**Department of Public Utilities** 

City of Richmond, Virginia

GEORGE H. WHITFIELD Director

# WATERING THE CITY OF RICHMOND

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# WATERING THE CITY OF RICHMOND

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The City of Richmond differed from the earliest settlements in this country in that it was built according to a prepared plan from the beginning. In many instances a town began with a cluster of houses huddled about a point of natural vantage and extended into the surrounding territory along cow paths or in some other haphazard manner. Not so with Richmond. Colonel William Byrd II owned property at the falls of the James River and recognizing that, as this was the limit of navigation, it must become a trading point where the products of the up country would be exchanged for manufactured products which could be brought up the river in boats, and therefore a good site for a town. In 1733 he discussed the project with Major William Mayo, who agreed to lay out a town here and at the head of navigation on the Appomattox, Petersburg. This he actually did in 1737 and the settlement was established as a town by the General Assembly of Virginia according to the plan of Col. William Byrd in 1742. This act of the Assembly authorized the town to hold two fairs each year (with special exemption from arrest of those who attend the fairs) but made no mention of a public water supply.

The original town was laid off with straight streets crossing each other at right angles regardless of the slope of the ground. These streets are today as originally planned and have been extended in straight lines. No advantage was taken of the opportunity which the hills afforded to make attractive winding roads. It was a real estate development pure and simple, with the greatest possible economy of salable lots and successors of William Mayo have been likewise obsessed with the utilitarian advantages of straight streets and monotonous rectangles. The original plan was bounded by what are now called Broad, 25th, Cary and 17th Streets. The streets were numbered from east to west, 17th Street being then First Street. From south to north the streets were designated by letters, Main Street being E Street and Broad Street was called H Street.

Between D Street and the river there was a strip of land reserved as a Commons. A narrow stretch of water extended where the dock is now as far west as 15th Street to a point called Rock Landing where the "upper gas works" was afterwards constructed. In this narrow slip came many sail boats bringing merchandise from the east, and taking away tobacco and other products of the country west of the falls.

Toward the northeast the town extended up the steep slopes of Richmond Hill to the corner where St. John's Church was erected about 1741.

The western limit of the town was a short distance east of Shockoe Creek but building operations soon crossed the creek and began to cover the slopes of Shockoe Hill.

Ordinarily the creek was a clear brook that served the community well on wash day—and conveniently too, for the wet clothes could be spread out to dry on the green grass between the market and creek. A foot bridge was constructed over the creek on E (Main) Street to provide easy access to the new development in fair weather, but the boards had to be taken up for preservation when heavy rains converted the gentle stream into a roaring torrent rushing down the valley between the red hills on either side. Red hills gave the name to the original Richmond (Rouge Mont) and suggested the same appellation for the new town at the falls of the James. These hills were very much steeper than now and were deep furrowed with gulleys cut by rushing waters. There were numerous springs in the hills and pure water flowed down some of the ravines and supplied some of the needs of the community. The water from Bloody Run spring which was and still is flowing just above the present Fulton Gas Works was carried by means of wooden pipes almost to Shockoe Creek. By similar pipes, laid at private expense, water was carried from springs on Shockoe Hill to houses east of the creek. Also water flowed in an open stream from the Capitol across Main Street and through Virginia Street.

"I have obtained from the proprietors the use of the water from four springs on Shockoe Hill for the purpose of watering, by means of pipes sunk so low as to keep the water perfectly cool, that part of the town between Mr. Graham's lot on the Main Street and the Market Bridge but am apprehensive that these springs will not be sufficient. Could I procure the use of the water from the two at the Capitol I think there would be little doubt of having a sufficient quantity. Would you be good enough to mention it to the Governor and Council of State and know of them if their consent can be obtained, that I may have the use of the surplus water from the two springs after supplying the Capitol and Barracks."

Wells too were a source of public and private water supply. The digging of wells by the city was authorized in the articles of incorporation.

In May 1782, just forty years after the establishment of the town of Richmond the General Assembly enacted an act incorporating the town which "shall be stiled the City of Richmond." The free holders were authorized to elect "twelve fit and able men" who should "elect from among their number a Mayor, a Recorder, four Aldermen and the other six of whom shall be the Common Council. \* \* \* The said free holders, housekeepers, etc. shall be a body politic and corporate, by the name of the Mayor, Aldermen and Commonalty of the City of Richmond, and by that name have perpetual succession and a common seal. \* \* \* They and their suc-

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cessors, by the name aforesaid, shall especially have power \* \* \* to cause wells to be sunk and pumps provided."

A number of wells were dug at prominent street corners for general use and especially for fire and "hydraulion" companies. One of these old wells was uncovered last year at the corner of 21st and Main Streets and the wall was found to be in perfect condition.

A suggestion of the conditions existing in 1827 is found in an ordinance passed by the Council in November of that year.

"Whereas the Hall has at considerable expense, sunk several wells and placed pumps therein on H Street and may from time to time sink others in like manner; and it is represented that sundry liberal and deserving inhabitants of the City of Richmond, have at their own expense, placed wooden pipes through which water is conveyed from the Basin of the Canal, through the Main Street of the said City as far as Shockoe Creek, and have erected Fountains or Jets in different parts of said pipes whereby many citizens are conveniently supplied with water;" Penalties were ordained for damaging or obstructing the flow of water in such pipes, fountains or pumps.

Following the war of 1812-14 there was a period of extravagant speculation. Lands were sold at prices far beyond their value and many new industries were promoted. This boom collapsed, of course, and there followed a period of substantial growth and rapid development. Many municipal improvements were also undertaken. The steep grade of Main Street was reduced by filling the lowest part and cutting the roadway down near 12th Street—operations that brought strenuous complaints of flooded cellars and exposed walls just as similar operations do today.

During the decade 1820-1830 the population increased  $33 \frac{1}{3}$ , and reached a total of about 16,000 people, 8,000 whites, 6,000 slaves, 2,000 free negroes. The corporate limits had been extended to First Street on the west and to Nicholson Street on the east.

The seat of government had been moved from Williamsburg. The bare mounds and gulleys of the Capitol Square had been converted to a well kept park at the summit of which stood the new Capitol building. The design of this building was adopted upon the recommendation of Thomas Jefferson. It is a copy of the Maison Quareè at Nismes, France, described by him as "an antient Roman temple, being considered the most perfect model existing of what may be called cubic architecture." It is said to have been the finest public building in America and from its prominent location it dominated the landscape. Numerous old pictures agree in showing nearby and hardly less prominent the Governor's mansion and the City Hall with its tall columns and dome. At some distance to the west the penitentiary stands out from the general landscape. This was also a suggestion of Jefferson's though designed in Baltimore. At one time it was proposed to locate the state prison at the approximate location of the new Public Library (First and Franklin Streets) but "Colonel Thomas Rutherford, disturbed at the prospect of such a neighbor arranged an exchange to the present site of the state prison."

The two markets were in use and two bridges, Mayo's and Trent's, connected the City with the Town of Manchester on the south side of the river.

One of the enterprises which contributed to the growth and importance of Richmond was the James River and Kanawha Canal. George Washington proposed this method of communication between the eastern and western sections of the country and came to Richmond to urge the chartering of the James River Navigation Company to construct and operate the canal. Boats traveled regularly along the canal and river as far west as Lynchburg, loading and discharging cargoes at a large warehouse at the foot of Seventh Street. The canal terminated in the Basin at a level above that of the business sections of D and E (Cary and Main) Streets.

In April 1828, a petition was made to the Council to construct iron pipes for the purpose of conducting water from the Basin down "D" and "E" Streets as far as Shockoe Creek. A committee was appointed to inquire into the practicability of doing this and this Committee recommended the construction at a cost of \$5,631.64, on August 29th. On October 17th a petition was sent to the General Assembly asking for authority to make this construction and charge the cost of the same to the parties benefitted thereby. On January 29, 1829, the General Assembly passed an Act authorizing the City of Richmond to have any streets watered upon the petition of the owners of two-thirds of the property and to levy a special tax



Designer of Richmond's Water Works.

against the owners of the property benefitted not exceeding twenty per cent of the cost to repay the City for the full amount of its expenditures. This is the first time that the City was authorized to construct a distribution system although it had provided numerous wells and pumps in various parts of the City.

In May, 1829 a number of property owners on "D" Street renewed their petition for a water supply from the Basin and after much discussion this petition was approved and the pipe line actually constructed as far as 14th Street.

A similar resolution was introduced by citizens whose property was on higher ground "to inquire into the practicability of supplying water for the extinguishment of fires and other purposes" by means of wells and reservoirs located north of H (Broad) Street. This resolution failed of passage. It carried an appropriation of \$20.00 for the expense incidental to the investigation.

By the next Spring the demand for a general supply of water throughout the City became so urgent that the time was ripe for councilmanic action. Along came one Albert Stein, said to be from Petersburg but more propably from Philadelphia, who made plans for a system of waterworks and interested some of the citizens who eagerly took up his definite proposals. On May 10, 1830 a petition from James Rawlings and others was introduced into the Council asking that plans and estimates be obtained "through a skillful, practical and experienced Civil Engineer for introducing into our City an abundant supply of good and pure water for all purposes." A committee was appointed immediately and apparently without opposition, with full authority to employ this engineer "to whom the Hall will pay a reasonable compensation" for the preparation of the necessary plans and estimates.

The following month, June 14th the president of the Council and chairman of the committee presented the following complete report:

"The committee appointed to procure the necessary surveys and estimates of the expense of supplying the City with good and pure water, and to whom were referred the petitions of the Citizens upon that subject, beg leave to report-That, in conformity with the authority vested in them by the Hall, they procured the services of Mr. Albert Stein of Petersburg,

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an Engineer of great skill and experience, who, under the direction of the Committee has made a survey of the river and of the adjacent ground and of a part of the City, and has also exhibited an estimate of the expense; all which are herewith submitted, with a letter from him on the subject. He proposes that the water should be taken out of the river a little below Mr. Rutherford's mill, and conducted by means of a canal to a point near the first arch. That, at that point a Pump house with a forcing pump should be erected, with power to raise by means of water power, six hundred thousand gallons of water out of the canal thus to be formed in twenty four hours, and deliver the same by means of a main pipe into a reservoir near Major John Clark's residence, which is eight feet higher than the residence of Mr. Charles Ellis, believed to be the highest point on Shockoe Hill. From the reservoir he proposes to bring the water to 1st Street, and has exhibited an estimate of the expense of supplying E (Main) Street down to 23rd Street; D (Cary) Street down to 18th; H (Broad) Street down to its intersection with Locust Street, thence along that street by Mr. John Rutherford's to E (Main) Street: 1st Street, 5th Street and 9th Street from D (Cary) to H (Broad) Street; and 13th, 15th Streets from D to E (Main) Street.

The whole cost of the work, including ten thousand dollars for the head race, dam etc. according to his estimate, is ninety thousand six hundred dollars; to this expense will necessarily have to be added, the expense of purchasing the water power, a site for the erection of the Pump house and sufficient ground for the reservoir, and liberty of putting down the pipes upon private property. The pipes thus proposed to be brought into the town are to be of sufficient calibre to supply the other streets of the City; so that the only additional expense in supplying them, will be the cost of the pipes and laying them down. Your Committee have applied to the James River Company and to Genl. Harvie, to ascertain from them upon what terms water can be obtained to work the machinery etc. The James River Company have in answer to the inquiry submitted to them, with great liberality offered to supply the Corporation with three hundred square inches

of water for the working of the machinery, which Mr. Stein considers an ample supply, and which will not be required upon an average more than four hours in the day, at the price of two hundred and fifty dollars per annum. The Corporation, in the event of entering into a contract with the Company, will have to procure sufficient ground between the canal and James River upon which to erect the machinery and your Committee have not been able to ascertain whether such site can be procured, or the terms: if the James River Company's proposition should be accepted, the cost of the head race, dam etc. would be saved. From Genl. Harvie your Committee this day received an answer to their enquiry (which is herewith submitted) in which he proposes, to supply the City with a sufficient water power to work the machinery, as well as with six hundred thousand gallons every twenty four hours for the supply of the City: to effect which, he proposes to erect the dam and canal, furnish the land for the erection of the Pump house and the privilege of passing the pipes through his land to the reservoir, for the sum of twelve thousand dollars. So that if Genl. Harvie's proposition should be accepted, the cost of supplying the streets above mentioned, would be ninety two thousand six hundred dollars, exclusive of the cost of the ground for the reservoir and of the liberty of laying down the pipes from the reservoir to the City, where it may be necessary to go through private property; the whole cost of which would it is believed be very trifling.

All which is respectfully submitted.

#### JOHN G. WILLIAMS, Chairman of Committee.

And the said report being read, a motion was made by Mr. Scott and seconded that the Hall come to the following resolution. Resolved that the said report be laid on the table: and that the Mayor be requested to convene a meeting of the qualified voters for the Common Hall on the 24th day of the present month at the Capitol, for the purpose of considering and determining on the expediency of executing the work referred to in the said report, or devising the best means for ascertaining the sense of the people thereon. And that the Editors of the Compiler and of the Constitutional Whig, be requested to insert the said report in their papers, three times each week until the said meeting shall be held. The question being then put upon the said resolution, the same was agreed to."

The meeting of freeholders was held and apparently great interest was expressed in the proposed plan of Mr. Stein's. The Council then asked the Mayor to obtain the number of families and other possible users of water on the streets to be "watered" and also asked for a vote of all who were legally qualified to vote for members of the Common Hall to be held on the 15th of July—that is within three days. The vote was conclusive and as a result an ordinance was passed on July 20, 1830, entitled "An Ordinance providing for watering the City of Richmond, authorizing the appointment of Commissioners for that purpose, and describing their duties, and for other purposes." This ordinance begins as follows:

"Whereas, by a recent vote taken of the legally qualified voters for members of the Common Hall, it appears that there is a decided majority in favor of watering the City agreeable to the plan submitted by Albert Stein to a Committee appointed by a meeting of the citizens held on the 24th day of June, last; and to carrying into effect their wishes it is necessary that the Hall should act in relation to the subject."

The ordinance then goes on to provide for the election by the members of the Common Hall of seven persons to be designated the Watering Committee, who should have the responsibility and authority for carrying out all of the details necessary to the construction of water works. This Committee consisted of: John G. Williams, Chairman, also President of the Council, James Rawlings, Samuel P. Parsons, John A. Lancaster, Samuel Sublett, John Bosher and Charles H. Hyde.

Thus was this great enterprise inaugurated seventy-one days after the original petition was presented to the Council by a small body of earnest and determined men.

The Committee held its first meeting three days after the passage of this ordinance, namely, July 23, 1830, at which meeting they did four things. They elected a Secretary, Charles H. Hyde.

They authorized the Secretary to secure a book to record the minutes of their meetings.

They made a proposition to Mr. Albert Stein to do all of the engineering work necessary for the design and construction of the water works for the sum of \$6,500.00 to be paid him upon the completion and acceptance of the work.

They voted to adjourn to meet the next morning on the Canal Bank near the Little Arch at sunrise.

And they did meet at sunrise, July 24, 1830, and selected the site for a dam and reservoir and instructed Mr. Stein to proceed with the construction of the Pump House which later became the Hollywood Electric Plant.

Thus did the Watering Committee begin to carry out the purposes for which they were elected and they continued to act promptly and vigorously until the complete plans of Mr. Stein were carried out in a satisfactory and economical manner. They held meetings early and often. After the work was well under way, they resolved to meet at the site of the new plant every Friday morning at sunrise. One day that summer they held two meetings. Later in the year they abandoned sunrise meetings. Possibly the sun rose so late that a meeting at that time would conflict with their business. Many problems arose but all were faced squarely and disposed of vigorously.

At their third meeting a letter was read from General Harvie in which he said that "the person upon whom I relied to make the estimate of the cost of the dam \* \* \* \* committed a very great error in as much as it turned out that the estimate was for 100 feet instead of 100 yards." General Harvie wanted concessions on this account, but the Committee said they would make none since his original proposal was a part of the information upon which the people decided and voted to construct water works, and they wanted to know at once whether he would stick to his proposition or whether the Committee should arrange to get their water and power from the James River and Kanawha Canal. He very promptly decided to stand by his original proposition.

However, General Harvie caused much trouble by the manner in which he did his work and because he became involved in a con-

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to the committee Resolved that the committee will meet, towners morning at Sumise at the title arch. Resolved that the Secretary be directed topsocure a book for recording the proceedings of the committee and the contracts. and then adjourned John & million of Char Holdy Do. Sets. July 24th 1830 The committee met this morning on the canal near the little arch. Present. Jas Rowlings, Sam? P Parions, Samuel Sublit John A Lancaster, John Boshes a Char Ho Hoy de. The chairman being absent Mr Rawlings was appointed chairman pro. tom. The committee after having examined the ground select a a site for the pump house ofor the reservice. Resolved that M. Stew be directed to surry a leve for the main pipe from the reservoir to the altor. a have road in a North " thistoric and along said road. to the commencements of Rutherfords live and also a direct live from the reservoir to the intervention of the Jaid soad with Ruther foods line and then adjourned Rmis Mawlings lehat & Hyde Lecty. July 28th 1830 A called meeting of the committee was held a this morning on 1st street Present I & Williams (chairmow) Las Rawlings, Same P. Parsons Samuel Sublett, John A. Laucas te, John Bosher stat & Hym The chairmans. laid before the commellee the following Communications from Gen? Harre

Second page of the minute book of the Watering Committee showing parts of the minutes of the first three meetings. troversy with the Canal Company who thought that their canal banks would be washed away. In all matters the Committee stuck by the judgment of their engineer, Mr. Stein, and required General Harvie to make good all the deficiencies pointed out by him.

Part of the machinery and fire hydrants were lost in transit from Philadelphia by boat.

In constructing pipe lines the Committee had great difficulty with Major John Clark who must have lived on what has been recently called the Clark Springs property.

The reservoir (afterwards called "the Marshall Reservoir") was built upon the site recommended by Mr. Stein and the plans called for pipes in direct lines from the pump house to the reservoir and from the reservoir to Main Street about Madison, crossing Major Clark's property twice. He objected to the way his land would be cut up and wrote to the Committee as follows: "The Committee I presume are aware, that pipes cannot be placed, in a direct line, from any part of my lot of ground to the centre of the City of Richmond, without passing two very deep and very wide valleys or ravines. If the pipes are to run horizontally or nearly so across those deep ravines, bridges at a great expense must be built. If the pipes are to run with the sloping sides of the ravines, I mean down one hill side and up the other, the pressure of water in the pipes, at the bottom of the ravines, will perhaps be so very great as to cause them frequently to give way and require repairs. But if a circuitous route should be adopted, the pipes might be carried nearly on a level by pursuing the present carriage road from the western side of my lot to the City, which, tho not in a direct line, will perhaps be found considerably less difficult and less expensive than a direct route passing over those deep ravines. I am far from wishing to obtrude any remarks of mine upon the attention of the Committee, but your letter seems to render them necessary and I therefore trust I shall be pardoned for saying, that if the most eligible route for their conduits should be adopted, it would not in my judgment pass through any part of my lot of ground.

Very respectfully, I am yr. ob. serv.:

JNO. CLARKE."





There were many other vexatious delays but finally all was in readiness and the James River Company was satisfied to permit the use of General Harvie's canal.

The Watering Committee decided that the occasion was worthy of public celebration and therefore adopted the following resolution:

"Resolved that Albert Stein, Esq., be and he is hereby requested to cause the reservoir to be filled on or before Tuesday morning next at 10 O'clock and that the chairman of this committee be requested to invite the Common Hall and the Hustings Court to accompany the committee on that day and hour to the Pump House and Reservoir for the purpose of examining the works."

The invitation was accepted and "a pleasant time was had by all" as is evident from resolutions passed at the next meeting of the Watering Committee. They accepted the water works, expressed "entire satisfaction" with the work of their engineer Mr. Stein and authorized payment to him, not only of the \$6500 fee which was withheld pending the "completion and acceptance of the work" but also \$18.55 "the cost of refreshments used on Wednesday last while examining the water works."

The committee instructed the chairman to draw up a report to the council to be signed by all members which report is as follows:

"Meeting at the office of J. G. Williams, Esq.

Evening February 17, 1832

Present John G. Williams (Chairman) John Bosher, James Rawlings and Chas. H. Hyde.

The Chairman laid before the committee the following report according to a resolution adopted this morning which report was agreed to and signed.

To the President and Members of the Common Council of the City of Richmond in Common Hall assembled:

The Watering Committee of the City of Richmond in addition to the report made to your body on the 5th day of January 1832 now take great pleasure in communicating to you that the water works so interesting to our fellow citizens, which were by Ordinance of the 20th day of July 1830 authorized and required to be constructed, and were committed to the Superintendance of your Committee, have been completed according to the original plan, with such alterations as were from time to time directed by your body and by this committee.-That your committee after having carefully inspected the said works in all their parts, and after having made full experiments with all the machinery, as well at the Pump House as at the Reservoir, and on and along the whole line of pipes, have at a meeting held on this day, come to Resolutions-That Mr. Stein our Engineer, has faithfully and to our entire satisfaction performed the duties required of him, by his contract in the premises-That the works ought to be received of him in discharge of his contract and that the same be and they are hereby received by your Committee, as competent to furnish an abundant supply of sweet and pure water for the use of our city. While your committee are anouncing to your body, intelligence so highly gratifying, as the fact of the introduction through all the contemplated streets of an abundant supply of water for all purposes, they avail themselves of the occasion to say that they feel themselves impelled by a sense of justice to Mr. Stein their engineer, to yield their most unqualified testimony to his superior skill, extraordinary attention and persevering industry, in the performance of the work, committed to his charge, by means of which your committee are assured, that the strength and permanency of the works have been rigidly consulted, and the pecuniary interest of the city has been essentially promoted. In the reception of the works herein referred to your committee, wish it to be destinctly understood that they have reference only to the works embraced by Mr. Stein's contract.

Respectfully submitted on this 17th Feby., 1832.

John G. Williams, Ch., Chas. H. Hyde John Bosher James Rawlings Sam'l. Sublett"

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A very complete description of the water works was made by Mr. Stein giving many details of construction and the expenditures up to the time of acceptance. This report does not include Mr. Stein's fee of \$6500.

The following report of the Engineer was received and ordered to be recorded:

John G. Williams esq.,

Chairman of the Watering Committee

#### Sir:

The duty which the Watering Committee of the City of Richmond have assigned me in the erection of the water works—I have performed—and in obedience to your instructions. I submit herewith a statement of the works.

The Pump House is of stone and brick 56 feet long and fifty eight feet wide the stone walls are carried up to a height of 18 inches above the center of the water wheel, and built with hydraulic cement, where they are exposed to the pressure of the water.

The house is intended for two wheels and two pumps—for the present only one wheel and pump have been put up. The pump room and forebays are arched, from the top of the stone walls with brick, over which is a terrace of 55 feet 8 inches long and 24 feet wide, paved with brick and railed and which will communicate by a foot bridge across the head race, with the towing path of the James River Canal.

The front wall of the Pump House is carried up with stone set in hydraulic cement to the top of the terrace.

The upper part of the Pump House is of brick 55 feet 8 inches long, 32 feet wide and 10 feet 9 inches high, and may be used, as a dwelling for the person, who has the care of the works.

A door leads from the terrace to the Pump room and platform, in front of the water wheel, on which is placed the gearing for raising and lowering the gate.

The wheel race is 11 feet 6 inches wide, built with masonry and the stones hewn and set in hydraulic cement; the stones of the circular sweep of the breast, are hewn to an exact arch



Pumping plant of the City of Richmond. The original building was one-half of that shown in the picture. The pumps were in arches under the terrace. The water was admitted through the gates shown on the face of the front wall and through arches between the pumps. of a circle so that the wheel passes very near to the sweep. The earth in front of the breast has been puddled to prevent leakage.

The forebay is 10 feet 6 inches wide and the bottom paved with brick.

The two gate openings in front of the forebay are  $4\frac{1}{2}$  feet wide and 3 feet high each and provided with gates which are raised and lowered on the top of the terrace by screws turned by a handle.

The front of the gates is surrounded by laths closely put together to prevent floating matters from entering the forebay, and to give still more protection to the pump and water wheel an additional grate of wire has been put up in the inside of the forebay.

The waste gate at the lower side of the Pump house by which the water can be drawn off from the head race is 4 feet wide and 3 feet high and is opened and shut by a screw turned by a handle.

The water wheel is of iron with the exception of the buckets and soleing, 18 feet in diameter, to the points of the buckets, 10 feet wide between the shroudings and 14 inches depth of shrouding.

The cast iron shaft of the water wheel is 10 inches diameter in the Journals and 16 feet 6 inches long.

The cast iron wall plates are 8 feet long and 16 inches wide; and are bedded in the top stones of the side walls which are built of hewn stone and set in hydraulic cement.

The crank wheel to which the connecting rod is attached is 7 feet in diameter, with a rim of  $3\frac{1}{2}$  inches thick and 5 inches wide and hooped with wrought iron around the sockets.

The head and fall of the water is 10 feet. The barrel of the double forcing pump is 9 inches in diameter, the stroke 6 feet in length and the pump intended to make 10 strokes per minute to raise 400,000 gallons into the reservoir in 24 hours. The thickness of the metal of the pump is  $1\frac{1}{2}$  inches. The valves of the pump are of brass  $\frac{7}{8}$  of an inch thick with Journals of  $1\frac{1}{2}$  inches diameter. The water way of the valve opening is equal to the area of the barrel.



The Air Vessel of the pump has a diameter of 3 feet in the clear and a height of 6 feet. The thickness of metal at the sides 2 inches and at the crown 3 inches.

At the end of the pump is a valve to retain the water in the ascending mains, in case of an accident to the pump or to relieve the air in the air vessel when the pump is at rest.

A stop cock is attached to the ascending main to draw off the water from the main in the pump house and a safety valve to ascertain the exact weight of water on the piston.

The pump is supplied with water from the forebay under a natural head.

The height to which the water has to be raised from the pump to the reservoir is 160 feet and the pressure on the piston when the engine is at work, supposed to be 6000 pounds.

The ascending main is 2400 feet in length and carried nearly in a straight line across the head race up the bank, and under the bottom of the James River Canal to the Reservoir having an air valve on the hill 106 feet above the water in the head race and a branch pipe with stop cock at the lowest level near Major Clarks 69 feet above the surface of the water in the head race.

The opening of the pipe into the reservoir can be closed when required by a gate, and a provision has been made to admit air into the ascending main when the gate is shut and the water drawn off from the main by means of the stop cock in the pump house.

A pipe of cast iron 15 inches in diameter and  $\frac{3}{4}$  of an inch thick, will be strong enough for a head of 600 feet hence the required thickness of a pipe of 8 inches diameter for a head of 200 feet would be 1/7 of an inch which is less than they can be cast with ordinary metal.

The ascending main is 8 inches in diameter from the Pump house up hill to a distance of 450 feet; and 9/16 of an inch thick from thence to the Reservoir a distance of 1950 feet.

If the pipes are sound there is no danger from bursting and the accidents, which may happen we must ascribe to the faults in the pipes and not to their thinness.





In order to prevent the delivery of defective pipes it was stipulated in the contract, that all the pipes should be proved at the furnace in presence of an agent by a pressure equal to a column of 300 feet of water.

Pipes of 8 inches diameter and  $\frac{3}{4}$  of an inch thick are laid along side of the ascending main across the James River Canal in order to lay hereafter the additional main without interfering with the navigation of the canal.

The Reservoir is at an average of 194 feet long 104 feet wide and 10 feet 8 inches deep and contains upwards of a million of gallons. It is divided into 4 apartments of which two serve for filtering, and all the apartments are connected together at the bottom by cast iron pipes of 10 inches diameter, with gates attached to them.

The walls are built of brick and grouted—the side walls are 7 feet high and built with common mortor. The partition wall which divides the Reservoir into two equal apartments and the walls around the filter are 12 feet 9 inches high and built with hydraulic cement. The remaining part of the bank above the top of the side walls, is sloped and paved with pebbles. The bottom of the Reservoir is paved with brick. The top of the partition wall of the reservoir is 12 feet above the highest ground in the city and 182 feet above the top of Market bridge E Street which is the lowest point in the line of pipes.

The filter is 22 feet 6 inches long and 16 feet wide. The water is made to percolate upwards in filtering through a body of gravel and sand and whenever the quantity of pure water falls short by the lodgment of sediment amongst the gravel and sand, the water is made to enter at the top, and in passing downwards with considerable force carries along with it the sediment into the reservoir from which it is carried off through the ascending main by means of a branch pipe with a stop cock attached to it.

The body of gravel and sand through which the water percolates upwards consists of gravel at the bottom where the water enters which becomes finer and finer towards the top.

The floor on which the body of gravel and sand is 3 feet above the bottom of the filter and affords therefore sufficient space to remove the sediment, which may remain at the bottom after the body of gravel and sand has been cleaned.

atter the body of graver and state the size of the present It is doubtful with me, whether the size of the present filter is sufficiently large, to produce the required quantity of pure water. This is the first filter I have formed upon a large scale and I believe is the only one formed in the United States for the purpose of producing pure water for the supply

of a town. If an increase of demand of water, should make an additional filter necessary, it would be advisable to form one near the second reservoir, from which the water is conveyed to the city, and by this means form a communication between the two reservoirs. The perfection of the filter requires such arrangement, because the water should be as pure as possible before it enters the filter in order to produce the greatest quantity of pure water, and if the water passes through a body of gravel and sand of moderate height in the first filter and remains at rest for some time in the next reservoir it will deposit the greater part of sediment before it enters the second filter. The main pipe which conveys the water from the reservoir

The main pipe which conveys the trace relation a straight line to the city is 10 inches in diameter and runs in a straight line from the reservoir to E Street, a distance of 4140 feet, from where by an easy turn it continues along E to the intersection of 1st and E Streets 853 feet and along 1st to the middle of H Street, a distance of 1182 feet, whole length of main 6175 feet. The mouth of the main pipe can be shut by a gate and can

The mouth of the main pipe can be share by a gate be inclosed by a wooden frame surrounded with laths closely put together to prevent floating matter from entering the pipes. Air valves are placed on the main at the summit level and

Air valves are placed on the main at the valves are placed on the main at the pipesnear the Reservoir to discharge the confined air in the pipesand branches with stop cocks are attached to the main at the two lowest levels to clean the pipes when required.

two lowest levels to clean the pipes when required the Supposing the head of water in the reservoir above the orifice of the main 10 feet—the length of the main 6000 feet, the quantity of water discharged may be taken at 400,000 gallons for 24 hours and allowing 100 gallons to a private family



the above quantity would be adequate to the supply of 4000 families.

Pipes of 6 inches core are laid

Tipes of o month	2 806 feet
In E Street from 1st to 13th Succe	3,000 1000
In G Street from 1st to 5th Street	1,032
In H Street from 1st to 9th Street	2,614
In sth Street from E to H Street	1,182
In oth Street from E to H Street	1,182
Making	9,816 feet

Pipes of 4 inches core are laid	
In G Street from 5th to 9th Street	1,582 feet
In 5th Street from E to D Street	395
In oth Street from E to D Street	395
In H Street from oth to Locust alley	<b>1,74</b> 9
In F. Street from 13th to 18th Street	1,919

6,040 feet

Pipes of 3 inches core are laid	<i>c</i> .
In D Street from 9th to 18th Street	3,111 feet
In 12th Street from D to E Street	395
In Locust alley from H to E Street	1,238
In 18th Street from D to E Street.	395
In F Street from 18th to near 24th	1,874

7,013

Stop cocks are placed at the intersection of pipes to shut off sections of pipes for repairs and in order to be easily found they are placed in the line of the houses.

For the extinguishing of fires 31 fire plugs are erected along the line of pipes.

We commenced laying of the 10 inch pipes in the intersection of 1st and E Streets, October 15th, 1830.

The private pipes are attached to the main by driving a

tapering ferule into the hole that has been previously drilled in the main with the first length of lead pipe soldered to it. The hole is drilled in one of the swells of the pipe. The pipes and other castings were delivered by Messrs. Saml. & Thos. S. Richards of Philadelphia in Richmond at the following prices:

10 inch pipes 9/16	of an incl	n thick	\$1.38	per foot
8 inch pipes 3/4	of an incl	h thick	1.25	66
8 inch pipes 9/16	of an incl	n thick	<b>I.20</b>	66
6 inch pipes 7/16	of an incl	n thick	.70	66
4 inch pipes 1/2	of an incl	n thick	.50	**
4 inch pipes 7/16	of an incl	n thick	.45	66
3 inch pipes 7/16	of an incl	h thick	•37	"
3 inch pipes 3/8	of an incl	n thick	•34	"
Branches, sto	op cocks e	tc. at \$55 per ton		
Plain casting	gs	50 per ton		

The stop cocks and fire plugs were made by Messrs. John Mingle & Son in Philadelphia at the following prices: 10 inch stop cock with brass faces cast iron excepted \$70 8 inch stop cock with brass faces cast iron excepted 56 6 inch stop cock with brass faces cast iron excepted 44.50 4 inch stop cock with brass faces cast iron excepted 30 3 inch stop cock with brass faces cast iron excepted 28 A fire plug including eye bolts cast iron excepted 16 In the erection of the water works has been expended

In the creetion of the water works has been expe	mucu
For iron pipes, branches etc.	\$25,095.57
For stop cocks, fire plugs etc.	2,383.55
For pump and water wheel	4,500.00
For gate gearings at the Pump house	290.
For Pump house	14,142.
For Reservoir	6,661.
For laying the pipes.	10,958.83
Being together	\$64,030.95
Adding to this the cost of the water power.	12,000.

ng		ne co	DSL OI	the	water	power .	- 1000 B	12,000.
	Making	the	total	cost				\$76,030.05

And add to this the amount	
of the articles on hand \$2,379.23	
to supply private families 1,000.25	
lost in the packet 637.62	
of the 12 pipes of 10 inch	
sold by A. Stein 152.50	
	dt
	\$ 4,169.60
amounting together to	\$80,200.55
From which must be deducted the balance	
for water power	3,339.72
From which must be deducted the balance for water power	3,339.72

Leaves the sum paid by the Chamberlain up to the 6th Jany 1832.....\$76,860.83 I am Sir Your most obedient Servant

Jany 7, 1832

Albert Stein