen, met Sorocold and Hadley in London in 1696, and it is not surprising to find that he had a water-engine installed on his property.

Ralph Thoresby tells us in his diary, that he was at Sprotborough on 15 Feb., 1703, " assisting Mr. Kirk and Mr. Arthington in taking a level for the new canal, that is now making from the water engine (which is very curious and conveys water to a large cistern upon the roof of the hall, a vast height from the foot of the hill) to the corn, mill, thence he can go to Coningsburgh Castle on one hand, or Doncaster on the other."[3]

It is true Thoresby does not mention Sorocold in connection with the water-engine at Sprotborough, but

[1] Op. cit., p. 14. [2] Op. cit, p., 22. [3] Thoresby's Diary, vol. 1, p. 412

there is a possibility if not a probability that it was his work, and possibly further information may come to light.

WIRKSWORTH. Thoresby tells us that Sorocold put in a water supply, but there is no other evidence available. Wirksworth is only fourteen miles from Derby, and it is quite possible that Sorocold put in a pumping plant at one of the lead-mines which at that time were very active in and around Wirksworth. Some sort of water supply there must have been as in 1827 new cast-iron pipes were laid down to give a better supply of water for the town.[1]

YARMOUTH, GREAT, 1694. This is another of the towns which, according to Ralph Thoresby, was supplied with water by Sorocold.

In 1694 the Corporation entered into an agreement with Richard Barry, of London, and George Sorocold, of Derby, to supply the inhabitants with good and wholesome fresh spring water. They proposed to collect a supply from wells on the Denes into a large reservoir, and distribute the water through the town by pipes for which purpose they had permission to break up the streets. A somewhat similar plan was proposed by Mr. Dodd in 1810, but, being opposed in Parliament, was abandoned.[2]

A later writer[3] describes Barry and Sorocold as "two adventurers from London," so they were in the language of 1694, but not in that of to-day, for 'adventurer' we should now say 'contractor.' The same writer goes on to say that their attempt was abandoned, as was another in 1753.

In view of Thoresby's definite statement, it seems unreasonable to say Barry and Sorocold failed in their undertaking.

The compilation of a record such as this would not have been possible without the assistance of many who possessed special knowledge of the history of the various

[1] Ince, Thomas, MS. notes on Wirksworth, 1827, in Derby Public Library.
[2] Manship, *Hist. of Gt. Yarmouth*, p. 307.
[3] In *Yarmouth Mercury*, 2 Mar., 1907.

places with which I have had to deal, and I cannot conclude without expressing my sincere thanks to the following:—Messrs. W. A. Atkinson, Knaresborough; Gilbert Berry, Librarian, Macclesfield; The Trustees of the British Museum; Messrs. Percy Clare, Reference Library, Bermondsey; H. W. Dickinson, Purley; A. A. Gomme, Librarian, Patent Office Library; R. J. Gordon, Librarian, Leeds; T. Walter Hall, Sheffield; William J. Harris, Librarian, Islington; George Hayward, Librarian, Norwich; Miss I. F. Jackson, Librarian, Deal; Rhys Jenkins, Hermitage, Berks.; J. P. Lamb, Librarian, Sheffield; Dr. E. Bosdin Leech, Manchester; Mabel Lady Mellor (née Serocold); Messrs. Henry Peet, Birkenhead; James Ross, Librarian, Bristol; H. Sargeant, Librarian, Portsmouth; C. H. Senior, Librarian, King's Lynn; Col. O. P. Serocold, Taplow, Bucks.; Arthur Smith, Gawsworth, near Macclesfield; Clifford Stott, Librarian, Rochdale; H. Tapley-Sopey, Librarian, Exeter; Major W. H. Tapp, Wimbledon; Thomas Thornton, Town Clerk, Leeds; Dr. W. Watkins-Pitchford, Bridgnorth; and R. G. Watlow, Librarian, Yarmouth.

POSTSCRIPT: After the foregoing was in print, Mr. John Hobbs, of Derby, drew my attention to three documents calendared in Moulton's, *Cat. of Palæography, etc.*, 1930, which show a connection between the district of Derby and the George Sorocold, whom I have assumed to be the grandfather of the engineer. The documents are dated respectively 1641, 1645, and 1647, and concern the assignment by George Sorocold, of Ashton in Makerfield, Lanc., gent., and William Whitfield, of Roby, Lanc., yeoman, to Anne Moseley, younger daughter of Rowland Moseley, esq., deceased, and sister of Sir Edward Moseley, of Rolleston, co. Staff. and Collyhurst, co. Lanc., of the manors of Etwall and Hardwick, co. Derby for the sum of £812.

This transaction was not known to Lysons and other local historians, who all make the manor of Etwall pass in 1641 direct from Sir William Gerard to Sir Edward Moseley, whereas it is clear from these deeds that there was a previous transfer.

Etwall lies six miles south-west of Derby, and Hardwick, now Hargate Manor is one mile further away in the same direction.