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DEPARTMENT FOR SUPPLYING THE CITY WITH WATER.

HISTORY OF THE WORKS,

AND

ANNUAL REPORT

OF THE

CHIEF ENGINEER OF THE WATER DEPARTMENT

OF THE

CITY OF PHILADELPHIA.

PRESENTED TO COUNCILS, FEB. 9, 1860.

PHILADELPHIA;

C. E. CHICHESTER, PRINTER, 316 CHESTNUT STREET,
1860

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HISTORY

OF THE

WATER WORKS OF PHILADELPHIA.

OLD CITY WORKS.

**Chestnut Street Wharf and Centre Square Works—Steam Works
at Fairmount—Fairmount Water-Power Works.**

THE water supply to a great city is necessarily one of the most important and interesting features, upon which depends, to a greater extent, possibly, than any of its other advantages, either natural or artificial, its ultimate growth and prosperity. A short and condensed history of the Water Works of Philadelphia will probably prove interesting and useful at the present time, and may serve as a source of reference for the future.

In selecting a suitable location for this city, a wise and prudent forethought was manifested by its early founders, when, after mature deliberation and examination of numerous other localities, they decided upon this spot as the most eligible, and possessing natural advantages over all others. One of the principal reasons which led to this decision, was the abundant supply of most excellent water, in the form of numerous springs and brooks, which for many years supplied to those early settlers and their immediate descendants, all they required of this essential element.

The increase of the city, which, owing to its superior advantages, drew many persons to it, crowded buildings together in such

a manner as finally to contaminate the natural springs, while the drainage of the increasing city affected the brooks and streams, causing their once limpid particles to become loathsome to the senses, as they carried away the offal and filth of the growing city ; and now hidden from view in underground sewers, they continue to perform the same kindly service, even though their actual existence is forgotten by the multitudes who hourly pass over them.

Recourse was next had to wells and pumps, but although good water was found by digging but a few feet below the surface, in almost every part of the city, it was difficult to multiply them sufficiently to supply the rapidly increasing demand, and finally, even these became, in many cases, unsuitable for use, from the fact of the peculiar formation upon which the city stands. First, the thin stratum of clay, which in many sections of the city is wanting, covers a deep stratum of water-bearing gravel and sand, resting upon gneiss rock ; this water-bearing strata was reached by almost every cesspool ; indeed so great was the difficulty, that it became necessary to pass ordinances bearing specially upon their depth, location, &c. Notwithstanding all precautions, many of the pumps and wells were abandoned, and at the present day there is scarcely a well in the built-up portions of the city, whose water can be used for any purpose.

This increasing impurity of the water of the now flourishing and extended city, naturally caused much speculation regarding a proper remedy, and the subject was constantly agitated in the public prints as well as in private circles. As early as 1793 or 1794, BENJAMIN FRANKLIN publicly called attention to the fact that the ravages of contagious diseases, and particularly the yellow fever, which had but recently visited the city, were doubtless greatly increased by the limited and impure supply of water, and he pointed out the necessity and practicability of procuring an abundant supply from sources beyond the city ; his will bearing date of June 23, 1789, contains the following clause :

“ And having considered that the covering of the ground plot of the city with buildings and pavements, which carry off most of

the rain, and prevent its soaking into the earth, and renewing and purifying the springs, whence the water of the wells must gradually grow worse, and in time be unfit for use, as I find has happened in all old cities, I recommend, that at the end of the first hundred years, if not done before, the corporation of the city employ a part of the hundred thousand pounds, in bringing by pipes, the water of the Wissahickon Creek into the town, so as to supply the inhabitants, which I apprehend may be done without great difficulty, the level of that creek being much above that of the city, and may be made higher by a dam; I also recommend making the Schuylkill completely navigable."

And here it may not be amiss, to consider this suggestion of FRANKLIN'S which, although it has never been acted upon, and carried out, is none the less worthy a place in these pages.

The great error of the city, in relation to its water-works, has been the rejection of this simple and perfectly feasible plan, proposed by the great philosopher. At that time, the land lying adjacent to, and whose surface is drained by the Wissahickon creek, on both sides, could have been purchased at a very moderate cost; and thus the stream would have been forever protected from contamination. Then the erection of the dam, as suggested in FRANKLIN'S will, would have given an abundant supply to all parts of the city, at a superior head to that from which it is now derived, without the assistance of any pumping machinery; and as the demand increased, as it has continued to do every year, store reservoirs could have been constructed along up the stream, at a moderate expense, and to this day, an abundance of the purest water would have been procured from this source, adequate for all demands.

The adoption of this plan would have saved the city several hundreds of thousands of dollars, besides the delay and difficulty in constructing the former and present works. The Department have had occasion, during the past summer, to make surveys of the ground, and find that the plan was feasible; and were it not that the surface, drained by the creek, is so densely inhabited, and

were not so many manufacturing establishments located upon its banks, it would still be worth the serious attention of the city, if other sources could not be procured possessing equal advantages.

The increasing importance to the inhabitants of the city, of a full supply of water, caused Councils to take the matter seriously in hand, and in 1797, FRANKLIN's suggestion was discussed by them. They immediately set about procuring the necessary information upon the all-important subject, and various plans and devices were recommended. The first plan which seriously occupied their attention, was a proposal made to furnish the necessary supply of water, by the DELAWARE AND SCHUYLKILL CANAL COMPANY, known as the UNION CANAL. This company had a provision in its charter of incorporation, allowing them to supply such citizens with water, as might be disposed to purchase and use it. The following is an abstract from their communication to Council. The canal was intended to answer a double purpose, viz : " To form a capital link in the great chain of inland navigation between our metropolis and Ohio, and the western lakes, and as furnishing the best and most practicable means of introducing an abundant supply of wholesome water into all parts of the city and its suburbs. It is proposed to conduct the water of the canal into a grand reservoir, situated in Broad street, a little to the northward of Callowhill, from which a canal was to be cut along Broad street, the whole width of the city, and be bridged over at the crossings of each street ; this canal, it was calculated, would discharge about half a million of cubic feet of water into the different streets in one hour, which calculating only ten streets at a time, would send fifty thousand cubic feet into a single street or its gutters, in that time ; not only far more than sufficient to fill all the gutters, but to overflow and wash the streets, as well as to extinguish fires by night or day. This, the first object of cleansing the streets and subduing fire, may be accomplished in a few months, at inconsiderable expense. The distribution of the water in pipes of conduit, which may be accomplished by means of pipes fed from the canal, and run into private cisterns and public fountains, from which it could be pumped

by ordinary pumps, will follow, of course, at ten per cent. clear profit; for if twenty-five hundred families or houses only, on an average, were supplied, at five and a-third dollars per house, an income of £5000 would be produced."

This proposal met the approbation of Council, and the company were offered £50,000 for one-half of the water of the canal, or so much as would pass through a water-way twelve and a-half feet wide, by three and a-half feet deep. The offer was rejected by the company. Councils then endeavored to purchase the whole interest of the Canal Company, with all its rights and privileges; and petitioned the Legislature to grant to the city all the duties upon sales by auction, which then amounted to about \$16,000 per annum, to be devoted to the carrying out of this object. The mode of supplying the water by this plan, was to have it flow into reservoirs or cisterns, placed in the cellars or lower parts of the houses, thence to be pumped or carried as required. It seems evident, that the deep interest felt by the public in this enterprise, and the flattering prospects of the company, had a marked effect upon the judgment of the Councils.

In 1799, Councils again appointed a committee to examine the subject, instructing them to ascertain whether a sufficient supply could not be obtained by water-power, and whether such power could be secured within a reasonable distance of the city. This subject was submitted, by the committee, to Mr. B. H. Latrobe, who, after examining the Schuylkill, and a number of other streams in the vicinity of the city, reported that no such water-power existed adequate for the purpose; but recommended the bringing of Spring Mill creek, a distance of about twelve miles, by means of an aqueduct, into the centre of the city, from thence to be raised by steam-power. The estimated cost of this undertaking was \$275,000. Why the Wissahickon creek was overlooked by him, when it was so much nearer than Spring Mill creek, besides possessing so many more advantages, it is impossible to explain; particularly when we consider the superior talent and industry of Mr. Latrobe. It is possible that the novel idea of

raising the water by steam, may have so occupied his attention, as to cause him to overlook this source. This plan, however, was rejected by Councils.

CENTRE SQUARE WORKS.

Mr. Latrobe next recommended to Councils the plan of using the water of the Schuylkill river, by erecting a steam engine at Chestnut street wharf and another at Broad and Market streets, and supply the city by this most expensive, but then novel plan; for at that time there were not more than three steam engines, of any considerable power, in the United States, viz: one in New Jersey, one in New York, and one in this city, used by Oliver Evans for grinding plaster; and no city, as yet, procured its supply of water by means of steam pumping machinery. The plan was adopted by Councils, influenced doubtless more by its novelty than its practicability, and a contract was entered into with Mr. Latrobe for their erection, requiring, at that time, no ordinary skill and attention.

The first difficulty was to find a person of sufficient skill and experience to construct engines which should be powerful enough to perform the work. A contract was finally made with Nicholas Rosevelt, of New Jersey, for the erection of two steam engines of sufficient capacity to raise three millions of gallons, fifty feet high, per day, for the sum of \$30,000, the contractor to keep the engines in proper repair for five years. These, when finished, were the largest steam engines erected in the United States, and with the defective tools then in use, and the small experience had in such matters, it was a great undertaking.

The following description of these works, by Mr. Frederick Graff, is taken from the annual report of the Watering Committee: "A basin was formed on the river Schuylkill at the foot of Chestnut street, extending from low water mark two hundred feet eastwardly, and eighty-four feet wide, provided with a set of tide lock gates. The bottom of this basin was three feet below low

water mark ; from this the water passed through a sluice to a second basin—or rather an open canal, forty feet wide, and one hundred and sixty feet long : the sides of both those basins were inclined, paved and coped with marble ; at the head of the canal, was a sluice gate set in marble, which admitted the water into a subterraneous tunnel of oval form, six feet in its greatest diameter, and three hundred feet long, cut nearly its whole distance through solid rock, with its bottom placed level with low water, and emptying into a well in which were placed the pumps of the lower Schuylkill engine, situated at the north-west corner of Chestnut and Schuylkill Front streets. This shaft or well was thirty-nine feet deep, and ten feet diameter ; in it was placed the pump, the bottom chamber on a level with low water, by which the water was raised into a brick tunnel six feet diameter, and three thousand one hundred and forty-four feet in length, which passed up Chestnut street to Broad, and thence to the Centre Square engine house. The Schuylkill engine house was sixty-six feet by fifty-four, built in the most substantial and solid manner, and was intended to contain two engines and pumps, though only one was ever put into it.

“ The Centre Square engine house was an exceedingly handsome building of marble, the lower story being in form a square of sixty feet, twenty-five feet high, with two porticos containing committee rooms, offices and engineer’s room, and surrounding a circular building forty feet diameter, and sixty feet high, covered by a dome, from the centre of which was carried the chimney of the steam engines. The engines in both the buildings were very defective in every respect ; the lever-beams, fly-wheel, shafts and arms, cold water pumps and cisterns, being all made of wood. The boilers to both engines were wooden boxes, nine feet high, nine feet wide, and fifteen feet long ; made of five inch white-pine plank, securely bolted through and braced on the outside. The fire box inside of the boiler, was of wrought iron, with vertical flues of cast iron ; subsequently, a cast iron boiler was substituted. At this time, not any wrought iron could be obtained in larger sheets than

fifteen inches by three feet, when it was squared, which had to be done by the purchaser; all the castings were patched by gun boring, cement and hard solder; the important parts of the pumps had to be lined with sheet copper, before they could be made air tight. The main steam cylinder of the Centre Square engine, was cast in two pieces, united by copper, the joints being secured externally by a cast iron band eighteen inches wide, and although it was but six feet six inches long, and thirty-six inches in diameter, nearly four months were consumed in boring it out fit for use. The pumps were double acting force pumps, and at first were without air chambers; this necessary article was, however, added to the Centre Square pump in 1810, but could not be made useful until it was lined with sheet lead.

“The engine at Schuylkill engine house, was forty inches diameter and six feet stroke; the pump attached to it being seventeen and a-half inches diameter, and six feet stroke. The engine run sixteen revolutions per minute, and pumped, by actual experiment, 1,474,560 ale gallons of water in twenty-four hours, with a consumption of seventy bushels of bituminous coal. The Centre Square engine had a cylinder of thirty-six inches diameter and six feet stroke, a pump of eighteen inches diameter and six feet stroke, and by experiment pumped 962,520 gallons of water in twenty-four hours, with a consumption of fifty-five bushels of coal. The water was pumped by this engine into two wooden tanks in the top of the building, fifty feet above the bottom of the brick tunnel, leading from the Schuylkill engine house; one of these tanks was ten feet diameter and twelve feet deep, and the other, fourteen feet diameter and twelve feet deep, containing together, about 17,094 ale gallons. The engine was able to pump these full in about twenty-five minutes, and they were exhausted in about the same time. Therefore, if the pumps were not constantly at work, the citizens suffered for water; and from the very defective work about the engine and pump, this was frequently the case. The water from the tanks was conducted into a cast iron distributing-chest, from which was carried two wooden logs of six inch bore

down High street to Front street, one of four and a-half inch bore down Arch street to Front street, and one of four and a-half inch down Chestnut street to Front street, from which the water was distributed through logs of four and a-half and three inch diameter. These works commenced supplying the City, January 27th, 1801; much difficulty was experienced in raising the money for the erection of the works by loan, and the Committee was several times obliged to get its joint or individual notes discounted, in order to raise funds to carry on the works. The subscribers to the water loan received a supply of water without charge, for three years from January, 1801."

It soon became necessary to construct a new boiler at the Centre Square works, on account of the leakage of the first one; and owing to similar difficulties with the one in use at the Schuylkill works, the committee were induced to make a trial with one of cast iron. This proved so successful, that a similar one was constructed and placed in the Centre Square works. Mr. Rosevelt must have found his contract far from profitable, having to maintain and repair the works for five years; and constant charges were made against him for work and material, remedying defects, &c.

The operations of these engines were, to a great extent, successful, notwithstanding the mechanical construction must have been extremely rough and defective in many points; but even at the present day, many engines are pumping water, and performing other services, yet doing no better duty than the Rosevelt engines, and consequently no more economical in their consumption of fuel. The duty of the Centre Square engine was 9,000,000 pounds raised one foot high, by the consumption of one bushel of bituminous coal. To convey some idea of the defective construction of these works, as well as the difficulties experienced in keeping them in repair: in 1805, the lever beam of the Centre Square engine was so far decayed as to require a new one; the wooden boilers, as already stated, would leak, while the plates and flues of those of cast iron would crack; and when wrought iron could be procured, and flues were constructed of it, the unequal expansion and con-

traction also caused leaks ; the wooden fly-wheel shaft gave trouble, and in 1809, one of cast iron was used ; among the repairs necessary, was the forging and finishing of a piston rod, done in the city shop, four inches in diameter, and ten feet long, which was a mechanical feat of so extraordinary a character as to make the fact worthy of a notice in the annual report of the Watering Committee of 1807, in the following words :—"The workmanship of this piece of iron could not, in the opinion of your committee, been better executed in any country."

One expense attending the construction of these works, not commonly directly paid by corporations now, was for liquor for the workmen, which, from the annual report of the Watering Committee, amounted to nearly \$3000. Owing to the amount of wood and bituminous coal used in running these engines, great fears were entertained that the price would be enhanced—the former costing \$4.50 per cord, and the latter 33 cents per bushel—and that difficulties would be experienced in procuring a sufficient supply. These considerations, together with the trouble of keeping the engines in repair, and more particularly, the constant difficulties with the boilers, as well as on account of the small amount of water which could be stored in the tanks in the Centre Square engine house, which was speedily used up by the citizens, when the engines, from any cause, stopped running, induced Councils to have another examination made. The subject was submitted to Mr. John Davis and Mr. Frederick Graff. These gentlemen made another careful examination of the Wissahickon and Spring Mill creeks, and the Schuylkill, for some distance, and presented an estimate for bringing the water of the Wissahickon creek into the city, by means of pumping, at a cost of \$359,718. Had the plan proposed by FRANKLIN, previously mentioned, been adopted by these gentlemen, it could have been done by a dam, at a much less cost, and without machinery; but the simple idea of water flowing into and supplying the city by its own gravity, seems never to have been entertained by either the committees or engineers appointed by Councils.

STEAM WORKS AT FAIRMOUNT.

Councils finally determined to erect new steam works at Fairmount, on the Schuylkill, upon the summit of which reservoirs should be constructed, of sufficient capacity to afford a more constant supply to the city. These works were commenced in 1812, and the following description is taken from the report of the Watering Committee :—

“ A substantial stone building was erected (now occupied as a public saloon and dwellings,) at the foot of the hill at Fairmount, in which was at first erected a Bolton and Watt steam engine, of forty-four inch cylinder and six feet stroke, working a vertical double acting pump of twenty inches diameter and six feet stroke, raising the water through a sixteen inch iron main, two hundred and thirty-nine feet long, into the reservoir, one hundred and two feet above low water in the Schuylkill. This engine had a boiler with a cast iron case, and vertical flues or heaters of wrought iron, and upon trial pumped 1,733,632 ale gallons in twenty-four hours, with seven cords of wood, carrying from two and a-half to four pounds pressure of steam. These works were commenced August 1st, 1812, and started September 7th, 1815. Before the starting of the works, a contract was made with Oliver Evans, for one of his high pressure engines, then just coming into notice, and one was accordingly put up of the following dimensions :—Steam cylinder, twenty inches diameter and five feet stroke, with a pump twenty inches diameter and four feet stroke. This engine was supplied by four cylinder boilers, thirty inches diameter and twenty-four feet long, upon which a pressure of two hundred and twenty pounds of steam was sometimes carried. The engine, upon trial, raised 3,072,656 gallons in twenty-four hours, running twenty-four and three-quarter revolutions per minute, and carrying one hundred and ninety-four pounds of steam, with a consumption of thirteen cords of wood. This engine was put to work, December 15th, 1817, and the cost at that time to raise 2,300,000 ale gallons per twenty-

four hours, was \$84 50 per day. The reservoir then erected, contained about 3,266,126 ale gallons, and the water was conducted from it to the distributing chest, at Centre Square, by six ranges of wooden logs, five of six inches diameter, and one of four and a-half inches, carried along the bed of the old Union canal to Broad street, and thence to the distributing chest, a distance of 9,537 feet. Although at the time of starting these works, considerable improvement had been made in making machinery, yet not a single furnace could be found, large enough to cast the steam cylinder of the Bolton and Watt engine, with its nozzle pipes entire, although its weight was but one and three-quarter tons; and the latter mentioned appendages had to be cast separately and bolted on. Most of the castings were made at Weymouth blast furnace, in New Jersey, but the smaller ones were cast at the Eagle works, the ruins of which are now standing at the corner of William and Callowhill streets,—a foundry where, it is believed, the first cannon cast in this country during the revolution, was made.”

Up to this time, 1815, the city had received no direct pecuniary benefit from the water works, for while the amount expended had reached the sum of \$657,398 91, the whole gross receipts amounted to but \$105,429 68, leaving a deficiency of \$551,969 23 without interest. In fact, not enough was realized from water rents in any one year to pay for the fuel consumed and working of the engines; and of all the work finished then, there remains in use at the present time nothing except the site of Fairmount, which cost originally \$16,666 67. If to this be added the amount spent on steam works and wooden pipes, of which the city had at one time laid and in use 241,604 feet, now all abandoned, the experiment of introducing water into the city must have cost about one million of dollars. Yet it cannot be said that this sum has been lost to the city, as many indirect advantages have arisen from it; character and impetus was given to the city; much was done to improve its sanitary condition, and an important feature added to its many attractions as a place of residence; nor was the early experience thus acquired by her mechanics, a small matter, for perhaps, to

their pumping engines and the practical knowledge derived from them, may be attributed much of the pre-eminence which this city has always enjoyed in the constructing of machinery ; and although the Watering Committee are found, in 1807, gravely inspecting the wonderful achievement of their workmen in manufacturing a piston rod *four inches in diameter and ten feet long*, it is satisfactory to know that from the workshops of this city much of the best machinery in this country, and much in foreign lands has been produced, and there is scarcely a water works, in the construction of which Philadelphia mechanics have not more largely contributed than any others, and are still contributing ; and in this city and vicinity are located the largest works for casting pipe and constructing the various apparatus necessary for water or gas works, in this country. Thus, it may be seen that the permanent interests of this city have been greatly promoted and advanced by the sums thus expended, although the burden fell heavily upon the citizens in the early history of the works. No investment made for an abundant supply of water to any city is ever lost, even though it may at first seem to remain unproductive. Time will prove it to be remunerative in many ways.

The population of the city still continuing rapidly to increase, the difficulty and expense of keeping up a sufficient supply, with the defective machinery then in use, kept the City Councils constantly on the alert for a cheaper, and more copious supply of water. The expense of pumping into the reservoir will be seen by the following estimate of the cost of working the Oliver Evans engines, made by the superintendent of the works, for one year, for an average of 2,300,000 gallons per day :

Six men, at \$9 75 per day, . . .	\$3558 75
Tallow, Oil, Chandlery, &c., . . .	1250 00
3650 Cords Wood, cording, hauling, &c., . .	24,550 00
Wear and tear of machinery, . . .	1500 00
	\$30,858 75

Or \$36 60 per million gallons pumped into the reservoir.

Prior to this, the water power of the Schuylkill river was looked at as a means of supplying the city; for, in a charter granted to James Kennedy, dated April 9th, 1807, by the State of Pennsylvania, allowing him the privilege of erecting a dam and locks at the Falls of Schuylkill, for the purpose of creating a water-power, a clause was inserted, reserving to the city the right to purchase of said Kennedy, all his rights and improvements, at any time the city thought proper to use them for supplying the city with water. This point would have been much more eligible for the works than Fairmount, and they could have been constructed at a much less cost; its only disadvantage being its distance from the centre of population, which could have been easily overcome.

The Legislature of the State also granted a charter to the Schuylkill Navigation Company, in the year 1815. Under this charter, they had, to a great extent, completed their valuable improvements, but, like all such enterprises in a new country, were short of means. The city rendered them valuable assistance in the completion of their works, by the erection of Fairmount dam, for the purpose of creating a water-power, for the use of the city. As it was also contemplated at that time to connect the Schuylkill and Delaware rivers, by a canal, large expectations were had of the importance that the pool, created by the dam, would be to the commercial interests of the city; and had it not been for these weighty reasons, the citizens would never have allowed the dam to be placed where it is, to the entire cutting off of so much valuable tidal front.

The water rights, dam, locks, &c., cost a large sum of money, all of which was contributed by the city; and the Navigation Company enjoyed the use of the pool and locks, free of all costs to themselves; notwithstanding all these advantages bestowed upon them by the city, at a time, too, when such assistance was of vital importance to them, differences have frequently existed between them and the city, some of which have led to litigation. They also received from the city a large amount of money, under

a subsequent contract, (1824,) for the use of the whole of the water-power, which the city appears to have previously purchased from White & Gillingham, and had also created by the dam constructed entirely at their own expense. The charter of the Navigation Company, it is true, granted them the right to improve the navigation of the Schuylkill river to its mouth, but not for the erection of dams where the tide flows in and out; the Legislature of no State can grant such privileges. The Falls of Schuylkill being the head of tidal navigation, at that point a dam could have been erected by them, had not the Legislature previously granted this right to James Kennedy, which right was reserved to the use of the city, at any time it might wish to purchase it, and which they *did* subsequently purchase from White & Gillingham, then the owners of the water-power, created under the charter granted to Kennedy. This company now lay claim to the structure of the dam, and have endeavored, during the past year, to prevent the city from erecting additional works, to supply the greatly increased demands for water, notwithstanding the contract of 1824, before mentioned, in which *all* the water-power, without any reservation, appears to have been sold to the city.

WATER-POWER WORKS.

The building of a dam at Fairmount, was an undertaking of no ordinary character. Ariel Cooley, of Chicopee, Massachusetts, was consulted upon its practicability, who, after a careful examination, reported favorably to the undertaking, and presented plans and estimates for its erection. Several other persons submitted plans and estimates, but that of Ariel Cooley was accepted, and a contract entered into with him for the construction of the dam, locks, head race, &c., for the sum of \$150,000. This contract was carried out with integrity; work was commenced April 19th, 1819, and water flowed over the dam, July 25th, 1821. Soon after this, and before the work was entirely finished, Mr. Cooley's health failed, by reason of the close application and exposure at-

tending his labors, and he found it necessary to return to his home, where he soon after died. The following tribute to the memory of Mr. Cooley, is to be found in the report of the Watering Committee of 1823 :—“This work is a monument to his memory, and he had nearly completed it when he was taken off by 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.” The dam, lock, and head race, although somewhat altered remain to this day as his only monument. The valuable services of Mr. Cooley should not be forgotten. Would it not be but justice, even at this late day, to place a tablet in the rock in the park, which would preserve his name, and those of others who assisted in the construction of these works, of which we are so justly proud ?

DESCRIPTION OF THE WORKS.

The following description of the works is taken from the report of the Watering Committee of 1823, immediately after their completion :—

“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, in 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 towards 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.

“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. 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 nineteen feet, the greatest depth of the excavation sixty feet. 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 perpendicu-

larly. 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. 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.

“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. The centre part of the building 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 wheels rooms ; on a line with the cornice of the central part is the base course of two pavilions, with doric porticos, which terminate the west front. 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. For the calculation of the water-power for the wheels, 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 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 were made by those ingenious engineers, Messrs. Rush and Muhlenberg, according to the designs of 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 forebay of the water-wheel. 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 Fairmount, 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.”

Mr. Frederick Graff was Superintendent of these Water Works during their construction, and continued in the same position up to the time of his death.

Of all the persons who ever engaged upon the construction of these works, there is probably not one now living, except Mr.

Frederick Erdman, who was again employed upon their enlargement during the last summer.

Dimensions of Wheels and Pumps at Fairmount.

Breast Wheels.

No. of wheel.	Diameter of wheel.	Width of wheel.	Diameter of pump.	Stroke of pump.	Revolutions of wheel per minute.	Capacity of pumps in gallons per revolution of wheel.	Gallons raised by each pump per hour.
1	15 ft.	15 ft.	16 in.	4½ ft.	14	91.08	76,507
2	16	"	"	5 "	13	101.2	78,936
3	16	"	"	5 "	13	101.2	78,936
4	18	"	"	6 "	11	121.4	80,124
5	18	"	"	6 "	11	121.4	80,124
6	16	"	"	5 "	13	101.2	78,936
7	18	"	"	6 "	11	121.4	80,124
8	18	"	"	6 "	11	121.4	80,124

Total capacity of eight pumps per hour, . . . gallons, 633,811

9 Capacity of turbine per hour, 87,408

Total capacity of Fairmount Works per hour, . . . 721,219

Average capacity of each pump per hour, . . . 80,135

Wheel No. 9 is a Jonval turbine, seven feet in diameter, with buckets thirteen inches wide and ten inches deep. It is keyed to a vertical shaft, the motion of which is communicated to the crank shaft of the pump by a pair of bevel and a pair of spur wheels. The pump is sixteen inches in diameter and six feet stroke, and of similar construction to those driven by the breast wheels. The usual speed of the pump is about twelve double strokes per minute, at which rate its capacity is 87,408 gallons per hour, without any allowance for loss by leakage through the valves, &c.

RESERVOIRS.—The storage of these works consists of four reservoirs at Fairmount, constructed at different periods, as it became necessary, and are all built in the most substantial manner. They will contain when full, 26,896,636 gallons; the water level in them is ninety-four feet fourteen-hundredths, above city datum, fifty-one feet above the highest, and ninety-one above the lowest regulated

curb height in the old city proper. There is also supplied from these works, a reservoir, situate between Twenty-second street and Corinthian avenue, and Poplar and Parrish streets; it is formed of earth embankments, lined with bricks, and will contain when full, sixteen feet deep, 20,321,392 gallons; making with those at Fairmount, a storage of 47,218,028 standard gallons; the water level is one hundred and ten feet above city datum, one hundred and seven feet above the lowest, and sixty-seven above the highest curb regulation of the city proper.

This reservoir being higher than those at Fairmount, is supplied by means of a stand pipe, fifty feet high and four feet diameter, erected at the latter place; the pumps being so arranged that the water may be pumped by one or all of them, either into the reservoir at Fairmount, or into the stand pipe, and through it to the higher reservoir.

MAINS.—From the reservoirs at Fairmount there is one distributing main of thirty inches, one of twenty-two, and one of twenty inches in diameter. From the reservoir at Corinthian avenue there is one distributing main of thirty inches in diameter.

PIPE.—In the report of the Watering Committee of 1818, after speaking of the perishable character and want of strength of the wooden mains, which had been used up to that time, it is interesting to see with what caution they recommended the use of iron pipe, and the difficulties seen by them, in its manufacture and in securing the joints, &c. Information upon the subject was sought from abroad as well as at home, and two interesting reports, with drawings, estimates, calculations of weight, flow of water, &c., were received by the committee, from Mr. J. Walker of London. The plan recommended in this report, of joining the pipes, is the same used by this and other water works generally, to the present day. The plan of street stop then adopted, is still in general use, with but slight variation; also that of the fire plug or hydrant.

The committee procured small quantities of iron pipe, which were laid down for actual experiment, and the result was so satisfactory, that from that time, iron pipe was gradually substituted for those

of wood, of which there was at one time, (1828,) forty-five and a-half miles in use.

The first pipes laid were imported from England, but they were soon constructed in this country, and Philadelphia has always been the centre for their manufacture. The improvement in this important article has been marked, both in the character of their construction and the material used; and a fair idea of the increased facilities with which they are now constructed, may be drawn from the following comparison of their prices, per foot, in 1823 and 1859:

	1823.	1859
30 inch pipe cost (none cast so large)	- - -	\$5 06
22 " " \$6 25	(none used of that size)	
20 " " 5 00	- - -	2 53
16 " " 3 33 $\frac{1}{2}$	- - -	2 06
12 " " (none used)	- - -	1 13
10 " " 2 40	- - -	85
8 " " 1 66	- - -	73
6 " " 1 10	- - -	55
4 " " 64	- - -	34
3 " " 45	- - -	24

SCHUYLKILL WORKS,

FORMERLY SPRING GARDEN AND NORTHERN LIBERTIES WORKS.

The Districts lying north of Vine street, viz: Northern Liberties, Spring Garden, and Kensington, all formerly known as Northern Liberties, were without a supply of water, except from wells, pumps, and natural sources, until 1826, when a contract was entered into with the old city authorities, for a supply from Fairmount works. The city, to compensate them for the large amount of money expended in the erection of the works, and probably with the design of discriminating in favor of their own district,

fixed the price to water-takers in these districts, fifty per cent. higher than that charged in the old city, but allowed them six per cent. for expenses of collecting the revenue. There is no doubt, that, had it not been for this increased charge, arrangements would have been made with the city authorities at a much earlier date. In addition to this charge, the districts were obliged to furnish their own street mains; this was done by the owners of property fronting on the streets in which water pipes were laid.

As buildings rapidly increased upon the higher ground north of the city, the necessity became apparent, that a supply would have to be procured, with a superior head to Fairmount. This consideration, as well as the high price paid by water-takers, led the districts to seek the proper legislation to enable them to construct works of their own. This the city resisted, but the State finally granted the request of the Districts of Spring Garden, Northern Liberties, and Kensington, by an Act, dated April 18th, 1843. The districts immediately took the necessary steps to carry out the provisions of the law, by the election of three commissioners each, who met on the 31st of July, 1843, for the purpose of organizing. The commissioners of Kensington refused to participate in the erection of the works, and withdrew from the Board, which then consisted of the following gentlemen: Alexander Cummings, President; George Williams, Secretary; Thomas Halloway, G. W. Dohnert, James Landy, and Joseph Yeager.

At this time, the city was collecting a revenue of \$51,783 17 for water rents, from these districts, viz:—Northern Liberties, \$25,470 59; Spring Garden, \$24,218 02, and Kensington, \$5,102 17. Northern Liberties had laid 77,784 feet of pipe, and erected 155 fire plugs; Spring Garden, 91,298 feet of pipe, and 160 fire plugs; and Kensington, 80,221 feet of pipe, and 56 fire plugs.

The Board immediately set to work examining sites suitable for the erection of the works, and had numerous surveys made, which resulted in the selection of the one now occupied by the works and reservoir. Although a reservoir of greater altitude would have been preferable, it must be admitted, that this site was well

chosen, and displayed considerable judgment on the part of the Board, especially when it is considered that they were proceeding without the services of an engineer. It is to be regretted, that so little store is set by experience and ability in this country ; for, notwithstanding the careful and economical management of this Board, great advantages would have been gained, now lost, had they procured the services of an engineer experienced in erecting water works, and a saving would have been effected, in the cost of construction, many times greater than the salary of such an engineer.

The estimate of the cost of works made by the commissioners, was, for land, buildings, engines, reservoirs, mains, &c., \$77,345 87. Without any previously digested plans for engines, mains, or reservoirs, work was immediately commenced upon the latter ; a superintendent was engaged, at \$1 50 per day ; horses and carts, \$1 75 per day ; and laborers at \$5 per week ; and proposals were issued for iron pipe, engines and pumps, bricks, &c. Work progressed in this manner until the 18th of October, when William E. Morris was elected engineer, by the Board. Although Mr. Morris, at that time, had but a limited experience in the erection of water works, still he was a man of ability and industry, and had the Board evinced more confidence in him, and submitted more to his judgment, it would have been greatly to the advantage of the works. Mr. Morris made a detailed estimate to the Board, December 16th, in which the whole cost of the work is estimated at \$173,700, for a daily average supply of two and a-half millions of gallons.

The corner stone of the engine house was laid with appropriate ceremonies, July 1st, 1844, about one year after the organization of the Board. Up to this time, no plan had been decided upon for the engines and pumps, although a great number of plans and estimates had been submitted. Finally, a contract was made with Messrs. Merrick & Town, now Merrick & Son, of this city, for two engines, now known as Nos. 1 and 2. When these engines were completed, the commissioners objected to them, and for a long

time refused to take them off of the hands of the manufacturers ; they are, however, the best engines of the kind in the department, and, for the time they were built, superior specimens of workmanship ; they are still in constant daily use.

While these works were progressing, the old city made several attempts to settle the difficulties, and induce these districts to continue as their customers. Legal steps were also taken, to enjoin them from taking water from the Schuylkill river, which the city claimed to have purchased from the Schuylkill Navigation Company, who, as we have previously shown, sold that which they never did or could possess, as was decided by the Supreme Court.

The works were finished, and started December 31st, 1844, and delivered to the joint Watering Committee by the commissioners, July 15th, 1845. Whatever errors the commissioners may have made in the commencement and construction of these works, they were clearly of judgment, for a more faithful, economical, and attentive Board never managed the interests of the public.

The whole cost of the work was . . .	\$159,074 65
For Northern Liberties main, . . .	30,739 99
For Spring Garden main, . . .	41,906 85
	<hr/>
	\$231,711 49

These works paid a profit of \$16,700 38 above all expenses, interest included, the first year they were in operation ; a fact but rarely realized in water works, although there are few but what ultimately pay a good return for the investment. The price at which water was supplied was reduced to the same price as that charged in the old city, causing a much larger saving to the water-takers in the districts, than the profits of the works.

A serious accident occurred to these works, before they had been in operation a year, in the partial destruction of the reservoir, by the yielding of the southern embankment, when the reservoir was pumped too full ; the water doing a large amount of damage to surrounding property. The capacity of the works soon became

too limited for the increasing demand; and May 10th, 1849, a new engine, now known as No. 3, was put in operation; although this engine gave the Watering Committee great satisfaction, when first started, it is, perhaps, the least efficient pumping engine belonging to the department, and has required more repairs. A large box or chest, was placed above the engine house, and the three mains from the engine, and two leading to the reservoirs connected with it, in the supposition that it would obviate the necessity of a third main; it was, however, a useless expense, and still remains obstructing the flow of water, without answering any good purpose. In 1851, a third main was laid, twenty inches in diameter, leading from the box to the reservoir.

The demand for water still rapidly increased, with the constant advances made in building improvements and populations of the districts supplied, and in 1854 it was determined to add a fourth engine to these works. Messrs. I. P. Morris & Co. were engaged to build a Cornish pumping engine, from their own plans and specifications; this engine is perhaps the most economical in fuel of any in the department, and has the single defect of being too light in some of its parts, requiring the greatest care in working it. Owing, also, to the want of sufficient capacity in the mains leading to the reservoir, it was found almost impossible to work this engine after it was started, in connection with any of the others then in use. To obviate this difficulty, a stand-pipe was erected, which relieved the shock upon the pump, and enabled the engine to be worked with safety, in connection with the other engines. This stand-pipe has but one defect, that of tapering so as to be smaller at the top than at the bottom, so that, in seasons of severe frost, the ice wedges fast and it becomes impossible to work this engine. It was also found necessary to lay an additional distributing main, and one of 30 inches in diameter was laid from the reservoir to Poplar street, and along Poplar to Nineteenth street.

In the year 1854, this, together with all the other works here described, in accordance with the act of Consolidation, passed into the possession of the Water Department.

DESCRIPTION OF THE WORKS.

These works are situated on the Schuylkill, at the foot of Thompson street. The water passes first through a sluice way into the forebay, and is taken from thence by the pumps. The engine and boiler house are a collection of substantial stone buildings, with two ornamental brick chimneys, one eighty-five feet and the other one hundred and six feet in height. A sideling track is brought from the Reading Railroad, from which the coal is dumped into bins, having a capacity of about 1000 tons; railroad tracks lead from these to the front of all the boilers, passing over a platform scale.

ENGINES.—There are four engines and ten boilers. Engines Nos. 1 and 2 are alike, and were the first constructed; they are low pressure, and have vertical steam cylinders with a beam overhead, supported on columns, with connecting rod and fly-wheel, eighteen feet in diameter, attached to the end of the beam, opposite to that of the cylinder. Steam is cut off at half stroke, by an independent cut-off, worked by a cam. The pumps are double acting and placed vertically, immediately under the steam cylinder, the piston rod of which is continued through the bottom and connected directly to the pump piston. The valves of the pumps are of brass, hinged and working on cast iron faces. The following are the principal dimensions of the engines and pumps :—

Diameter of steam cylinder	. .	36 inches.
length of stroke	. .	6 feet.
Diameter of pump cylinder	. .	18 inches.
length of stroke	. .	6 feet.

Engine No. 3 is also a double acting condensing engine, vertical steam cylinder, connected to a nearly horizontal pump, by means of suitable connecting rods, and a bell crank. The valves of the pump are of gun metal, and hinged as in Nos. 1 and 2. The following are its principal dimensions :—

Diameter of steam cylinder	.	36 inches.
stroke of piston	. .	6 feet.
Diameter of pump cylinder	.	21 inches.
stroke of piston	. .	4 feet.

Engine No. 4 is a Cornish engine, with a cylinder sixty inches diameter and a stroke of ten feet, working a single-acting plunger pump thirty inches diameter and ten feet stroke. The cylinder and pump are placed under opposite extremities of a balance lever beam, and the piston rod and pump plunger connected to the ends by suitable connecting rods. The pump plunger is made by the addition of weights, sufficiently heavy to cause it to descend against the resistance of the water in the ascending main, the friction of the engine, &c. The receiving valve of the pump is a double beat valve, and placed immediately under the plunger, and the discharge a treble beat valve constructed on the same principle, fixed in a valve box on a short curved branch near the bottom of the pump. The valves are both of cast iron, working upon beats of a composition of lead and tin, cast in dove-tail grooves, turned in the castings which form the valve seats.

The operation of the engine is as follows : The piston being at the top of the cylinder, and a vacuum formed under it, by the exhaust valve—or valve that opens and closes the communication between the bottom of the cylinder and the condenser—being open, and steam admitted through the steam valve into the top of the cylinder, the piston descends, at the same time raising the pump plunger at the opposite end of the beam. As the piston descends the steam valve is closed, and when near the end of the stroke the exhaust valve also, by tappets on the plug rod—a rod suspended from the beam and moving with it—coming in contact with the handles that operate the valves. The exhaust valve, in closing, releases a weight which in falling opens the equilibrium valve and allows the steam to pass from the top to the bottom of the cylinder; thus equalising the pressure on both sides of the piston, when the plunger descends by its own weight, thus forcing

the water in the pump, through the discharge valve and ascending main into the reservoir. The plunger in descending raises the piston in the steam cylinder to near the top, when a tappet on the plug rod closes the equilibrium valve, and further escape of steam from above the piston being thus prevented, the engine completes its stroke and comes to rest. By an ingenious contrivance called a cataract, motion is given to a small rod which continues to move after the engine has completed its journey, and in moving disengages weights, which, in falling, open, first the exhaust valve, allowing the steam under the piston to pass into the condenser, and then the steam valve, admitting steam above the piston from the boiler, when the engine makes its stroke as before.

BOILERS.—In the south boiler house are four flue-boilers, with cylindrical shells enclosed in brickwork, the diameters of the different boilers varying from seven and a-half to eight feet, and the lengths from thirteen and a-half to twenty feet. They are all of the same general type; the fire being under the front end, the products of combustion pass along the bottom and sides to the back end, where they enter the lower flues, through which they pass first to the front, enter the upper flues, and through them to the back, thence to the chimney.

The four boilers contain about two thousand five hundred square feet of absorbing surface, and about one hundred and twenty-five feet of grate surface.

In the north boiler house are four cylindrical boilers, fifty-four inches diameter, and thirty feet long, with two cylindrical heaters or drums under each, twenty-six inches diameter and twenty-six feet long, the whole enclosed in brick work.

The total amount of absorbing surface in the four boilers is about two thousand square feet, and grate surface one hundred square feet.

Also two tubular boilers seventeen feet nine inches long and sixty inches diameter, each boiler containing eighty-three tubes, three inches inside diameter, and twelve feet long. To the bottom of each boiler a heater is attached, thirty inches diameter and twelve feet long. The products of combustion pass first through the tubes to

the back end, thence under the boiler to the front end, where they turn down, and pass under the heater to the chimney. The total amount of absorbing surface is about one thousand square feet, and grate surface fifty square feet.

These boilers are so connected that they may be used to drive any or all of the engines, and contain together about fifty-five hundred feet of absorbing surface and two hundred and seventy-five feet of grate surface.

STAND PIPE.—Immediately in front of the engine-house is a stand-pipe, one hundred and thirty-seven feet high, six feet in diameter at the base, tapering to three feet six inches at the top, with an octagon base of stone-work and a cornice and cap at the top. With this all the pumps are connected. Leading from the pumps to the reservoir, are three mains, two of eighteen, and one of twenty inches in diameter, and three thousand two hundred and fifty feet long each.

RESERVOIR.—This is situated at Twenty-sixth and Master streets. The surface of the water is one hundred and fifteen feet above the dam. It is formed by embankments, puddled with clay and faced with brick, and contains 9,800,000 gallons. In it is a division wall, coming to within four feet of the ordinary surface of the water, which creates two basins when the water is below its top, for purposes of cleansing or repairs. When full, the water flows over this wier, from the one in which it is pumped, to that from which it is supplied, thus allowing the water to deposit its grosser impurities, before passing into the distributing main.

MAINS.—From this reservoir, there is one distributing main of thirty inches, and two of sixteen inches in diameter.

DELAWARE WORKS.

FORMERLY KENSINGTON WORKS.

When the Commissioners appointed by the Act of Legislature to build the Schuylkill Works, met for the purpose of organizing, the representatives of the District of Kensington, as was mentioned in a preceding page, refused to participate in the construction of the works, and withdrew from the Board. They, however, entered into a contract subsequently for a supply of water from these works at the same price charged to the water takers in Northern Liberties and Spring Garden. In 1845, Kensington paid to these districts for water rents, the amount of \$4,261 61, and in 1846, \$6,008 50.

The rapid increase in population and large number of manufactories erected in this district, soon made a larger supply necessary than could be procured through the mains supplying the Northern Liberties. December 20th, 1847, a resolution was adopted by the Commissioners of the district to erect works of their own, by the appointing of a committee of one from each ward of the district. No positive action, was taken except to examine sites for the works, until the latter part of 1848, when the president of the Board was authorized to advertise for plans and specifications for the erection of the works. The plan adopted by them was one presented by a person entirely ignorant himself of the construction of water works or pumping machinery, having never had any previous experience in that branch. The result was what might have been expected—a largely increased cost of the work and a total failure of the machinery as first constructed; the machinists employed in the construction of the engine and pumps, being also without any previous experience in work of that character. It became necessary to alter and reconstruct much of the machinery before it could be used to any advantage.

During the progress of the work political changes occurring, the entire board was changed, and contracts were entered into with other parties, also entirely unacquainted with the business, for the

completion of the works, which led to much litigation, and after spending a large amount of money and consuming a great amount of unnecessary time, the works after several unsuccessful attempts, were finally started, and the district supplied with water early in the year 1851. The first pumping engine worked so unsatisfactorily, even after it had been to a great extent rebuilt, that steps were immediately taken to procure another engine, pump and boilers. The works were not really in successful operation until the middle of summer. From the frequent changes in the administration, and the various alterations and repairs, it is impossible to get at the entire costs of these works. Probably \$200,000 would not be far from the amount paid up to this time. The following minute was reported by the committee, October 7th, 1851.

The Committee on Water Works reported "That after many vexatious delays, arising from the very imperfect manner in which the works were planned, as well as from the workmanship of its parts, they had at last so far completed the works as to have them in successful operation, and that they are now furnishing the inhabitants of the district with the Delaware water."

The Committee "congratulate their fellow-citizens on the happy and successful result of the remodeling of the pumps, and the puddling of the basins; such alterations become absolutely necessary to insure the successful operation of the works."

The Committee further reported "that the new engine was in progress of completion, that they expected it to be completed by the 1st of January, 1852, and that the northern basin was almost finished, and would be completed by Monday next."

DESCRIPTION OF THE WORKS.

They are situated on the Delaware river, at the foot of Wood street, in the 18th ward. The water is taken from the end of the wharf which projects some distance into the river, passes through a sluice way to the front of the boiler house, from thence, by separate pipes to the pumps. The engine and boiler house is a substantial brick building, and contains the following machinery:—

ENGINES.—No. 1, is a double-acting high pressure engine, with a cylinder 30 inches diameter, and six feet stroke, giving motion to a double-acting horizontal pump, 18 inches diameter, and six feet stroke. The pump piston is worked by a vertical lever beam, 18 feet long, to the upper and lower ends of which, respectively, the piston rods of the engine and pump are attached, by suitable connecting rods. From the upper end of the beam, a connecting rod also extends to a crank on the end of the fly-wheel shaft. The valves of the pump are metallic—flap or hinge valves—working on seats placed at an angle of 45° . The pump is provided with an air vessel, on both its receiving and discharging pipes; that on the latter being of unusually large dimensions. The valves of the steam cylinder are of the single puppet variety, operated by revolving cams, fixed on a shaft that receives its motion through a pair of bevel wheels, from the fly-wheel shaft of the engine.

No. 2, is a condensing engine, with a vertical cylinder, 42 inches in diameter, and six feet stroke, and an overhead lever beam, supported by two columns and an entablature. One end of the beam is connected with a crank on the end of the fly-wheel shaft, by a connecting rod, and the other to the piston rod of the engine, by two short links. A prolongation of the piston rod passes through a stuffing box in the bottom of the cylinder, and is connected by links, to the horizontal arm of a right-angle bell-crank lever; a rod from the vertical arm giving motion to the piston of a pump, $19\frac{1}{2}$ inches diameter, and six feet stroke, similar in other respects to the pump of No. 1. The valves of the steam cylinder are double puppet valves, cutting off at about three-fourths of the stroke. The pumps of both Nos. 1 and 2 are on a level, several feet below the surface of the river, from which they receive their supply, and are both connected to a single main, 18 inches diameter, through which they force the water into the reservoir.

BOILERS.—The boilers belonging to engine No. 1, are cylindrical, and six in number, and were originally 46 feet long, and 42 inches in diameter, but were subsequently altered, by reducing

their length to 26 feet, and adding a heater under each, 30 inches diameter, and $16\frac{1}{2}$ feet long.

The boiler of No. 2 is a wagon boiler, of the single return rising flue variety. The following are its principal dimensions: Breadth of boiler, 8 feet 6 inches; length, 21 feet 1 inch; height, 8 feet $8\frac{1}{2}$ inches; diameter of cylindrical shell, 7 feet 8 inches; number of furnaces, 2; length of furnaces, 5 feet 11 inches; width of furnaces, each, 3 feet 6 inches; number of flues, 16 above, 6 below; diameter of upper flues, $6\frac{1}{2}$ inches; length of upper flues, 16 feet 4 inches; diameter of lower flues, two of 16 inches, two of $10\frac{1}{2}$ inches, and two of 7 inches; length of lower flues, 11 feet 9 inches; diameter of flue to chimney, 2 feet 7 inches.

The steam pipes of both engines are so connected that steam can be taken from either or all of the boilers.

Total amount of absorbing surface in cylindrical boilers, is about	1500 square ft.
Total amount of grate surface,	100 "
Total amount of absorbing surface in wagon boiler,	800 "
" " grate surface " "	41 "

There is but one ascending main, leading from these works to the reservoir, 18 inches diameter, and 13,260 feet long.

RESERVOIRS.—There are two reservoirs connected with these works, situated at Lehigh avenue and Sixth street, Nineteenth ward. These reservoirs are also formed by embankments, puddled with clay and lined with brick, and will contain 9,284,000 gallons. The surface of the water in them is 112 feet above mean tide, when filled.

MAIN.—Leading from this reservoir, there is one distributing main of 18 inches in diameter.

TWENTY-FOURTH WARD WORKS.

In the fall of 1851, several influential citizens of the District of West Philadelphia, met for the purpose of considering the expediency and practicability of erecting water works, and from estimates made and presented to them, at a subsequent meeting, they were satisfied that the plan was feasible. The subject was then taken up by the District Commissioners, and a committee was appointed for the purpose of procuring plans and estimates, consisting of

Benj. R. Miller,	J. Sidney Keen,
Dr. R. Bicknell,	Robert L. Martin,
C. C. Pearson,	E. M. Eakin, <i>President.</i>

This committee employed Messrs. Birkinbine and Trotter to make a thorough examination of the whole subject, by whom the following plan was submitted.

The works to be erected at or near Belmont Cottage, on the west side of the Schuylkill, near the foot of the old Inclined Plane. It was proposed to construct a subsiding reservoir, an engine and boiler house, and two direct acting vertical Cornish pumping engines. Two reservoirs were to be constructed on the elevated ground near the top of the Plane.

This plan was objected to only on account of its cost, (\$300,000,) which was thought by the commissioners too great for the district at that time. At their request, plans and estimates were made for works located as above, but of a more limited capacity. These were also objected to for a similar reason. The committee then visited the works of the Germantown Water Company, which met their approbation. Plans and estimates for similar works were furnished. Upon the basis of these plans and estimates, with several modifications to meet the wishes of the commissioners, a contract was entered into.

The reasons which influenced the commissioners in deciding upon this plan, were the comparatively small cost (\$120,000,) and

the short time necessary to put the works in operation, being one year. It was the intention to depend upon a stand pipe for a supply only until the district was in a condition to construct store reservoirs, and lay the large amount of main over three miles, to connect them with the built portions of the district.

A site was selected, but on account of difficulties existing in the title, it was abandoned, and the one now occupied selected by the commissioners. As soon as the purchase was concluded, operations were commenced, January 24th, 1853, and the works were pushed forward energetically, when, in the summer a number of changes were made in the works by the then existing Board of Commissioners. They ordered a portion of the eastern end of the subsiding reservoir to be filled up, the remainder to be excavated to the depth of seventeen feet; the retaining wall to be carried up two feet above the grade of Thirty-fifth street, giving it a height of thirty-eight feet instead of twelve feet, originally contemplated. The high pressure engines, then in course of construction, were ordered to be taken away with a view to substitute for them the two direct acting vertical Cornish engines now in operation at the works. They also directed larger mains to be laid, and in some instances, those already laid, had to be taken up and mains of greater capacity substituted. A much larger amount of pipe was also ordered. These alterations made it necessary to enlarge the boiler houses, to construct a new chimney, and to build an engine house to accommodate the new machinery.

The reasons which influenced the commissioners in making these changes, were the impression that works of greater capacity were necessary, and, in the engines, to gain large savings in fuel over those which were then being erected, leading, in fact to the adoption of engines such as were proposed in the first plan and are now in actual operation, by which, but one-fourth the amount of fuel is required to do the same work. These changes greatly retarded the work.

DESCRIPTION OF THE WORKS.

They are located a short distance above the Fairmount dam on the west side of the river. The water from the river first passes through a tunnel to a chamber in which are placed three strainers. The flow of water through this tunnel, in which, in ordinary stages of the river, the water is five and a half feet deep, is very slow; less than two miles per day, should two million gallons be pumped. This allows time for all the heavy particles to settle to the bottom of the tunnel, which is planked and the chamber paved, so that all sediment can be removed with but little trouble; the larger and lighter particles which would float at or near the surface are stopped by the strainers. From this the water is conducted into the subsiding reservoir.

SUBSIDING RESERVOIR.—This is one hundred and sixty-five feet long, and seventy-five feet wide; at ordinary stages of the river, the water is sixteen and a-half feet deep. In this reservoir, the water deposits most of its impurities, which, in the waters of the Schuylkill and large rivers generally, are held in suspension and not chemically combined. As the depth of water is of the greatest importance in purifying by subsidence, it has been found that this reservoir is of sufficient capacity to render the water comparatively pure and limpid at almost all the conditions of the river, with no greater amount of water pumped from it than the works are calculated to supply.

BUILDINGS.—They are all of stone, of the hard gneiss rock, found in the vicinity of the work. The masonry of the engine house and foundations of the engines, are all of large stone, dressed upon both beds and faces, and are laid in hydraulic mortar to two feet above the water line, and securely bound together with iron; the same character of stone work is carried up to the base of the cylinders of the engines, forty-two feet above this line. The buildings are of dashed rubble work. They consist of an engine house, which is a circular building, surmounted by a dome, supported on cast iron girders, which are arranged and provided with

strong hooks over each cylinder, and may be used to lift the machinery, when examinations or repairs are necessary. On each side of the engine house are the boiler houses, accessible from the engine house by a short flight of stairs. The roofs are of slate, supported on iron framing, making the houses fire proof. They communicate with the coal yards, which are on the outside of each boiler house. On each side of the passage way leading from the engine house, is a sleeping room for the engineers, and under these are store rooms. In the rear is the stack, which has a base of cut stone thirty feet high, and is continued up of brick ninety feet, making its whole height one hundred and twenty feet; the flue is forty inches in diameter, and lined with fire-brick thirty feet from the bottom.

ENGINES AND PUMPS.—The water is pumped by two direct acting vertical Cornish engines, known as the Bull engine; the steam cylinder of each is fifty inches bore, and the stroke of piston eight feet. The cylinders are inverted, and placed immediately over the pumps; the piston rods connect immediately to the plungers of the pumps. These plungers are each seventeen inches in diameter and same stroke as the engines, eight feet. They are plain plunger pumps, fitted with double beat valves, with metallic facings. The air, feed, and cold water pumps, are worked by a lever beam. These engines are fitted with Birkinbine's patent equilibrium governor, which makes the adding to or taking off of weights from the plunger, as the head of water rises or falls, unnecessary.

All the parts of the machinery are made of unusual strength, and the work and materials are all of the best kind and character.

Great care has been taken to economize fuel and make the engines as effective as possible. Each steam cylinder is enclosed in a jacket or outer cylinder, and steam is introduced into the space between them. This jacket is covered with two inches of felt, outside of which is a six inch brick wall, and around this is a casing of wooden staves, bound with bright metallic bands.

BOILERS.—There are two Cornish boilers in each boiler house,

six feet in diameter, each, and thirty-two feet long, with an internal flue of four feet diameter; the fire is built in this flue, and passes back through it; the heated gáses are brought forward again along the exterior, each side of the boiler, and returned back under the bottom, when they are allowed to escape out of the chimney, thus making the heat travel ninety-six feet in contact with the boiler. Each boiler has two safety valves.

Either of the engines may be supplied with steam from any one or all of the boilers; and they are so arranged, that any one of them may be removed without disturbing the others. The engines are also entirely independent of each other.

STAND PIPE.—The stand pipe is situated on the high ground, about two thousand feet from the works, near Thirty-fifth and Sycamore streets. Its base is one hundred feet above the level of the river. The central portion of it consists of a pipe of heavy boiler plate, five feet in diameter, and one hundred and thirty feet high. Around the lower part of the pipe is an octangular base of ashler work, of gneiss rock, thirty-six feet high; each angle of this base is sustained by a buttress. On the top of the stone work there is a landing, enclosed by a railing, and from this landing a spiral stairs, winding around the stand pipe, terminates in a platform one hundred and fifteen feet above the base; a railing of gothic scroll work protects the outside of the steps. Eight cluster columns, standing opposite each angle of the stone base, support the outside of the steps; the upper platform is sustained by ornamental brackets, springing from the columns, which are continued above the platform, where they are connected together, and to the stand pipe, by flying buttresses; this platform is surrounded by a gothic railing. The stand pipe is surmounted by a spire and flag-staff. The whole structure is of iron, except the base.

A sixteen inch main, from the works, introduces the water into the stand pipe, near the bottom, from whence it is distributed to the district, by a sixteen inch main. The water is maintained at from one hundred to one hundred and twenty-seven feet in the

stand pipe, giving a head of water, in all parts of the district, from one hundred and twenty to two hundred and twenty-five feet.

CAPACITY.—As these works are at present arranged—without store reservoirs—more than twenty thousand inhabitants could not be supplied with water by them; but when these shall be constructed, the works will be capable of supplying a population of seventy-five thousand, without any alteration; the necessary additional mains, and store reservoirs, only, will be required.

At each stroke of the pump, ninety gallons of water are raised; at ten strokes per minute, each engine will pump fifty-four thousand gallons per hour. They may be worked to fourteen strokes per minute.

CHARACTER OF WATER SUPPLIED.

The Schuylkill river, from which the water supplied by the Fairmount, Schuylkill and Twenty-fourth ward works is pumped, is remarkable for its purity. It rises among the mountains of Pennsylvania, and flows about twenty-five miles through a mountainous country, receiving large accessions. After leaving this section it enters a fertile, highly cultivated and densely populated country, through which it flows a distance of about seventy-five miles, receiving occasional accessions of streams of considerable size, until it reaches this city. The river is subject to frequent and sudden freshets, caused by the direct surface drainage into it of all the rain and snow water from the large amount of land lying upon each side of it, and more especially from the steep declivities of the mountains near its source. Of late years the stability of the flow has been much improved and regulated by the large store reservoirs constructed by the Navigation Company; and also from the great amount of water which is steadily pumped from the numerous coal mines near the head and source of the river. The mean or usual flow of the river has been estimated to be, at Fairmount, about eighty millions of cubic feet per

day; this, in seasons of drought is sometimes reduced to fifty millions. From the mountains to Reading, the fall of the river is rapid, but from that point to the city, a distance of about sixty miles, the fall is but $187\frac{1}{2}$ feet.

The remarkable purity of the water of this river, as well as its low temperature in summer, cannot be fully accounted for, although many reasons may be adduced.

From the numerous large towns situated along its banks, and the high state of cultivation of the country drained by the river, as well as the use to which it is put for purposes of navigation, being frequently dammed along its course, and forming feeders to the different levels of the canal, one of which is twenty-two miles in length, it would be presumed that upon arriving at the city it would be unfit for culinary or drinking purposes; but such is not the case. During seasons of freshet the water is turbid, the discoloration being caused by finely divided particles of clay held in suspension, brought in principally by the Perkiomen creek, one of its largest tributaries; filter beds would scarcely remove them unless they were constructed of enormous dimensions. The plan of a subsiding reservoir, as at the 24th ward works, has been found to work satisfactorily, and a similar one might readily be arranged at the Schuylkill works; but little can be done in this matter at Fairmount works, and as the inconvenience is felt for a few days only at a time, and at long intervals, it is perhaps unnecessary.

Another reason for supposing that the water of the Schuylkill river would be unfit for use, is the large amount of mine water which is being constantly pumped into it from the coal mines, and which, owing to its chemical qualities, renders the water of the river unfit for use, and has destroyed all the fish, above Reading. Near that city several tributaries empty into the river, the principal of these, the Tulpahockin and Maiden creeks, are largely impregnated with lime, which is acted upon by the mine water, forming a precipitate, and after flowing a few miles the water is pure and limpid. To this chemical action may be attributed in a great measure, the remarkable purity of the water of this river. The length of Fair-

mount dam, nearly eight miles renders it a valuable subsiding reservoir for the large amount of water contained in it, but had a sluice been constructed in this dam so that the excess of water could have been drawn from the bottom of the pool, it would have answered for this purpose much more satisfactorily.

The following comparison of the chemical condition of water, some of which is supplied to different cities, will show the relative purity of the Schuylkill river.

	<i>grains per gal.</i>	<i>grains per gal.</i>
Cochituate, Boston,	3.37	
Mill River, proposed for New Haven,	4.00	
Gunpowder, proposed for Baltimore,	4.41	
Schuylkill, analyzed by Boye,	4.42	
Patroon's Creek, supplied to Albany,	4.72	
Pine River, proposed for New Haven,	5.30	
Schuylkill, analyzed by Sillman,	5.50	
West River, proposed for New Haven,	5.60	
Supplied to Detroit,	5.72	
Jones' Falls, supplied to Baltimore,	5.85	
Schuylkill, analyzed per Booth & Garrett,	6.10	
Troy,	6.29	
Ohio River, supplied to Cincinnati,	6.73	
Hudson River, Albany,	7.24	
Passaic, to supply Jersey City,	7.44	
Mohawk, Troy,	7.88	
St. Charles River, Quebec,	8.10	
Lake Ontario, Rochester,	10.00	
Croton River, supplied to New York,	10.93	
Genesee River, Rochester,	11.21	
Average of all the above,	6.54	
Average of the three analyses made of the Schuylkill,	5.34	
		EUROPE.
		Lake Geneva,
		Selne, at Paris,
		Rhone, at Lyons,
		Elbe, at Dresden,
		Supplied to London, from Thames, by the Kent Company,
		Supplied to London, by New River,
		“ “ from Thames, by West Middlesex Co.,
		“ “ “ Thames, by Lambeth Co.,
		“ “ “ Thames, by Grand Junction Co.,
		“ “ “ Thames, by Southwark Co.,
		“ “ “ Thames, by East London,
		“ “ “ Lea River,
		“ “ “ Thames, by Chelsea Co.,
		Hempstead Co., from Wells,
		Bristol “ “
		Average of all the London Companies, from the Thames,

From a number of analyses made of the water of the Schuylkill, the average of solid matter, per gallon, is found to be as above, 5.34. By comparing this with the water from a well at the corner of Fifth and Cherry streets, which was found, upon an analysis, to contain 115 grains of solid matter to the gallon, it will be seen what the character of the water-supply would be, if the city had to depend upon wells, at the present time.

The quality of the water supplied from the Delaware, is not so satisfactory, owing to the locality of the works, which are in the

built portions of the city, and the large amount of shore water carried up and down in front of the wharf from which the water is taken, by each tide.

GERMANTOWN WORKS.

These works are owned by a private company, and supply a portion of the Twenty-second ward. They were constructed for the company by Birkinbine and Trotter, and first commenced to supply water in 1851. The supply of water is procured from the Toolpahockin creek, which is dammed so as to form a store or subsidiary reservoir, at the foot of Toolpahockin street. Such arrangements are made at the works that, notwithstanding the large amount of impurity drained into the creek, the water pumped from the collecting well is limpid and free from all objections.

ENGINES.—The water is raised, by means of two high-pressure engines, working double acting pumps, into a stand-pipe on the hill, about 2000 feet distant, to an elevation of 225 feet. From the stand-pipe, the water flows to a reservoir on Mount Airy.

The company have laid about thirty-eight miles of pipe.

CHESTNUT HILL WORKS.

These works are also intended to supply a portion of the Twenty-second ward, and are to be worked by water-power. They are now in course of construction.

WATER RATES

CHARGED BY THE CITY OF PHILADELPHIA.

Dwellings.

	Per annum.
Hydrant in Yard and Kitchen, or either	\$5 00
Hydrant in Yard and Kitchen, and each supplied by a separate ferule from the main, for each public attach- ment	5 00
Baths, each tub	3 00
Baths; if supplied by a separate ferule from the main—for one bath only	5 00
For each additional bath	3 00
Water Closets, each	1 00
Urinals, each	1 00
Biddets, or Foot Tubs, each	1 00
Wash Basins in chambers, each	1 00
Wash Basins, or Sinks in Pantries, each	1 00
Wash Pavements of every description, each	3 00

(A screw nozzle on a hydrant in the yard is considered a wash pavement, unless there is a wash pavement charged to the dwelling.)

Small Dwellings.

With but one room on a floor	2 50
With one room on a floor and one story kitchen back	3 75

Stores.

Hydrant in Yard, or Basin in the Store	5 00
Each Basin or Sink additional	2 00
Water Closets, double acting, self-closing, each	1 00
Water Closets, single acting or hopper, each	2 00
Urinals, self-closing, each	2 00
Urinals of other descriptions, each	3 00

Public Buildings.

Hydrants, each	\$5 00
Each Basin or Sink	3 00
Water Closets, double acting, self-closing, each	3 00
Urinals, self-closing, each	3 00
Water Closets and Urinals of other descriptions, each	5 00

Hotels.

Hydrant, Family keeping the Hotel	5 00
Hotel Bars, with water in or not	10 00
Wash Basins, each	2 00
Slop Sinks, each	3 00
Water Closets, double acting, each	3 00
Water Closets of other descriptions, each	5 00
Urinals, self-closing, each	3 00
Urinals of other descriptions, each	5 00
Baths for use of Boarders, each	6 00
Wash Tubs in washing room, each	1 00
Kitchen, according to capacity and number of draw- cocks	\$5 to 25 00
Boarders, ten Persons or under	5 00
Boarders, twenty-five Persons or under	10 00
Boarders, for each 25 Persons additional	5 00
Horse Troughs for watering horses	10 00

Stables.

Stables, per stall	1 00
Each four-wheeled carriage	1 00
Each two-wheel carriage	0 50
Country Stables, per stall	0 50

Public Bathing Establishments.

Baths, each tub	6 00
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Bakeries.

Family Bakers, in addition to charge for dwelling, each \$3 00
 Large Establishments rated according to capacity.

Barber Shops.

One Basin, private attachment	8 00
One Basin, public attachment	5 00
Each additional Basin	1 00

Drug Stores.

One sink, private attachment	2 50
One sink, public attachment	5 00
Counter fountains, not exceeding one-sixteenth of an inch	5 00

Public Schools.

Each hundred children	3 00
And their several openings to be charged the same as in <i>“ Public Buildings.”</i>	

Hatters' Planks.

Fours, per set	8 00
Sixes, per set	10 00
Eights, per set	12 00
And the Dye Houses assessed in accordance with their capacity.	

Building Purposes.

Bricks, per thousand	0 05
Stone, per perch	0 02

Packet Ships, or other Vessels.

For each one hundred gallons water	0 05
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Steam Engines.

High pressure steam Engines, per horse power	.	\$3 00
Low do do do for boiler only	.	4 00

Distilleries, Breweries, Dye-Houses, and Manufacturing Establishments.

Rated according to capacity and size of ferule granted.

Fountains.

Flowing ten hours a day for Six Months of the year from a half-inch ferule (*five* dollars being always charged on the first opening.)

For the first jet of 1-16th of an inch	.	6 00
For each additional jet of 1-16th	.	1 00
For the first jet of $\frac{1}{8}$ th of an inch	.	7 50
For each additional jet of $\frac{1}{8}$ th	.	2 50
For the first jet of $\frac{1}{4}$ th of an inch	.	14 00
For each additional jet of $\frac{1}{4}$ th	.	9 00
For half-inch jet	.	32 00

No ferule larger than a half-inch granted for Fountains exclusively.

For a flow of water 12 hours per day—

From a $\frac{1}{4}$ inch ferule, per annum	.	200 00
Do $\frac{1}{2}$ inch do	.	315 00
Do $\frac{3}{4}$ inch do	.	450 00
Do $\frac{1}{2}$ inch do	.	600 00
Do 1 inch do	.	800 00

**ORDINANCES RELATING TO THE USE OF THE SCHUYL-
KILL WATER,**

OF GENERAL IMPORTANCE.

Ordinance, March 15, 1806.

SEC. 4. If any plumber or other person shall, without a written or printed permit from the Watering Committee, introduce a ferule into any public or private pipes, or form any connection or communication whatever with said pipes, or break ground for that or any other similar purpose, in the public streets or alleys; or if any person or persons shall introduce or use a ferule of a larger diameter than is specified in his or their permits, he, she or they so offending, shall forfeit and pay for each and every such offence, the sum of *twenty dollars*, and for every day's continuance of the use of such pipe, after conviction, the further sum of *one dollar*.

Ordinance, April 28, 1814.

SEC. 1. That all persons who may intend to discontinue the use of the Schuylkill water, shall give notice thereof to the Register, at the office of the Watering Committee, on or before the 30th day of November in any one year, and on their failure so to do, shall be chargeable with, and pay, the whole rent for the year next ensuing.

SEC. 4. *It is further enacted*, That all persons who may remove from or dispose of the premises they have contracted to be supplied with water, shall transfer the same on the books at the office of the Watering Committee, otherwise they are taken to be still parties to the said contracts, and chargeable with the rents due and to become due for the same, and liable to be sued therefor.

~~SEC. 5.~~ *Transfers made at the office of the Register free of charge.*

Ordinance, May 21, 1818.

SEC. 1. Every person who, on or after the first day of November next, may be supplied with the Schuylkill water from a branch connected with a private pipe, shall have a sufficient stop-cock affixed to the said branch, as near as conveniently may be to the private pipe aforesaid, so as to stop the supply of water through the said branch, when requisite, and not interrupt the supply to other persons having a right to use the pipe with which such connection may be formed; and every person who may be supplied with water from a private pipe, having a branch or branches connected therewith, as aforesaid, shall, in like manner, have a sufficient stop-cock affixed to such private pipe, above the said branch or branches, for the purpose aforesaid; and, in case of neglect or refusal to have such sufficient stop-cock affixed, as aforesaid, every person so offending shall forfeit and pay the sum of *five dollars*.

SEC. 2. All plumbers or other persons who may hereafter be employed to lay branch pipes, communications with private pipes, or private pipes having a branch or branches, as aforesaid, or to alter or repair such branch pipes or private pipes as aforesaid, are hereby required and enjoined to affix to such branch pipes and private pipes, sufficient stop-cocks, with proper openings to the same, walled up and covered as herein mentioned, under the penalty of *ten dollars* for every neglect thereof.

Ordinance, December 9, 1847.

SEC. 2. That if the said water is used for any other purpose, or through a ferule of any greater size, or by means of any other fixtures and attachments than are expressed in such permit aforesaid, it shall be the duty of the Superintendent of the Water Works to stop off the supply of water authorized to be used by such permit, notwithstanding the water rent for the same may have been paid.

Ordinance, June 20, 1850.

SEC. 1. That from and after the passage hereof, no permit shall issue for the introduction of the water into, or for the extension of any pipe used for the conveyance of such water in any premises,

within the City of Philadelphia, until the owner of such premises, or his or her authorized agent, shall have given his or her consent thereto in writing.

Ordinance, December 26, 1854.

SEC. 1. That all water rents shall be payable to the Register of Water Rents, at his office, annually, in advance, on the second Monday of January ; and upon all water rents unpaid upon the first day of April in any year, there shall be charged the sum of *five* per centum, and upon all rents unpaid on the first day of July in any year, there shall be charged an additional sum of *ten* per centum ; and if any such rent, with the said additional charges, shall remain unpaid on the first day of September in any year, the said Register shall notify the Chief Engineer of the Water Works of the name of such delinquents, who shall cause the ferules of all such delinquent water tenants to be detached from the pipe of conduit, and suit be instituted for the recovery of such rent ; and after such ferules shall have been detached, the water shall not again be supplied or furnished to the said premises, except upon payment of all arrears of water rent, and the sum of *two* dollars for expenses incurred ; and a printed notice containing the first section hereof, shall be left upon the premises.

SEC. 2. The said Register shall cause notice to be inserted in two or more of the daily newspapers of the city, and published in posted handbills, of the time and place, when and where the water rents are payable, and the penalties for delay in, and for the non-payment thereof.

SEC. 3. The water tenants of the city shall be charged for the water for the year 1855, at the same rate they were respectively charged for water for the year 1854 ; but all permits issued for the year 1855, shall be charged at the rates of the Corporation of the Mayor, Aldermen and Citizens of Philadelphia, for the year 1854.

Ordinance, January 29, 1855.

SEC. 1. That whenever any pipes for the conveyance of water

shall be laid in any of the streets or highways within the City of Philadelphia, the owners of the ground in front whereof the same shall be laid, shall pay for the expenses thereof the sum of seventy-five cents for each foot of the front of their ground upon such street: *Provided*, that on all corner lots an allowance shall be made of one-third the length of one of their fronts, but such allowance shall be made on the street or highway having the longest front, and in case both fronts are of equal dimensions, the allowance shall be made on the street in which the pipe shall be last laid; but in no case shall the allowance exceed fifty feet on any corner lot: *And provided always*, that where a corner lot shall have erected upon it two or more separate tenements, there shall only be an allowance made equal to one-third of the depth of the corner tenement and the yard adjoining.

SEC. 2. That no permit for the use of water shall be issued, unless at the time of the application, the person or persons shall exhibit the receipt of the proper officer for the amount of assessment or other satisfactory evidence of the payment thereof, for the expense of laying the water pipe in the premises for which the permit is requested.

Ordinance, November 12, 1855.

SEC. 1. That the water tenants of the city corporation shall be charged for the use of water furnished by the same for the year 1856, and thereafter, the same rate which was charged by the Corporation of the Mayor, Aldermen, and Citizens of Philadelphia, for the year 1854, and all ordinances inconsistent herewith be, and the same are hereby, repealed.

Ordinance, April 10, 1856.

SEC. 1. That all persons owning property on any street, lane, or alley where pipes for the conveyance of water are not laid, who shall apply for the water to be introduced into his or her premises, through any adjoining street or otherwise, shall, before any permit be granted, pay to the Register of Water Rents, at the same rate per foot in proportion to the front on the street, lane, or alley where

such property is situate, as the property fronting on the street where such water is taken from may, by law, be assessed for the expense of laying the said pipe; and it shall be the duty of the said Register to give such person or persons a receipt for the same, and whenever the pipe shall thereafter be laid in the street, lane, or alley fronting such property, the amount so paid, on the production of such receipt, shall be deducted from the assessment on the property for the expenses of laying the pipes.

Ordinance, October 18, 1858.

SEC. 2. That hereafter there shall be levied a tax, to defray the expenses of the Water Department, to be styled a water tax, against each and every dwelling house situate on any street, lane, alley, court, or other place where the water pipe is laid; and, as fast as it may be laid along the line of any such property as aforesaid, it shall be the duty of the Chief Engineer to assess a rate of tax of such amount against every dwelling house as is now charged where the water is introduced. And the Register of Water Rents is hereby authorized and directed to collect the same at the time water rents are collected by law; and in the event of any owner or owners of such property neglecting or refusing to pay the same on or before the thirtieth day of September in each year hereafter, the same shall be registered against his or their property, and be collected as other registered taxes are now collected by law: *Provided*, That the owners of such properties cannot show that the said property obtains water from other sources than the Water Department of the City of Philadelphia.

SEC. 3. That hereafter no permit shall be issued for the construction of wash paves, except such permit shall contain a proviso that the same shall be constructed so that the water may be checked from a stop in the street, and any person who shall construct, or cause to be constructed, a wash pave without having a cock that may be used from the street, shall be liable to a penalty of twenty dollars for each and every such offence, to be recovered as sums of like amount are now by law recoverable.

ANNUAL REPORT,

. PRESENTED FEBRUARY 9, 1860.

TO THE SELECT AND COMMON COUNCILS OF THE CITY OF PHILADELPHIA :—

Gentlemen,—In obedience to the ordinance regulating this department, the following report of the present condition and operation of the works during the past year, is respectfully submitted for your consideration.

The past year has been one of unprecedented activity in this department; and, perhaps, in no former year, since the commencement of the works, has so much been accomplished. The annual revenue has been greatly increased; the extent of service mains laid has been greater; a much larger number of new permits for the use of water have been issued; a larger amount has been expended in the extension of the works; and more extensive repairs have been made to the works, mains, pipes, and plugs.

CONDITION AND OPERATION OF THE WORKS.

The condition of the machinery of the different works appertaining to this department, has been much improved since the last report, and it may now be considered in fair working order. The former dilapidated condition of the machinery, the large demands made upon the works in comparison to their capacity, and the destructive character of the works, rendered it difficult to bring them up and maintain them in good order, and at the same time furnish a full supply of water, as none of the engines or pumps can be

spared from active service for any length of time. The necessary repairs have been made at intervals, and to great disadvantage, both as to time and cost.

The following tables will show that the machinery has been worked to its full capacity during the past year, and should the demand increase in the same ratio, during the coming year, as during the past, it will be a matter of no small difficulty, with all the machinery in perfect order, to maintain a supply adequate to the demand. The necessity of additional machinery at all the works, is such as to require immediate attention. Considerable relief will be had at Fairmount when the extensions now in progress there, are completed and in operation. Buildings and fences have been much neglected for several years, and although considerable repairing has been done, much is still required to place them in such a condition as true economy calls for.

The consumption of supplies, at all the works, has heretofore been larger than necessary, causing much waste of coal, oil, and tallow; efforts have been made to correct this evil, and with most satisfactory results, (the engineers having endeavored to economise wherever possible,) as will be seen by the running expenses.

FAIRMOUNT WORKS..

The nine water-wheels at these works have been worked during most of the season, to their full capacity, and the daily average has been about equal to that originally estimated of them. Several of the breasts and gates are now being repaired, and wheel No. 6 is being rebuilt. No. 4 has required a large amount of repairs, but is still in an unsatisfactory condition, and may not last the season through. During the past year, all the head-gates, the flume-gates and frames have been renewed, and a large amount still remains to do. It is to be regretted that so much timber was used in constructing these works, as, on account of its perishable nature, when exposed to the action of air and moisture, it requires constant replacing.

It has been found necessary to make a new step for the turbine wheel to run upon, and to insert a new set of wooden cogs into the bevel spur wheel belonging to it. This wheel and pump, prior to the past summer, have required but a small amount of repairs, and have been kept in almost constant use since first started in 1851. Pumps Nos. 2 and 3 have been fitted with new air-vessels. Examinations are now being made, and each wheel and pump is being placed in good repair, to meet the demand of the coming summer.

During the freshet, when the wheels were stopped for several days, and subsequently, while they could be run only a portion of the time, it was found necessary to procure a partial supply from the Schuylkill steam works.

The portion of the city supplied by these works, being the first ten wards, now have a full and abundant capacity of mains. The 1st, 2d, 3d, and 4th wards are supplied by the new main, from the Corinthian avenue reservoir; since the laying of this main, the increase in the demand for water from these wards, has been perceptible. The 5th, 6th, 7th, 8th, 9th, and 10th wards, receive their supply from the Fairmount reservoirs, and the difficulties heretofore experienced by them of a want of capacity in the mains, will be in a great measure removed, and should any further difficulty arise, it will be from the want of capacity of the works. This may also be obviated, should councils make the necessary additional appropriations early enough to ensure the completion of the present extensions before the summer sets in, and the demand is increased.

The frame stop-house on the ascending mains, near the stand pipe, having rotted entirely down, it became necessary to replace it. This has been done with a substantial stone one, covered with a brick arch, over which a path will lead, connecting the pavilion at the top of the first flight of stairs, with the terrace at the stand pipe.

There has been no scarcity of water to work the pumps, with a single exception of five or six days, during the entire year, and most of the time a large surplus has flowed over the dam, so that

had the new works been completed, they could have been run, almost without interruption, for at least ten months.

By the accelerated speed the wheels are now worked, the power of the works are greatly increased.

By altering the arrangement of receiving and distributing the water in the reservoirs at Fairmount, the frequent complaints of discolored water could, in part, be remedied, though not entirely, in the manner the works are now constructed.

During the past year, the water supplied by these works, has been entirely satisfactory, as regards quality, and while other cities have experienced great inconvenience from the offensive smell, taste, &c., of the water supplied, we have had no complaints. When the river commenced rising, at the time of the late freshet, there were indications of trouble, which continued for several days, and were watched with care, but after the freshet these entirely disappeared.

Our great laboratory still works well, although the mine water seems to be steadily advancing towards the city, and has already passed Reading, when the river is low, above which point it has destroyed all the fish ; but as the coal fields, at the head waters of the Schuylkill are now fully developed, there will be but a trifling increase in the mine water, and no fears need be had of its ever reaching this city. The purity of the river is maintained at Fairmount, and we may still boast of being supplied with water of a superior character to that of the majority of cities, and that without any artificial process.

For a history and description of these works, see page 19.

The following table exhibits the amount of water pumped, and oil and tallow used. There has been a marked saving in the consumption of all the supplies, during the past year, as will be seen by an examination of the table.

No. 1.

OPERATION OF FAIRMOUNT WORKS.

	WATER.		OIL.			TALLOW.		
	Number of gallons pumped each month during the year.	Average number of gallons pumped per day, each month.	Oil used each month during the year.	Number of gallons raised in Reservoir, per quart of oil.	Duty in million gallons raised one foot high, per quart of oil.	Tallow used each month during the year.	Number of gallons raised in Reservoir, per pound of tallow.	Duty in million gallons raised one foot high, per pound of tallow.
January	188,502,642	6,080,730	14 qts.	13,464,474	1346	20 lbs.	9,425,132	942
February	165,050,915	5,894,676	14 "	11,789,351	1178	22 "	7,502,314	750
March	187,190,290	6,038,396	14 "	13,370,736	1337	29 "	6,454,830	645
April	209,047,535	6,968,251	24 "	8,710,314	871	25 "	8,361,901	836
May	268,463,285	8,660,106	28 "	9,587,974	958	20 "	13,423,164	1342
June	255,992,090	8,533,069	22 "	11,636,004	1163	28 "	9,142,574	914
July	379,522,500	12,242,661	28 "	13,554,375	1355	28 "	13,554,374	1355
August	372,270,000	12,008,709	15 "	24,818,000	2481	10 "	37,227,000	3722
September	267,997,500	8,933,250	20 "	13,399,875	1339	10 "	26,799,750	2679
October	405,405,000	13,077,580	26 "	15,592,500	1559	16 "	25,337,812	2593
November	359,995,000	11,999,833	22 "	16,363,409	1636	00 "	none used.	none.
December	330,835,000	10,672,096	24 "	13,784,125	1378	14 "	23,631,071	2363
	3,390,271,757	9,288,415	251 qts.	13,507,059	1350	222 lbs.	15,271,494	1527

The following exhibits the cost of running these works during the past year :—

RUNNING EXPENSES OF FAIRMOUNT WORKS

Salary of engineers and labor,	\$1869 94
Gas for lighting works,	188 62
Coal for warming works,	165 00
62½ gallons of oil, at \$1,	62 75
222 lbs. of tallow, at 12 cents,	26 64
Packing, small stores, &c.,	637 32
Repairs,	2853 50
	<hr/>
	\$5803 77
Interest on cost of water-power and works,	36000 00
	<hr/>
	\$41803 77
Cost of raising water into reservoirs, per million gallons, including interest on cost of works,	\$12 33
not including interest on cost of work,	1 71
Cost of raising water per million gallons one foot high, including interest on cost of works,	12½ cts.
not including interest on cost of works,017 cts.

The water from these works is supplied to the first ten wards of the city, and yield a revenue of \$260,265 per annum, from thirty-two thousand one hundred and seventy-five water tenants.

SCHUYLKILL WORKS.

The extensive repairs made necessary by the dilapidated condition of the machinery of these works, have been completed. The engines, pumps, and boilers are all in good working order. Some painting and ordinary repairs are all that will be needed this year, unless some casualty should arise. The valve-boxes of the pump, connected to the bell-crank engine No. 3, have been broken for

several years; having been carefully stayed, it is hoped that, with proper usage, they may last for a long time,—but they are liable to fail at any time. The boilers are all in good repair; the two new boilers placed in the north boiler-house, have fully realized the expectations in regard to them; they are more economical in fuel than any of the old ones. Since their addition, a gang of boilers can always be kept out of use, and thus all are kept cleaner, and, together with their furnaces, in thorough repair; a valuable consideration in an economical point of view.

These works have been of great service to the city during the past year; in addition to keeping up a constant and abundant supply of water to the district dependent upon them, they have rendered valuable assistance to Fairmount works, during the continuance of the freshet, and to the Delaware works, through the season of greatest demand, and no complaints have been made of an inadequate supply, where the mains could carry it, or of its character. A portion of the district, lying very high, is insufficiently supplied with mains; here the want of water has been greatly felt. The occasional turbid state of the water would be greatly improved, were a large subsiding reservoir constructed between the works and the river, for which there is ample room, and it could be constructed at a moderate expense.

An additional pumping main is much needed, as it is almost impossible to work the four engines at once, as the velocity of water through the mains leading to the reservoir is nearly double that of the pump-pistons. There are at present two mains of eighteen inches in diameter, and one of twenty.

These works supply the 11th, 12th, 13th, 14th, 15th, 16th, and 20th wards, to 80,997 water takers. The revenue derived from them is \$174,319.

The following table exhibits the amount of water pumped, coal consumed, and oil and tallow used. There has been a marked saving in the consumption of all the supplies during the past year, as will be seen by an examination of the table.

For a history and description of these works, see page 26.

OPERATION OF SCHUYLKILL WORKS.

	WATER.		COAL.				OIL.			TALLOW.		
	Number of gallons pumped each month during the year.	Average number of gallons pumped per day, each month.	Coal consumed each month during the year.	Number of gallons raised in Reservoir per pound of coal.	Duty in gallons, raised one foot high, per pound of coal.	Oil used each month during the year, in quarts.	Number of gallons raised in Reservoir per quart of oil.	Duty in million gallons raised one foot high, per quart of oil.	Tallow used each month during the year, in pounds.	Number of gallons raised in Reservoir, per pound of tallow.	Duty in million gallons raised one foot high, per pound of tallow.	
			T. cwt. qr. lbs.									
January	166,844,810	5,382,091	275 17 1 11	270	31,050	100	1,668,448	192	230	725,412	83	
February	152,379,810	5,442,136	261 12 3 8	260	29,900	96	1,587,289	182	225	677,243	78	
March	174,383,060	5,625,260	261 3 7 4	298	34,270	90	1,937,589	223	250	697,532	80	
April	168,816,200	5,627,206	269 2 4 19	280	32,200	94	1,795,917	206	268	629,911	72	
May	207,162,360	6,682,657	330 1 3 24	280	32,200	90	2,301,804	265	226	916,647	105	
June	213,851,470	7,128,382	361 9 0 0	264	29,860	92	2,324,472	267	260	822,505	95	
July	260,593,170	8,406,231	385 13 0 0	302	34,730	90	2,895,479	333	258	1,010,090	116	
August	299,787,040	9,670,550	442 17 0 0	302	34,730	92	3,258,554	375	306	979,696	113	
September	304,621,020	10,154,034	449 10 0 0	302	34,730	76	4,008,171	449	240	1,269,254	146	
October	267,765,320	8,637,591	433 9 0 0	265	30,475	80	3,347,066	385	276	970,164	112	
November	226,409,980	7,546,999	345 8 0 0	296	34,040	76	2,979,078	342	274	826,313	95	
December	201,122,380	6,487,818	333 18 0 0	268	30,820	58	3,467,627	390	218	922,579	106	
	2,643,736,620	7,243,114	4150 4 0 10	284 ³ ₁₀	30,694	1034	2,556,805	294	3031	872,232	100	

Average duty for the year, 25,578,300 pounds raised one foot high, by the consumption of 100 pounds of anthracite coal.

The following exhibits the cost of running these works, during the past year :—

RUNNING EXPENSES OF SCHUYLKILL WORKS.

Wages of engineers and firemen,	\$6511 27
4150 tons of coal at \$3 18,	\$13197 00
5 per cent for loss,	659 85
	<hr/>
	13856 85
258½ gallons of oil at \$1,	258 50
3031 lbs. of tallow at 12 cents,	363 62
Packing, small stores, &c.,	391 16
Repairs,	3723 19
	<hr/>
	\$25104 59
Interest on cost of works, (\$150,000,)	9000 00
	<hr/>
	\$34104 59
	<hr/>

Cost of raising water into reservoir per million gallons, including interest on cost of works,	\$12 90
not including interest on cost of works,	9 49

Cost of raising water per million gallons one foot high, including interest on cost of works,	11 2-10 cts.
not including interest on cost of works,	8 2-10 cts.

DELAWARE WORKS.

The machinery of these works is also in good repair, and have been worked up to their full capacity. Owing to the small size of the main, and the great distance from the reservoir, it is impossible to run more than one engine at a time, with any degree of safety.

The rapid growth of the district supplied by these works, and the numerous manufactories located there, call for a much larger supply of water than can be either pumped or distributed through an eighteen inch main, which is the size of both the pumping and distributing mains. Through the season of greatest demand, it has been found necessary to assist in supplying this district from the Schuylkill Works, but owing to the want of suitable mains connecting these works, it is always done to the annoyance of many of the water takers on higher parts of the city, who are partially deprived of water by this arrangement.

The coming season, it will be impossible to supply the increased demand of this district, as the works cannot supply more than was done last summer, in addition to which 30,000 feet of pipe have been laid during the year

No complaints have been made regarding the quality of the water, and all will be done in the power of the department to prevent any during the coming season. As to the cause and certain remedy of the difficulties formerly experienced, the department are unable to say.

The operation of these works has been very satisfactory, and a large saving in supplies effected.

The revenue derived from them, is \$62,429 from 11,452 water-takers.

The following table will show the amount of water pumped, coal consumed, and oil and tallow used. It will be noticed that at these works also, a marked saving has been made in the consumption of the supplies.

For a history and description of these works, see page 35.

No. 3.

OPERATION OF DELAWARE WORKS.

	WATER.		COAL.			OIL.			TALLOW.		
	Number of gallons pumped each month during the year.	Average number of gallons pumped per day, each month.	Coal consumed each month during the year.	Number of gallons raised in Reservoir, per pound of coal.	Duty in gallons, raised one foot high, per pound of coal.	Oil used each month during the year, in quarts.	Number of gallons raised in Reservoir, per quart of oil.	Duty in million gallons raised one foot high, per quart of oil.	Tallow used each month during the year, in pounds.	Number of gallons raised in Reservoir, per pound of tallow.	Duty in million gallons, raised one foot high, per pound of tallow.
			T. cwt. gr. lbs.								
January	54,792,360	1,767,495	123 16 1 15	197	22,064	30	1,826,412	205	62	883,747	99
February	53,339,356	1,904,977	120 11 3 9	197	22,064	30	1,777,978	199	60	858,989	99
March	55,397,440	1,787,014	120 5 3 1	205	22,960	31	1,787,014	200	62	893,507	100
April	58,344,624	1,944,820	129 2 1 11	202	22,624	32	1,823,269	204	60	972,210	109
May	80,498,400	2,596,722	160 15 0 25	223	24,976	32	2,515,575	282	62	1,298,361	145
June	80,287,520	2,676,250	174 1 3 6	206	23,072	15	5,352,501	599	60	1,338,125	159
July	98,224,970	3,168,548	198 0 1 25	221	24,752	31	3,168,547	355	62	1,584,273	177
August	94,372,520	3,044,275	206 18 3 9	203	22,736	31	3,044,274	341	62	1,522,137	170
September	81,993,600	2,733,120	166 12 2 20	219	24,528	34	2,411,576	270	93	892,404	100
October	81,574,060	2,631,421	159 18 3 2	228	25,536	38	2,146,685	240	134	608,761	68
November	77,995,270	2,599,842	144 13 1 6	240	26,880	38	2,166,535	243	90	866,614	97
December	51,746,980	1,669,257	125 19 3 13	183	20,496	26	1,980,268	222	52	990,134	111
	868,567,100	2,379,635	1830 17 1 2	211.3	23,665	366	2,373,134	266	859	1,011,137	113

Average duty for the year, 19,720,800 pounds raised one foot high, by the consumption of 100 pounds of anthracite coal.

The following exhibits the cost of running these works during the past year :—

RUNNING EXPENSES OF DELAWARE WORKS.

Wages of engineers and firemen,	\$3527 25
Coal consumed, 1835 tons, at \$3 47½, \$6376 62	
5 per cent. for loss,	318 83
	<hr/>
	6695 45
91½ gallons of oil at \$1,	91 50
859 pounds of tallow at 12 cents,	103 08
Packing, small stores, &c.,	128 46
Repairs,	969 67
	<hr/>
	\$11515 41
Interest on cost of works, (\$150,000,)	9000 00
	<hr/>
	\$20515 41

Cost of raising water into reservoir per million gallons, including interest on cost of works,	\$23 63
not including interest on cost of works,	13 26

Cost of raising water per million gallons one foot high, including interest on cost of works, 21 1-10 cts.
not including interest on cost of works, 11 8-10 cts.

TWENTY-FOURTH WARD WORKS.

These works are now in complete working order, and since the replacing and mending of the broken parts, they have performed with great satisfaction, furnishing an uninterrupted supply of water to the ward. The demand upon them during the past season, has been fully up to their capacity, without a reservoir. In the month of August, the amount supplied was frequently beyond their estimated maximum capacity. Should the demand increase to any considerable degree, it will be impossible to furnish an adequate supply during the coming season.

The machinery of these works will require no extraordinary repairs this year, unless some accident should occur. The wear upon it is much less than upon any of the other works, particularly when the great height the water is pumped, 230 feet, *double that of any of the other works*, is taken into consideration, and also, the fact that these engines, for want of a reservoir, must be kept constantly in operation. Had they never been placed in incompetent hands, as was the case as soon as they were taken from the contractors, they would have given great satisfaction.

The accompanying table of the amount of water pumped, and the quantity of coal, oil and tallow consumed, will show them to be the most economical of all the works.

The revenue of these works is \$7,054, from 954 water-takers.

For history and description of these works, see page 39.

	WATER.		COAL.			OIL.			TALLOW.		
	Number of gallons pumped each month during the year.	Average number of gallons pumped per day, each month.	Coal consumed each month during the year.	Number of gallons raised in stand pipe per pound of coal.	Duty in gallons raised one foot high per pound of coal.	Oil used each month during the year, in quarts.	Number of gallons raised in stand pipe per quart of oil.	Duty in million gallons raised one foot high, per quart of oil.	Tallow used each month during the year, in pounds.	Number of gallons raised in stand pipe, per pound of tallow.	Duty in million gallons raised one foot high, per pound of tallow.
			T. cwt. qr. lbs.								
January	19,611,900	632,642	76 2 3 14	114	26,427	6	3,268,650	752	25	784,476	180
February	17,653,230	630,472	79 18 0 24	98	20,655	6	2,942,205	677	23	767,531	177
March	22,118,580	713,502	88 12 1 8	111	25,622	5	4,423,716	1017	24	921,607	212
April	18,896,580	629,886	52 10 3 16	160	36,915	4	4,724,145	1086	22	858,935	198
May	22,093,200	712,684	66 3 2 18	149	34,270	6	3,682,200	847	20	1,104,660	254
June	20,877,600	695,920	61 13 0 4	151	34,753	4	5,219,400	1200	23	907,721	209
July	25,556,220	824,394	62 2 2 11	183	42,128	5	5,111,244	1176	15	1,703,748	392
August	28,825,710	929,861	72 14 1 24	176	40,687	4	7,206,427	1657	16	1,801,606	414
September	25,683,750	856,125	74 19 2 6	152	35,029	3	8,561,250	1969	20	1,284,187	295
October	23,185,530	747,920	61 5 3 16	168	38,824	3	7,728,510	1778	16	1,449,695	333
November	20,767,500	692,250	52 7 1 8	177	40,710	3	6,922,500	1592	14	1,483,393	343
December	29,186,370	651,173	47 13 2 18	189	43,470	3	6,728,790	1548	14	1,443,312	332
	265,456,170	727,277	796 4 1 17	148	34,224	52	5,104,926	1174	232	1,442,207	263

Average duty for the year, 28,520,000 pounds, raised one foot high, by the consumption of 100 pounds of anthracite coal.

The following exhibits the cost of running these works during the past year :—

RUNNING EXPENSES OF TWENTY-FOURTH WARD WORKS.

Wages of engineers and firemen,	\$2500 00
Coal consumed, 796 tons, at \$3 70,	2945 20
5 per cent. for loss,	147 26
	<hr/>
	3092 46
13 gallons of oil, at \$1,	13 00
148 lbs. of tallow, at 12 cents,	17 76
Packing small stores, &c.,	39 63
Repairs,	2099 88
	<hr/>
	\$7762 73
Interest on cost of works, (\$55,000,)	3300 00
	<hr/>
	\$11062 73
	<hr/>
Cost of raising water into stand pipe, per million gallons, including interest on cost of works,	\$41 66
not including interest on cost of works,	29 23
Cost of raising water per million gallons one foot high, including interest on cost of works, 18 1-10 cts.
not including interest on cost of works, 12 7-10 cts.

No. 5.

TOTAL QUANTITY OF WATER PUMPED BY ALL THE WORKS OF THE DEPARTMENT DURING THE YEAR 1859.

	Number of gallons pumped each month during the year.	Average number of gallons pumped per day each month.
January	429,751,712	13,862,958
February	388,423,311	13,872,261
March	439,089,370	14,164,173
April	455,104,939	15,170,164
May	578,217,245	18,652,169
June	571,008,680	19,033,621
July	763,896,860	21,641,834
August	795,255,270	25,633,395
September	680,295,870	22,676,529
October	777,929,910	25,094,513
November	685,167,750	22,838,925
December	603,890,730	19,544,862
	7,168,031,647	19,638,442

No. 6.

TABLE SHOWING THE COMPARATIVE COST OF PUMPING WATER IN 1858 AND 1859.

WORKS.	Million gallons pumped during the year 1859.	Height of Reservoirs.	Cost of raising one million gallons into Reservoirs in 1858, including repairs.	Cost of raising one million gallons into Reservoirs in 1859, including repairs.	Difference in cost per million gallons, in 1858 and 1859.	Saving in running expenses of 1859 over 1858.
Fairmount	3,390	100	\$14 66	\$12 33	\$2 33	\$7,898 70
Schuylkill	2,643	115	14 70	12 90	1 80	4,757 40
Delaware	868	112	33 47	23 63	9 84	8,541 12
24th Ward	265½	230	51 38	41 66	9 72	1,580 66

Saving in running expenses of 1859 over those of 1858, . \$22,777 88

A large portion of the cost of repairs to all the works for 1859, was for work that should have been done several years previously, and though appearing above, is not properly chargeable to the running expense of this year.

A part of the above saving in running expenses, as exhibited by table No. 6, is due to the increased amount of water supplied. Notwithstanding the great reduction in the running expenses, there is still room for greater economy. The consumption of coal, it will be seen by reference to table No. 7, is an average of 8 pounds per horse-power per hour; this is about the average of thirteen engines pumping water for the supply of London, erected about the same date as these belonging to the department, which consume an average of 7.7 lbs. per horse-power per hour. The Cornish engine, at the Schuylkill Works, when in complete order, as it now is, will run with about $3\frac{1}{4}$ pounds per horse-power per hour. The Cornish engines at the 24th Ward works, would work with equal economy, if provided with a reservoir to pump into, so that the engines could be kept constantly running at an uniform velocity.

It is expected that the lively interest felt in the works by the engineers and their assistants, and the system of management, with the experience gained, will lead to still greater savings during the present year, and the running expenses be reduced to a perfectly satisfactory amount.

As an instance, the saving in oil and tallow has been very great, in proportion. The cost of these articles during the first six months of 1858, was \$3,184 03, and for the whole of 1859, but \$1,507 07.

The following table, No 7, exhibits a comparison between the different works, in the amount of supplies used, coal, oil and tallow, being the whole amount bought and used during the year.

No. 7.

COMPARATIVE ECONOMY OF THE WORKS.

WORKS.	Average number of gallons raised one foot high per pound of coal.	Average number of pounds of coal, per horse power, per hour.	Average number of pounds raised, one foot high, by one hundred pounds of anthracite coal.	Average number of million gallons raised, one foot high, per pound of fallow.	Average number of million gallons raised, one foot high, per quart of oil.
Fairmount.....				1,527—	1,350—
Schuylkill	30,694	7.7	25,578,300	100—	294—
Delaware	23,665	10.0	19,720,800	113—	267—
Twenty-fourth Ward	34,224	6.9	28,520,000	263—	1,174—
	29,527	8.1	24,606,366	500—	771—

BUILDINGS, RESERVOIRS, AND GROUNDS.

The buildings and grounds of all the works have been so long neglected, that it has been found necessary to make a large amount of repairs, and there is still much that requires immediate attention. The buildings about Fairmount have been thoroughly painted and much repairing done; numerous dead trees have been removed and replaced by others; the embankment sodded, where needed, and placed in good order. The steps leading from the park to the reservoir are in a very dilapidated condition, and will require rebuilding, or other means of ascending provided, which is proposed to be done.

The improvements made during the past two years upon the hitherto neglected lot lying north of the reservoir at Fairmount, have entirely changed its appearance. It has all been laid out, and to a great extent, graded; some of the walks gravelled; a large number of shade and evergreen trees planted; all the plats put in grass, and a good dressing of shell lime placed upon them. Two fountains have been constructed, although in a rude manner, and wanting entirely in ornament, the basins for them being built of sod. A variety of jets have been fitted to the upper fountain, so that the display of water may be varied from time to time; the

lower fountain is played by the waste water from the upper one, and from this the water is led through short canals, and made to fall several times in thin sheets, until it finally reaches the river. These fountains were first played on the 4th of July, and have since afforded much delight to the thousands who daily throng the grounds. During the coming season, this part of the grounds will present an attractive appearance, as the trees and grass will be sufficiently forward to be somewhat ornamental. The increased amount of ground now to be kept in order (about 32 acres,) at Fairmount, will make larger appropriations necessary for that purpose.

Some difficulty has occurred from the leasing to a third party, by another department, of a portion of the ground enclosed, and which has for many years formed a part of Fairmount. The ordinances regulating these departments, should be so altered as to place all the grounds and wharves, occupied or belonging to the several works, under the sole control, charge, and management of this department, or such difficulties may again arise.

It is hoped that all the buildings at the other works, will be put in thorough repair during the coming summer; also, the wharf at the Delaware works, to which a large amount has already been done, but to which much is still required.

DISTRIBUTION.

The large and steadily increasing demand for service mains, is a matter of surprise. It was supposed by some, that from the large amount laid in 1858, (72,124 feet) less would be required in future, but, on the contrary, the demand has been even greater, and notwithstanding in 1859, 98,931 feet were laid, independent of 18,013 feet, of large supply mains, there are still a number of streets, in which councils have ordered pipe to be laid, to be attended to.

When it is considered that service mains are laid only when petitioned for by the owners of property along whose front it is laid, who are assessed for the expense of laying it, there is, perhaps, no

more satisfactory evidence of the rapid growth of the city than that about nineteen miles of new streets have required the water pipes laid in them during the past year.

The expense of laying pipes has been reduced during the past year, from what it was the last six months of 1858, to 26 cents per foot, which includes all expense attendant upon laying pipe, materials only excepted. During the first six months of 1858, this expense reached 61½ cents, and during the last six months, was reduced to 28½ cents; this will show a saving in the expense of all the pipe laid, over the first six months of 1858, of \$34,873 17, and over the last six months of that year, of \$2,473 27. The cost of measuring pipe, and making bills and plans of the streets, paid to district surveyors, has been four cents per foot and in some instances five. The whole amount paid them for such services was, during the year, \$3,063 64. Several of the surveyors have drawn a larger amount from this department, during the year, than the salary paid to the purveyors, who devote their entire time to the interests of the city, and to whom much of the above saving in pipe laying may justly be attributed. The salaries of these officers, as well as those of the inspectors, should be advanced, their pay being now far below what the importance of the services they render to the city is worth.

It is probable that the demand for service mains will be at least as great this year as it was during the past, there being already about four miles ordered by councils. This, with the large amount of service mains laid, calls for new supply mains, which will be pointed out under the head of Extensions.

The amount received by the department on account of pipes, has been \$67,834 04. The amount returned to the City Solicitor to be leined was \$29,415 23. Amount unpaid upon the books, \$27,141 12.

The following is a list of the streets in which pipe has been laid during the past year:—

FIRST DISTRICT.

PIPES LAID IN THE FIRST, SECOND, THIRD AND FOURTH WARDS.

Street.	Location.	Size.	
		Inches.	Feet.
Moore.	From Shippen lane to Evans,	4	175
Bedford.	“ Twentieth to Twenty-first,	4	594
Catherine.	“ Seventeenth to Twentieth,	6	1350
Fisher.	“ Sixth to Seventh,	4	450
Twenty-first.	“ South to Shippen,	6	330
Shippen.	“ Twenty-second to Gray's Ferry road,	6	541
Stocker.	“ Carpenter to Washington,	4	410
Lentz.	“ Eleventh to Twelfth,	4	400
Eighth.	“ Reed to Dickerson,	6	455
Christian.	“ Eighteenth to Twentieth,	6	940
Nineteenth.	“ Fitzwater to Washington,	6	1480
Dickerson.	“ Front to Meadow,	6	975
Pemberton.	“ Nineteenth to Twentieth,	4	450
Twentieth.	“ South to Pemberton,	6	505
“	“ Pemberton to Christian,	10	842
	Attachments,	4	152
Emeline.	“ Eighth to Ovington,	4	340
Thirteenth.	“ Wharton to Reed,	6	445
Peters.	“ Twelfth, westward,	4	352
Catherine.	“ Broad to Sixteenth,	6	991
	Connections,	6	103
Fifteenth.	“ Fitzwater to Catherine,	6	375
Moore.	“ Fourth to Fifth, south side,	6	453
“	“ Fifth to Sixth,	4	455
“	“ Front to Ostag, north side,	4	265
“	“ Second to Moyamensing road, north side,	6	545
“	“ Second to Moyamensing road, south side,	4	545
	Connections,	6	99
Lancaster.	“ Dickerson, northward,	4	85
	Attachments,	4	118

SUPPLY MAINS AND CONNECTIONS TO FIRST DISTRICT.

Street.	Location.	Size.	
		Inches.	Feet.
Broad.	From Washington to Carpenter,	30	580
Washington.	“ Broad to Tenth,	20	1578
“	“ Tenth to Fifth,	16	2290
	Intersection of Broad and Washing- ton,	20	200
	Connections,	10	76
	“	6	541
	“	4	36
	“	6	50
		20571	

SECOND DISTRICT.

PIPES LAID IN THE FIFTH, SIXTH, SEVENTH, EIGHTH, NINTH,
TENTH, AND TWENTY-FOURTH WARDS.

Street.	Location.	Size.	
		Inches.	Feet.
	To supply Penn Hospital.	6	87
	“ “ “	4	32
	Fire Plug for Media R. R. Comp.,	4	198
Mary.	From Twenty-fourth to Twenty-fifth,	3	315
Malony.	“ Twenty-first, eastward,	3	292
Vine.	“ Twenty-second, westward, relaid,	6	459
“	“ Twenty-third, “ “	6	235
	Fire-plug at Market street Bridge,	3	90
	Fairmount Park, north of Reservoirs,	8	740
	“ “ “ “	6	146
Bridge.	From Twenty-fourth, eastward,	6	700
Hamilton.	“ Thirty-fifth to Thirty-sixth,	6	390
“	“ Pine to Baltimore pike,	6	397
“	“ Chestnut to Walnut,	6	558
“	“ Thirty-third to Thirty-fifth,	6	836
Barring.	“ “ “ “	6	869
Haverford.	“ Forty-first to Lancaster pike,	6	933
	Attachments,	4	179
Pearl.	“ Quince to Prosperous,	3	87
Kerr.	“ Pine to Lombard,	4	337

Street.	Location.	Size.	
		Inches.	Feet.
Arch.	From Nineteenth to Twentieth,	6	235
Haverford.	“ Thirty-seventh to Forty-first,	6	1751
Twenty-first.	“ Market to Chestnut,	6	524
Ashburton.	“ Twenty-third to Twenty-fourth,	4	290
Lancaster.	“ Thirty-eighth to Bridge,	8	1197
Thirty-second.	“ Bridge to Garden, relaid,	4	174
Tilgham.	“ Forty to Forty-first,	6	891
	Intersection relaid,	6	70
	Attachments,	4	191
Lombard.	From Thirty-third to Willow,	6	607
Chestnut avenue.	“ Walnut to Chestnut,	6	162

SUPPLY MAIN TO FIRST DISTRICT.

Poplar.	From reservoir to Ridge avenue,		
Ridge avenue.	“ Poplar to Broad,		
Broad.	“ Ridge avenue to Carpenter,	30	13365
	Connections,	12	18
	“	8	18
	“	6	36
		<hr/>	
		27409	

THIRD DISTRICT.

PIPES LAID IN THE ELEVENTH, TWELFTH, SIXTEENTH, SEVENTEENTH, EIGHTEENTH, NINETEENTH, AND TWENTY-THIRD WARDS.

Street.	Location.	Size.	
		Inches.	Feet.
Howard.	From Putnam, southward,	4	238
“	“ “ to York,	6	4246
Cadwallader.	“ Columbia to Montgomery,	4	588
American.	“ Jefferson to Oxford, both sides,	4	810
Salmon.	“ York to Cumberland,	4	351
Ann.	“ Emerald, northwestward,	4	320
Norris.	“ Frankford road to West,	6	1896

Street.	Location.	Size.	
		Inches.	Feet.
Front.	From York to Cambria,	6	2810
Seviva.	“ “ Cumberland,	6	801
Susquehanna.	“ Sixth to Germantown road,	6	72
Moore.	“ Emerald to Amber,	4	837
Hope.	“ York to Dauphin, At reservoir,	4	85
Trenton avenue.	“ Otis to Cumberland, both sides,	4	3039
Dreer.	“ Coral to Amber,	4	405
Lithgow.	“ Diamond to Susquehanna avenue,	4	600
Washington.	“ Emerald to Franklin Cemetery,	6	251
Belgrade.	“ Otis to York,	6	1081
	Relaid on Germantown road,	10	335
	“ “ “	4	70
	“ Culvert street,	4	445
	Laid on Germantown road,	4	223
Lehigh.	From Frankford road to Coral,	6	73
Coral.	“ Lehigh to Somerset,	6	785
Huntingdon.	“ Second to Mascher,	6	601
Ella.	“ Amber to Emerald,	4	854
Miffin.	“ Master to Thompson,	6	423
	Plug attachments,	4	236
Frankford road.	“ Westmoreland to Harrison,	12	11723
“	“ 260 feet south of Ruan to Ox- ford road,	4	3021
	Connections,	6	192
			<hr/>
			37973

FOURTH DISTRICT.

PIPES LAID IN THE THIRTEENTH, FOURTEENTH, FIFTEENTH,
TWENTIETH, AND TWENTY-FIRST WARDS.

Street.	Location.	Size.	
		Inches.	Feet.
Twenty-second.	From Callowhill to Brandywine,	6	1190
Twentieth.	“ Master to Berks,	6	3229
“	“ Spring Garden to Green,	10	500
Perth.	“ Thompson to Master,	4	463
Pratt.	“ Twenty-third to Twenty-fourth,	4	522

Street.	Location.	Size.	
		Inches.	Feet.
Cadbury.	From Oxford to Columbia,	4	567
Amboy.	“ Jefferson “	4	1062
Willow.	“ Twelfth to Thirteenth,	4	448
Oxford.	“ Thirteenth to Broad,	6	625
Columbia.	“ Seventh to Eleventh,	6	1678
Seventh.	“ Columbia to Germantown road,	6	3376
Twenty-first.	“ Callowhill to Spring Garden,	6	1021
“	“ Ridge avenue to Columbia,	6	817
Brown.	“ Twenty-third to Minor,	6	1574
Sixteenth.	“ Thompson to Master,	6	457
Master.	“ Sixteenth to Twentieth,	6	1820
Ringgold.	“ Pratt to Brown,	4	466
Cabot.	“ Fifteenth to Sixteenth,	4	444
“	“ Eighteenth to Nineteenth,	4	444
Cambridge.	“ Twentieth to Twenty-first,	4	355
	Attachments,	4	213
Perkiomen.	“ Frances to Poplar,	10	1071
Tenth.	“ Jefferson to Montgomery,	6	1607
Poplar.	“ Nineteenth to Grape,	6	281
Broad.	“ Columbia, northward, west side,	6	231
Scott.	“ Nineteenth to Twenty-first,	4	929
Fawn.	“ Columbia to Montgomery,	4	560
Twelfth.	“ “ “ “	6	560
Wallace.	“ Twenty-first to Twenty-second,	6	456
Bellevue.	“ Wylie to Frances,	6	394
Master.	“ Twentieth to Ridge avenue,	6	89
Twenty-fourth.	“ Callowhill to Carlton,	6	270
Wallace.	“ Twenty-third to Twenty-fourth,	6	448
Thompson.	“ Sixth to Seventh,	6	456
Davis.	“ Twelfth to Thirteenth,	6	458
Beckett.	“ Sixteenth to Seventeenth,	4	460
	Attachments,	4	216
Sharswood.	“ Ridge avenue to Twenty-second,	6	749
Twenty-third.	“ Mount Vernon to Wallace,	6	108
West.	“ Brown, northward,	4	178
	Connections,	12	9
	“	6	63
	“	4	127

30991

RECAPITULATION.

WARDS.	3 in. diam.	4 in. diam.	6 in. diam.	8 in. diam.	10 in. diam.	12 in. diam.	16 in. diam.	20 in. diam.	30 in. diam.	TOTAL.
1, 2, 3, 4,.....		4827	10,178		918		2,290	1,778	580	20,571
5, 6, 7, 8, 9, 10, 24,.....	784	1401	9,886	1,955		18			13,365	27,409
11, 12, 16, 17, 18, 19, 23, 13, 14, 15, 20, 21,.....		12,684	13,231		335	11,723				37,973
		7,454	21,957		1,571	9				30,991
Total,	784	26,366	55,252	1,955	2,824	11,750	2,290	1,778	13,945	116,944

Being a total of over 22 miles.

Total number of feet laid previously,	1,501,161
“ “ “ during the year,	116,944
now laid,	1,618,105

Being a total of 306½ miles of water main now laid in the city.

ACCOUNT OF THE NUMBER OF HOLES DRILLED FOR MAKING NEW ATTACHMENTS TO PUBLIC MAINS DURING THE YEAR 1859.

MONTH.	Half inch diameter.	Five-eighth inch diameter.	Three-fourth inch diameter.	One inch diameter.	Total holes drilled and attachments made.	Shot off for repairs to private pipes.	Shot off for repairs to public pipes.
January.....	37	6	3	2	48	16	20
February.....	40	5	2	0	47	11	3
March,.....	107	12	4	3	126	12	12
April,.....	180	24	6	2	212	25	1
May,.....	167	20	6	1	194	26	2
June,.....	154	31	3	0	188	27	1
July,.....	134	28	6	2	170	25	4
August,.....	191	23	6	4	224	24	0
September,.....	166	34	10	4	214	25	13
October,.....	159	45	3	0	207	22	15
November,.....	138	33	6	1	178	27	11
December,.....	76	16	8	1	101	27	13
	1549	277	63	20	1909	267	95

THE ABOVE ATTACHMENTS WERE MADE IN THE WARDS, AS
FOLLOWS :

WARDS.	Half inch diameter.	Five-eighth inch diameter.	Three-fourth inch diameter.	One inch diameter.	Total holes drilled.	Shut off, private pipes.	Shut off public pipes.
1st, 2d, 3d, and 4th,...	272	42	15	4	333	35	40
5th, 6th, 7th, 8th, 9th, 10th, and 24th,.....	427	95	25	5	552	105	19
11th, 12th, 16th, 17th, 18th, 19th, and 23d.	406	43	13	6	468	67	16
13th, 14th, 15th, 20th, and 21st,	444	97	10	5	556	60	20
	1549	277	63	20	1909	267	95

ACCOUNT OF NEW STOPS AND FIRE PLUGS.

DISTRICT.	No. of Stops.	No. of Fire Plugs.
First,.....	25	18
Second,.....	60	47
Third,.....	69	71
Fourth,.....	49	45
New Stops,.....	203	New Fire Plugs,..... 181
Account per last report,.....	3099	Account per last report,..... 2501
Total,.....	3302	Total,..... 2682

Councils have ordered pipes to be laid in the following streets,
which still remains to be done:—

Pipes ordered to be laid in the First District.

Catherine.	From Twentieth to Twenty-first.
Twenty-sixth.	“ Park to Gray’s Ferry road.
Twenty-second.	“ South to Shippen.
Nineteenth.	“ Shippen to Fitzwater.
Twenty-seventh.	“ Federal to Gray’s Ferry road.
Moore.	“ Front to Second.
“	“ Sixth to Ninth.

Pipes ordered to be laid in the Second District.

Twenty-second.	From Pine to Locust.
Burton.	“ Sixteenth to Seventeenth.
Ninth.	“ Spruce to Pine.

Pipes ordered to be laid in the Third District.

Clinton.	From Columbia to Diamond.
Hope.	“ Oxford to Chatham.
Allen.	“ Frankford road to Leiper.
Leiper.	“ Allen to Oxford road.

Pipes ordered to be laid in the Fourth District.

Spring Garden.	From Eighteenth to Twenty-third.
Fairview.	“ Sixteenth to Nineteenth.
Spring Garden.	“ Broad to Sixteenth.
Montgomery.	“ Tenth to Broad.
Alder.	“ Girard avenue to Thompson.
Mary.	“ Jefferson to Thompson.
Ontario.	“ Thompson to Jefferson.
Shirley.	“ Coates to Wylie.

To lay the above streets, will require about 30,000 feet of pipe.

SHOP.

The shop connected with this department, has heretofore been a bill of expense to the city, and its abandonment has been recommended, but by careful management it has been made to yield a profit during the past year of nearly \$5,000, and it is now too small for the purposes required of it. It was originally constructed for the manufacture and repair of stops, plugs, &c., for the old city, but since the consolidation of all the works, it has been found inadequate; no new tools have been placed in it for many years, with the exception of a small lathe, taken from the Schuylkill works last summer. By enlarging it, and the addition of a steam engine, and some few tools, involving an expense of about \$10,000, it

would be made much more remunerative, and enable the department to do a large amount of work and repairs, now sent to other shops, for want of proper tools and shop room.

The following statement exhibits the operation of the shop for the past year :—

1859.	CR.	
Dec. 31.	By stops, plugs, &c., furnished to the	
	First District,	\$2651 80
	" Second District,	3641 51
	" Third District,	2482 13
	" Fourth District,	2477 53
	" To Frankford main,	1575 00
	" Repairs for Fairmount works,	19 49
	" " " Schuylkill "	3 05
	" " " Delaware "	180 32
	" " " 24th Ward "	3 62
	" Ferules for Register's Office,	849 50
		<hr/>
		\$13883 95

Extension to Works.

By	Materials furnished the First District, for 16, 20 and 30 inch mains,	\$1478 74
"	Second District, for 30 inch main,	\$2219 92
"	Reservoir,	206 59
"	Mill House,	191 81
		<hr/>
		4097 06
"	Stock on hand,	3564 11
		<hr/>
		\$21545 12

	DR.	
Jan. 1.	To Stock on hand,	\$2787 23
Dec. 31.	" Bills of materials, iron,	
	brass, &c.,	8688 09
	" Wages,	5106 69
		<hr/>
		16582 01
		<hr/>
	Balance profit of shop for 1859,	\$4963 11

No. 8. COMPARATIVE EXPENSE OF WATER UPON TAXABLE PROPERTY, &c.

WARDS.	Value of real estate and personal property for 1859.	Number of taxables for 1859.	Number of water tenants assessed for 1860.	Amount of water rents assessed for 1860.	Number of steam engines supplied from works.	Aggregate of horse power.	Amount assessed for manufacturing purposes.	Average water rent, per each taxable.	Average water rent, per each tenant.	Per cent. of water rents upon taxable property.
First	\$5,255,600	4,946	3,812	\$25,360	10	112	\$1,432	\$5 12	\$6 65	Mills, 4.8
Second	3,628,931	5,714	4,703	26,263	12	175	1,109	4 59	5 58	7.2
Third	2,553,209	3,815	2,696	15,520	6	27	335	4 04	5 75	6.0
Fourth	3,062,960	4,320	5,355	19,661	4	27	347	4 55	3 67	6.4
Fifth	13,815,307	3,720	2,510	26,787	29	295	1,646	7 20	10 64	1.9
Sixth	21,388,495	3,650	2,244	32,778	39	656	5,105	8 98	4 60	1.5
Seventh	7,560,382	5,250	3,281	30,848	12	281	1,281	5 87	9 40	4.1
Eighth	13,738,300	3,500	2,159	29,827	10	106	1,051	8 52	13 88	2.2
Ninth	11,570,000	3,870	2,516	25,738	23	345	2,382	6 65	10 23	2.2
Tenth	8,469,700	4,500	2,890	27,483	20	242	1,117	6 10	9 86	3.2
Eleventh	4,648,000	3,400	2,201	17,448	20	225	2,618	5 13	7 91	3.8
Twelfth	4,067,275	3,650	1,718	18,402	14	212	1,824	5 04	10 71	4.5
Thirteenth	5,467,500	4,248	3,069	26,014	13	108	1,315	6 12	8 47	4.7
Fourteenth	5,161,365	4,650	4,077	30,437	24	248	1,047	6 54	7 46	5.9
Fifteenth	6,876,000	5,483	4,512	32,643	41	615	4,456	5 95	7 23	4.4
Sixteenth	3,097,456	4,061	2,700	20,835	43	697	2,315	5 08	7 64	6.6
Seventeenth	2,005,000	4,500	2,875	18,002	18	404	1,962	4 00	6 30	8.9
Eighteenth	2,704,350	4,374	2,452	18,365	20	408	2,262	4 20	7 08	6.8
Nineteenth	5,671,135	5,764	3,425	26,062	28	437	3,064	4 52	7 64	4.6
Twentieth	7,387,360	5,505	4,334	28,740	22	180	1,632	5 16	6 63	3.9
Twenty-first	2,977,226	2,850	No water supply.							
Twenty-second	4,605,483	3,250	Supplied by two private companies.							
Twenty-third	5,023,922	4,760	Water just introduced.							
Twenty-fourth	5,228,250	3,950	594	7,054	21	360	1,793	1 78	11 87	1.3
	\$155,697,669	103,850	61,129	\$504,067	438	6,763	\$40,693	\$4 85	\$7 86	Average, 3.5 of 21 wards supplied from city works.

COMPARATIVE EXPENSE OF WATER UPON TAXABLE PROPERTY, ETC.

The preceding table, No. 8, exhibits the assessed value of real and personal property in the different wards, for 1859, and the number of taxables in each ward; the number of water tenants assessed for 1860, and the amount of water rent assessed in each ward; the number of steam engines supplied with water from the works, their aggregate horse-power, and amount of water rent assessed upon manufacturing establishments. Most of the large engines and manufactories are so located as to procure their supply of water direct from the rivers, but where the supply for steam engines is drawn from the creeks, still accessible, or from wells, it is certainly poor economy, when water so unexceptionable can be procured from the city works, without pumps, for the small sum charged, three dollars per horse-power per annum, which is more than made up by the expense of pumping, waste of fuel, and wear of boilers. There are, however, portions of the city, where, from the want of adequate mains, the supply is frequently interrupted, and manufacturers are obliged to use water from other sources.

The 438 steam engines supplied by this department, consume about 150,000 tons of coal per annum; were human muscle used to perform the labor required of them, an army of nearly 50,000 able bodied men would be needed, and the extra expense of muscle over coal would not be less than ten millions of dollars per annum.

There is perhaps no city where water is supplied at so cheap a rate as in this, as will be seen by examining the table. The average water tax is but 35 cents to the hundred dollars of taxable property, in the twenty-one wards supplied with water, more than one-half of which is returned to the city in the profits of the works. In 1797, the water tax of the city was equal to about 90 cents on one hundred dollars. The amount received

from manufacturing purposes is \$40,693. This amount would be doubled if the supply to some of the more flourishing manufacturing wards was more constant and abundant. If adequate facilities should not be afforded for procuring the necessary amount of water required by the numerous steam engines and manufactories, seeking a supply from the water works, they will be compelled to seek locations away from the built up portions of the city. This city is conceded to be the principal manufacturing city in this country, and the regulations of this department, and indeed of all others, should discriminate in favor of its manufacturing interests, and everything should be done to induce and foster their location and growth.

RECEIPTS AND DISBURSEMENTS.

For the receipts of the department at the office, corner of Fifth and Chestnut streets, see the Register's report, (W. J. P. White, Esq.,) appended to this.

The re-assessment of the water rents of the entire city has more than met the most sanguine expectations, and the revenue of the department has been thereby greatly increased. The large number of water tenants now upon the books of the department, (64,125,) and the rapid increase of this number, renders the greatest vigilance and care necessary to protect the city's interest, as new discoveries are constantly being made of frauds upon the department. It is believed, if the revenue for water rent, pipes, &c., could all be collected, it would reach the sum of six hundred thousand dollars. The department has determined to do all in its power to collect what is its legitimate due, but there are many difficulties in the way, particularly in the collecting of frontage for pipe, arising from defects in the law and carelessness in the returns made to the office. By judiciously extending the works and mains, a very largely increased revenue would be received by the city from this department, and a consequent increased profit. The extensions already made and now in progress, will not be sufficient to meet the

requirements of the city, or give to it an ample water supply, as the growth of the city has been larger, in proportion, than the increased and enlarged capacity of its water works.

The entire income of the department for the last year was \$551,180 08, an excess of \$93,661 37 over the receipts of 1858.

The clerks of the department have faithfully performed their duties, and the two additional ones granted by a recent ordinance, will prove of great assistance to it.

The following table will exhibit the income and expenses of the department for several years :

	Receipts.	Expenditures.	Balance, profit.
1855.	\$382,036 72	\$250,895 37	\$131,141 35
1856.	351,936 49	138,954 85	212,981 64
1857.	425,426 11	200,605 82	224,820 29
1858.	457,518 48	187,978 09	269,540 39
1859.	551,180 08	*225,082 03	326,098 05
Total.	\$2,168,097 88	\$1,003,516 13	\$1,164,581 72

* Of this amount, \$22,772 53 was paid for the Frankford main.

RECEIPTS FOR THE YEAR 1859.

The following amounts have been received at the Cherry street office during the year, and paid to the City Treasurer.

West Chester and Media Railroad Co., for work and materials, putting in plug at West Philadelphia station,	\$209 88	
Brass turnings,	31 60	
Leather scraps,	5 00	
Germantown and Norristown Railroad Co., for attachment,	45 47	
Horstman & Sons, for replacing fire plug,	7 61	
Jos. Kiehl, for rent of lot on Poplar street,	15 00	
Amount carried forward,	————	\$314 56

Amount brought forward,		\$314 56
Trustees of the Philadelphia Gas Works, returned payment for connection and service pipe at Fairmount,	\$29 50	
Geo. W. Carpenter, for new plug case, and repairs to plug on Main street, Ger- mantown,	12 00	
Scrap iron,	205 23	
Grass,	12 50	
Jos. Kiehl, for rent of lot on Poplar street, David M'Cully, for rent of lot north of Spring Garden reservoir,	15 00	
Jno. F. Lewis & Bro., for fire plugs, &c., at factory,	20 00	
Rowley & Ashburton, for old pipe,	126 89	
Caleb S. Wright, for rent of wharf at Fairmount,	2 88	
Jos. Kiehl, for rent of lot on Poplar street, David M'Cully, for rent of lot north of Spring Garden reservoir,	100 00	
Scrap iron,	15 00	
Brass turnings,	20 00	
Grass,	396 25	
Manure,	40 00	
Frankford and Southwark City Passenger R. R. Co., for 4 in. pipe at Frankford,	6 50	
Pennsylvania Hospital, for laying pipe and making connections,	50	
Race and Vine street Passenger R. R. Co., for gas at Fairmount,	1221 37	
R. C. Hicks, for sand,	313 37	
Henry Post, for stone,	25 43	
Jos. Kiehl, for rent of lot on Poplar street, Rent of wharf at Schuylkill works,	11 22	
Cement barrels,	60 00	
Old lead pipe,	15 25	
Tree,	10 00	
Scrap iron,	42 14	
Brass turnings,	2 00	
	50	
	6 00	
	27 80	
		2737 83
Total,		\$3051 89

EXPENDITURES OF THE DEPARTMENT,

For the year 1859.

Salaries of chief engineer, register, clerks, &c., .	\$17246	75
Office expenses,	2185	18
Salaries of engineers, firemen, &c., at works, .	16298	73
Supplies to works, viz.,		
Coal,	\$24489	48
Tallow and oil,	1507	50
Small stores,	1064	71
		<hr/>
		27061 69
Repairs viz.,		
buildings, grounds, &c., .	\$6907	91
Works viz.,		
Fairmount,	\$2896	97
Delaware,	969	67
Schuylkill,	3723	19
24th Ward,	2099	88
		<hr/>
		9689 71
		<hr/>
		16597 62

Service mains,—materials.

Iron pipe, fire plugs, castings and other fixtures, and materials for laying pipes, &c., viz.,		
Iron pipe,	\$51113	92
Lead "	6569	51
Iron castings,	3086	49
Brass castings,	1663	14
Lumber,	736	14
Gaskets,	241	08
Wrought iron,	584	96
Hardware,	253	83
Blacksmith coal,	116	25
Stop cocks,	963	37
Bolts, &c.,	1114	77
		<hr/>
		66443 46
		<hr/>
Amount carried forward,	\$145833	43

Service mains,—labor.

	Amount brought forward,	\$145683	43
Labor laying pipe, setting plugs, &c., and for fitting up fire plugs, stop-cocks, &c.,			
Pipe First District,	\$2948	60	
“ Second District,	3235	55	
“ Third District,	2616	55	
“ Fourth District,	6533	73	
“ Frankford, (4 in.)	652	86	
			\$16037 29
Shop,			
Wages,	\$5106	69	
Merchandize, . .	831	31	
Horse and harness,	238	62	
			6176 62
Pipe plans,			678 00
Assessment of new streets, . .			111 00
Overpaid water rents,			563 18
Surveyors, for measuring pipe,			2923 73
			26489 82
Keeping pipe, plugs, stops, and fixtures in good order,			
Wages paid, First District, . . \$1248 08			
“ Second “	2143	30	
“ Third “	1904	76	
“ Fourth “	1771	28	
			\$7067 42
Repairs to mains, at 24th Ward works,			237 49
New stop-house at Fairmount, . .			382 55
Sundries,			172 71
			7860 17
Drilling and making new attachments, viz.,			
Wages paid in First District, . .	\$1180	07	
“ Second District,	1071	38	
“ Third District,	1173	87	
“ Fourth District,	837	47	
“ Connection with 20 inch main,			146 24
			4409 03
Amount carried forward,			\$184592 45

	Amount brought forward,	\$184592 45
Grading and planting trees on lot north of Fair-		
mount reservoir,		\$1985 92
State taxes,		74 78
New boilers at Schuylkill Works,		4182 04
Completing the re-assessment,		3993 25
Bill for overcharge on water-pipe,		64 63
Drinking hydrants,		497 25
Testing turbines,		473 08
Old bills of 1856, 1857, 1858,		6451 10

EXTENSION.

 \$202314 50

Frankford main,		
Wages,	\$6154 53	
Pipe,	14769 77	
Stop-castings, &c.,	147 80	
Smith-work,	120 07	
Hardware,	27 06	
Lumber,	33 98	
Surveyor,	139 91	
Lead,	1379 41	
	<hr/>	\$22772 53

Paid from Loan.

Iron pipes, branches, stops, lead, &c.,		
labor and materials, in laying sup-		
ply main to first district, viz.,		
Pipe,	\$90309 60	
Lead,	8239 90	
Gaskets,	206 36	
Iron castings,	634 20	
Brass do.	99 88	
Lumber,	509 97	
Hardware,	206 46	
Ropes, blocks, &c.,	371 43	
Machine and smith-		
work,	1150 32	
Bolts,	67 77	
Wages,	25302 87	
	<hr/>	126098 76
	<hr/>	\$148071 29
Amount carried forward,		<hr/> \$351185 79

	Amount brought forward,	\$351185 79
Raising the reservoir at Corinthian avenue, and building retaining wall :		
Coping, . . .	\$2811 52	
Iron, . . .	87 60	
Lime, . . .	1210 00	
Hardware, . . .	87 68	
Smith-work, . . .	796 18	
Powder and fuse, . . .	308 25	
Bricks, . . .	129 50	
Wheelwright work, . . .	105 98	
Bolts, blocks, &c., . . .	168 88	
Wages, . . .	30237 80	
	<hr/>	
		\$35943 39
Stand-pipe at Fairmount :		
Plate-iron pipe, . . .	425 08	
Lumber, . . .	320 39	
Hardware, . . .	60 86	
Tin-work, . . .	61 12	
Mouldings, &c., . . .	26 68	
Wages, . . .	662 47	
	<hr/>	
		1556 60
		<hr/>
		37499 99
Erecting two turbine wheels, and four pumps at Fairmount, viz :		
Iron castings, . . .	1014 90	
Brass do. . . .	242 00	
Machine work, . . .	688 08	
Bolts, &c., . . .	9 91	
Wages, . . .	104 25	
	<hr/>	
		2059 14
Erecting Mill-house along the Mound dam at Fairmount, viz :		
Coping, . . .	657 00	
Lumber, . . .	2603 69	
Cement, . . .	970 97	
Bricks, . . .	347 20	
Iron, . . .	77 01	
Ropes, . . .	126 38	
	<hr/>	
Amounts carried forward,	\$4782 25	<hr/>
		\$398744 92

Amounts brought forward,		\$4782 25	\$390744 92
Powder, . . .	\$162 50		
Blacksmith's coal,	18 00		
Bolts, &c., . . .	103 54		
Scow, . . .	175 00		
Hardware, . . .	246 40		
Engine and ma-			
chine work, . . .	1047 36		
Wheelwright work,	70 26		
Smith-work, . . .	479 77		
Wages, . . .	13907 09		
	<hr/>	16209 92	
		<hr/>	20992 17
			<hr/>
			\$411737 09

REGISTER'S STATEMENT.

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER,
REGISTER'S OFFICE,
January 25, 1860.

H. P. M. Birkinbine, Esq.,
Chief Engineer of the Waterworks :

DEAR SIR, I have the honor of submitting to you a statement of the receipts of this office for the year 1859.

It will be found, by a comparison with the receipts of 1858, that there has been an increase of \$90,609 61 during the past year ; this is, undoubtedly, due to the wise measures adopted by Councils, for the re-assessment of the water rents, and levying a water tax on houses fronting on streets where the water pipe is laid, and also to the indefatigable exertions on the part of the clerks and officers of the department, to execute the requirements of the ordinance providing for the same.

During the past year, great inconvenience was suffered, both by the public and the officers and clerks, for the want of proper accommodations for the necessary transaction of the business of the department. I trust that this will be remedied at an early day.

The amount of water rents and water tax outstanding on the first of January, 1860, was \$29,263 50; since which time, \$1,840 22 has been paid, leaving a balance of \$27,423 36, most of which consists of water tax on property fronting on streets where the water pipe is laid. Owners of such property are required to pay this tax, or "to show that their property obtains water from other sources than the Water Department of the City of Philadelphia;" when this is done, the balance will be found to be a very small amount.

Respectfully submitted,

W. J. P. WHITE, *Register.*

No. 9.

Statement of Receipts at the Register's Office, from January 1st to December 31st, 1859.

	Rents of 1867.	Rents of 1868.	Rents of 1869.	Penalties.	Fractional rents.	Iron pipe.	Total.
January	\$166 74	\$4,223 26	\$3,352 25		\$916 04	\$3,148 98	\$11,801 17
February	5 75	347 14	35,128 00		928 15	4,540 42	40,949 46
March	40 25	126 22	314,910 26		1,145 88	2,483 80	318,706 41
April	12 65	69 60	8,183 75	261 00	2,354 92	3,388 22	14,270 14
May		17 25	7,827 75	320 61	2,008 90	4,627 36	14,801 87
June	14 95	41 40	37,283 88	1,710 76	1,916 59	5,911 24	46,878 82
July	74 75	80 50	3,219 75	323 15	1,359 99	6,443 57	11,501 71
August		8 63	11,478 25	1,568 28	1,656 32	8,633 10	23,344 58
September	52 90	20 90	13,540 75	1,466 14	1,612 17	6,859 40	23,552 26
October		8 00	7,343 50	725 68	1,420 31	5,206 33	14,703 82
November	10 00	221 20	4,637 63	481 35	1,005 14	7,142 66	13,497 98
December		5 75	3,177 75	275 51	1,211 98	9,448 96	14,119 95
Total	\$377 99	\$5,169 85	\$450,083 52	\$7,132 48	\$17,537 29	\$67,834 04	\$548,128 19

EXTENSIONS.

In the report to Councils from this department, in October, 1858, extensions to the works were recommended, some of which were authorized by ordinance, approved April 8th, 1859, (see Appendix to Journal of Select Council, No. 157, p. 517,) and a loan of two hundred and twenty-one thousand dollars made, to carry out its provisions. The following work has been done:—

MAIN TO FIRST DISTRICT.—A thirty inch main has been laid from the reservoir at Corinthian avenue, along Poplar street to Ridge avenue, along Ridge avenue to Broad street, and along Broad street to Washington avenue; a twenty inch main along Washington avenue, from Broad to Tenth street, and a sixteen inch main from Tenth street, along Washington avenue to Fifth street.

The whole length of 30 inch main laid was	13,945	feet.
“ “ 20 “ “	1,778	“
“ “ 16 “ “	2,290	“

For this purpose, the sum of one hundred and thirty-seven thousand five hundred dollars was appropriated. The whole expense of these mains, with their connections, amounted to \$126,098 76.

The expectations, in regard to this main, have been fully realized. Immediate relief was felt in all that section of the city, the supply being as constant and copious as the most favored localities. The demand for water has sensibly increased, and the revenue was greatly augmented; part of this increase is attributable to the more perfect assessment which has been made, but much the larger part is owing to the regular and abundant supply of water. The increase in revenue, from the portion of the city supplied by this main, being the first four wards, is \$24,269 23 above what it was in 1858. This is a profit already, of nearly twenty per cent. upon the whole outlay for the main; enough to pay the interest and absorb the debt created by it, long before the bonds issued in

payment will mature. Large additional increase of the water rents in this district may be confidently expected.

The department feel assured, that the same favorable results will follow all the other extensions, when completed.

RAISING RESERVOIR.—From the above loan, an appropriation was also made for raising the Corinthian avenue reservoir nine feet higher, in order that the surface of the water may be the same as that in the Spring Garden reservoir. To accomplish this, retaining walls were found necessary on Corinthian avenue, Poplar, and Twenty-second streets. These have been built of heavy stone, procured from Fairmount, with cut faces and beds. Some difficulty was experienced in procuring a satisfactory foundation for the wall on Twenty-second street.

The following work has been done :—

Excavation, 2,374 cubic yards in foundation, &c.

Mason work, 1,794 perches, (of 25 square feet,) in foundations.

“ 3,465 “ “ “ above ground.

“ 18,296 superficial feet of cut face.

“ 79 cubic yards of concrete.

Brick, 20,000, in arches and stop houses.

Embankment, 19,839 cubic yards.

1,195 cubic yards of clay puddle on hand.

75 shade trees have been planted and boxed in, around the reservoir.

The stand pipe at Fairmount has also been raised twenty-one feet higher, the expenses of which have been paid out of the above appropriation.

The amount expended thus far, has been \$37,499 99, which exceeds the appropriation, and it will require an additional amount of \$8,500 to finish the works. A careful examination of the work, as far as it has progressed, will demonstrate that the money has been judiciously and economically expended.

The value and importance of this reservoir will be greatly enhanced by the improvements upon it; the water in it will then be of an equal height with the Spring Garden reservoir, and it will

render great assistance in maintaining a more regular supply from the Schuylkill works; it will also serve as a medium from which the water pumped by Fairmount water power may assist the steam works, thus saving fuel; and, in return, the Schuylkill works, in cases of emergency, may assist through it the Fairmount works. It is hoped that an early appropriation will be made, in order that work may be resumed, as the department stands greatly in need of the assistance this reservoir will render in supplying the city.

MILL HOUSE.—From the same loan, an appropriation was also made for erecting a mill house, along the mound dam at Fairmount, the work on which was commenced early in the summer.

The Schuylkill Navigation Company immediately objected to the erection of the new mill house upon the mound dam, asserting that it could not be done without endangering the permanency of the structure, to which they claimed a right. After examining the plans for constructing the mill house, they withdrew their objections, but claimed that the city could not proceed with the work without having first obtained their consent; the department refused to ask this consent, believing, as it does, that the structure of the dam is the sole property of the city, they having purchased the water power, and erected the dam at their own expense, the Navigation Company possessing no right, save that of using the pool created by the dam, for the purpose of navigation.* Several communications were addressed to your honorable body, by the company, upon the subject; but Councils taking the same view of the matter as the department, refused to enter into any contract with the company. Application was then made to the Court for an injunction against the city, which was granted, upon the plea that the navigation of the river might be affected by the danger they asserted the dam would be in during the prosecution of the works. The Court did not prohibit or stop the work, but directed it to proceed according to the specifications furnished by the department, and according to which the work was then being carried on.

* See page 18.

The following exhibits the work done and materials on hand:—

- 673½ perches of cement grouted mason work.
- 3,685 superficial feet of cut face.
- 22,413 brick, in arches, laid in hydraulic cement.
- 117,293 feet of hemlock and white pine timber, in platform, coffer dams, &c.
- 3,699 feet yellow pine sheet piling.
- 1,481 cubic yards of earth and stone excavations.
- 1,590 cubic yards of earth and stone filling in.

Materials on Hand.

- 3,973 cubic feet of stone for cutting.
- 493 cubic feet of cut stone coping.
- 389 perches building stone.
- 7,000 brick.
- 20,000 feet of hemlock timber.
- 1,000 feet of white pine.
- 269 barrels of cement.

Cement house, smith shop and tools, pumping engine, scow, pile-driver, three derricks, tackle, tools, barrows, trucks, &c.

Upon this work the sum of \$20,992 17 has been expended, which is also above the appropriation originally made for it. One reason of this is, that the estimate was for a much smaller house than the one now in course of construction; this being 90 feet long on the north, and 108 on the south front, instead of 60 feet, as in the original estimate. (See report of 1859, page 45.) As originally projected, it would have contained but two wheels and four pumps; as now constructed, it will furnish accommodations for three Turbine wheels, of one hundred and twenty-five horse power each, and six pumps 18 inches in diameter, and six feet stroke; their combined pumping capacity will be greater than that of the nine wheels and pumps in the old mill-house, and will more than double the capacity of Fairmount works. As there is sufficient water to drive all this machinery the greater part of the year, the new work will prove

a saving of at least \$20,000 per annum, in the expense of supplying the city with water, owing to the great assistance they will be to the steam works. Several freshets, also, occurred since the commencement of these works, which added greatly to their expense.

The greatest care has been taken in constructing the works in the most substantial manner, and no trouble or expense has been spared to insure its perfect stability, as insecurity in any portion of the work, might result in serious loss to the city.

To finish these works upon the scale they have been thus far prosecuted, will require an additional appropriation of twenty thousand dollars. The work may, probably, be done for considerable less, but on account of its peculiar character, a large margin is necessary. Great care will be exercised that no money is wasted, but, at the same time, no work will be allowed by this department which will not comport with the uniform substantial character of the public buildings of this city. Your early attention is respectfully urged upon this subject also, as our means for pumping water for the city are now entirely too limited, and the department is anxious to have the valuable assistance these works will give, at as early a day as possible.

TURBINE WHEELS AND PUMPS.—From the appropriation made for this purpose, but \$2,059 14 have been expended; this has been for the head-gates and flumes, which are constructed entirely of iron, with brass faces, and will probably never need repairs or renewals. It would be to the advantage of the city, if the department were enabled to proceed immediately to the construction of the third wheel and pumps, as accommodations for them are already prepared. This will require an additional appropriation of \$17,500. The experiments directed to be made upon Turbine wheels, are still in progression, and the result will be communicated to your honorable body as soon as they are completed.

An appropriation of \$13,000 will be required to connect the new works at Fairmount with the ascending main leading to the reservoir and stand-pipe. This main, which is 30 inches in diameter, should be of greater capacity. It will answer for the present,

until the demand exceeds its capacity, when a larger one will have to be laid.

MAIN TO FRANKFORD.—The 12 inch main to supply the district of Frankford, authorized by an ordinance of Councils, and for which an appropriation of \$23,000 was made, has been laid the entire distance from Westmoreland to Harrison streets, excepting about 60 feet, which being rock excavation, will delay the completion of the work for a few days more.

PROPOSED ADDITIONAL EXTENSIONS.

The works have been so long neglected that the city has grown far beyond their capacity, and additional extensions, it is confidently believed, would prove remunerative to the city as soon as completed; not, perhaps, to the extent that the new main to the first district has realized, but more than sufficient to pay the interest and absorb their cost, before the bonds issued for their construction can mature.

The following additional extensions the department deem immediately necessary for the interest of the city. There are many portions of the city in which manufactories cannot procure a sufficient supply of water, and others where the demand upon the mains frequently exceeds their capacity. A thirty inch main should be laid from the Corinthian avenue reservoir, commencing on Poplar street and running to Corinthian avenue, along Corinthian avenue to Girard avenue, along Girard avenue to Broad street, and out Broad street to Columbia avenue; a twenty inch main along Columbia avenue from Broad to Sixth streets, along Sixth to Norris street, and along Norris to Germantown avenue, and there connect with the eighteen inch main leading from the Kensington reservoir.

This main would give to the inhabitants of the Twentieth ward a much better supply of water, the want of which is now greatly felt by them, on account of the elevation of the ground, and the fact that there is not a supply main in the ward. It will also con-

nect the works on the Schuylkill with those on the Delaware, and render to them that assistance which is found necessary at the season of the greatest demand, which they now derive through the mains supplying other portions of the city, greatly to the disadvantage of those residing upon them ; or should the Delaware works be ultimately abandoned as hereafter proposed, that district could be supplied from the works on the Schuylkill by this main. This will require 7000 feet of 30 inch and 6100 feet of 20 inch main, and will cost, with the necessary stops and connections, \$85,000.

The Nineteenth ward is greatly in need of a supply main, there being now but one of eighteen inches in diameter, passing through only a portion of it—along Norris street to Frankford avenue. This is the only main leading from the Kensington reservoir, and its capacity is almost exhausted before it reaches Frankford avenue. This district is rapidly filling up with manufactories and dwellings. The Twenty-third ward will also receive its supply through this main, and will require a large amount of water for the numerous manufactories and dwellings being built in it. If a more copious and constant supply could be given these districts, the revenue to the city would be still more increased. To furnish this supply, it is proposed to lay a twenty inch main from the reservoir, along Lehigh avenue to Frankford avenue, requiring about six thousand one hundred feet of pipe, which would cost, with stops and connections, about \$22,000.

RESERVOIR FOR TWENTY-FOURTH WARD.—The necessity for this has been frequently discussed and admitted, and the rapidly increasing demand for water in this district, is constantly making the necessity more apparent. A suitable site has not been selected, there being no ordinance directing it to be done. A reservoir will now be required of much greater capacity than originally proposed. An appropriation of \$50,000 would probably be sufficient to construct this reservoir, if an eligible site can be procured. These works have yielded a constant and abundant supply of water since they have been put in order, nearly a year ago ; but during the season of greatest demand, the full capacity of the works were called

into requisition. The increased revenue, and saving in running expenses, which would be incident upon a reservoir to these works, would more than compensate for the cost of constructing it.

DELAWARE WORKS.

The department would recommend the abandonment of the Delaware works, and the procuring of the supply of water for the entire city, from the Schuylkill river. The character of the water supplied by these works is not satisfactory; and as the machinery is the most expensive to maintain, it would be a source of direct profit to the city, and a satisfaction to the water takers, to discontinue them entirely. The erection of another large Cornish pumping engine at the Schuylkill works, say one of a capacity to pump six millions of gallons a day into the reservoir, with an additional pumping main from the engine to the reservoir, would cost about \$60,000. This would have double the capacity of the Delaware works through the present main, and give this district a sufficient supply of Schuylkill water. The engines, building, pumps and wharf, could probably be sold for the above amount, thus not increasing the debt of the city, while a saving would be effected in the amount of coal consumed at these works, in pumping the amount of water supplied during the past year, (which was eight hundred and sixty-eight millions of gallons,) at \$3 50 per ton, \$3,943 00

Engineers and firemen, 3,900 00

\$7,843 00

There would also be a saving at the Schuylkill works, in pumping an amount equal to the present capacity of the Delaware works, by the superior economy of the proposed Cornish engine over the old engines, and its having double the pumping capacity. This saving would be equal to \$3,943 in fuel, making in all \$11,786, as the direct saving which would follow the expenditure of the \$60,000, supposing there would be no return from the sale of the present works.

The indirect advantages which would follow the above suggestions, would be the increase of three millions of gallons per day to the present pumping capacity of all the works. The present pumping main of the Delaware works could be used as a distributing main, to a portion of the city now greatly in need of a better supply of water; this main is thirteen thousand two hundred and sixty feet long, and would thus prove a saving of \$47,825 to the city. The interest of the city in the above matter can be clearly seen, and needs no further comment, but to add that there is a necessity for doing something at once, to secure a more satisfactory, better, and abundant supply to this district, whose interests are too important to be overlooked.

RECAPITULATION.

Extensions in progress.

Finishing reservoir at Corinthian avenue, . . .	\$8,500 00
New mill house at Fairmount,	20,000 00
Additional wheel, and two pumps,	17,500 00
Connecting new works to main and stand pipe, . . .	13,000 00
	<hr/>
	\$59,000 00

Proposed extensions.

Main, from Corinthian avenue reservoir to Broad street, Columbia avenue, and Germantown avenue, and York street,	\$85,000 00
Main, from Kensington reservoir to Frankford avenue and Lehigh avenue,	22,000 00
Reservoir for Twenty-fourth ward,	50,000 00
Cornish engine and main at Schuylkill works, . . .	60,000 00
	<hr/>
	\$276,000 00

From this amount should be deducted the value of the Delaware works, which could be sold for at least	50,000 00
	<hr/>
	\$226,000 00

It would probably not be advisable to commence all of the above extensions at once, although they would doubtless prove remunerative to the city, and their entire cost, it will be seen, would be considerably below the net profits of the works during the past year. The department would prefer finishing the work already commenced, before beginning any of those proposed, except such as you may think the immediate interests of the city positively demand.

The project of making surveys for a supply of water to the city, by surface drainage and store reservoirs, has been frequently brought to your notice. Its importance is still felt, and your attention to the subject is again respectfully urged. The appropriation of \$2000, would settle the practicability of the plan.

The main sewer, now being constructed by the city along Pennsylvania avenue will be so far completed in a short time as to cut off nearly all of the sewers now emptying into Fairmount dam. It is to be regretted that your honorable body does not deem it advisable to purchase all the property lying between Fairmount and the Park, west of the Reading Railroad. This would prevent entirely any drainage into the dam, south of the railroad bridge from the east; and should the proposition urged upon your consideration, be favorably entertained, of purchasing the land lying upon the west bank of the dam, to be also dedicated to the purpose of a public park, our great subsiding reservoir (the dam) would be forever protected, on both sides, immediately in the vicinity of the works, from all drainage, which must necessarily flow into it if it is permitted to be crowded with factories and dwellings.

The citizens and department have suffered much annoyance for want of suitable office accommodations. It now occupies three distinct offices, one at Fairmount, one at 918 Cherry street, and the Register's office at Fifth and Chestnut streets. None of these are suitable, and the business cannot be satisfactorily organized, or conducted with that system which its magnitude demands, unless they can be combined, in some central locality, with ample room.

While the past year has been one of unusual activity, the grati-

fyng results in the large increase of the revenue, and the decreased expenses, have more than compensated for the increased labor. It is but justice to the employees of the department to say, that to their industry and lively interest in everything pertaining to the welfare of the city, have these results been mainly due. The experience which they have acquired, in their respective positions, is daily becoming more important to the city, and is as requisite as ability. Such modifications in the organization of the department as would make its officers more permanent, and would remove them from immediate political influence, would tend greatly to insure its permanent interests.

Respectfully yours,

HENRY P. M. BIRKINBINE,
Chief Engineer.

REPORT

ON A

SUPPLY OF WATER FOR THE TWENTY-FIRST WARD.

TO THE SELECT AND COMMON COUNCILS OF THE CITY OF PHILADELPHIA :—

Gentlemen,—In answer to the following Resolution, “That the Chief Engineer of the Water Department be, and he is hereby instructed to report to the Councils the expediency of providing for the erection of water-works in the upper end of the Twenty-first ward, for the purpose of providing the northern section of the city with a better supply of water; and the probable cost thereof,” I would report:—That no appropriation having been made for making the necessary surveys and plans, it became necessary to make them with the assistance of such persons in the employment of the department, as were best qualified. The examinations have been but superficially made, in order that the department might present the subject before you, and if, upon consideration, you deem it expedient to prosecute the inquiries further, an appropriation, say of five hundred dollars, will be necessary to make the surveys, drawings, plans and estimates.

The section of the city embraced in the Resolution, viz., Twenty-first ward, comprising Manayunk and Roxborough, contains a population numbering about twelve thousand. Of these, at least three thousand are operatives employed in the different factories. This part of the city is much in need of a supply of water for culinary, manufacturing and sanitary purposes, and for protection against fire, as the property in the manufactories is of great value, and now almost entirely without protection against fire,

except so far as they are supplied with private water-works, which can be of little use, even in case of fire, to the mills in which they are located, and of none to the surrounding properties.

From the dense population of parts of the district, the wells have become so contaminated, that the water in but few of them is now fit for culinary purposes. The necessity of a supply for manufacturing and mechanical purposes, is evident.

In addition to the Twenty-first ward, the greater portion of the Twentieth ward is without an adequate supply of water; and even in those parts in which water-mains are now laid, the head is so slight that water can only be drawn at certain times of the day, and then not in the upper stories of the houses.

This district is rapidly filling up with inhabitants, and the difficulty experienced in procuring water from the present mains is daily becoming greater, while none of the reservoirs are sufficiently elevated to supply that part of the city bounded on the south by Girard avenue, east by Eleventh to Dauphin avenue, then south by Dauphin avenue to Sixth street, comprising a large and important district.

The water-works in the Twenty-second ward, (that of the Germantown company,) will soon be found inadequate, if, indeed, they are not now, for the rapidly increasing population of that ward. All this section of the city, which will, in a few years, be teeming with inhabitants, and does not now contain less than seventy-five thousand, must look for a supply of water, to reservoirs of a greater altitude than any now constructed by the city, as the greater part of the surface of the ground is higher than the Spring Garden reservoir, which is one hundred and fifteen feet above the dam, and the highest of all the reservoirs.

LOCATION OF WORKS.—A short distance above the Flat Rock dam, on the Schuylkill river, there are several sites well adapted for locating a water-works. There is, perhaps, no location on the Schuylkill where purer or better water could be procured, than from this dam, there being no towns for some distance above, and

but little, if any, manufacturing. The water is deep, and the dam is fitted with sluices, so that there need be no fear of sediment accumulating in it, as it now does in the Fairmount dam; and the shores for miles, are protected by hills. Pumping machinery could be erected above the dam, to raise the water to an elevation of two hundred feet, and hills of sufficient elevation can also be found in the neighborhood, for reservoirs, or a reservoir of very large capacity could be constructed at a comparatively small expense, by taking advantage of one of the ravines near the pumping machinery, so that, in many respects, this is a most desirable location. This would command Manayunk, Falls, Kenderton, and, in fact, most of the settled district above mentioned. The reservoir would be of the same elevation as the stand-pipe of the Twenty-fourth ward works, viz., two hundred and thirty feet above tide, and should the works ever be connected, they could mutually assist each other.

For supplying Roxborough and Germantown, it would require a reservoir elevated much above this one, say one hundred and fifty feet higher; this would be the same level with that of the Germantown Water Company's reservoir at Mount Airy. Locations for a reservoir as above described could be found much nearer the centre of the city, but it would not be safe to locate works near Manayunk. The distance between Fairmount and Manayunk allows time for all impurities to separate from the water, but should works be placed a short distance below that town, this would not be the case, and the water would most probably be found objectionable.

THE AMOUNT OF WATER NECESSARY.—At present, it is probable one million gallons per day would be found sufficient for Manayunk and Roxborough, but should the works embrace Germantown, and all of the Twentieth Ward, three millions would be the amount required at present. The increase, which will no doubt be rapid, when once water is introduced, will make works necessary for an average supply of six millions per day to the first reservoir, and two millions to the second or higher reservoir.

ENGINES, RESERVOIR AND MAINS. The experience of the department is decidedly in favor of Cornish pumping engines. It has now in operation one high pressure reciprocating engine, three condensing reciprocating engines, two direct acting (Bull) Cornish engines, and one balance beam Cornish engine, and we find the difference in the consumption of coal in pumping a given amount of water a given height, between some of the reciprocating engines, to be as fifteen to twenty-three, and between the best reciprocating engines and the Cornish engines, to be as twenty-three to forty-five. It is therefore an established fact that the Cornish engines, although most expensive in first cost, are in the end the most economical.

To pump six million gallons per day, two hundred feet high, would require a pump thirty inches diameter of plunger, and twelve feet stroke of piston; a steam cylinder seventy-two inches diameter, and twelve feet stroke of piston.

The main leading from the pump to the reservoir should be thirty inches diameter, and it will require about two thousand feet to reach convenient localities for erecting a store reservoir, which should hold at least fifty millions of gallons.

There are several locations where reservoirs of even larger dimensions can be constructed at very moderate expense, within the above described distance, from convenient points for erecting pumping machinery at the river. At this reservoir a smaller pumping engine, though of similar character, should be erected to force water into a second reservoir, about one hundred and fifty feet higher than the first described. This engine would require to be about one third the capacity of the first, and the reservoir in the same proportion, and if Germantown should receive its supply from this source, the reservoir of that company could be used by erecting a stand pipe at the engine house.

DISTRIBUTING MAIN.—A thirty inch main should lead from the first reservoir to a central point in the Twenty-first ward, say Dauphin and Broad streets; this would supply Manayunk and the lower ends of the Twenty-first ward, the Twentieth ward, and such

parts of the Nineteenth and Twenty-third wards as are too elevated for the present reservoirs.

COST OF WORKS.—The expenses of works as above described, viz., six millions of gallons to the first reservoir, and two millions of gallons to the second; two engines; reservoirs to contain fifty millions of gallons; thirty inch pumping main; and stand pipe to second engine, would cost about one hundred and eighty thousand dollars, without any distributing mains, which would be about six miles long.

It would not be safe to estimate the cost of the works at less than five hundred thousand dollars, without service mains, the cost of these being paid by the frontage tax levied on properties in front of which the pipe is laid. Should you deem it advisable to prosecute the work, more careful surveys and definite estimates will be necessary, but the result will not vary materially from the above estimate.

EXPENSES OF RUNNING WORKS.—To pump three millions of gallons per day (the amount that would be required when first starting the works,) two hundred feet high, will be for coal, oil, repairs and attendance, say ten thousand dollars per annum. To raise one million of gallons one hundred and fifty feet into the second reservoir, would cost for coal, oil, repairs and attendance, say three thousand dollars, add to this the interest of the cost of the works, (five hundred thousand dollars,) thirty thousand dollars; will make the whole annual expense fifty-three thousand dollars, say including superintendence and expense of collecting revenue, fifty-five thousand dollars per annum.

REVENUE.—At the first starting of works as above described, the revenue would not be sufficient to pay the interest and expenses, but this would only be the case for the first few years, and such deficiencies would be made up very soon by the increased income. A city is benefited by an abundant supply of water, much more in its general interest, health, safety from fire, facilities for manufacturing, comfort, &c., than by that of the water taxes. The present revenue from the Twentieth Ward, for water rates is

twenty-six thousand eight hundred and seventy-one dollars : it would not be fair to include the whole of this in the estimated income of the proposed works. Most of these rates are, however, now reluctantly paid, on account of the inadequate supply of water furnished, for want of sufficient head. Assume one half of this sum as the income of the proposed works, (thirteen thousand four hundred dollars,) from this ward.

The Germantown company would no doubt be willing to pay from eight to ten thousand dollars per annum for a supply of water delivered in their reservoir. It might be to the interest of the city to purchase these works from the company, or so much of them as will be found of use, and supply this important portion of the city on the same terms and regulations as other portions. Say for pumping water for Germantown, (nine thousand dollars;) the water-works of Manayunk and Roxborough would produce a revenue of about ten thousand dollars, making in all a revenue of thirty-three thousand four hundred dollars per annum, leaving an annual deficiency when the works are first started of twenty-one thousand six hundred dollars, but as the history of all the works erected by the city has demonstrated, this deficiency would only exist for a few years. From the Schuylkill works, formerly Spring Garden and Northern Liberties, the revenue was in 1854, thirty-nine thousand six hundred and fifty-one dollars and sixteen cents, this year it is one hundred and forty-two thousand nine hundred and thirty-five dollars. The income from the Delaware, (late Kensington) works has already reached the sum of eighty-five thousand dollars per annum. The Twenty-fourth Ward works, although in existence but about five years, will next year meet expenses and pay interest, and before the works are in operation ten years, will yield a large profit to the city, and such no doubt would be the history of the proposed works, should they be constructed. It should not be forgotten that the capacity of the works will be double the capacity of what will supply the above estimated income, and should the future growth of this city equal its past, before bonds of thirty years would mature, the whole interest would be paid and principal

absorbed, and the city enjoying all the benefits of the works. That this will be its history we have no doubt, if we may judge the future from the past.

Should you deem it expedient to prosecute the proposed work, it should be at once commenced, as a company is now formed and only wait your action either to do the work, or allow them the privilege of doing it. Works of much smaller capacity, and consequently much reduced in cost, could be constructed, and, however wise such a course might be in a company looking for immediate dividends, a city, borrowing its money at thirty years, should look to that which would be sure to pay, and of permanent advantage.

An objection may be urged of adding another to our already too numerous water-works, and also to the proposed location being far removed from the present works and the centre of population. I cannot, therefore, let this opportunity pass without calling your attention to the subject of looking for a supply of water for the *whole* city, to be procured by means of store reservoirs located so that our supply may be obtained by gravitation instead of pumping, and from sources far removed from the influence of the city. That such a plan is practicable, an appropriation, as asked for, (two thousand dollars,) in my last annual report, I feel confident will demonstrate.

Yours, respectfully,

HENRY P. M. BIRKINBINE,
Chief Engineer.

September 8, 1859.