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**REPORT**

*Jeremiah Park*

*2 mo 5. 1823*

**OF THE**

**WATERING COMMITTEE,**

**TO THE**

**SELECT & COMMON COUNCILS**

**OF THE**

**CITY OF PHILADELPHIA.**

**READ JANUARY 9, 1823.**

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**1823.**

**SELECT AND COMMON COUNCILS**

OF THE

**CITY OF PHILADELPHIA.**

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THE great work at Fair Mount, with which the Watering Committee have been intrusted, being now brought to a conclusion so far as it is contemplated at present to extend it, the Committee think it will be acceptable to Councils, as well as to their fellow-citizens, to have a detailed account of the nature of the work, its value, with its cost of time and money.

The small and expensive supply of water by the Steam Engines, induced the Watering Committee, in the fall of 1818, to inquire into a more economical means of furnishing the City, which it was found could be obtained by the erection of a dam and other works, at Fair Mount, on the river Schuylkill, if permission could be had from the Schuylkill Navigation Company, who had an Act of Incorporation for the improvement of that river, and if the right of White & Gillingham

to a Water Power at the Falls, about five miles above the City, could be purchased. Both these objects, it was found, could be obtained;—the first, by an agreement with the Navigation Company to erect locks and a canal on the west side of the river, opposite Fair Mount, at the expense of the City; and the other object, by a purchase from Messrs. White & Gillingham of their Water Power, for 150,000 dollars.

When arrived at this stage, the subject was submitted to the Councils of the City, who unanimously approved the measure; and, with a feeling of public spirit, (which, while it relied upon the good sense of their fellow-citizens for support in the prosecution of so important a design, was nevertheless willing to encounter all the responsibility of commencing it,) appropriated 350,000 dollars to the object. The same disposition has been continued in subsequent Councils, to whose steady support the Watering Committee are indebted for their own regular progress in the execution of their important task.

On the 19th of April, 1819, the work was commenced by Captain Ariel Cooley, with whom a contract was made for the erection of the Dam, the Locks and Canal, the Head Arches to the Race, and the excavation of the Race from a solid rock, for the sum of 150,000 dollars. This work is a monument to his memory; and he had near-

ly completed it when he was taken off by a disease, supposed to have been contracted by his exposure to the sun and night air, at the closing part of his work. His talents, his integrity, and his general worth, will long be held in grateful remembrance by the citizens of Philadelphia.

It will be proper, in this stage of the report, to state the nature of the work that was to be accomplished, and to expose certain of its difficulties. The river is about nine hundred feet in width; one fourth of which, at the bottom, on the eastern side, is supposed to be rock, covered with about eleven feet of mud; the remainder is of rock. The greatest depth is thirty feet at high water; and it gradually shoals to the western shore, where the rock is left bare at low tide. The river, whose average rise and fall is six feet, is subject to sudden and violent freshets.

Mr. Cooley determined, where rock was to be found, to sink cribs, formed of logs, about fifty feet up and down stream, by seventeen or eighteen feet wide, which were sunk and filled with stone, and securely fastened to each other above low water, having the up-stream side planked from the bottom to the top; and the space immediately above, filled to some extent, with earth, small stones, and other matter, to prevent leakage. In that part where mud was found, the dam is made of quarry spalls and earth, and raised

about fifteen feet higher than the other part of the dam, which is an over-fall for the water; the base of this mound is at least one hundred and fifty feet, and its width on the top twelve feet; and the whole of the top, and of the up-stream side from the water edge, is paved to the depth of three feet, with building stone, to prevent washing by water, and injury from ice. Between the mound dam and the over-fall, there is sunk, on the rock, in twenty-eight feet water, a stone pier, twenty-eight feet by twenty-three feet, which supports the end of the mound, and protects it from injury by ice or water. The contraction of the river by the mound dam, suggested to Mr. Cooley the idea of forming the dam in a diagonal line running up stream, and when nearly over to run the rest of the distance at a right angle toward the shore, so as to join the head pier of the guard lock, on the western side, by which means a large over-fall was created, and the rise above the dam, in cases of freshet, considerably abated. The whole length of the over-fall is twelve hundred and four feet; the mound dam, two hundred and seventy feet; the head arches, which will presently be mentioned, one hundred and four feet, making the whole extent of the dam, including the western pier, about sixteen hundred feet, and backing the water up the river about six miles. The water power thus created is calculated to be

equal to raise into the Reservoir, by eight wheels and pumps, upwards of ten millions of gallons ; the lowest estimate of the quantity of water afforded by the river in the dry season, is four hundred and forty millions per twenty-four hours, and as it is calculated, allowing for leakage, waste, &c. that forty gallons upon the wheel will raise one into the Reservoir, the quantity raised would be eleven millions of gallons per day.

On the west side of the river there is erected a head pier and guard locks, whence there is a canal extending five hundred and sixty-nine feet to two chamber locks, of six feet lift each, by which the boats ascend or descend ; and below these locks there is a canal into the river four hundred and twenty feet long. The locks are built of dressed stone ; the upper canal is walled on the east side, and on the west it is rock ; the lower canal is formed of the stiff mud of the river, and covered with stone. The whole of the outer front of the locks and canal is protected by a wall on the upper part, and on the lower with stone thrown on the bank to prevent washing. On the east side of the river the whole of the bank was a solid rock, which it was necessary to excavate to the width of one hundred and forty feet, to form a race, and a site for the Mill-houses, running parallel with the river. The length of the mill race is four hundred and nine-

teen feet ; the greatest depth of the excavation, sixty feet, and the least sixteen feet ; the gunpowder used, alone cost the contractor upwards of 12,000 dollars. At the upper part of this excavation were erected the head arches, three in number, which extend from the east end of the mound dam to the rock of the bank ; thus forming a continuation of the Dam.

On the west of the excavation are erected the Mill-houses, forming the west side of the race, which is supported on the other side by the rock rising above it seventy or eighty feet perpendicularly. The south end, or wall of the race, is also of solid rock ; and the Mill-houses are founded on rock, so that nothing can be contrived more secure in all respects.

The race is about ninety feet in width, and is furnished with water through the head arches, which allow a passage of water of sixty-eight feet in breadth, and six feet in depth, to which the race is excavated below the over-fall of the Dam, and of course room is allowed for a continual passage of four hundred and eight square feet of water. These arches are on the north of the race, and the Mill-buildings being on the west, the water passes from the race to the wheels, which discharge the water into the river below the Dam. The gate of the centre arch is upon the principle of a lock gate, and admits the pas-



sage of boats, &c. into the race; at the south end of the Mill-buildings there is a waste gate, eight feet wide, by which (the upper gates being shut) the water can be drawn off to the bottom of the race. A ground plot and elevation of the Works are annexed, upon reference to which, the situation of the Dam, Locks, Mills, &c. will be seen at a glance.

The Mill-buildings are of stone, two hundred and thirty-eight feet long, and fifty-six feet wide. The lower section is divided into twelve apartments, four of which are intended for eight double forcing pumps. The other apartments are for the forebays leading to the water wheels. The pump and forebay chambers are arched with brick, and are perfectly secure from the inclemency of the winter. Those now in use are kept warm by means of two large iron stoves, heated to great advantage and economy with Schuylkill and Lehigh coal. A gallery will be erected, extending the whole length of the building, from which all the wheels may be seen at one view. The centre part of the buildings is one hundred and ninety feet by twenty-five feet, with circular doors to the pump chambers, and a range of circular windows over the arch ways of the wheel rooms; on a line with the cornice of the central part is the base course of two pavilions, with Doric porticoes, which terminate the west front.

One of these is used for the Office of the Committee ; and the other is the residence of an old and faithful servant of the Corporation, who has the general care of the property at Fair Mount. On the east front, immediately over the pumps and forebay rooms, is a terrace, two hundred and fifty-three feet long, and twenty-six feet wide, paved with brick, and railed, forming a handsome walk along the race, and leading by steps at the end to the top of the head arches, mound dam, and pier.

In the erection of the Mill-buildings, Mr. John Moore was employed as the mason ; and to his care and skill we are much indebted, not only for the excellence of the work in appearance, but for its substantial properties ; it being ascertained, that in the whole extent of the foundation along the race, under a six feet head of water, there is no leak. Mr. Frederick Erdman, the carpenter, also deserves particular notice, for his part of the work, which has been most faithfully done, and to our entire satisfaction.

It has been from the commencement determined, for the present to erect only three wheels and pumps, which are now completed, and with them the most important part of the duty of the Committee. The first of the wheels is fifteen feet in diameter, and fifteen feet long, working under one foot head, and seven feet fall. This

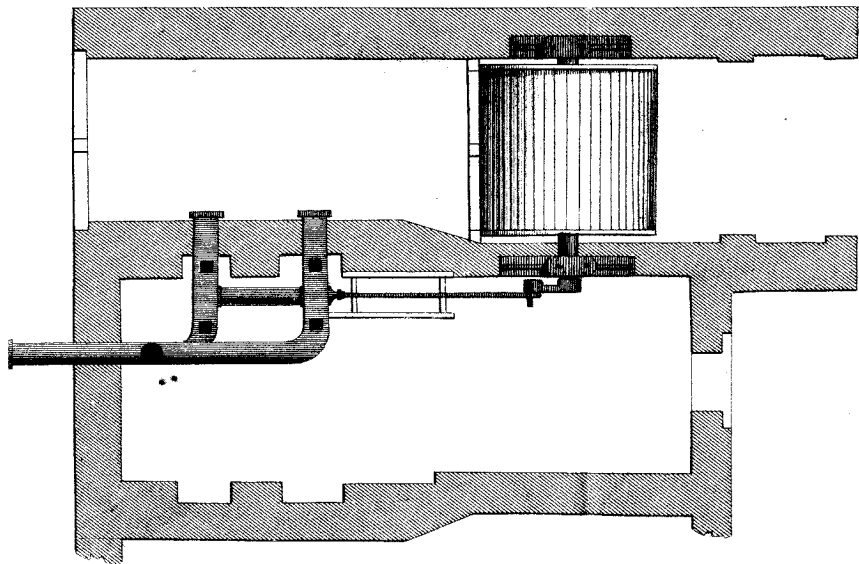
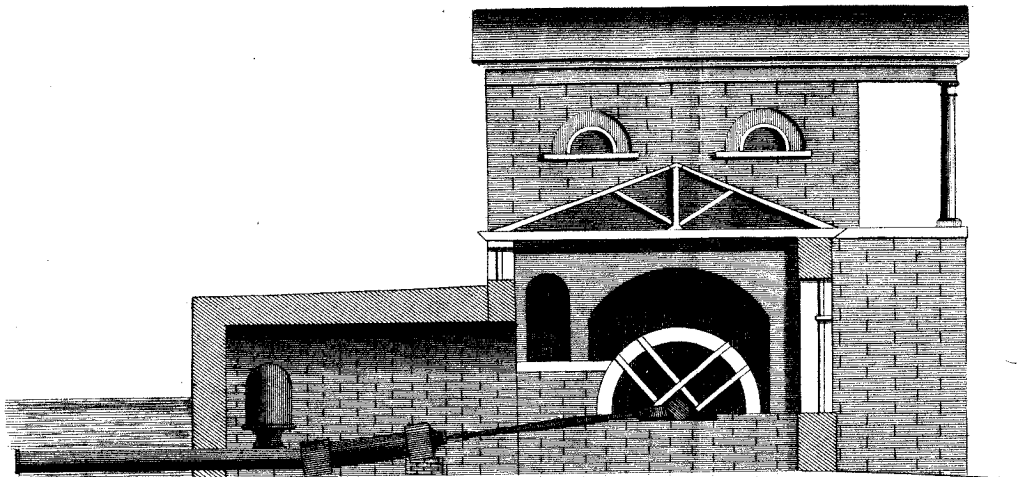
was put in operation on the 1st of July last; and it raises  $1\frac{1}{4}$  million of gallons of water to the Reservoir in twenty-four hours, with a stroke of the pump of four and a half feet, a diameter of sixteen inches, and the wheel making eleven and a half revolutions in a minute. The second wheel was put in operation on the 14th of September last; and is the same length as the first, and sixteen feet diameter; it works under one foot head, and seven and a half feet fall, making thirteen revolutions in a minute, with a four and a half feet stroke of the pump, and raising  $1\frac{1}{4}$  million of gallons in twenty-four hours. The third wheel, which went into operation on the 24th of last month, is of the same size as the second, and works under the same head and fall, making thirteen revolutions in a minute, with a five feet stroke of the pump, and raising  $1\frac{1}{2}$  million of gallons in twenty-four hours. It is not doubted that the second wheel can be made to raise an equal quantity; thus making the whole supply upwards of four millions of gallons in twenty-four hours. For the calculation of the water power, and the application of it to the pumps, with much valuable information in other matters connected with the works, we are largely indebted to Mr. Thomas Oaks, a gentleman of science and practical knowledge, now employed

as the Engineer of the Schuylkill Navigation Company.

The wheels are formed of wood, and put together with great strength. The shafts are of iron, weighing about five tons each. The great size and weight of the wheel give it a momentum which adds greatly to the regularity of its motion, so necessary to preserve the pumps from injury under so heavy a head as they are required to work, which is a weight of 7900 lbs. the height ninety-two feet.

The wheels being sunk below the usual line of high water, it might be supposed that they would be obliged to stop at that time; but this seldom happens, except in the spring tides, at the full and change of the moon, which, upon the average, stops them about sixty-four hours in a month. It is found that they are very little affected until the back water is about sixteen inches on the wheel. The excellence of the work in the wheels and gates, with the whole arrangement of the Mill Works, does the highest credit to Mr. Drury Bromley, whose attention has been most assiduous, and whose skill is of the first class.

The Pumps are the work of those ingenious engineers, Messrs. Rush & Muhlenberg. They are placed horizontally, according to a design of



PLAN & SECTION

*of the Water Wheel and Pump.*

Mr. F. Graff, and are worked by a crank on the water-wheel, attached to a pitman connected with the piston at the end of the slides. They are fed under a natural head of water, from the forebays of the water-wheel, and are calculated for a six feet stroke; but hitherto it has been found more profitable to work with not more than five feet. They are double forcing pumps, and are connected, each of them, to an iron main of sixteen inches diameter, which is carried along the bottom of the Race, to the rock at the foot of Fair Mount, and thence up the bank into the new Reservoir. At the end of the pipe there is a stop-cock, which is closed when needful for any purpose. The shortest of these mains is two hundred and eighty-four feet long: the other two are somewhat longer. The Reservoir next the bank is one hundred and thirty-nine feet by three hundred and sixteen feet, is twelve feet deep, and contains three millions of gallons. It is connected at the bottom with the old Reservoir, by two pipes of twenty inches diameter, with stop-cocks. This Reservoir contains four millions of gallons. All the water being raised into the Reservoirs, one hundred and two feet above low tide, and fifty-six feet above the highest ground in the City, is thence conveyed to the City, in a mode which will be pointed out when the Committee speak of the Iron Pipes.

On the 24th of October last, the steam-engines were stopped, and it is believed will never again be wanted. The satisfactory test to which the Dam was exposed, on the 21st of February last, by an ice freshet, which rose eight feet above the over-fall of the Dam, and which is supposed to be the greatest that has been ever known in the Schuylkill, has quieted all fears as to its safety, and done away all the objections that ever could be raised to a resort to Water Power, where Nature had kindly done so much.

In another Report, the Committee will submit the usual estimates for the coming year: in this place, they deem it proper to state the cost of the whole work done since the Ordinance passed, April 18th, 1819:—viz.

Purchase of White & Gillingham,	\$ 150,000
Erection of the Dam, Locks, Head Arches, Race, and Piers, includ- ing estimate of damages for over- flowing by the Dam, - -	181,000
Three Pumps, - - -	11,000
Mill-houses, Mills, and other work connected with them, - -	71,250
Iron Raising Mains, - -	4,480
New Reservoir, - - -	8,600
Amounting together to	<u>\$ 426,380</u>

A comparative view of the advantage of Water Power over Steam Power, will close this part of the Report.

By an estimate made by Mr. Graff, and exhibited to Councils, with the Report of the Committee on Water Power, on the 5th of February, 1848, it appeared, that the cost of working one steam-engine and pump for one year was 30,858 dollars; and it has been found, that with this expenditure, not more than 1,600,000 gallons could be raised in twenty-four hours; a very inadequate supply for the population of the City, consisting of above sixty thousand souls; without a gallon being afforded to the adjoining Districts, containing an equal number, and for whom, until the present period, there was no provision except by means of wells. If, therefore, it were required, at the same rate of expense, to raise an equal quantity with that at present afforded by three wheels, the cost would be upwards of 70,000 dollars; but, estimating the cost at only double that of one engine, it will amount to 61,716 dollars. From this is to be deducted the interest on the capital expended in erecting the Water Power and Works, which was 426,330 dollars, and was principally borrowed at an interest of five per cent., and amounts to 21,316 dollars annually, and also the expenses for wages, fuel, oil, &c., estimated at 1,500 dollars annually,



amounting together to 22,816 dollars, which being deducted from the sum of 61,716 dollars, leaves a clear annual saving of 38,900 dollars, equal, at an interest of five per cent., to a capital of 778,000 dollars.

As before stated, it is not doubted that the Water Power is sufficient to work five wheels and pumps, in addition to the three in operation, which would raise an additional quantity of more than six millions of gallons; and, estimating the saving on this quantity in the same ratio as before stated, the amount would be 103,000 dollars more, equal to a capital of upwards of two millions of dollars, and showing the whole saving or profit to be 142,000 dollars annually, a sum nearly double the amount of the City Taxes, exclusive of interest on the City Debt, which will soon melt away by the operation of the Sinking Fund.

The uses and importance of this water, it is impossible sufficiently to value. The additional cleanliness of the City,—the supply of the neighbouring Districts, for culinary purposes, as well as for purposes of refreshment,—the great advantage in cases of fire,—the ornament of fountains in the Public Squares so wisely provided by our Great Founder,—the benefit to manufactures,—and the establishment of Water Power in the City for various purposes, may be named

among the advantages of this New Work ; but above all we are to place its effect upon the health of a great and growing community, which of itself would justify a much greater expenditure.

Necessarily connected with this subject is the distribution of the water, after it has been raised to the Reservoirs, and the Committee therefore detain Councils a little longer, whilst they show what has been done on that head.

The former inadequate supply of water, derived through the Wooden Pipes of Conduit, from Fair Mount, and the constant vexation and expense, occasioned by the bursting of those in the streets, had long turned the attention of the Committee to the propriety of substituting Iron Pipes, but the experiments which had been made were not encouraging, and therefore it became desirable to get information from abroad : several attempts were made without success, until the Summer of 1818, when, through a respectable House in London, Mr. J. Walker, an engineer of much eminence, made a report, which was submitted to Councils, with a report from the Committee, on the 11th of November, 1818, and both were ordered to be printed.

At the same time, some of the Iron Pipes were procured, and the information derived was so sa-

tisfactory, that it determined Councils to commence the work with laying down a large Iron Main, from Fair Mount to the junction of Chesnut and Broad Streets. An appropriation was made of 70,000 dollars for this purpose, at that time, and other appropriations, equally liberal, have since been added for Iron Pipes.

The Work was commenced at the Old Reservoir at Fair Mount, into the bottom of which there was inserted a bell-muzzle pipe of thirty inches diameter, tapering off to twenty-two inches; this size pipe was continued along Hunter Street, which was filled up to a proper level for the purpose, at the expense of the City, and thence on the old Canal Bank, as nearly level as possible, to Callowhill Street, 2664 feet; the Pipe was then diminished to twenty inches diameter, and continued along Callowhill Street to Broad Street, and thence along Broad Street to Chesnut Street, 6909 feet. The opening into the Reservoir is closed when required, by a stop-cock. The whole quantity of Wooden Pipes, from Fair Mount and through the City, was about thirty-two miles in extent, all of which, in process of time, will have to be removed, and Iron substituted; but, in the meantime, the Committee have deemed it right to lay down some important Mains, even where the Pipes do not actually require taking up; for

instance, there is placed a ten inch Iron Main on the south side of Chesnut Street, extending from Broad to Water Street, and contracts have been made for Pipes of the same size, to be laid next season, on the north side of Chesnut Street, which will thus furnish an ample supply to both the north and the south part of the City.

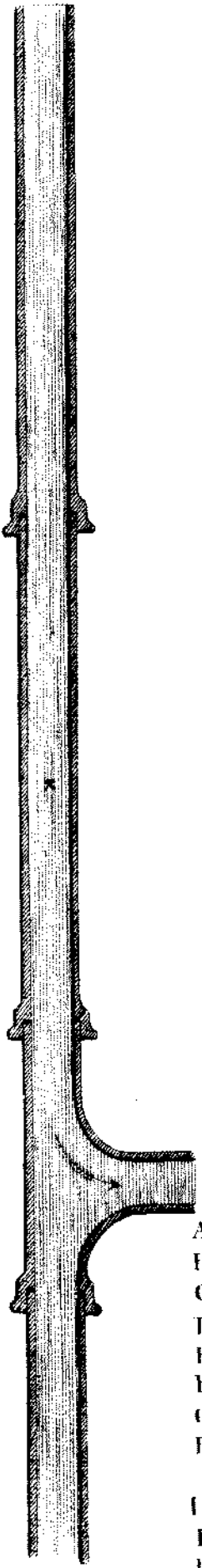
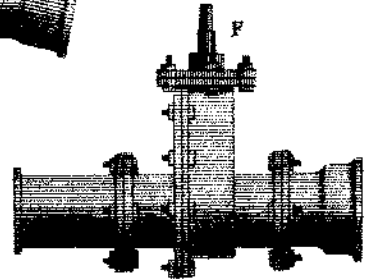
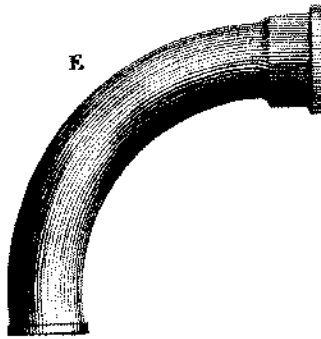
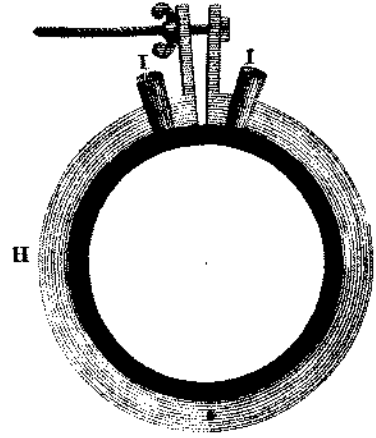
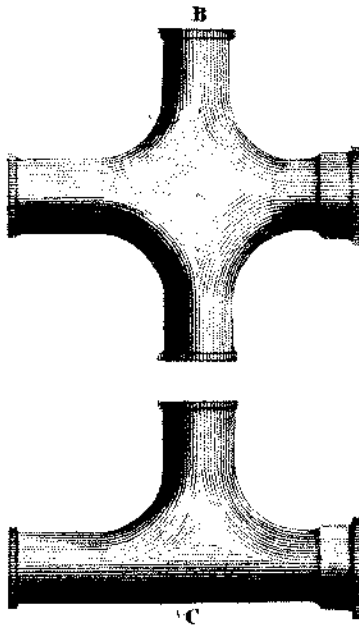
In High Street, six inch Pipes are laid on the south side, from Broad Street to Water Street, and are nearly completed on the north side, and will be entirely so, early in the Spring. Front Street, from Chesnut Street, with an eight inch Iron Main, is laid to Union Street, and will be completed early in the season from High to South Street,—the Pipes for both the abovementioned sections being all prepared. Walnut, from a little west of Sixth Street, to Water Street, is laid with six inch Iron Pipes, and some other streets are laid partially, where it was found to be necessary: the whole quantity of Iron Pipes now laid, is 35,205 feet, and in no instance has a leak been discovered. The contrast between this and former experience with the Wooden Pipes, is highly gratifying.

The straight Pipes are made in lengths of nine feet each, with what are called spigot and faucet joints: other Pipes, of a circular form, to pass round corners, are made of different lengths, as

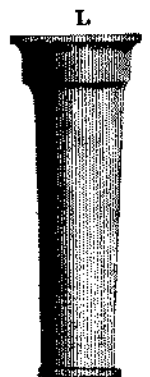
may be required, with easy turns, by which it is obvious the passage of the water is much facilitated; a Drawing of the different kinds of Pipes is annexed.

The laying of the Pipes is very easy, care being taken to keep them firm in their bed—the hub, or large end of one, laps about four to six inches over the small end of the other, leaving a space of from one-fourth to one-half of an inch all round, which is first caulked in with a ring of plaited hemp, to prevent the lead running into the Pipes; then a pair of nippers, with a joint in the lower part to fit all round the Pipes, and having an opening on the top for the lead, and another for the escape of the air, which will be shown in the annexed drawing, is affixed next to the opening on the outer part of the Pipe, so as to prevent the lead coming out in front, which is further secured by a ring of clay, outside of the nippers, and formed into a cap at top, into which melted lead is poured, forming a ring of lead three or four inches in depth. When the lead is cold, the clay and nippers are removed, and it is then upset with a hammer and chisel, which completes the joint.

Although the Iron Pipes cost more in the first instance, yet, with the experience this City has had with Wooden Pipes, there can be no hesitation in adopting Iron in preference to the latter.



- A Straight pipe 9 feet long
- B Double branch pipe
- C Single branch pipe
- D Bevel hub pipe
- E Circular pipe
- F Stop lock
- G Double hub pipe
- H Nippers or Screw Cramp placed around the pipe for casting the lead joints
- I Tubes for raising the lead in
- K Section of pipes with a single branch connected
- L Reducing pipe



The cost of Iron Pipes, it may be satisfactory to mention, is as follows:—

			D.	C.
22	inch Pipes, per foot,		6	25
20	do.	do.	-	5 00
16	do.	do.	-	3 33 $\frac{1}{3}$
10	do.	do.	-	2 40
8	do.	do.	-	1 66 $\frac{2}{3}$
6	do.	do.	-	1 10
4	do.	do.	-	64
3	do.	do.	-	45
1 $\frac{1}{2}$	do.	do.	-	40

These prices do not contain the prices of lead, laying, &c., as the difference of situation makes so material an alteration. The twenty and twenty-two inch Main cost 7 dollars and 42 cents per foot, on the average, but this includes the filling up of Hunter Street, &c.

The greater part of the Pipes now laid, or on hand, were made in the United States, and the Committee have never imported any when they were to be had here, except as samples, for the benefit of our manufacturers. In the first contract for the large Main, only one offer was made that could be accepted, and after the acceptance of the contract, the person who proposed for it preferred making only the twenty-inch Pipes, which induced the Committee to import the twenty-two inch Pipes. Since that time, none

others were imported until the last Summer, when one of the contractors failed in his performance, owing to an accident to his furnace, and the other contractor could not undertake to make more during the season in which the Committee had made arrangements to complete High and Front Streets. An offer being made to contract for the quantity thus deficient, to be obtained from England, an engagement was made for the deficiency, and the contract has been fulfilled. The sum paid to the manufacturers here, for Iron Pipes, and those now contracted for, amounts to 97,814 dollars and 20 cents, and the cost of those imported amounts to 16,940 dollars and 31 cents.

The Committee cannot close this Report, without presenting, in the most distinct manner, to the notice of both the Councils and the City, Mr. Frederick Graff, for many years Superintendent of the Water Works, whose taste in the design, and whose judgment in the arrangement, of the Works at Fair Mount, with his indefatigable zeal for the public interest, in every department, have attracted the regard and thanks of the Committee, and entitle him to those of the Councils.

All which is respectfully submitted,

By Order of the Committee,

JOSEPH S. LEWIS,

*Chairman.*

*January 6, 1823.*