DEPARTMENT

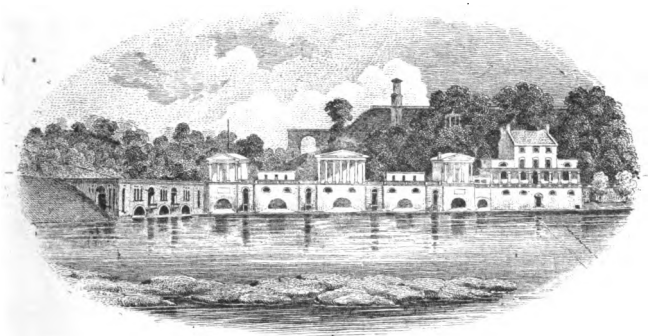
FOR

SUPPLYING THE CITY WITH WATER.

ANNUAL REPORT

OF THE

Chief Engineer of the Water Department



OF THE

CITY OF PHILADELPHIA,

For the Year 1875.

PRESENTED TO COUNCILS APRIL 6TH, 1876.

PHILADELPHIA:
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1876.

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COMMITTEE ON WATER WORKS, 1875.

E. A. SHALLCROSS, *Chairman.*

JAMES W. ALLEN,	JOHN FOX,	J. H. KENNEDY,
DR. W. W. BURNELL,	JOHN F. GLENN,	A. H. MCADAM, M. D.,
GEORGE W. BUMM,	J. C. GILBERT, M. D.,	JOHN A. MISKEY,
WILLIAM BRADLY,	GEORGE E. HALL,	ADAM MYERS,
JOHN C. BICKEL,	ALEXANDER L. HODGDON,	W. ELLWOOD ROWAN,
R. H. CLIFFORD,	CHARLES THOMSON JONES,	JOSEPH H. TATEM,
JOHN CLOUDS,	C. ERNEST KAMERLY, M. D.,	WILLIAM WRIGHT,
GEORGE DORLAN,	RUDOLPH KLAUDER,	NATHAN SPERING, from July 8.

R. W. DOWNING, *Ex-officio.* A. WILSON HENSZEY, *Ex-officio.*

DR. W. W. BURNELL, *Ex-officio*, from July 8.

OFFICERS.

Chief Engineer.—WILLIAM H. MCFADDEN.

Assistant Engineers,

JOHN L. OGDEN, ELIAS J. SHAW, ABRAM D. EMERY.

CHARLES G. DARRACH, SURVEYOR.

General Superintendent of Works,

JOSEPH DEBOZEAR.

Chief Clerk.—SAMUEL P. FERREE.

JOHN E. CODMAN, *Draughtsman.*
HENRY L. BUTLER, "
W. H. METTAM, *Telegraph Operator.*
MILTON S. SLEEPER, *Assistant Clerk.*
GEORGE W. ECKERT, *Pipe* "
WM. L. FOREMAN, *Muster* "

Messenger.—Thomas J. Lister.

Superintendent of City Shop.—Robert McFadden.

Purveyors,

1st District.—James Brown, 807 Reed Street.
2d " —Wilbur H. Myers, 918 Cherry Street.
3d " —Henry S. Myers, 1420 Frankford Road.
4th District.—David A. Craig, 810 Corinthian Avenue.
Germantown.—D. B. Morrell, Main and Tulpohocken Streets.
Manayunk.—Henry Dawson, Lyceum Building, Roxborough.

Engineers at Works,

Fairmount.—Wm Wright, A. F. Farrell.
Schuylkill.—Joshua Bartley, David Pyke.
Delaware.—Benj. F. Norman, Jos. Thompson.
Belmont.—Abraham Stott, Christian Betzold.
Roxborough.—J. Hughes, Wm. H. Saunders.
Chestnut Hill.—William Gaffey.

REGISTRAR'S DEPARTMENT.

Registrar.—H. C. SELBY.

Chief Clerk,
CHARLES D. THOMAS.

Receiving Clerk,
JAMES H. WATSON.

Permit Clerks,

WILLIAM J. HALLIDAY, ISAAC CREAMER.

General Clerks,

GEORGE S. MACAULEY, ROBERT P. KING, GEORGE BECK,
CHARLES ZELL, ISAAC R. MULOCK.
R. F. MUSTIN, JR., Clerk of Committee.

Inspectors,

John F. Scheidt,	William L. Stiles,	James M. Rowe,
J. L. Warner,	E. D. Thomas,	Joseph H. Edwards,
F. M. Pfouts,	William H. Hergesheimer,	Joseph B. Totten,
W. Stephenson,	Jacob H. Boon,	John H. Neveil,
Henry Marshall,		William Erwin.

Committee on Water Works, 1876.

E. A. SHALLCROSS, *Chairman.*

James W. Allen,	John Fox,	A. H. McAdam, M. D.,
John C. Bickel,	J. C. Gilbert, M. D.,	John A. Miskey,
B. Frank Bonham,	I. J. Griffiths,	William S. Reyburn,
William Bradly,	E. Hicks Hayhurst,	John Rink,
J. G. Brooke,	Thomas Hill,	George A. Schafer,
Joseph Cartledge,	Charles Thomson Jones,	Joseph H. Tatem,
Samuel C. Collins,	A. H. Ladner,	Charles Weyman,

O. H. Wilson, J. P. Woolverton

George A. Smith, *Ex-officio.* Joseph L. Caven, *Ex-officio.*

Officers.

Chief Engineer.—William H. McFadden.

Assistant Engineers,

John L. Ogden, Charles G. Darrach.

Jacob Herold, Surveyor.

General Superintendent of Works,

Robert McFadden.

Chief Clerk.—Samuel P. Ferree.

John E. Codman, *Draughtsman.*
John Truran, "
W. H. Mettam, *Telegraph Operator.*
George W. Eckert, *Pipe Clerk.*
William L. Foreman, *Muster* "
Thomas J. Lister, *Messenger.*

Superintendent of City Shop.—James F. Neall.

Purveyors,

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2d " —Wilbur H. Myers, 918 Cherry Street.
3d " —Henry S Myers, 1420 Frankford Road.
4th District.—David A. Craig, 810 Corinthian Avenue.
Germantown.—D. B. Morrell, Main and Tulpohocken Streets.
Manayunk.—Henry Dawson, Lyceum Building, Roxborough.

Engineers at Works.

Fairmount.—A. F. Farrell, A. Bonsall.
Schuylkill.—Joshua Bartley, David Pyke.
Delaware.—John Penn, Jos. Thompson.
Belmont.—Abraham Stott, Christian Betzold.
Roxborough.—J. Hughes, L. Culp.
Chestnut Hill.—William Gaffey.

Registrar's Department.

Registrar.—H. C. Selby.

Chief Clerk,
CHARLES D. THOMAS.

Receiving Clerk,
JAMES H. WATSON.

Permit Clerks,

WILLIAM J. HALLIDAY, ISAAC CREAMER.

General Clerks,

Charles Zell, George Beck, R. F. Mustin, Jr.,
Robert P. King, Isaac R Mulock.
George Kearney, Clerk of Committee.

Inspectors,

John F. Scheidt,	William L. Stiles,	James M. Rowe,
J. L. Warner,	E. D. Thomas,	Joseph H. Edwards,
F. M. Pfouts,	William H Hergesheimer,	Joseph B. Totten,
W. Stephenson,	Jacob H. Boon,	John H. Neveil,
Henry Marshall,		William Erwin.

HISTORY

OF THE

WATER SUPPLY

—OF—

PHILADELPHIA.

HISTORY.

A BRIEF HISTORY AND REVIEW OF THE WATER SUPPLY OF PHILADELPHIA.

Above the gneiss-rock and below the clay, there is an intervening stratum significantly characterized by the term *water-bearing* gravel and sand. This is the natural filter, the subterranean water-way, and the underground reservoir, whence issued the numerous springs and brooks that furnished to the early settlers and their immediate descendants, an abundant supply of sparkling, pure, and wholesome water.

The plot on which the city stands was thus well watered, evincing great prudence and wise forethought in its selection. Nature is less exclusive than art, but art is more exacting of time and space, demanding more comforts and greater conveniences, hence the well was dug to localize the spring, and the pump was erected in which the brook was forced to flow. Of these first and simple means for a water supply, the many have no recollection, and the few who do remember, regret the loss of the cooling water of the well and the refreshing draught from the wayside pump, for as yet the use of ice had not been learned.

The march of civilization demanded improved roads and "the mending of our ways," whereby the rain-fall could not return, by soakage, to moisten and purify the earth, nor foster and replenish the springs and wells, but passed as drainage to the streams.

In obedience to necessity, cesspools were foolishly, if not wickedly, *dug through the clay* and into the subterranean water courses, thereby poisoning them with the sewage, and making them vehicles to convey and diffuse the germs of disease and death, at the same time robbing the soil of its proper and natural nourishment.

Nature, though slow in action yet sure in effect, will not permit the violation of its laws, without exacting the penalty. For these blunders (the double interference with its circulatory system), sanitary engineering has not, as yet, provided the remedy. The only advance it can boast in this direction is, the poor excuse of commingling the sewage with the drainage. Thus the same pernicious system that destroyed the subterranean water-ways, continues polluting and befouling the rivers, which in time will compel cities to abandon them and seek their water supply in the sources of streams.

A faulty sewer system is repeating in another form the same mistake, impregnating the soil with noxious gases and disease generating germs. The gaseous eliminations are communicated to our dwellings, being diffused through our homes and giving rise to epidemics of a low congestive character, by means of the connections with the sewers, and to which, we fear, we must attribute the change from the inflammatory to the typhoid type of disease.

Science owes a debt to society which humanity must pay, and the sooner the drainage is separated from the sewage, the sooner will the latter, with the refuse of the industries, be utilized, and the pollution of rivers and streams cease, else the germs of disease now latent will spring into life on the appearance of the causes necessary to their development, when the death-rate will record the penalty. Of men, we can predicate generations, but of nations, centuries, and one hundred years of violated law brought its penalty to our city in 1793, in the form of yellow fever, the cause of which, after the lapse of years, was traced by Dr. La Roche, to heat, moisture, and eremacausis, or the fermentation of decaying wood, overlooking, however, how much it was aggravated by a limited and impure supply of drinking water. History teaches that wisdom is born of calamities, and to the ravages of this fever we owe the erection of the first water works.

Benjamin Franklin deserves the credit not only of arousing and educating public sentiment to the importance of a pure sup-

ply of wholesome water, but also of presenting the most simple, feasible, and least expensive plan for water works to attain the same. With that marked simplicity of common sense or pure intuitive science, in his will bearing date June 23, 1789, he makes use of these words, so pregnant with meaning, so exhaustive in treatment, yet so little heeded, though his death warning to his fellow-citizens:

"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*."

Attesting his faith by this gift, his simple plan of supplying the city with water by gravity from the Wissahickon Creek would doubtless have been consummated had he not died in 1790.

In 1797, the first petition for the introduction of water into the city was presented to Councils, when Franklin's suggestion was discussed, but the charter of the Union Canal Co. of April 10, 1792, having given them the right to supply such citizens as might be disposed to purchase and use the water of the canal, Councils, in response to their proposal, offered January 31, 1798, £50,000 for the water that would pass a water-way of 12½ feet deep and 3½ feet wide; the offer being rejected, Councils endeavored to purchase all their rights and privileges; and petitioned the Legislature to grant them the duties on sales at auction, amounting then to $16,000 per annum, to be devoted to carrying out this object.

Fortunately for the beauty and symmetry of the city, Councils finally considered it inexpedient to undertake this scheme, which involved conducting the water of the canal into a grand reservoir, a little north of Callowhill on Broad Street, along which a canal was to be dug and bridged at the street-crossings. The water was to flow from the canal through pipes into private cisterns in the cellars and thence pumped.

In July, 1798, a Committee of Councils examined Spring Mill Creek, and employed Benjamin Henry Latrobe to survey it and to investigate the whole subject, who reported his views December 29, 1798, to John Miller, Jr., Chairman of Committee of Select Council, "as to the practicability and means of supplying a sufficiency of wholesome water for culinary use, and an additional supply for washing the streets, and if possible, for cooling the air." The Schuylkill was preferred for its uncommon purity, and the Delaware was rejected because of its contaminations from the decayed vegetation of the marshes, filth from the vessels, and public sewers.

LATROBE'S REVIEW OF PROPOSED SCHEMES.

1. "To complete the canal immediately," which he considered feasible, but feared the ice would embarrass the winter supply for culinary use, and that it could not be made *immediately* available, showing the dire straits to which they were reduced, and the need of early and instant relief.

2. "To conduct the water of the Wissahickon Creek to the city."

He regarded this stream insufficient, as yielding but little water, and that it had been almost frozen to the bottom, and could not be made immediately available. Strange oversight of Franklin's suggestion to erect a dam, impound the water and supply by gravity. Had this been done, with a water-shed of 44 square miles, it would have furnished a daily average of 60 million gallons, a quantity not yet required, and would have formed a part of the gravity mode of supply from the Perkiomen,

as recommended by the Water Commission of Experts appointed by the Mayor under ordinance of June 5, 1875.

3. "To erect water works to be driven by one of the two rivers."

The examples of London and Versailles deterred him from recommending a water power works, having seen fires raging when the wheels were stopped by the tides, and his fears that such were not likely to be permanent, which is forcible and likely to be true.

4. "To collect water (in impounding reservoirs) from any practicable source, and bring it over hill and dale in wooden or perhaps iron pipes."

He thought it very bad economy to bring water in pipes a yard further than necessity required, overlooking the value and economy of a gravity supply, thinking it not permanent and efficient, and not heeding the lesson of experience and foreseeing that the causes which operated in the fouling of the subterranean water courses would eventually befoul the rivers and compel their abandonment as a source of supply.

After the consideration of these schemes he recommended a reservoir in Centre Square, with an elevation of 40 feet to throw the water up in fountains, the water of the Schuylkill to be conducted to and raised into said reservoir by steam, at an estimated cost of $75,000.

"This much of the proposed object accomplished enough to substitute pure for putrifying water, and to cleanse and cool the streets. An important part still remains which may be a work of more leisure, to bring Spring Mill Creek to the City in an elliptical culvert 3 feet by 6 feet in section, three feet under ground, the valleys to be crossed on light aqueducts of segment arches, the distance 12 miles, at an estimated cost of $275,000, and $52,000 for 104,000 feet of wooden pipes;" the latter was never undertaken and the former constitutes the first water works, and were operated by steam at Chestnut Street wharf on the Schuylkill, and at Centre Square (the present site of the new Public Buildings) and were known as

THE CENTRE SQUARE WORKS,

Plans of which were adopted by Councils, January, 1799, the work was commenced the following March under the superintendence of Mr. Benjamin Henry Latrobe, and the first water supplied from them January 27, 1801.

To raise money was difficult, and the committee jointly and individually had their notes discounted to carry on the work, the subscribers to the water loan receiving a three years supply free from January, 1801.

Steam, the motive power, was then a novelty, there being but three steam engines of any considerable size in the United States: an imported one put up in 1763 by a son of Hornblower, at the Schuyler Copper Mines on the Passaic River, in New Jersey; another at a saw-mill, in New York; and the third in Philadelphia, used for grinding plaster, by Oliver Evans; it was therefor difficult to find skilful and experienced persons to construct the engines. A contract was made with Nicholas J. Roosevelt, of Soho Works, on the river Passaic, in New Jersey, for the construction and erection of two steam engines of capacity to raise three million gallons per day 50 feet high, to maintain and keep them in repair five years, for the sum of $30,000. These were the largest and first pumping engines in the United States, and with the tools and experience of the time it was a great undertaking.

The City having determined to obtain its supply of water, the following is a general description of the arrangements and connections:

"A basin was formed on the Schuylkill River, at the foot and on the north side of Chestnut Street, extending from low water-mark 200 feet eastwardly, and 84 feet wide, provided with a set of tide-lock gates. The bed of this basin was three feet below low water-mark; thence the water passed through a sluice to a second basin or canal 40 feet wide and 160 feet long. The sides of both 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 subterranean tunnel of oval form, six

feet in its greatest diameter, and 300 feet long, cut through solid rock nearly the whole distance, its bed level with low water, and emptying into a shaft or well 10 feet diameter, and 39 feet deep, 22 feet of which was cut out of solid rock, and in which was placed the pump, the bottom chamber being on a level with low water. This was called the Lower Engine House, and was located at the northwest corner of Chestnut and Schuylkill Front (Twenty-second) Streets, where the water was raised into a brick tunnel six feet in diameter, and 3,144 feet in length, leading the water under ground down Chestnut to Broad ; thence to the Centre Square Engine House, where it was again pumped to a height of 36 feet from the surface, or 50 feet from bed of brick tunnel, into two tanks of 17,094 ale, or 20,868 wine gallons capacity; from thence it descended into an iron chest 4 by 8 feet, outside the building, to which the wooden mains were connected that supplied the city. Two 6-inch down Market, one 4½-inch down Arch, and one 4½-inch down Chestnut to Front Street; from these the water was distributed through 4-inch and 3-inch logs.

The Schuylkill Engine House was 66 by 54 feet, built in the most substantial manner to contain two engines and pumps, though only one was ever put in.

The Centre Square Engine House was an exceedingly handsome building of marble, the lower story containing the offices, committee and engineers' rooms, built in the form of a square of 60 feet, 25 feet high, with two porticos, and surrounded a circular building 40 feet diameter and 60 feet high, covered by a dome, through the centre of which the stack was carried.

The engines in both buildings were very defective in every respect, the lever beams, fly wheels, shafts and arms, cold water pumps and cisterns, *being all made of wood.* 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 18 inches wide; and although it was but 6 feet 6 inches long, and 36 inches in diameter, nearly four months were occupied in boring it out fit for use.

The boilers to both engines were wooden boxes 9 feet high, 9 feet wide, and 15 feet long, made of five-inch white pine plank, securely bolted through, and braced on the outside. The fire-box inside the boiler was of wrought-iron, with vertical flues of cast-iron; subsequently, a cast-iron boiler was substituted.

At that time wrought-iron could not be obtained in sheets larger than 15 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 pumps were double-acting force, and had to be lined with sheet copper before they could be made air-tight. At first they were made without air-chambers, which were added to the Centre Square pump in 1810, but were useless until lined with sheet lead.

Dimensions, Capacity, and Duty of Engines and Pumps at the Schuylkill and Centre Square Engine Houses.

	Diameter.	Stroke.	Rev. per Minute.	Pumped by trial in 24 hours, ale gallons.	Bit. coal, bushels.	Duty per bus. of coal one foot high.
Schuylkill Engine.....	40-in.	72-in.	16	1,474,560	70	
" Pump.....	17½-in.	72-in.				
Centre Square Engine.	36-in.	72 in.	.....	962,520	55	9,000,000
" " Pump...	18-in.	72-in.				

The first cast-iron boiler built was used at the Schuylkill Works, and was so successful that a similar one was placed at Centre Square.

In 1807 the forging and finishing of a 4-inch piston rod 10 feet long was thus noticed in the annual report of the Watering Committee—"The workmanship of this piece of iron could not, in the opinion of our Committee, have been better done in any country."

In 1809, a cast-iron fly-wheel shaft replaced a wooden one.

Fears were entertained that the price of wood, $4.50 per cord, and of bituminous coal, 33 cents per bushel, would be enhanced by the amount used by these engines, and that there would be difficulty experienced in procuring a sufficient supply.

These considerations, with the trouble of keeping the engines in repair, and the constant difficulties with the boilers, as well as the small storage in the tanks at Centre Square Engine House, rendered the supply intermittent and uncertain, which led Councils to have another examination made.

The subject was submitted to Mr. John Davis, B H. Latrobe's successor as engineer and superintendent, and Mr. Frederick Graff, who succeeded Mr. Davis as superintendent in 1805.

Attention again reverted to the Delaware and Schuylkill Canal, whose level was found to be only six inches above the highest point of the city, whereupon for a second time this project was abandoned.

They examined several sources and reported various plans, one of which was a water-power works, the power to be supplied by a race or canal from the Wissahickon Creek to machinery to be erected at the foot of Simes' (Laurel) Hill, upon which they proposed two large reservoirs from which iron pipes of 18-inch diameter were to conduct the water to the iron distributing chest at Centre Square.

Simes' Hill was reported to be 110 feet above high-tide, and a head of 30 feet could be attained by building the race or canal to the Falls of Schuylkill.

Careful examinations were made of the Schuylkill for some distance, also Spring Mill Creek, and an estimate was presented for bringing the water of the Wissahickon Creek into the city by means of pumping, at a cost of $359,718.

Here again was an opportunity to apply the suggestion of Franklin to impound the water of the Wissahickon by means of a dam, and furnish a gravity supply without the aid of machinery, but instead they reported in favor of Steam Works at

Fairmount, which was adopted December 18, 1811. They also proposed water power works in the following words, replete with contingencies.

"If the canal already commenced should ever be completed, and it is found that a portion of its waters can be spared for the use of watering the city, a water power machinery could be erected near to Morris' Hill (the present Fairmount) to pump or elevate the necessary quantity of water into reservoirs constructed upon the hill."

Up to 1815, the city had received no direct pecuniary benefit from the water works, in fact not enough was realized from water rents in any one year to pay for the fuel and the working of the engines.

The cost of the Schuylkill and Centre Square Works, with yearly expenses added, from March 1799, to September 1, 1815, when steam was started at Fairmount, was $657,398.91, the whole gross receipts amounting to but $105,351.18, leaving a deficiency of $552,047.73, without interest.

Yet it cannot be said 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, an important feature which 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 construction of machinery, and although the watering committee are found, in 1807, gravely inspecting the wonderful achievement of their workmen in manufacturing a piston rod 4 inches in diameter and 10 feet long, it is satisfactory to know that from the workshops of this city, much of the best machinery in this country and in foreign lands has been produced, and there is scarcely a water-works in the construction of which Philadelphia mechanics have not, and are still contributing more largely than any others. In this city and vicinity are located the largest works for casting pipe and

constructing the various apparatus necessary for gas or water 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 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.

STEAM, OR THE FIRST, WORKS AT FAIRMOUNT.

The original works at Fairmount, driven by steam power, were commenced August 1, 1812, to supplant those at Broad and Chestnut, and were put in operation September 7, 1815.

In the present mansion house at the foot of Fairmount Hill, was erected a Bolton and Watt engine of 44-inch cylinder, and 6 feet stroke, working a double-acting pump of 20-inch diameter and 6-feet stroke, raising the water through a 16-inch main, 239 feet long, into a reservoir 102 feet above low water in the Schuylkill. Upon trial the engine pumped 1,733,632 ale or 2,116,382 wine gallons in 24 hours, with 7 cords of wood; the boiler had a cast-iron case with vertical flues or heaters of wrought-iron, carrying 2½ to 4 pounds pressure of steam.

Although at this time considerable improvement had been made in building machinery, yet not a single furnace could be found large enough to cast the steam cylinder entire, the nozzle pipes being cast separately and bolted on, though their weight was but 1¾ tons. Most of the castings was made at Weymouth blast furnace, in New Jersey, but the smaller ones were cast at the Eagle Works, where it is believed *the first cannon were cast in this country during the Revolution*, and the ruins of which are now standing at the corner of Callowhill and William, now Twenty-fourth Street.

Before starting the works a contract was made with Oliver Evans for one of his high pressure engines, then coming into notice. It was accordingly put up, dimensions as follows: steam cylinder 20-inch diameter and 5 feet stroke, with a pump 21-inch diameter and 4 feet stroke. This engine was supplied by 4

cylinder boilers 30-inch diameter and 24 feet long, upon which a pressure of 220 pounds was sometimes carried. The engine, upon trial, raised 3,072,656 ale gallons in 24 hours, running 24¾ revolutions per minute, and carrying 194 pounds of steam with a consumption of 13 cords of wood. It was put to work December 15, 1817; the cost at that time to raise 2,300,000 ale gallons per 24 hours being $84 50.

The reservoir then constructed 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, 5 of 6-inch diameter, and one of 4½-inch, carried along the bed of the old Union Canal to Broad Street, thence to the chest, a distance of 9,337 feet.

The population rapidly increasing, the difficulty and expense of keeping up a sufficient supply with the machinery then in use kept Councils constantly on the alert for a cheaper and more copious supply of water. The expense will be seen by the estimate of the working of the Oliver Evans engines, as made by the superintendent of the works for one year, for an average of 2,300,000 ale gallons per day:

Six men at $9.75 per day, - - - - -	$3,558 75
Tallow, and chandlery, &c., - - - - -	1,250 00
3,650 cords wood, cording, hauling, &c., - - -	24,550 00
Wear and tear of machinery, - - - - -	1,500 00
	$30,858 75

or $36 $\frac{60}{100}$ per million gallons pumped into the reservoir.

The cost of the steam works at Fairmount with yearly expenses added, from August, 1812, to July 1, 1822, when the water power works were started, was $809,318.04.

THE RIGHT OF THE WATER POWER OF THE SCHUYLKILL.

The State of Pennsylvania granted, April 9, 1807, to James Kennedy, authority to erect a dam and locks at the Falls of Schuylkill, reserving to the city the right of purchase at any time for the purpose of a water supply. Messrs. White and Gillingham

subsequently became the owners of this right, and in 1818, sold it to the city for $150,000.

In 1815 a charter was granted to the Schuylkill Navigation Company to improve and make navigable to its mouth the Schuylkill River, but not to erect dams on tide water, this power being vested in the United States.

By the contract of 1824 the city paid this company a consideration of $26,000, for the use, apparently, of the whole of the water power, without any reservation.

Actual experience has demonstrated that even in a drought the department is better off with the canal in active operation than idle, inasmuch as more water is admitted at Manayunk to pass the boats than is withdrawn at Fairmount. The true mode of management in a drought is to maintain the head by reducing the number of wheels in operation, and by taking advantage of the low tides.

WATER POWER WORKS AT FAIRMOUNT.

For the main facts in this brief history I am much indebted to the Department reports, particularly those for the years 1852 and 1859, also to a pamphlet issued in 1842 by Manly Orr & Lippincott, from statistics furnished by S. W. Rush, Register of Water Rents, and compiled by my friend Hector Orr, the printer.

The following were the most prominent actors in the erection of the Fairmount Works.

Mr. Frederick Graff, then Superintendent of the Steam Works, who continued in the position until his death, a period of over 40 years.

Mr. Joseph S. Lewis, chairman of the Watering Committee, from the inception of the works, through the progress and to the completion of the same, to whom much credit is due for urging the matter through Councils, settling property damages a distance of six miles up the river, for lands overflowed with back water by the erection of the dam, and for negotiations with the Schuylkill Navigation Company, whereby a double purpose was served;

helping a struggling corporation in an important enterprise which benefited the city in its internal commerce, while securing a water supply.

Captain Ariel Cooley, of Chicopee, Massachusetts, the builder of the dam.

Mr. Drury Bromley, the millwright, whose untiring attention, skill, and excellence of workmanship, reflect the highest credit for the construction of the wheels, gates, and whole arrangement of this branch of the work.

Mr. Frederick Erdman, the builder and carpenter.

Mr. John Moore, the mason of the mill buildings.

Mr. William Rush, the chairman of the Building Committee during the entire progress of the work, who devoted twenty-seven years to the public service in the City Councils and various departments. The following anecdote concerning him we have from undoubted authority:

Some time before the present works were seriously suggested, Mr. Rush was standing with others on the summit of Fairmount. At a pause in the conversation he placed his hands over his eyes, and turning playfully to Mr. Joseph S. Lewis, said, "I see; I see." "What do you see?" inquired Mr. Lewis; "can you see with your eyes shut?" "Why, I see," rejoined Mr. Rush, "I see those stones rolling into the Schuylkill River and forming a dam, and the river, by the aid of machinery, flowing over this hill to supply the city."

For the calculation of the moving power of the wheels, with much valuable information on other matters connected with the works, the committee were largely indebted to Mr. Thomas Oaks, a gentleman of science and practical knowledge, who served the Schuylkill Navigation Company for some time as civil engineer.

The fear of the tides, the impediments from ice and freshets seriously obstructing the operations of the wheels having vanished, together with the inadequate and expensive supply, led to the construction of water power works.

The suggestions of Messrs. Davis & Graff, in their report of December 18, 1811, were revived. Plans for the construction

and erection of the dam were presented by Thomas Oaks, Briggs & Lehman, Frederick Graff, Lewis Wernwag (who had just finished the wooden bridge at Callowhill Street), and Captain Ariel Cooley, whose plan was adopted, and the contract awarded him at $150,000, by City Councils, April 8, 1819. Work was commenced in eleven days, April 19, and water flowed over the dam July 25, 1821. Mr. Cooley faithfully executed his contract, although from exposure during the work he died soon after its completion.

The entire length of the dam was 1,600 feet, the mound dam being 270 feet, head arches of the forebay 104 feet, piers about 22 feet, and overflow 1,204 feet of 13½ feet fall at low tide.

The dam built of hemlock timber was in 1842-43 rebuilt from low tide with white pine; overflow 1,148 feet 10 inches.

The building of the present new dam was commenced June 1, 1872, in front of the old one, upon the rock at the west end, and upon cribs sunk in 1865 at the east end; overflow 1,112 feet.

The first, a breast wheel, was put in operation July 1, 1822; the ninth, a turbine, was started December 16, 1851.

The cost of running the nine wheels and pumps in 1852, including repairs, oil, tallow, packing, wages of attendants, and fuel for heating, was $7.67 per day, equal to $1.33 per million gallons raised into the reservoir.

The cost of water power works, from July 1, 1822, with yearly expenses added to December 31, 1852, including 13 miles of wooden logs, iron pipes and mains, in fact all expenses, amounted to $1,781,177.09.

Total cost of all, from the old steam works at Centre Square, commenced March, 1799, with yearly expenses added, to December 31, 1852, amounted to $3,247,894.04.

Dimensions of Wheels and Pumps at Fairmount.

Kind.	Number.	Diameter, in feet.	Width, in feet.	Revolutions, per minute.	Diameter, in Inches.	Strokes, in feet.	Gallons capacity per Revolution of Wheel.	Gallons raised per hour.	Builder.	Started.
Breast.	1	15	15	14	16	4½	91.08	76 507	.....	July 1, 1852.
"	2	16	"	13	"	5	101.2	78,936	.....	.....
"	3	16	"	13	"	5	101.2	78 936	.....	.....
"	4	18	"	11	"	6	121.4	80,124	.....	.....
"	5	18	"	11	"	6	121 4	80,124	.....	.....
"	6	16	"	13	"	5	101 2	78,936	.....	.....
"	7	18	"	11	"	6	121.4	80,124	.....	.....
"	8	18	"	11	"	6	121 4	80,124	E. Geylin.	Dec. 16, 1852.
Turbine.	9	7	10×13 Bucket.	12	"	6	121.4	87,408	.....	.....
Total capacity of Fairmount Works per hour.....								721,219		
" " " day.....								17,309,256		
Average of each pump per hour.....								80,135		

Nos. 1, 2, and 3, made of wood, were replaced in July, 1846, after a constant use of 24 years.

Nos. 4, 5, 6, 7, and 8, were made of cast-iron with wooden buckets, and weighed about 22 tons each. All had cast-iron shafts working under one foot head, and 7½ feet fall when the dam was full and tide low.

The tide rose about two feet above their lower edges, and prevented their use from 4 to 6 hours each day.

The Sizes, Capacity, and First Cost of each of the Fairmount Reservoirs.

When finished.	Number.	Size in feet.	Depth in feet.	Capacity in ale gallons.	Cost.
1815.....	1	167 x 317	12½	3,917,659	$32,508 52
1821.....	2	140 x 316	12½	3,296,434	9,579 47
1827.....		160 x 317	12½	2,707,295	24,521 75
1835.....	4—1st Sec.	136 x 350	12½	3,658,016	67,214 68
1835.....	2d "	358 x 392	12½	4,381,322	
1836.....	3d "	.....	12½	4,071,250	
Total.....				22,031,976	$133,824 42

Capacity in wine gallons about 27 millions. Water level $94\frac{14}{100}$ feet above city datum—51 feet above the highest and 91 feet above the lowest curb regulation in the old city proper.

DISTRIBUTING MAINS FROM FAIRMOUNT RESERVOIRS.

The first, 22-inch diameter, partly of imported pipes from England, was commenced to be laid in 1819 from the north-east corner to the Reading Railroad; thence to Twenty-first Street, a distance of 2,661 feet, where it is reduced to 20-inch, and continues down to Callowhill; thence to Broad; thence to South Street, a distance of 9,516 feet, making a total of 12,177 feet.

The second, a 20-inch, laid in 1829, from the south side of the reservoir down Callowhill to Fifteenth Street; thence to Spruce, being 10,596 feet, where it is reduced to 16-inch, and continued 1,227 feet to South Street, making in all 11,823 feet.

These mains pass across the city on its summit, those streets being the highest in the old city proper.

The third, a 30-inch, laid in 1850, passed from the south-east corner down Hamilton to Twenty-second, thence to Arch, thence to Second, a distance of 13,821 feet.

SCHUYLKILL WORKS.

FORMERLY THE SPRING GARDEN AND NORTHERN LIBERTIES WORKS.

(Situated at the foot of Thompson Street, on the Schuylkill.)

The districts north of Vine Street, embracing Spring Garden, Northern Liberties, and Kensington, all formerly known as the Northern Liberties, obtained a supply of water from wells, pumps, and natural sources, until 1826, when a contract for water from Fairmount was made with the authorities of the old city proper, which was continued until December 31, 1844; the rate being 50 per cent. higher, and 6 per cent. allowed for its collection. The frontage for the mains or water pipes was paid by the respective property owners.

The higher charge for water, and the greater elevation of the ground, led the districts to seek legislation for the construction of their own works, which was resisted by the city, but the Legislature granted the requisite authority by Act approved April 18, 1843. The city subsequently endeavored to retain her customers by legal steps, enjoining them from taking the water from the Schuylkill River, which she claimed to have purchased from the Schuylkill Navigation Company, who sold to the city what they never did or could own or possess, as was decided by the Supreme Court.

The following table shows the amount of water-rents received by the city at this time from the district, with feet of pipe laid and fire-plugs erected:

DISTRICTS.	Water Rents.	Feet of Pipe Laid.	Plugs Erected.
Northern Liberties	$25,470 59	77,784	155
Spring Garden	24,218 02	91,298	160
Kensington	5,102 17	30,225	56
Total	$54,790 78	199,307	371

Three Commissioners from each district met July 31, 1843, to organize, but those from Kensington refused to participate, and withdrew from the Board, which then consisted of Alexander Cummings, President; George Williams, Secretary; Thomas Halloway, George W. Dohnert, James Landy, and Joseph Yeager.

The Board selected the sites now occupied by the works and reservoir. The estimate of the Commissioners was $77,345.87; work was commenced and carried on by the day until October 18, 1843, when Wm. E. Morris (late a member of the Commission of Water Experts), was appointed engineer, who furnished a detailed estimate December 16, 1843, amounting to $173,700, for a daily average supply of 2,500,000 gallons.

July 1, 1844, the corner-stone of the engine and boiler-house was laid—substantial stone buildings with two ornamental brick chimneys, the one 85 feet, and the other 106 feet high. A forebay, 450 by 60 feet, was built, into which the water passed through a sluice (now a brick culvert), thence to the pumps through conduits. From a siding on the Reading Railroad, coal is dumped into bins of 1,000 tons capacity, thence by tracks over a platform scale to all the boilers.

A contract was made with Merrick & Town for two engines, known as No. 1 and 2.

The works were started December 31, 1844, and delivered to the Joint Water Committee by the Commissioners, July 15, 1845.

The whole cost of the works was, - - -	$159,074 65
For the Northern Liberties main, - - -	30,739 99
For the Spring Garden main, - - - -	41,906 85
	$231,721 49

The first year these works paid a profit of $16,700.38 above all expenses, including interest, and the price of water was reduced to the old city rates.

These works had not been in operation a year before the southern embankment of the reservoir, now known as the Spring Garden or Schuylkill, yielded on being pumped too full, doing much damage to surrounding property.

May 10, 1849, a new engine known as the Sutton or No. 3 was put in operation. Two 18-inch mains led the water from the engines to a box or chest, thence to the reservoir. In 1854, a fourth (No. 4) engine was determined upon and built by I. P. Morris & Co., on their own plans and specifications. The small mains necessitated the erection of a stand pipe, to which all the pumps were connected. It was located in front of the engine house, with an octagon base; is 137 feet high, six feet at the bottom, tapering to 3½ feet, with a cornice and cap at the top. An additional 30-inch main was laid from the reservoir to Poplar Street, where it communicates with the Corinthian Avenue basin, thence to Nineteenth Street.

By act of consolidation in 1854, all the works passed into the control of the Water Department.

ENGINES.

There have been six engines in these works. There are now three (Nos. 4, 5 and 6), and one of 20,000,000 gallons capacity contracted for, and in process of construction, by William Cramp & Sons.

Nos. 1 and 2 were the first, and alike, both low pressure, with vertical steam cylinders, and a beam overhead, supported on columns, with connecting rod and fly-wheel of 18 feet diameter; steam was cut off at half stroke by an independent cut-off worked by a cam. The pumps were double acting, placed vertically under the steam cylinder, the piston rod of which was continued through the bottom, and connected directly to the pump piston. The valves of the pump were brass, hinged, and working on cast-iron faces. These engines were in constant use for twenty-four years. See page 13, Report of 1867.

No. 3 (the Sutton) was a double-acting condensing engine, vertical steam cylinder connected to a nearly horizontal pump by suitable connecting rods and a bell crank. The valves of the pumps were of gun metal, hinged as in Nos. 1 and 2.

No. 4 is a Cornish engine, with a single acting plunger pump. The cylinder and pump are placed under opposite extremities of a balance lever beam, and the piston rod and pump plunger con-

nected by suitable rods. The pump plunger is weighted sufficiently to cause it to descend against the resistance of the water in the ascending main, the friction of engine, &c. The receiving valve of the pump is a double beat, and placed under the plunger, the discharge a treble beat constructed on the same principle, fixed in the valve box on a short curved branch near the bottom of the pump. The valves are cast-iron, working on beats of a composition of lead and tin, cast in dove-tail grooves, turned in the castings which form the seats.

No. 5 is a side lever Cornish, started to work November 3, 1869, constructed by Merrick & Sons. For it a 36-inch main, connected with the stand pipe, was provided, which enters the Spring Garden basin over the embankment on its south side, and along the division wall.

No. 6 (the Simpson) is a compound cylinder rotative of the Simpson type, constructed by Henry G. Morris, of the Southwark Foundry. For it a large inlet from the Forebay into the building was built, which will also answer for the new 20 million engine contracted for, and for which a 48-inch main is provided, as a 36-inch main 3,468 feet long had been for the No. 6. This main was laid up Thirty-third to Master, at which point there is a branch, and the necessary stop-cocks, so as to pump either into the East Park Reservoir or the Spring Garden basin, which it enters over the north-west corner of the embankment.

Engines and Pumps at Schuylkill Works.

When started.	No	Diameter of steam cylinder.	Length of stroke	Diameter of pump cylinder	Length of pump.	Duty.	Kind.	Capacity.	Built by
July 1, 1844....	1	36	72	18	72	Average of all four 32 millions.	.....	18,963,221 for 24 hours.	Merrick & Sons ..
"	2	36	72	18	72		.....		"
May 10, 1849...	3	36	72	21	72		.....		Sutton .....
1854...	4	60	120	30	120	50 mil.	Overhead Cornish.		I. P. Morris & Co.
Nov. 3, 1869....	5	72	120	36	120	.....	Side lever.	7½ mil.	Merrick & Sons..
1872....	6	H. P. 36	61	28½	86	.....	Simpson...	.....	H. G. Morris.....
.....	.....	L. P. 57	96	28½	96	.....	.....	.....	.....

BOILERS AT SCHUYLKILL WORKS.

Four plain cylinder boilers, with two mud drums to each, built by I. P. Morris & Co., four feet three inches diameter by thirty-two feet long. The mud drums, twenty-six inches diameter by twenty-three feet long.

Two hog-nose tubular boilers, built by Matthews & Moore, five feet diameter by twenty feet extreme length, with eighty-three 3-inch tubes, fifteen feet three inches long. A heater, thirty inches diameter by twelve feet long, under each boiler.

Six plain cylinder boilers, with two mud drums to each, built by Neafie & Levy, in 1869, four feet six inches diameter by thirty feet long. . The mud drums, twenty-eight inches diameter by twenty-two feet long.

Five plain tubular boilers, built by I. P. Morris & Co., in 1871, six feet diameter by fifteen feet long, with seventy-five 4-inch tubes.

The original boilers consisted of three tubular, and one flue boiler, which were removed in 1871 to make room for the five tubular boilers.

SPRING GARDEN OR SCHUYLKILL RESERVOIR.

This reservoir, at Twenty-seventh and Master Streets, having a capacity of 9,800,000 gallons, is formed by embankments puddled with clay faced with bricks, with a division wall built within four feet of the ordinary surface (115 feet above the dam), dividing it into two basins when the water is below its proper level, and giving facilities for cleansing and repairs. When full, the water flows from the receiving apartment over the division weir (allowing the subsidence of the grosser impurities) into the distribution apartment, which is provided with two 16-inch outlet mains, and one 30-inch main communicating with the Corinthian Avenue Reservoir. It is proposed to add another main of 48-inch to communicate with the three 30-inch distributing mains from Corinthian Avenue Reservoir, which will enable this basin to receive and discharge 37 million gallons, whereas now there is only outlets for 13 millions.

CORINTHIAN AVENUE RESERVOIR.

In 1850 the City purchased over thirteen acres at Twenty-second and Poplar Streets, on a portion of which this Reservoir was erected. The inside dimensions at the foot of the slope are 258 by 577 feet, and on the outside 400 by 721 feet, having a capacity of 20,321,392 gallons; the water level when full being $66\frac{94}{100}$ feet above the highest, and $98\frac{14}{100}$ feet above the lowest curb in the City, and 16 feet higher than Fairmount.

In order to fill it a stand pipe was built at Fairmount of 48-inch cast-iron pipes, 50 feet high from its base, 30 feet above the level of the Fairmount, and 14 feet above the level of the Corinthian Avenue Reservoir when full, to which the ascending main from the pumps is attached, so as to throw its supply into either basin. From the base of the stand pipe a 30-inch main is carried 3,747 feet, and enters this basin on Twenty-second Street.

Water was admitted into the Reservoir December 22, 1852, and the cost of construction, exclusive of land damages, was $46,030.47.

It now receives its supply partly by steam power from the Spring Garden Works via Spring Garden Basin, through the 30-inch communicating main, and partly by water power via the tower and stand pipe at Fairmount, through a 48-inch and 30-inch main.

It has four 30-inch outlets: one to Kensington Basin; one to the First District, south of South Street; one to supply Spring Garden District, and one blank.

DELAWARE OR KENSINGTON WORKS.

The representatives of the District of Kensington having refused to participate in the erection of the Schuylkill Works, by withdrawing from the Board of Commissioners, contracted however with them for a supply of water at the same rates charged their own citizens, and in 1845 paid $4,261.61 for water rents, and in 1846, $6,008.50.

The Commissioners of the District adopted a resolution, December 20, 1847, appointing a committee of one from each ward

to erect works of their own. Sites were examined, and the foot of Wood, now Otis Street, in the Eighteenth Ward, selected, and the President of the Board was authorized, in the latter part of 1848, to advertise for plans and specifications for their erection.

The engine and boiler house is a substantial brick building. The water is taken from the end of the wharf, which projects into the river, passes through a sluiceway to the front of the boiler house, thence, by separate pipes, to the pumps. Although water was supplied early in 1851, the first machinery worked so unsatisfactorily that steps were taken to procure another engine, pumps, and boilers. After some litigation, the Committee on Water Works reported, October 7, 1851: "That after many vexatious delays, arising from the 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 Delaware water;" they also "congratulate their fellow citizens on the happy and successful result of the remodelling of the pumps and the puddling of the basins, such alterations became absolutely necessary to insure the successful operation of the works," and "that the new engine was in progress of completion, that they expected it to be completed by the first of January, 1852, and that the northern basin was almost finished, and would be completed by Monday next." The cost of the works to 1859 would probably reach $200,000.

ENGINES.

No. 1 is a double-acting, high-pressure engine, giving motion to a double-acting, horizontal pump, whose piston is worked by a vertical lever beam, 18 feet long, to the ends of which 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 pump valves are metallic flap or hinge, working on seats, at an angle of 45°. The pump is provided with an air-vessel on its receiving and discharging pipes, that on the latter being unusually large. The valves of the steam cylinder are of the single

poppet 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 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, 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 the pump, similar to that of No. 1. The pumps of Nos. 1 and 2 are on a level, several feet below the surface of the river, whence their supply, and connected to a single main, 18 inches diameter, through which the water is forced into the reservoir.

No. 3 is a Worthington duplex engine of six million capacity, which was started October 25, 1871, and for which a 36-inch pumping main was laid from the stand pipe a distance of 11,858 feet to the new reservoir, which received water from the old one, December 20, 1871. This new reservoir, at the foot of the embankment, covers an area of $4\frac{83}{100}$ acres, at the water surface $3\frac{29}{100}$ acres, and its contents, with 17 feet 9 inches of water. are 16,373,718 U. S. gallons. The old reservoirs are two, the north one and the south one, formed by embankments, puddled with clay, and lined with brick, and contain 9,800,000 gallons, The water surface, when filled, is 112 feet above mean tide, from which are two distributing mains, each 18 inches diameter, one passing down Sixth Street, the other down Seventh.

Engine and Pumps of Delaware Works.

	Diameter of steam cylinder.	Length of stroke.	Diameter of pump cylinder.	Length of pump.
No. 1	30	72	18	72
No. 2	42	62	19¼	72
No. 3, Worthington Duplex	.....	.....	.....	.....

BOILERS AT DELAWARE WORKS.

Six plain cylinder boilers, built by I. P. Morris & Co., in 1849, 40 inches diameter by 26 feet long, each having one mud drum 30 inches diameter by 15 feet long.

Two boilers, of the same size and construction, built by Matthews & Moore, in 1865.

Five plain tubular boilers, built by Southwark Foundry, in 1872, each 70 inches diameter by 15 feet long, with 75 4-inch tubes.

A marine boiler, by Reanie & Neafie, removed in 1872 to make room for the five tubular boilers, was placed at Fairmount to run the Worthington. Its length, 19 feet 6 inches; fire box, 6½ long by 8½ feet wide, on the outside; the shell, 7½ feet diameter by 13 feet long. Two furnaces, each 6 feet by 3½ wide. Two 16-inch, two 11-inch, and two 7-inch flues to each furnace. Sixteen 6½-inch return flues.

TWENTY-FOURTH WARD WORKS.

In the Fall of 1851 a meeting was held by the enterprising and influential citizens of West Philadelphia, for the purpose of having water works erected. Plans were prepared and estimates presented, which satisfied them of its feasibility, when the Commissioners of the District took the matter up and appointed a Committee consisting of

Benj. R. Miller,	J. Sidney Keen,
Dr. R. Bicknell,	Robert L. Martin,
C. C. Pierson,	E. M. Eakin, *President.*

They employed Messrs. Birkinbine & Trotter to make a thorough examination of the whole subject, who submitted the following views: To locate the works on the west side of the Schuylkill, near the foot of the old Inclined Plane, at or near the Belmont Cottage; to consist of a subsiding reservoir, engine and boiler house, two direct-acting vertical Cornish pumping engines, and two reservoirs on the elevated ground near the top of the plane. The cost ($300,000) was the objection to this plan, which was modified, to which a similar objection was made,

whereupon the Germantown Works were visited, when a contract was made on the basis of these, with modifications approved by the Commissioners. The small cost ($120,000), and the short time (one year) necessary to get into operation, led to the adoption of similar works, using a stand pipe until the District would be able to construct reservoirs, and lay over three miles of large mains, to connect with the built up portion of the District. Failing to secure a good title for the site selected, it was abandoned, and another was chosen by the Commissioners on Thirty-fifth Street, north of the Pennsylvania Railroad now in the Park and occupied by the Zoological Garden. January 24th, 1853, operations were commenced. Changes were ordered, such as filling up a portion of the eastern end of the subsiding basin, excavating the remainder to a depth of seventeen feet, carrying up the retaining wall two feet above the grade of Thirty-fifth Street, thereby giving it a height of 38, instead of 12 feet, as originally contemplated. Two direct-acting vertical Cornish engines were substituted, as a matter of economy in fuel, for the high-pressure engines in course of construction. The mains were increased in size and quantity, and larger pipes replaced smaller ones. The water passes from the river through a plank tunnel to a paved chamber, in which are placed three strainers. In ordinary stages the water is 5½ feet deep, the flow very slow, less than two miles per day, should two million gallons be pumped, allowing time for the heavy particles to subside. Provision was made for the easy removal of the sediment, and the stoppage by the strainers of the larger and lighter floating particles.

Subsiding Reservoir.—This is 165 feet long by 75 feet wide, and at ordinary stages a depth of 16½ feet of water, which is sufficient to render it pure, limpid, and free from all impurities held in suspension, and prevent the injurious action of reflected sunlight on the sediment.

Buildings.—They were stone, of the hard gneiss-rock, found in the vicinity. Large ones were used for the masonry of the engine-house and foundation of the engines; beds and faces dressed, securely bound with iron, laid in hydraulic mortar two feet above

the water line, and carried 42 feet above this to the base of the cylinders of the engines. The buildings, of dashed rubble work, were a circular engine house, with sleeping and store rooms, surmounted with a dome, supported on cast-iron girders, arranged and provided with hooks, over each cylinder, which could be used to lift the machinery when examination and repairs were necessary. On either side the boiler houses, outside of which were the coal yards. The roofs were slate, on iron framing, making the houses fire-proof. In the rear a stack, the base of cut stone, 30 feet high, and continued up of brick 90 feet, making its height 120 feet, the flue 40 inches in diameter and lined with fire-brick 30 feet from the bottom.

Engines and Pumps.—Two Bull Cornish engines, the steam cylinder 50 inches, the stroke of piston 8 feet. The cylinders were inverted and placed over the pumps, the piston rods connecting to the plungers of the pumps each 17 inches, and 8 feet stroke. Plain plunger pumps with double beat valves and metallic facings. The air feed and cold water pumps worked by a lever beam. These engines were independent of each other, and fitted with Birkinbine's patent equilibrium governor, which obviates the addition or removal of weights from the plunger, as the head of water rises or falls. Each steam cylinder was jacketed, and steam entered the interspace. Two inches of felt covered the jacket, outside of which was a brick wall six inches thick, and around this a casing of wooden staves, bound with bright metallic bands. These provisions had in view economy of fuel; the unusual strength, the kind and character of the work and materials, the efficiency of the machinery.

Boilers.—In each house, two Cornish boilers, each 6 feet in diameter and 32 feet long, with an internal flue of 4 feet diameter, in which the fire was built, the heated gases passing through to the back, forward along the exterior, back again under the bottom to the chimney, where they escape after travelling 96 feet in contact with the boiler, which can supply steam to either engine, or any boiler can be removed without disturbing the other.

Stand Pipe.—Near Thirty-fifth and Sycamore Streets, 2,000 feet from the works, on high ground, is situated this structure, its base of gneiss rock ashler work 36 feet high and 100 feet above the river level, its central portion a heavy boiler plate pipe of 5 feet diameter and 130 feet high. There is a landing on the top of the stone work, enclosed by a railing, from it a spiral stairs winds around the stand pipe, and terminates in a platform 115 feet from the base. Eight cluster columns opposite each angle of the stone base support, and a railing of gothic scroll work protects the outside of the steps. The upper platform, surrounded by a gothic railing, is sustained by ornamental brackets springing from the columns; these are continued above the platform, where, by flying buttresses, they are connected together and to the stand pipe, which is surmounted by a spire and flag staff, the whole of iron except the base. From the works there is a 16-inch inlet into and a 16-inch outlet from the bottom of the stand pipe, in which the water is maintained 100 to 127 feet high, giving in all parts of the district a head of 120 to 225 feet.

Without reservoirs, not more than 20,000, and with reservoirs, not less than 75,000 inhabitants could have been supplied with water from these Works, mains and reservoirs the only additions required. Each stroke of the pump raised 90 gallons, and ten strokes a minute made them capable of lifting 1,296,000 gallons per day of 24 hours, and if capable of making 14 strokes per minute, as claimed, then their capacity was increased to 1,804,400 gallons per day for each pump, and twice that, 3,608,800, or say 3½ millions per day for the Works, which could have been retained either for sprinkling the drives in the Park, or for pumping water for City purposes. They were abandoned however, October, 1870, when the Belmont Works were started, and sold for $2,500, for which no justification whatever has been advanced, nor can be found or maintained. As they stood, and in the face of the necessities for water which befel the City in 1869, they were worth $100,000, and should have been kept in service; for, according to the reports, they were the most eco-

nomic engines in the Department, showing an average duty of 45 millions for several years.

The Report for 1859, pages 98 and 99, and the Report for 1860, pages 74 and 75, contain an account of the extension of the water works, recommended October, 1858, and authorized by Councils April 8, 1859. Additional extensions are recommended on pages 104 and 105 of the Report for 1860. Those authorized were a 30-inch main for the First District, south of South Street, the raising of the Corinthian Avenue nine feet, to a level with the Spring Garden Basin, involving retaining walls on three sides, the addition of 21 feet to the stand pipe at Fairmount; these have been completed, "leaving the mill house at Fairmount still to finish, which, if properly managed, could be completed in from 60 to 90 days, which is intended to contain three Jonval turbines of 9 feet diameter, and with fifty buckets, each wheel working two pumps of 18-inch diameter and 6 feet stroke of piston, with double beat valves, working vertically, and an air chamber over each set of valves, an air chamber between these on the connecting main, and one on the suction pipe, which takes the water from the flumes supplying the wheels. The theoretic capacity of the six pumps is eighteen millions per day, their mean capacity sixteen millions, though it is claimed that they could, if necessary, be worked up to eighteen millions." Practically they pump about fifteen millions per twenty-four hours.

The Report for 1864 treats of the extension of the wharf at the Delaware Works, 125 feet, to the Port Wardens' line; the laying of a 30-inch suction main from a chamber in the outer pier to the pumps, and the erection of a stand pipe upon the forcing main in front of the Works.

In 1865 the crib at Fairmount in front of the old dam was commenced, and finished in 1866, and a new one of stone recommended. This year the Roxborough Works and Reservoir at Flat Rock were commenced, and a Cornish engine was constructed for them by Messrs. Matthews & Moore. The steam cylinder 72 inches, the pump plunger 20 inches, and the stroke of each 10 feet; the special features of the engine are in the equilibrium governor and the valves of the pump.

In 1865 the Perkiomen recommended as a source for a gravity supply, by Chief Engineer H. P. M. Birkinbine.

The Germantown Works, erected by Birkinbine & Trotter, for a private company, supplied water to a portion of the Twenty-second Ward early in 1851, came under the care of the Department by purchase, in May, 1866, and were used until the completion of those in process of construction at Flat Rock, on the Schuylkill.

Two high pressure engines working double-acting pumps, raised the water into a stand pipe, 2,000 feet distant on the hill, to an elevation of 225 feet, from which it flowed into a reservoir at Mount Airy. The company laid about 38 miles of pipe.

In 1867 the Turbine No. 3 was constructed and erected in the place of Nos. 2 and 3 breast wheels; its diameter was 10½ feet, the depth of bucket 17 inches, the diameter of each of the two pumps 22 inches, and stroke six feet, of a theoretic capacity of eight million gallons per day, and practically about 5½ million gallons, with a 30-inch pumping main 240 feet long, used exclusively for the reservoirs at Fairmount.

In 1868, the Belmont Works were commenced,—the engine-house in November.

The Cornish engine for Roxborough was completed and ready to pump into the reservoir which had been finished for over six months. The turbine wheels and pumps which were commenced in 1868 were started to daily work February 17, 1869. The Roxborough Cornish engine was started April 5, 1869.

The No. 4 Turbine was started to regular work June 20, 1870, and can deliver water either into the Fairmount or Corinthian Avenue Basins.

In 1870, a 36-inch suction main from the engine house at the Delaware Works, 336 feet long, was required for the Worthington engine. Engine No. 1, at Belmont, a Worthington, was started September 19, 1870; and pumps through a 30-inch main 4,167 feet long, passing over the division embankment, and lifts 208 feet vertical above the level of the dam. The boilers are cylinder, 54 inches diameter, with heaters 26 inches diameter under them. After repair of the basin at Roxborough, pumping re-commenced December 21, 1870.

In report, 1870, page 12, "as has been before detailed, an auxiliary engine will be required at the Roxborough Reservoir to raise water for the purpose of supplying Germantown. A small engine and boiler-house has been erected for this purpose, with a stand pipe formed of the ordinary 30-inch mains; into this the water will be pumped by means of two Knowles pumps. These were purchased during the drought of 1869 for use at Fairmount, and will now be made useful at Roxborough" to supply the higher ground on the Ridge Road above the basin. This standpipe was finished, and water supplied November 21, 1875.

November 30th, 1869, it was proposed to supply east of the Schuylkill from Belmont in a manner similar to the Pipe Bridge. Fortunately this proposal was abandoned, and a submerged main with Ward's joints substituted. This main is 36 inches diameter, 963 feet long, and in the deepest water is 25 feet below the surface.

July 18, 1871—No. 2 engine, a Worthington, at Belmont, was started to regular work.

The East Park Reservoir was commenced November 9, 1871.

July 1, 1872, the new dam was commenced. August 1, 1872, the Worthington started to work at Roxborough, and restarted September 17, 1872, after the repair of the breeches pipe. September 30, 1872, the Germantown Works abandoned. December 19, 1872, water let into the Western Section of the Belmont Reservoir.

January 20, 1873, the Department took possession of the Chestnut Hill Water Works by purchase, at $65,000.

In the Spring of 1874, the extension to the Roxborough boiler house was completed.

February 17, 1875, one of the line of pipes over the Wissahickon was destroyed by the frost.

During the past three years little has been projected, the effort being to co-ordinate and introduce a general system which would compel the cessation of the patching policy, and I am proud that every view urged in my last Report was sustained by the Commission of Experts, whose Report is so recent and so full that I need only refer to it.

DATE OF IMPORTANT EVENTS CONNECTED WITH THE WATER WORKS OF PHILADELPHIA.

Month.	*Year.*	
June 23	1789	Benjamin Franklin's will to dam the Wissahickon, and bequeaths £100,000.
April 10	1792	Charter of the Delaware and Schuylkill Canal Co.
	1793	Yellow fever.
	1797	First petition to Councils, asking for the introduction of pure water into the city.
Jan. 31	1798	Councils offered £50,000 for one-half the water of the Delaware and Schuylkill Canal.
July	1798	Benjamin Henry Latrobe surveyed Spring Mill Creek, and reported to Councils.
Dec. 29	1798	Latrobe's review of proposed schemes. 1st Aqueduct from Spring Mill. 2d. Wissahickon Creek. 3d. Water power works. 4th. Impounding reservoirs.
Jan.	1799	Latrobe's plan for Centre Square and Schuylkill Works adopted.
Feb. 7	1799	Ordinance passed authorizing a loan of $150,000 for purpose of supplying the city with water.
March	1799	First works commenced under the superintendence of B. H. Latrobe.
Jan. 21 or 27	1801	The first water was supplied from these works.
	1801	Fourteen pieces six feet cast-iron pipe laid at Centre Square engine house to prove best mode of securing joints under greatest pressure.
Oct. 12	1801	City Councils, by resolution, approved of Report of the Committee for superintending the introduction of wholesome water into the city, and ordering 500 copies printed.
	1803	John Davis as Superintendent.
	1803	Public hydrants, pumps, and iron fire-plugs first introduced, up to and including which time the cost of the works was $295,452.09.
	1804	Four cast iron fire-plugs in use.
	1804	The first iron pipes laid, 3,978 feet, as an experiment, in Water Street.
	1804	Cast iron boiler at Centre Square Works cost $234.79.
	1805	Frederick Graff, Sr., as Superintendent.
	1809	Expense of keeping steam engines going was for Schuylkill engine, ... $6,254 36 And Centre Square Engine, . . . 7,552 87 Together, ... $13,807 23
	1811	Up to this time there were 230 hydrant pumps, and 185 fire-plugs in the city.

Month.		Year.	
Oct.	24	1811	Councils directed the Watering Committee to enquire for a better method of supplying the city. Up to this time, the cost of the works was, for engine building, canals, tunnels, etc., ... $248,985 59 For distribution, logs, etc., ... 259,525 92 Together, ... $508,511 51
Dec.	18	1811	John Davis and Frederick Graff made surveys of Wissahickon and Spring Mill Creeks, and the east side of the Schuylkill, from Upper Ferry Bridge to the Falls, and reported in favor of steam works at Fairmount, which report was adopted.
June	28	1812	First purchase made at Fairmount for $16,666.67.
Aug.		1812	The steam works at Fairmount commenced.
Feb.	16	1813	Bill authorizing city to lay pipes through the streets of the district passed Legislature. The cost of keeping the engines going, was, for Schuylkill engine, ... $11,900 07 For Centre Square engine, ... 13,740 18 Together. . . . . $25,640 25 to raise 793,250 gallons per day.
Sept.	7	1815	Started steam works at Fairmount, and finished reservoir No. 1, when Centre Square Works were discontinued.
		1817	First iron pipes, similar to those now in use, were laid, imported from England.
		1818	Committee resolved to lay iron pipes in future; Cherry Street shop erected.
June	20	1818	The boiler of Oliver Evans' engine burst.
Jan.	26	1819	Committee approved of the plan of distribution of iron pipes as devised by Frederick Graff.
April	8	1819	Councils resolved to erect water power works at Fairmount.
April	19	1819	Building of the dam was commenced by Captain Ariel Cooley.
July	20	1819	Authority was obtained to raise the dam 18 inches higher than at first contemplated.
June	25	1820	First iron main laid 20 and 22-inch diameter.
July	23	1821	Last crib sunk.
July	25	1821	Water flowed over dam first time.
April	28	1821	Register water rents adopted.
July	1	1821	Corner stone of mill buildings laid on Saturday.
Oct.	25	1822	First water wheel started to work to supply city, Monday.
Jan.	14	1822	Use of steam works at Fairmount discontinued.
		1824	Extra water power purchased from Navigation Company for $26,000.
June	14	1824	Agreement with Schuylkill Navigation Company to protect the Fairmount pool from dye stuffs, noxious, fetid, or injurious substances.

Month.		Year.	
April	26	1826	Contracted to supply Spring Garden.
June	1	1826	Contracted to supply Southwark.
June	6	1826	Contracted to supply Northern Liberties.
Nov.	10	1827	Wheel No. 4 started; reservoir No. 3 finished.
April	12	1828	Act to protect the purity of the Schuylkill River.
		1829	Second main laid from Fairmount.
		1829	Centre Square engine building taken down.
Feb.	13	1829	Bill to prevent passage of streets through Fairmount, passed Legislature.
Oct.	10	1831	Second contract to supply western part of Spring Garden.
Feb.	7	1832	Act to protect Fairmount pool from pollution.
March	26	1832	Building guard pier.
April	5	1832	Wheel No 5 started; 22 inch main taken up and relaid on the railroad.
June	6	1832	Contract to supply Moyamensing.
Oct.	5	1833	Contract to supply Kensington signed.
Nov.	5	1834	Wheel No. 6 started.
Dec.	20	1834	Bill for protection of purity of Schuylkill water passed the Legislature.
Nov.	4	1835	First section of No. 4 reservoir finished.
		1835	Pavilion at the end of dam built, and old engine building altered to a public saloon.
Nov.	12	1836	Second and third section of No. 4 reservoir finished.
		1837	Retaining wall on Fairmount, Twenty-fifth Street, built.
		1840	New set of forebay head gates put in.
May	2	1842	Rebuilding the dam from low-tide up, commenced.
Dec.	7	1843	Rebuilding the dam from low tide up finished; cost, $56,216.85.
Aug.	24	1843	Started wheels Nos. 7 and 8. Put in new head-gates for all the flumes.
Dec.	31	1844	Supply of water discontinued to Spring Garden, Northern Liberties, and Kensington.
Jan.	1	1845	New contract to supply Moyamensing and Southwark for ten years from this date.
July	14	1846	Started wheels Nos. 1, 2, and 3, which had been rebuilt, with their pumps.
		1846	Took up 3-inch pipes in Water Street, and relaid with 6 inch, per Girard's Will.
		1847	Frederick Graff, Chief Engineer.
March	9	1847	Bill to vacate Biddle Street passed Legislature.
		1847	Enlarged the garden, and put up iron railing.
Nov.	11	1848	Supplied the northern districts for two weeks whilst they repaired their reservoir, which was partly carried away.
July	5	1849	Councils authorize the laying of 30 inch main from Fairmount.
Aug.	30	1849	Councils agreed to purchase lot for new reservoir.
		1850	Purchased thirteen acres one hundred and fifteen perches, on part of which Corinthian Avenue Basin now stands.

Month.	Year.	
	1850	30 inch main laid from Fairmount.
April 21	1851	New reservoir commenced, Corinthian Avenue. Cleansed Reservoirs Nos. 1 and 3, and one section of No. 4.
Dec. 16	1851	Turbine started. Cleansed Reservoir No. 2.
Dec. 22	1852	Water admitted to new reservoir. Cost to December 31, $46,030.47.
	1852	Hydrographic survey made by the Schuylkill Navigation Company.
	1855	The wine gallon (of 231 cubic inches) adopted in place of the ale gallon (of 282 cubic inches).
	1855	Stand-pipe erected at Schuylkill Works, and overhead Cornish engine started.
August	1855	Twenty fourth Ward Works went into operation.
	1856	Samuel Ogdin, Chief Engineer.
	1858	H. P. M. Birkinbine, Chief Engineer.
	1859	Corinthian Avenue Reservoir raised nine feet, and work commenced on the new mill house at Fairmount, under Chief Engineer H. P. M. Birkinbine.
	1859	A suggestion to abandon the Delaware Works.
	1859	A 30 inch main laid from the Corinthian Avenue Reservoir, to supply the southern sections of the city.
	1861	Hydrographic survey of Fairmount pool to Columbia Bridge, made by Chief Engineer Birkinbine.
	1862	Isaac Cassin Chief Engineer.
June	1862	The machinery in the new mill house at Fairmount started.
Sept.	1862	Spring Garden Works stopped for fourteen days, the forebay having been filled with earth by a freshet.
	1864	H. P. M. Birkinbine, Chief Engineer. A second hydrographic survey made to Columbia Bridge.
	1865	The wharf at Delaware Works extended to Port Wardens' line, a distance of 125 feet, and stand pipe erected.
	1865	Roxborough Reservoir commenced.
	1865	H. P. M. Birkinbine, Chief Engineer, reports a plan for a gravity supply from the Perkiomen.
May,	1866	Germantown Works came under care of the Department.
	1866	30 inch main laid, connecting the Corinthian Avenue Reservoir with the Delaware Reservoir.
	1866	A third hydrographic survey made as high up as Reading Railroad Bridge at the Falls.
	1866	48 inch main laid from Fairmount to Corinthian Avenue Reservoir.
	1866	Belmont Reservoir commenced.
	1867	Frederick Graff, Chief Engineer.
Aug.	1867	Spring Garden Forebay twice filled with gravel by heavy rains washing the Reading Railroad embankment.
Oct.	1867	The removal of old breast wheels, Nos. 2 and 3, at Fairmount, commenced under Chief Engineer F. Graff.

Month.	Year.	
	1868	Old Engine No. 1, at Schuylkill Works, removed, and the erection of the side lever Cornish Engine commenced.
	1868	Cross-head of the sutton engine at Spring Garden broke.
Feb. 17	1869	New Turbine (in place of breast wheels Nos. 2 and 3) started, and the removal of old breast wheels Nos. 4 and 5 commenced.
	1869	Drought during the month of August.
April 5	1869	Cornish engine at Roxborough Works started.
Oct. 4	1869	Greatest freshet on record in the Schuylkill River; the water rose eleven feet nine inches above the level of the dam.
Nov. 3	1869	The side-lever Cornish engine at the Schuylkill Works started.
	1870	New section of Delaware Reservoir commenced.
June 20	1870	The second new turbine at Fairmount (now No. 4), started, and the removal of old breast wheels Nos. 6 and 7 commenced.
	1870	Belmont Reservoir completed.
Sept. 19	1870	No. 1 Worthington duplex engine at Belmont started, and the old West Philadelphia Works abandoned.
	1870	Five new tubular boilers erected at the Schuylkill Works.
	1870	Submerged main laid across the Schuylkill River at Belmont.
	1870	Pipe aqueduct across the Wissahickon Creek completed.
March	1871	Water passed over the pipe aqueduct to Mount Airy Reservoir.
July 18	1871	The second Worthington engine at Belmont started to regular work.
Aug. 19	1871	The Belmont Works commenced to supply the high ground of the Twentieth and Twenty-ninth Wards.
	1871	New aqueduct built connecting the Spring Garden Forebay with the river.
Oct. 25	1871	The Worthington engine at Delaware Works started.
Nov. 9	1871	East Park Reservoir commenced.
Dec. 14	1871	The third new turbine (now No. 5), in place of wheels Nos. 6 and 7 at Fairmount, was ready to start.
Dec. 20	1871	New section of Delaware Reservoir finished and filled.
	1872	Compound engine at the Schulykill Works started.
June 1	1872	Rebuilding of the new dam commenced.
Aug. 1	1872	Worthington duplex engine at Roxborough Works started.
Sept. 30	1872	Old Germantown Works abandoned.
Dec. 19	1872	Water let into the western section of the Belmont Reservoir.
Jan. 20	1873	Department took possession of the Chestnut Hill Water Works.
March	1873	Wm. H. McFadden Chief Engineer.
	1874	The rain-fall of April served to June 26, when a severe drought set in and continued to November 23. The minimum flow of the Schuylkill was never less, unless in the succeeding Spring of 1875, due to the severe winter not permitting the springs to be replenished.

Month.	Year.	
April 15	1874	Commenced to clean all sections of Fairmount Basin; removed nearly 6,000 cubic yards.
Feb. 17	1875	Pipe bridge across the Wissahickon broken by freezing.
	1875	According to ordinance of Councils of June 5, the Franklin Institute nominated the following eight scientific and practical engineers: Frederick Graff, Jas. F Smith, Wm. E. Wilson, Wm. Milnor Roberts, Wm. E. Morris, Wm. J. McAlpine, Solomon W. Roberts, and Fairman Rogers, of whom his Honor the Mayor appointed five, viz: Messrs. W. Milnor Roberts of New York, Wm. J. McAlpine of Albany, Wm. E. Morris, Solomon W. Roberts, and Fairman Rogers of Philadelphia, who together with Dr. Wm. H. McFadden, the Chief Engineer of the Water Department, formed a commission of experts, to whom was referred the entire subject of the present and future water supply of the City of Philadelphia.
		Mr. Fairman Rogers declining, by the unanimous recommendation of the remaining appointees, Col. Julius W. Adams of Brooklyn, was appointed in his place.
		The following is a synopsis of their deliberations, recommendations, &c.
		Theoretical capacity of the present Works 102,000,000 gallons.
		Practical working capacity during a full supply of water in the river: by water-power, 30,000,000; by steam-power, 41,000,000; Total, . . 71,000,000

ACTUAL CAPACITY DURING A DROUGHT.

By water power, ...	14,000,000
By steam-power, ...	41,000,000
	55,000,000

Minimum flow of the Schuylkill, 245,000,000 gallons

PLANS FOR PERMANENT WATER SUPPLY

By conduit from the Delaware at Belvidere, 90 miles, at an estimated cost of 5, 4, or $300,000 per mile.
By pumping and conduit from New Hope for 75,000,000 gallons daily; cost $23,000,000.
By the New Hope canal and conduit; cost, $22,500,000.
By the Scudder's Falls canal and conduit; cost, $21,500,000.
By gravity supply from the Perkiomen:
For a daily supply of 100,000,000 gallons, ... cost, $10,000,000
For a daily supply of 200,000,000 gallons, ... cost, $12,000,000

Month.	Year.	RECOMMENDATIONS FOR THE PRESENT AND FUTURE SUPPLY OF THE CITY.
		The completion of the East Park Reservoir, and connecting it by 48-inch pumping mains with the works at Spring Garden and Fairmount, and by distributing mains of the same size with the Spring Garden, Corinthian, and Delaware Reservoirs.
		That the six large turbines at Fairmount be altered, so as to operate more economically; estimated cost, about $16,000
		The construction of two new turbines, in place of the old breast wheels Nos. 2 and 6; estimated cost, 70,000.
		The erection of a pumping engine of 10,000,000 gallons capacity, at the Spring Garden Works.
		Re-arranging the pumping mains at the Belmont Works and putting in a proper distributing main from Belmont Reservoir to supply the east side of the river.
		The building of an intercepting sewer on the east side of Fairmount pool, or of a conduit for purer water from Flat Rock dam to the pumping works at Belmont, Spring Garden, and Fairmount.
		The extension of the inlet pipe at the Kensington Works into deeper water.
		The raising of the Delaware Reservoir six feet.
		The establishment of a new pumping station at Lardner's Point, with a reservoir at or near Wentz Farm, with proper mains connecting the pumping works with the Delaware Reservoir, and with the new reservoir supplying Frankford, &c.
		The consideration of the purchase and use of water-power at Manayunk, and the construction of the proposed new works dependent thereon.
		Paper by Julius W. Adams, C. E., on the pollution of rivers, as applicable to the future water supply of the City of Philadelphia.
		Chemical examination of the waters of the Schuylkill and Delaware Rivers, by Messrs. Booth and Garrett.
		Chemical examination of the waters of the Schuylkill and Delaware Rivers, by Charles M. Cresson, M. D.
		Report of James F. Smith on the flow of the Schuylkill River, and the means of increasing the power for pumping water by impounding reservoirs.
		Estimates for a gravity supply from the Perkiomen, by Wm. J. McAlpine.
September		The springs at Chestnut Hill failed, and a main was laid from Mount Airy Reservoir a distance of 5,772 feet, for its supply.

Statistics relating to Fairmount Water Works previous to Consolidation.

Year.	Amount of Water Rents.	Amount of Expenditures.	Feet of wood pipe laid.	Feet of iron pipe laid.	Average daily supply, in gallons.	Number of tenants.	Number of gallons supplied each tenant.	Chairman of Committee.	Engineer or Superintend't
1801	$278 00	.....	7.000	.....	.....	34	.....	J. Miller, Jr ...	B. H. Latrobe
1802	537 60	.....	29,963	.....	.....	152	.....	" ...	"
1803	961 00	$295,352 09	18,000	.....	.....	267	.....	S. Wetherill...	John Davis.....
1804	1,800 00	34,213 06	30,472	3,978	.....	345	.....	J. Vanuxum...	"
1805	3,260 00	41,168 17	28,200	.....	.....	685	.....	" ...	F. Graff, Sr.....
1806	5,050 00	57 623 05	12,000	.....	.....	1,166	.....	" ...	"
1807	4,987 17	26,164 93	2,000	.....	.....	1,181	.....	" ...	"
1808	6,207 01	24,629 62	2,164	.....	.....	1,284	.....	" ...	"
1809	9,105 00	29,467 13	5,630	.....	.....	1,59[illegible]	.....	" ...	"
1810	10,931 50	26,906 48	7,891	.....	.....	1,922	.....	" ...	"
1811	12,163 00	29,702 26	5,015	.....	.....	2,127	.....	" ...	"
1812	15,629 00	27,946 85	6,718	.....	.....	2,396	.....	" ...	"
1813	16,638 00	30,359 58	7.426	.....	.....	2,637	.....	" ...	"
1814	17,883 00	33,865 69	4.441	.....	968,383	2,850	340	" ...	"
1815	18.499 00	183,289 62	9,395	.....	1,025,455	2,983	344	George Vaux...	"
1816	19.974 50	51,219 63	14,410	.....	.....	3,227	....	" ..	"
1817	19 922 00	51,389 26	6,399	400	1,073,905	3.248	331	J. S. Lewis.....	"
1818	21 120 50	34,771 33	3,785	.....	.....	3,488	.....	"	"
1819	21,998 50	119,063 68	3,000	.....	.....	3,847	.....	"	"
1820	23,016 50	149,700 75	3,588	9,570	.....	4,170	.....	"	"
1821	24,584 50	115,746 36	5,803	8,475	.....	4 590	.....	"	"
1822	25,485 50	106,517 82	3,397	16,035	.....	4,758	.....	"	"
1823	26.013 09	69.268 54	3,754	14,993	1.972,975	4,844	407	"	"
1824	26 574 20	82,208 94	3,072	20.500	1,798,452	5,061	355	"	"
1825	27,299 18	44 307 37	5,895	11,394	1,563.452	5,470	286	"	"
1826	29,764 64	73 517 40	4,913	27,496	1,709,091	5,879	291	Thomas Hale..	"
1827	37,558 27	80,749 92	2,197	41,044	1,635,844	6,204	264	" ..	"
1828	46,475 61	64,150 64	2,275	23,285	2,045,801	6 775	302	" ..	"
1829	52,313 17	81,180 06	600	16,868	2,197.647	9,633	228	" ..	"
1830	68,918 27	35,660 84	850	26,675	2.466,096	10,143	243	W.J. Duane...	"
1831	65,694 62	63,009 57	1,131	15,630	2.954,286	11,386	259	" ...	"
1832	73,019 81	65 195 58	220	16,296	3,662 582	11,646	314	J. P. Wetherill	"
1833	79,437 01	37.354 06	.....	9,497	4,014,044	13,472	298	"	"
1834	85,258 15	65,163 33	.....	13.597	4,150,771	14,204	292	"	"
1835	92,116 82	73,288 38	.....	17,637	4.107,464	18,704	220	"	"
1836	101,266 39	71 706 51	.....	17,283	4,178,317	19,674	212	"	"
1837	105,870 92	49,730 10	.....	8,050	4,219,481	20,462	206	"	"
1838	109.826 06	50,642 29	.....	11,803	4,700,790	21,947	214	" pro tem.	"
1839	121,099 87	24.742 39	.....	5,255	4,856,696	22,636	215	"	"
1840	126,074 51	22,452 44	.....	2,618	4,925,402	23,482	210	"	"
1841	134,634 67	24,701 75	.....	1,865	5,427,133	24,828	219	"	"
1842	139,682 97	63,911 40	.....	3 083	5,246,274	25,816	203	"	"
1843	144.765 74	63,171 84	.....	5.373	5,398,774	26,549	203	"	"
1844	151,501 37	29,713 35	.....	6,618	6.507,309	28,082	232	"	"
1845	92,226 76	25,891 93	.....	5,520	5,026,631	20,165	249	"	"
1846	100.200 20	50,771 29	.....	15,421	4,264,137	21,551	198	"	"
1847	110,505 17	34.316 18	.....	9,279	4,975,508	22,789	218	"	F. Graff.....
1848	117,976 30	49,580 32	....	17,781	5,219,505	24,230	216	"	"
1849	125,511 41	84,576 74	.....	11,342	5,397.297	25,670	210	"	"
1850	132,592 31	131,826 22	.....	22,253	5,841,841	27,550	212	"	"
1851	140,313 50	92,380 19	.....	7,867	6,947,142	29.014	239	"	"
1852	151,323 05	72,347 09	.....	12,620	6,997,194	30,592	229	"	"
1853	163,071 01	43,511 05	.....	5,180	7,607,157	32,300	235	J. M. Thomas..	"
1854	175,465 67	66,502 40	.....	3,372	11,709,786	.....	.....	" ..	"
Tot'l	$3,434,382 00	$3,356,627 47	241,604	465,953					

Paid into City Treasury — Per duplicate

The pipes laid in 1804 and 1817 were taken up, and should be deducted from the above amount.

REPORT

OF THE

CHIEF ENGINEER.

4

REPORT.

To the Presidents and Members of the
Select and Common Councils of the City of Philadelphia

GENTLEMEN:—Your suffrage conferred upon me the honor whereby, for the third time, it becomes my duty, in accordance with law, to submit the annual report of the Water Department for the year ending December 31st, 1875.

My aim has been to embody the department in its reports, for the convenience of parties interested, for a more intelligent understanding of its operations, and as a suitable and proper record for reference. Hence plans have been prepared of the pipes, their sizes, an alphabetical list of the streets on which laid, the location of the fire-plugs, valves or stops, also those covered by railroad tracks, all of which are now of record in the office, but are too bulky for the report. Copies should be preserved in some place of safety, such as the Survey Department, or the office of the Recorder of Deeds. Tables have been formulated showing the practical operations of each of the works, the quantity of water pumped, the daily average and increase, the number of hours run, the relative percentage of time in which they were standing idle, or undergoing repairs, and the causes of the same, either too little power, or too full basins, due to the mixed system of pumping by water and steam.

The tabulated receipts show that 1874 was the first year in seven when they exceeded all expenditures, loans included, and that 1875 was the first in fifteen when they were in excess over $230,000, while the expenditures were less than in any of the five preceding years. The sources of revenue have been classified as water rents, receipts for pipe laid, receipts at the engineer's office, with their totals and yearly increase, the amounts collected by, and returned for lien to the City Solicitor, with the expendi-

tures from annual or special appropriations, provided from taxation for maintenance and from loans for construction, with the annual profits. The increase of revenue by re-assessments amounts to over $68,000. This is continuously going on, enabling its completion over the entire city every five years. A form has been prepared classifying the outlets with their rates in such a manner that, with a little care, any consumer can determine his water rent, check and correct errors for or against, and no longer plead ignorance in excuse. Co-operation is solicited, so that a check may be had upon the officers of the Department, who will be found ever ready to give such information as will render it easily susceptible of comprehension. The greatest difficulties which beset the Registrar's Department arise from a want of uniformity in charges. To this end, if citizens would unite in introducing meters, not generally, but for the sake of uniformity in charges, which could be readily done by applying meters in single instances, and rating similar classes according to it, a definite standard, of which we are now deprived, would be established in the place of an arbitrary system of rating.

Believing I have by law such power, I would deem it wise to use, say 100 to 200 meters, in the manner herein mentioned, and at the proper time will ask permission of the Committee to carry out this view, hoping for such results as will be mutually satisfactory and advantageous.

A table shows the water surface of the basins and their average levels, refuting the charges that they are intentionally carried low, unless in cases demanding repair, when necessity compels their reduction in order to do the work.

The operations of the Cherry Street Shop show the work it performed for the pumping stations, in the preparation of valves, plugs, &c., for the distribution of pipes, the amount of which during the past three years is unprecedented, having added over 116 to the 546 miles previously laid, the number of valves repaired and raised, amounting to 217 during the year and 260 in the previous two years, whereby the water and its circulation was improved, and a better supply enjoyed and guaranteed.

There have been few complaints, save of a local character, or where the elevation of the ground is nearly that of the reservoirs, and where large supply mains are demanded. The closing of dead ends, which are not terminal ones, is in progress, improving the circulation and removing causes of complaint. Tables of the rainfall, the overflow of the dam, the flow of the Schuylkill River, valuable and instructive quotations on "the waste of water," and the test of the measure of its purity, have been added. The Spring drought of 1875, and that of the Fall of 1874, were unprecedented in the annals of the department. They occurred at the period of the greatest demand, and relief was experienced by the checking of the useless waste through wash-paves, sprinkling wagons, and street cleaners, which amounted to over twenty per cent. of the entire pumpage. Numerous plans accompany the report, showing the progress made, and each on examination will explain its purport.

The total pumpage of all the works is 15,097,160,067, a daily average of 47,639,741, a yearly increase of about ten per cent., which manifests an inordinate growth, either for useless waste or consumption in manufacturing interests, or both, and the necessity for some remedy that will not interfere with furnishing water cheaply by checking its useless waste.

WATER-POWER WORKS AT FAIRMOUNT.

By the department report for 1852, page 40, the total quantity pumped was "2,092,086,692 gallons," and on page 43, the "cost of the water-power works from July 1, 1822, with yearly expenses added, to December 31st, 1852, was $1,781,177.09." Assuming about one-third of the above as the cost of the works proper, say $600,000, and adding the expense of pumping, $1.33 per million, as per same report, page 33, the cost will be found $18.53 per million gallons raised 100 feet high, more than the cost of pumping by steam-power.

The department reports show that in 1866-67, and '68, the daily average pumpage at Fairmount by water-power was nearly 22 million gallons, since which time, and up to January 1, 1873, more than $600,000 was expended in constructing the new dam,

the new wheel-house, and the erection of three new turbines, yet the daily average pumpage has never equalled 25 million gallons. Thus the three million gallons per day additional has cost, including interest on the above outlay, added to the expense of pumpage, more than twice what it would have cost to attain the same result by means of steam-power. This is demonstrated by the following figures: Three million gallons per day equals 1,095 per year, which divided into $36,000, the interest on this outlay would equal $32\frac{87}{100}$ per million gallons lifted into the reservoir, say 100 feet high, to which add the expense of pumping per million, which was in 1866 $2\frac{1}{100}$, 1867 $2\frac{26}{100}$, and in 1868 $1\frac{87}{100}$ dollars, or an average, for the three years, of $2\frac{5}{100}$, making $34\frac{92}{100}$ per million gallons.

This demonstrates that to pump by water-power at Fairmount costs as much as by steam-power. It is known in well regulated steam-works that the cost, including interest on the plant and renewals, should not exceed $18 per million gallons raised 100 feet high. I cannot explain the delusion which led to such results, unless it be in the use of the word *cost* (excluding interest on plant) in place of the word *expense*. The importance of this deduction is apparent in view of the future water supply of the city, narrowing the choice to a steam-power or gravity plan, and at the same time is an answer to those who make abstruse mathematical calculations based on the average flow of streams which are not controllable, and whose value is dependent not upon their maximum nor average, but upon their minimum flow.

It may here be pertinently asked, would it not be economy to have a storage sufficient to meet the demands, and avail thereby of an average flow. In answer, would say, if every drop of the Schuylkill could be stored, it could not be done as cheaply as to pump by steam. This river, never flowing less than 240 million per day, is the cheapest reservoir.

The three turbines, No's 7, 8, and 9, which were constructed to pump theoretically six million gallons each, practically pump a little over five million gallons (see report for 1874, page 96), and 10 per cent. less for leakage would approximate nearly their ac-

tual delivery, while those constructed later, but numbered No's 3, 4, and 5, were erected to pump theoretically eight million gallons, while practically they do not pump five and a half millions, allowing the same percentage for loss, and their co-efficient of duty is much less ; besides, their issue of water is as 2,250 square inches is to 1,750, or 25 per cent. more power required to get nearly the same result. A comparison of co-efficients of duty is as 82 to 67. My duty compels this plain statement of facts, in view of and inasmuch as the next important enterprise to be undertaken is the erection of water works, looking to the future supply of a city extending in every direction, and destined to become the London of America.

The pumpage at the Fairmount Works, by water power, during 1875, was 7,670,009,198, a daily average of 21,013,724 gallons ; the maximum, 25,909,418, was in August, and the minimum, July, was 14,326,853. These works run 53 per cent. of the time, stood idle because of full basins 33 per cent., idle from high or low water, particularly the latter, 13 per cent., and for repairs 1 per cent. The machinery is in good condition for a summer run, and the only thing to fear is the low water in the river not furnishing the power to pump.

SPRING GARDEN WORKS.

These works, during 1875, run only 17 per cent. of their time, pumping 1,349,526,570 gallons, a daily average of 4,904,395, a maximum in July of 11,564,992, and a minimum in May of 3,294,027. The four months of January, February, March, and December these works stood idle there being enough power at Fairmount to dispense with their running, and thereby effected a saving of the coal which otherwise would have been used.

This machinery is in good condition, and the present capacity is 22,000,000 gallons per day, and if the department be ready with foundations, the new engine of 20,000,000 capacity contracted for, and in process of construction by William Cramp & Sons, will be erected and ready to pump water on the 10th of May, the day on which the Centennial Exposition opens, and will be well worthy of a visit by every one interested in pumping

machinery. The forebay at these works should be reconstructed; the walls are a constant source of trouble, and it should be rendered impervious to the sewage from the breweries in the immediate neighborhood which should be diverted into the sewer passing along Pennsylvania Avenue, and down Twenty-fifth Street to the Schuylkill River and emptying below the dam. Attention has been called to this, but no provision has been made to remedy the evil, which is sometimes a source of complaint, and which the department can neither control or remedy, as it belongs to a co-ordinate department, either to the Survey or the Highways.

DELAWARE WORKS.

These works run 46.5 per cent. of their time, and pumped 1,818,984,193 gallons, a daily average of 4,974,998, a maximum in July of 7,994,648, and a minimum in January of 3,030,178. Thus their maximum demand is nearly up to their full capacity, and, did they not receive aid from the Corinthian Avenue Reservoir, would be inadequate for the district dependent thereon. This behooves the department to hasten the completion of the Frankford Works. Connection with these will obviate the necessity of introducing larger machinery or that by a 48-inch main with the East Park Reservoir will accomplish the same end. The department will then be enabled to abandon as a pumping station, that which is not only objectionable now, but was so declared at the time of its inception. The dock on the south side, and the wharf on the north, should be put under the care of some private individual, who could control and prevent the skinning and cleaning of fish, the debris of which is liable to enter the suction pipe and into the water distributed. The forebay needs dredging out, and will receive early attention.

BELMONT WORKS.

The Belmont Works, which supplanted the West Philadelphia or Twenty-fourth Ward Works, run 39.6 per cent. of the time, and pumped 2,987,203,000 gallons, a daily average of 8,180,709, a maximum in July of 8,901,657, and a minimum in January of 7,631,978. These works are in good condition, the machinery

has been put in order, the boilers are in process of cleaning, and should their own works prove inadequate, or anything happen to them during the season, upon Belmont must depend the supply for the Centennial Exposition. Some arrangement or understanding should be entered into whereby a harmonious working of the two could be made of mutual advantage. The stand-pipe of the Centennial Works is so small that, as a storage, it has no value, and unless it is of sufficient elevation it cannot at night pump water into the Belmont Reservoir, and hence the works must stand idle and fail, for want of storage adequate for the day demand. So far all the water has been obtained from the City by the Park and Centennial Commission as a gratuity, to which there is no serious objection, so long as it is abundant; but should the demand, by any unforeseen event, exceed the supply, I will deem it my first duty to provide for the City.

ROXBOROUGH WORKS.

These works run 29.1 per cent. of their time, and pumped 853,283,343 gallons, a daily average of 2,337,762, a maximum in July of 2,840,669, and a minimum in February of 1,831,328.

These works have a pumping capacity of 7½ million gallons; but for want of a sufficiently large pumping main are limited to about one-half this capacity, and in the period of maximum demand the 2½ million engine would be inadequate, and in case of accident to the five million engine, a large district in the Twenty-first, Twenty-second, Twenty-eighth, and other wards, would be deprived of a supply. This is rendered more serious inasmuch as Chestnut Hill is now dependent upon these works for its supply, as the springs have failed to furnish that section with water.

CHESTNUT HILL WORKS.

These works are local and irregular in their running, at certain seasons they are in operation not more than three hours per day, in others four to five times as long, due to the large quantity of water used by the consumers for irrigation, more especially when the season is dry. The springs failed entirely last Summer, and the water, from putresence, became unfit for use.

A temporary main was laid over the ground, from Mount Airy basin, to meet the necessities of the case until authority to lay a permanent main could be obtained; this main is in process of laying, but has been seriously delayed from the deep rock cut encountered, which was necessary to provide a gravity flow from the above basin to the pump well of the engine at these works. They are undergoing such repairs of boilers and engines as will put them in good condition for the Summer.

BUILDINGS, GROUNDS, AND RESERVOIRS.

The buildings, grounds, and reservoirs of the Department are in good condition, except the one at Sixth and Lehigh Avenue, which has been a source of trouble, due to the pipes being carried through the embankment. Since the disaster at Birmingham, England, this plan of construction has been made a penal offence by act of Parliament; and it is surprising that at so late a day, after the experience of such mishaps, and in the face of penal enactments, such a mode should be used. It may be economic in first cost, but fearfully expensive in repairs, and should never be undertaken. The same cause gave trouble during the year at Roxborough, and fortunately we were compelled to examine it because of a leak running along an outlet main. Upon investigation it was found that the bank had been melting away gradually in a position not visible, and had an accident occurred, none could have given a satisfactory reason for the disaster. The slight leak on Twenty-second Street, below Poplar, has been so for many years, and gives no evidence of growing worse.

The following report of the East Park Reservoir, the Frankford Works, and the Inverted Siphon, has been submitted by Charles G. Darrach, Engineer in charge of construction:

EAST PARK RESERVOIR.

"In accordance with orders of May 5th, 1875, I have used every effort to obtain the data by which to make correct estimates of the earth work at the East Park Reservoir.

"In the report of the Chief Engineer, for 1872, I find the following:

"'The work of constructing the large storage reservoir in the East Park (after two years delay in obtaining the necessary loan) was commenced November 9th, 1871, and carried forward energetically; during a part of the season difficulty was experienced in getting a sufficient number of men. A very large amount of work has been done, much of an entirely preparatory character, such as the stripping of the black vegetable and unsuitable soil from the base of the embankments, and its cartage to spoil banks for future use upon the outside slopes of the banks when finished. This soil was, in places, 15 to 18 inches deep, and had to be hauled to very considerable distances.

"'The preparation of the ground for the reception of the new embankment occupied much care and labor, as it is a work upon which the future safety of the reservoir may mainly depend, and upon which the strictest care is required. This work has been done for nearly the whole circuit of the embankment, nearly one and one-half miles in extent. The raising of the banks can go on rapidly and without interruption next year.

"'Considerable work was required in making new park roads over the heads of two valleys, at the points where the reservoir crossed the old roads.'

"There is also in the department a plat of the area occupied by the East Park Reservoir, showing the elevation of the ground at equal distances of 100 feet, made before the work of excavation and filling was commenced.

"No bill of quantities, however, showing the amount of excavation required to finish the reservoir from the beginning; nor one showing the amount of work done at the time of the above report, can be found in the Department.

"A plat and field notes, showing the condition of the work May 15th, 1874, was made at the time of the letting of the contract and notes have been taken showing the condition of the work, October, 1875. By a comparison of these data, and bearing in

mind the necessary contingencies incident to construction, we are enabled to determine the amount of excavation required to build the reservoir.

"Those portions of the bottom of the basin originally below sub-grade, before being filled to that grade, should have been, and no doubt were, denuded of their soil and objectionable matter, so that in estimating the amount of material excavated in building the basin, we must take into consideration not only that, above the sub-grade of the basin, but also the vegetable soil removed and the material excavated for the puddle ditches; also, such sub-grade excavations as were considered expedient.

"These items would give the amount of material moved once. Such a quantity as would be required from the soil piles, to place on the outer slope of the embankments, has of necessity, however, been moved twice.

"Such of the material excavated found unfit for use in the embankments, was placed in spoil banks. An examination of the estimates will show how much material was *used* and how much *wasted*.

"The exact amount of work done before the contract cannot be determined, inasmuch as we cannot ascertain the total amount of material handled twice. The estimate is made not crediting the city with any material so handled. The contractor hauled only into the embankments and spoil banks.

ESTIMATE.

	Cubic Yds.	Cubic Yds.	Cubic Yds.
Excavation done before the contract,			378,600
Embankment made before the contract, shrinkage included, . . .		345,000	
Material unfit for use and wasted, .	33,600		
Excavation done under the McGlue contract, ...			487,000
Embankment made " " "		420,000	
Material wasted, ...	67,000		
Amount carried forward, .	100,600	765,000	865,600

	Cubic Yds.	Cubic Yds.	Cubic Yds.
Amount brought forward, .	100,600	765,000	865,600
Excavation to be done, excluding trimmings, ...			81,400
Embankment to be made, including bottom puddle, ...		196,000	
Material to be wasted, . . .	11,400		
Total wasted, ...	112,000		
Total embankment required, .		961,000	
Total excavation to bring basin to sub-grade, .			947,000

Total amount utilized, . . .	835,000
Amount to be borrowed, . .	126,000
Total embankment, . . .	961,000

Total excavation required from the beginning:

Excavation proper, ...	947,000
" to be borrowed, . .	126,000
Material required to be handled twice, say	60,000
Total approximate estimate, . .	1,133,000 cubic yds.

Of which 438,600 cubic yards was done prior to the contract,
487 000 " " " " under " "
207,400 " " is to be done.

1,133,000 cubic yards.

THE FRANKFORD WORKS.

"Work at the Wentz Farm Reservoir was commenced October 28th, 1875, Mr. Richard A. Malone, Contractor, and by December 31st, 24,000 cubic yards of earth had been excavated and placed in the embankments.

"Without the necessity of an extra appropriation this reservoir has been increased in size from one of eleven millions of gallons

capacity, to one of thirty-five and three-quarters millions of gallons capacity.

"The banks are to be fifteen (15) feet wide on top, with outside slopes of one and a half horizontal to one vertical, the inside slopes being two horizontal to one vertical; upon these inside slopes will be a clay lining nine feet thick, measured horizontally; upon the bottom this clay lining will be two feet deep. Plans for a stone outlet chamber have been prepared, to be used instead of carrying the pipes through the embankment. The leaks at the Roxborough and Delaware Reservoirs, incident upon this method of construction, are a fruitful cause of great expense, and often of danger to the neighboring inhabitants.

"The pumping station will be located at the foot of Robbins Street, on the Delaware, and will be built to accommodate two engines of a capacity of ten millions of gallons each.

"One of these engines is under contract. The plans of the engine and boiler houses, and the inlet conduit, are being made.

"The pumping main, thirty (30) inches diameter, will follow the line of Robbins Street to the State Road, thence to Devereaux Street, thence to the Second Street Pike, and thence to the Reservoir, where it will be carried over the embankment and will discharge into the inlet channel.

"The outlet main, twenty (20) inches diameter, will follow the line of Comly Street to the Oxford Pike, thence along the Pike to the Seven Stars Hotel, Frankford, where it will connect with the distribution.

THE SIPHON.

"The inverted siphon to be used instead of the pipe bridge over the Wissahickon was commenced November 17th, 1875. The pipes at the bottom of the valley are under a head of 295 feet; they are twenty (20) inches internal diameter, and the metal $\frac{11}{16}$ of an inch in thickness. Each pipe had been previously tested under a hydraulic pressure of 345 pounds per square inch. The joints in the bottom were cast almost solid, 60 pounds of lead being used to the joint. The crossing of the creek was accomplished by the use of an oak cradle, in which

four lengths of pipe were laid and the joints made; it was then lowered to the bottom of the creek, previously prepared for its reception. The connections on each side of this submerged pipe were then easily made. A stop and outlet four (4) inches in diameter was placed at the lowest point of the siphon, so that it may at any time be drained. Air cocks are placed in the pipe immediately below the main stop valves on each side of the valley, to be opened when the siphon is to be filled.

"The pipe in the creek has been covered with stones to protect it from floods and injudicious or malicious persons.

"When the water was turned into the pipe but one joint in its entire length showed any signs of leakage; the water was drawn off and the joint recaulked; no signs of leakage can now be found.

"The basin at Mt. Airy, since the use of the siphon, has been filled to the depth of thirteen feet one inch, carrying more water than when the pipe bridge was in use. Upon examination it was found that the broken pipe was badly clogged with sediment; this bridge being 660 feet long, the 4-inch drains at each end did not produce a current sufficient to cleanse it.

"The pipe forming one cord of the bridge, broken by frost, has been strengthened with wrought iron bands, which, although insuring its stability, do not render it useful.

"The entire cost of the siphon does not exceed $6,000."

THE TELEGRAPH.

During 1875 there has been sent from the Chief Engineer's Office 1,912, and 1,745 messages received, a total of 3,657, in addition to which, a large number have passed between various department stations. 126 leaks in mains, plugs, and hydrants have been reported through the telegraph, which is now connected with all the works except Chestnut Hill, Frankford, and Delaware. The instrument at the latter place will be in working order by February.

Great inconvenience is often felt for want of telegraph communication with First and Third Districts. The workings of

the line have been very satisfactory, with the exception of a few unavoidable delays, which always met with prompt attention on being reported to the Central Station.

DISTRIBUTION.

The demand for service pipe has been less than during either of the two preceding years; yet, as an evidence of the continued march of improvements, 179,388 feet, or nearly 34 miles have been added to the distribution. 224 fire plugs have been set, making their total number 5,363.

No large mains have been laid, although pipes have been purchased, and are now on the ground for a 48-inch pumping main from the Spring Garden Engine House to the East Park Reservoir, and for a 30-inch pumping, and a 20-inch supply main for Frankford.

The repairs have been greater than usual, owing in a great measure to the severe weather of last winter, and the unusual depth of the frost. One hundred and twenty-five fire plugs were frozen, and more than two thousand feet of pipe burst. In most cases the latter occurred where there was no circulation, or where the pipes had been laid and subsequently a change of grade left them too shallow to escape the frosts of a severe winter. During the spring and early summer, citizens living in the north-western section of the City complained of an insufficient supply of water. An investigation revealed the fact that a great number of the stop valves in that section had, through the negligence of the workmen, been left partially or entirely closed; and others, of primary importance, which should have been closed, were found open. This led to an examination of the entire distribution, and one hundred and one valves were found down, and one hundred and fourteen partially closed. These having been corrected, a marked improvement was found in the supply through all sections of the City. I regret to state that in some instances I am constrained to believe they were tampered with for malicious and sinister purposes.

During the summer, in order to satisfy numerous complaints, the District east of the Schuylkill River, supplied from the Bel-

mont Reservoir, was extended south, from the north side of Fairmount Avenue, to the north side of Spring Garden Street, west of Broad Street, relieving the high ground in this section, formerly supplied from the Corinthian Avenue Reservoir. In the old City proper are many small pipes which have been in service probably fifty years, and are now too small for the demands upon them; they should be removed, and others of larger size substituted.

Their sizes and lengths are as follows:

1½	inch	diameter,	1,600 feet.
2	"	"	440 "
3	"	"	128,178 "
4	"	"	25,950 "
			156,168 "

Throughout the City are many dead ends, which seriously interfere with a proper circulation, which will be connected this year.

The time for the correction of these evils seems to be when the streets are being repaved or repaired by the Highway Department, whose co-operation will render it less expensive to the City; a notification from them will enable an examination of our plans, and they can receive information from this Department of the necessity, or otherwise, of making any change in the size of the pipes.

Owing to the limited capacity of its reservoir, and the small size and number of its supply mains leading from it, the steam power of the Schuylkill Works is not all available, and of necessity must remain idle, while large sections of the City may be suffering the inconveniencies of a short supply of water.

The reservoir at Corinthian Avenue is the most important in the Department, and if its water level can be maintained at the maximum, there need be no fears from a drought. The attention of Councils has frequently been called to the urgent necessity of another main pipe connecting these two reservoirs, and so arranged that the engines at the former works can deliver their water, directly or indirectly, into the latter reservoir.

To this end I have sought authority for a 48-inch, the failure of which may subject the City to the dangers of a conflagration or water famine.

RECOMMENDATIONS.

1st. A 48-inch communicating main between the Spring Garden and Corinthian Avenue basins, which could be extended north on the completion of the East Park Reservoir, also connecting the Delaware Basin by a 48-inch distributing main, thus making the East Park Reservoir a feeder and filter to the first system or all the ground below an elevation of 100 feet.

2d. A 30-inch descending main from the Belmont Basin, along Fifty-second Street to Lancaster Avenue, thence southwardly to Market Street.

3d. A new engine and pumping main from the Roxborough Works to Roxborough Basin.

4th. A 30-inch main from the Frankford Basin, west to Broad Street, to supply the high ground, and limit and confine the distribution from the Roxborough Works, relieving them, already taxed to their capacity, and by assisting to supply the Delaware Basin enable the abandonment of the Delaware Works.

5th. Supply mains to supplement and increase the supply where deficient from small pipes laid many years ago.

6th. The substitution of larger for small pipes in the old City proper, where such are needed in co-operation with the Highway Department when repairing or repaving the streets.

WM. H. McFADDEN,
Chief Engineer.

WHEN IS WATER UNFIT TO DRINK?

BY PROFESSOR ALBERT R. LEEDS.

There is perhaps no question more important to the inhabitants of many cities, nor one which more severely taxes the resources of applied science, than the determination of the fitness or unfitness of a water supply. The difficulty arises from the fact that, in some cases, a water may have taste, smell, color, and a considerable amount of foreign matter, and at the same time be drunk with little or no injury; while another water, which is agreeable to the taste, limpid, colorless, and with little foreign matter, may yet contain abundant sources of disease.

The literature of the subject shows that there are two classes of thinkers, one of which puts great faith in the efficacy of natural agencies to bring about the purification of polluted streams, the other which contends that the only safe plan is to reject water which has ever been contaminated by sewage, etc. The evidence elicited by the Royal Commission on the water supply of London is that principally quoted by both classes, and cannot be regarded as conclusive. The rapid extension of our knowledge in this branch of sanitary chemistry is such, however, that we may anticipate greater certainty in these matters, and imparts great interest to some recently published methods of investigation. Any one who refers to analyses, made a few years back, will find that it was deemed sufficient to give the character and amount of the mineral substances contained in the water, while the organic and volatile substances were expressed in a sum total, no attempt being made to determine their precise character. But, except in cases where the mineral substances were positively deterious or excessive in quantity, this did not settle the question. Of late, the greatest attention has been paid to the organic constituents, and the analyses state what amount of putrefiable matter is present. A careful determina-

tion is also made of the amount of ammonia, and of nitrous and nitric acids. These are regarded as the forms which the organic matter in large part assumes after it has passed through the putrefiable stage, and indicate therefore the degree of previous contamination.

But it is said, and with truth, that all these things may be known to a wonderful degree of nicety, and yet there may be substances present capable of rendering the water altogether unsafe for drinking. It is urged that the living organism is exceedingly sensitive to substances whose capacity for injury is fatal, even when present in amount so small as to render their weighing, and even detection, impossible. But of late, the fauna and flora of water courses have been studied, with a view of learning what assistance they could be in the matter, and the results are highly encouraging.

It has long been known that dissolved oxygen played a great part in the purification of streams, and was the principal agent by which putrefiable substances were broken up and converted into harmless inorganic compounds. A recent essay by M. Gerardin, to which the prize was awarded by the Paris Academy of Sciences, contains some striking results obtained by the above-mentioned methods of investigation. To summarize, these methods were:

1. A determination of the amount of oxygen held in solution. 2. An observation of green plants and aquatic mollusks. 3. A microscopic examination of algæ and infusoria. It is claimed that the results obtained by these three methods were identical, and that, where the water was clear, with abundance of fish, watercress, etc., the water contained a correspondingly large amount of oxygen; while in places where the dissolved oxygen was small, fish and the higher types of aquatic plants were wanting, and certain low forms of vegetable growth had taken their place. The river Vesle, in France, from Rheims to Braisne, was taken as the field of observation. It was studied over a distance of 37½ miles, during which it received the sewage of one large town (that of Rheims, the daily flow of which amounts to 4,180,000 gallons) and other impurities. Above Rheims, the water

(which was clear, wholesome, and with abundance of fish, charas, watercress, iris, etc.) contained 0.66 cubic inch in 61 cubic inches of water. In passing through a suburb above Rheims, the Vesle received the refuse of some dye works, which colored the water; and in place of the fish and watercress, *sparganium simplex* makes its appearance. At a point where the water had received the contents of the five principal sewers of Rheims, the water was thoroughly polluted and contained but 0.03 cubic inch of oxygen in 61 cubic inches. Two species of *algæ*, the *biggiatoa alba* and the *oscillaria natans*, were developed largely, the latter to such an extent that the whole surface of the sluggish water was covered with a thick blackish coat.

This coat was seemingly so solid, that animals and even men have rushed on it, mistaking it for *terra firma*. Above the mill at Macan, where the oxygen had increased to 0.45 cubic inches, the two varieties, *algæ* mentioned above, had disappeared, and the bed of the Vesle was covered with a long whitish *alga*, called *hypheothrix*.

At Compensé mill, the oxygen had increased to 0.5 cubic inch, the *hypheothrix* had almost completely disappeared, and the *sparganium simplex* was again abundant. Below this point, the amount of oxygen increased, and with it a corresponding change took place in the vegetation, until, at Braisne, the water contained 0.66 cubic inches of oxygen per litre, all traces of pollution had disappeared, and fish and watercress flourished.

From this it would appear that a properly areated and pure water showed, when polluted, the amount of pollution by a corresponding diminution of oxygen, by the appearance of *sparganium simplex, spirogyra, hypheothrix, biggiatoa* and *ossilaria*, and a progressive improvement by a corresponding increase of oxygen, and the appearance of these plants in reverse order. It remains for us to apply and extend this knowledge to our own streams. Fortunately, the means are not wanting, since the great monograph on the fresh water *algæ*, magnificently illustrated with plates, by Dr. H. C. Flood, which was not published by the American Philosophical Society, has been recently printed by the Smithsonian Institution.

THE ABUSE IN THE USE OF WATER.

(Furnished for publication in the HYDRAULIC ENGINEER by Americus Warden, Engineer Pumping Department, Cincinnati Water Works, from forthcoming reports.)

Your attention is directed to the subject of leakage and waste of water, as practically exhibited in the operation of our pumping works. In order to arrive at the measure of loss sustained, all the engines of the works were stopped and held quiescent, from the hour of 12 at midnight, until 4 o'clock Sunday morning, when comparatively all domestic and manufacturing consumption has ceased; meantime, careful notation of the level of water in the reservoir, at the time of stopping, and throughout the test, was taken from the water-table in the engine-house.

The result of this investigation is illustrated in the following table:

Time of Notation.	Stage of Water in Reservoir. Ft.	In.	Fall per Hour in Inches.	Areal Dimensions of Reservoir at Water Surface, in feet.	Fall of Water per Hour. In Cubic Feet.	In Gallons.
12 M.	19	3½	.....	342.5625 x 115.7375	.....	.....
1 A. M.	18	4⅛	11⅜	341.959 x 115.3754	37,493.8	280,453.62
2 "	17	4½	11⅝	341.3594 x 115.0156	38,137.5	286,278.5
3 "	16	5⅛	11⅜	340.7669 x 114.66	37,187.14	278,159.8
4 "	15	5¼	11⅞	340.1486 x 114.29225	38,584.63	288,612.93
Total for 4 hours.....			46¼	.....	151,403.07	1,133,504.85
Average per hour.....			11⅝	.....	37,850.77	283,376.21
Rate per 24 hours.....			.....	.....	908,418.42	6,801,029.10

Thermometer 29°.

Assuming that one-fourth of the amount shown in above table is legitimately used, we have a loss in waste equal to 212,532 gallons per hour, or 5,100,768 gallons per twenty-four hours,

being about one-third of the daily average consumption. If, by judicious method and vigilant effort, this enormous waste be prevented, we will be enabled to supply our city for thirteen years to come, with the power now in possession; whereas, according to the ratio of increase experienced, which is about 10 per cent. per annum, the demand will equal all our present capacity in nine years hence. Moreover, if said waste be overcome, the saving in money for pumping (alone) will amount to $29,000 per year, and at the end of thirteen years, will equal $377,000, without interest, and adding interest, a total saving of $550,000, an amount sufficient to procure a new power equal to 20,000,000 gallons per 24 hours. This waste of water, at meter sales rates, of 15 cents per thousand gallons, would bring the sum of $765.10 per day, or $279,261.50 per annum.

The total amount of water pumped into our reservoirs, during the past year, being nearly 5,400,000,000 gallons, at meter rates of 15 cents per thousand gallons, would bring a revenue of $810,000.00; whereas, the revenue of 1875 was $452,295.51, so that the gross loss from leakage, waste, donations to public interests, etc., amounted to the enormous sum of $357,704.49.

In connection with the foregoing we present the following exhibit of the velocity of water, with its measure of quantity discharged under different proportions of pressure, from which may be determined the actual amount of waste, where water is permitted to run continuously day and night.

Taking the mean pressure throughout the city, which is about 20 pounds per square inch, we find that the amount passed through a ⅝-inch lead pipe 67 feet long, is equal to 13,712 gallons per 24 hours, so that in the instance of abuse of water license in one water-closet, we have a loss amounting to $2.05 per day, or $748.25 per annum.

TABLE OF VELOCITY OF WATER,

With the corresponding quantity discharged at different pressures as demonstrated by actual test at the Front Street Pumping Works.

Pressure in Pounds.	Size of Orifice. Inches.	VELOCITY OF WATER IN FEET PER SECOND.							GALLONS WATER DISCHARGED.			
		Due to Hyd. Head.			Through 32 feet Lead Pipe.		Through 67 feet Lead Pipe.		Through 32 feet Lead Pipe.		Through 67 feet Lead Pipe.	
		Velocity, in Feet.	Height. Ft.	In.	Velocity, in Feet.	Coefficient for Friction.	Velocity, in Feet.	Coefficient for Friction.	Per Hour.	Per 24 Hours.	Per Hour.	Per 24 Hours.
47½	⅝	83.89	103,	4.8	22.536	0.7314	.....	.....	1,264.2	30,340.8	.....	.....
40	"	76.99	92,	1.92	20,384	0.735	13.2	0 83	1,143.54	27,444.96	740.	17,771.1
30	"	66.76	69,	1.44	17.20	0.742	11.68	0.8252	964.92	23,158.	655.25	15,726.
25	"	60.79	57,	7.2	15.76	0.757	.....	.....	884.136	21,219.26	.....	.....
20	"	54.44	46,	0.96	14.28	0.730	10.25	0.8118	801.108	19,098.72	571.33	13,712.
15	"	47.15	34,	6.72	12.72	0.730	.....	.....	713.58	17,125.93	.....	.....
10	"	38.496	23,	0.48	10.56	0.726	7.03	0.815	592.416	14,217.984	393.8	9,474.9
5	"	27.22	11,	6.24	7.96	0.710	.....	.....	446.556	10,717.344	.....	.....
2½	"	19.24	5,	9.12	5.31	0.724	.....	.....	298.01	7,152.07	.....	.....

In Boston, Massachusetts, an investigation was made, whereby the proportion of loss from leakage and waste might be determined, and to effect this necessary information a certain district of the city, containing about 60,000 inhabitants, was selected. The time chosen to gauge the consumption was between the hours of 12 and 3 o'clock Sunday morning, when industrial and domestic consumers make, comparatively, the least demand.

At the end of two hours' time, 386,857 gallons were consumed, or 4,642,284 gallons in 24 hours. This waste was attributed mainly to defective service pipes, stop-cocks, and fittings.

Another important instance, exhibiting the necessity for providing means preventing leakage and waste, is furnished in a special report made by Col. Henry Flad, to the St. Louis Board of Water Commissioners, wherein he estimates the daily waste of water at 10,000,000 gallons (about one-half the daily supply), costing for pumping alone $45,000, per year. He states that said waste is chiefly caused by wilful neglect to shut off the water after use, and in the use of water-closets, where water is allowed to run continuously day and night; also, that the waste of *one* water-closet running all the time will equal 20,000 gallons per day, which amount, at sales rates (20 cents per thousand gallons), would bring $4.00 per day, or $1,460.00 per year. He also states that, if all the waste could be prevented, the capacity of the present works (St. Louis) would be sufficient for twenty years hence, and at the end of the next period the city would have saved a total of $1,200,000 (not counting interest), and during the last 14 years the interest, on $1,000,000, would be $840,000, making a total of $2,040,000.

We also present the following extract from the Chicago Water Works Report for the year ending March, 1875: "It is believed to be a very moderate estimate, to say that one-half of the water now pumped is wasted. This represents an annual expenditure, for fuel alone, of $70,000. If to this we add the cost of labor, interest on cost, and depreciation of machinery, besides repairs and incidentals, the amount would be increased to not less than $105,000, or the interest, at 7 per cent. on $1,500,000.

In connection with this subject of provident and improvident use of water, we may profitably inquire what should be a fair proportion, per capita, and in order to compare our city with cities in this and foreign countries, as to ratio of consumption, per inhabitant, we have collected from reliable sources the following useful information :

TABLE NO. 1.

Ratio of Daily Consumption per Inhabitant.

	Galls.		Galls.
New York	90	St. Louis	60
Detroit	88	Boston	60
Chicago	80	Philadelphia	56
Hartford, Conn	80	Toledo	54
Reading, Pa	75	Cincinnati	53
New Haven, Conn	75	Baltimore	50
Albany, N. Y	70	Lowell, Mass	44
Springfield, Mass	66	Cleveland, O	43
Buffalo, N. Y	63	Providence, R. I. (use meters)	30
Brooklyn, N. Y	60	Milwaukee	25

Foreign Cities.

	Galls.		Galls.
Doublin	60	London	33
Glasgow	52	Liverpool	30
Paris	38	Manchester	21
Edinburgh	35	Sheffield	20

Average of 20 American cities..... 61.1 gallons.
" " 8 Foreign " ..... 36.1 "

TABLE NO. 2.

Rates of Increase in Consumption of Water per Inhabitant.

Between what Years.	Name of Cities.	Gallons of water per Inhabitant.		Increase.	Percentage of Increase.
		1874.	Earliest Year mentioned.		
1874-1862..	Brooklyn.....	60	17	43	253
1874-1861..	Cleveland.....	43	16	27	170
1874-1860..	Chicago.....	80	43	37	86
1875-1860..	Cincinnati.....	53	31	22	71
1874-1861..	Detroit.....	88	53	35	66
1874-1867..	New York.....	90	62	28	45
1874-1868..	Paris, France....	38	29	9	31
1874-1867..	Philadelphia.....	56	46	10	21
1874-1867..	Boston.....	60	55	5	10
1874-1849..	London, Eng.....	33	33	...	.....

RATIO OF INCREASE PER INHABITANT IN CINCINNATI.

1845, . .	15 gallons.	1865, . .	32 gallons.
1850, . .	21 "	1870, . .	40 "
1855, . .	27 "	1875, . .	53 "
1860, . .	31 "		

Yearly consumption in 1875 (nearly),	5,400,000,000 gallons.
" " " 1845 (about),	400,000,000 "
Increase, ...	5,000,000,000 "
Population in 1875, ...	275,000
" " 1845, ...	70,000
Increase, ...	205,000

Percentage of increase in consumption of water, 1,250 per cent.
" " population, 300 " "

The averages of the two countries, according to the above tables, show a vast difference in the use of water. For example:

London,	3,713,108	inhabitants,	uses	daily	122,319,000	gallons.
New York,	1,200,000	"	"	"	107,000,000	"
Manchester,	750,000	"	"	"	16,000,000	"
Philadelphia,	750,000	"	"	"	42,111,730	"
Chicago,	475,000	"	"	"	38,000,000	"
Sheffield, E.,	264,500	"	"	"	5,000,000	"
Cincinnati,	275,000	"	"	"	14,772,382	"

Another striking example is given in table No. 2, showing in American cities a larger increase in consumption of water in proportion to the increase in population, ranging from 10 to 213 per cent., while in the city of London the ratio of consumption has been the same for the last 25 years. Whether this difference arises from the more skilful and watchful management of water-works in cities of the Old Country, is difficult to determine. One conclusion may be drawn, either we use too much water, or they too little. It is asserted that domestic consumers use less water than manufacturers, in which case, cities engaged chiefly in manufacturing pursuits would show a much larger rate of consumption than one mainly devoted to commercial interests. But compare New York, as a commercial city, with Sheffield, as a manufacturing one, and we have an increase of 70 gallons per inhabitant over the latter.

The preceding remarks and citations, from eminent sources, are offered for your consideration, in order that in the future judicious method and means may be put in practice for the prevention of the enormous loss now sustained by improvident use of water. We are aware that it is difficult to control consumers, and that prosecution for waste of water is productive of vexation, disputation, and expense, in time or money ; nevertheless, abuse of water license should be punished, for water, delivered into the reservoir and transmitted through the service pipes to the consumer, is of intrinsic value, and a commercial commodity to be sold under certain restrictions for the benefit of the municipality at large, as well as for the use of the individual consumer, and a license to *use* water in no sense grants privilege to *waste* it.

AMERICUS WARDEN,

Engineer Pumping Department Cincinnati Water Works.

RECEIPTS

OF THE

WATER DEPARTMENT

FOR

1875.

Receipts of the Department and sources whence derived, as exhibited by statement of H. C. Selby, Registrar, -	$1,160,345 14
Receipts at Chief Engineer's office, as per statement, -	9,321 14
Total receipts from all sources for 1875, - - -	$1,169,666 28

RECEIPTS AT CHIEF ENGINEER'S OFFICE FOR 1875.

For old iron, - - - - - - -	$1,800 70
For rents, - - - - - - -	1,160 00
For brass scrap and turnings, - - - -	794 66
For old barrels, - - - - - -	9 32
For stone &c., - - - - - -	203 07
For ice, - - - - - - -	120 00
Philadelphia and Reading Railroad Co., attachments, stops, and repairs, - - - - - -	1,386 30
J. M. Preston, attachment, - - - -	490 89
Seville Schofield & Co., attachment, - - - -	408 09
Commissioners Fairmount Park, connections, - - -	404 30
Wm. Cramp & Son, attachment &c., - - - -	380 67
Centennial Board of Finance, attachment, - - -	252 42
Thos. Schofield, attachment, - - - - -	203 45
Wiley & Smith, resetting iron railing, Fairmount, - -	174 00
S. J. Solms, attachment, - - - - -	141 18
Philadelphia Gas Works, plugs &c., - - - -	134 68
Guardians of the Poor, repairs, - - - -	122 72
Centennial Market Co., plug, - - - - -	107 73
John Dobson, attachment, - - - - -	100 52
Reading Gas Co., stop, - - - - - -	86 25
Jos. Smyth, attachment, - - - - -	84 81
Fitzpatrick & Holt, attachment, - - - -	81 57
United States Courts and Post Office, attachment, - -	75 70
Young Mens' Christian Association, moving plug, - -	66 70
Bergdoll & Psotta, stop &c., - - - - -	61 97
H. Russell, moving plug, - - - - -	60 29
United States Arsenal, plug &c., - - - -	59 23
Eastern Market Co., plug &c., - - - - -	55 80
Mitchell & Co., attachment, - - - - -	54 81
J. C. Harris, moving plug, - - - - -	48 92
Est. M. Mills, moving plug, - - - - -	44 25
Mantua Market Co., moving plug, - - - -	42 81
Midvale Steel Works, repairs, - - - - -	16 50
St. Stephens Church, old pipe, - - - - -	25 11
Wilhelm & Neuman, moving plug - - - -	15 85
James L. Welsh, repairs, - - - - -	10 85
W. Massey, repairs, - - - - - -	8 20
D. De LaQuestra, moving plug, - - - - -	7 37
C. Magargee, gooseneck, - - - - -	7 25
Delaware Avenue Market Co., repairs, - - - -	6 20
House of Refuge, repairs, - - - - -	6 00
	$9,321 14

Receipts and Expenditures since Consolidation.

YEARS.	RECEIPTS.				Yearly increase of receipts.	EXPENDITURES.				Annual profits.
	Registrar's Office.		At Chief Engineer's office.	Total.		From annual appropriation.	From special appropriations.	From loans for construction.	Total.	
	For water rents.	For pipe laid.								
1855....	$360,059 16	$21,351 01	$626 55	$382,036 72	.....	$168,765 22	$82,130 15	.....	$250,895 37	$131,141 35
1856....	320,013 88	31,922 61	960 11	352,896 60	Decrease.	138,293 60	21,174 42	.....	160,468 02	192,428 53
1857....	395,288 36	30,373 58	302 20	425,964 14	$73,067 54	177,459 93	23,145 96	.....	200,605 89	225,358 25
1858....	420,372 57	37,145 91	129 75	457,648 23	31,684 09	175,016 86	12,961 23	.....	187,978 09	269,670 14
1859....	484,879 06	63,249 13	3,051 89	551,180 08	93,531 85	194,828 44	30,258 59	$186,650 06	411,737 09	326,093 05
1860....	494,824 22	62,297 54	1,409 77	558,531 53	5,941 68	193,528 64	4,767 74	54,209 85	252,506 23	360,235 15
1861....	498,599 40	34,495 36	885 30	533,980 06	Decrease.	161,277 54	1,447 36	76,264 60	238,989 54	371,255 12
1862....	516,802 94	28,164 31	1,025 82	545,793 07	11,813 01	156,023 43	21,099 81	40,842 94	217,966 18	368,669 53
1863....	538,025 58	30,715 02	937 69	569,678 29	23,885 22	187,486 49	23,273 43	2,989 28	213,749 20	358,918 37
1864....	586,978 71	22,278 57	855 29	610,112 57	40,434 28	251,831 13	21,325 68	.....	273,156 81	336,955 76
1865....	595,746 40	34,141 07	6,540 95	636,328 42	26,275 85	270,404 83	13,857 80	138,074 95	422,337 58	3 2,125 79
1866....	634,263 84	32,031 11	3,927 18	670,222 14	33,833 71	273,606 24	4,552 93	338,553 75	616,712 92	392,062 96
1867....	684,621 06	76,938 39	5,891 44	767,450 89	97,228 76	322,935 30	37,584 24	215,324 95	575,844 49	406,931 35
1868....	707,646 73	64,959 03	4,404 83	777,009 59	9,558 70	301,595 23	86,777 44	413,814 79	802,217 46	388,637 92
1869....	747,443 17	61,065 06	4,962 60	813,470 83	36,461 24	388,742 15	52,499 47	468,526 06	909,768 28	372,229 21
1870....	810,716 83	117,319 12	7,335 01	935,370 96	121,900 13	441,947 54	2,657 29	695,468 68	1,144,073 51	486,766 13
1871....	859,939 06	96,110 98	7,184 04	963,234 08	27,863 12	439,406 38	5,857 85	623,929 20	1,069,193 43	517,969 85
1872....	911,790 15	131,822 96	10,668 40	1,054,281 51	91,047 43	471,219 80	10,218 35	582,138 13	1,063,576 28	572,843 36
1873....	961,296 78	116,997 17	4,691 06	1,082,985 01	28,703 50	532,486 89	1,663 56	1,030,068 03	1,564,418 48	548,634 56
1874....	1,023,980 81	198,896 99	6,994 58	1,229,881 38	146,896 37	689,504 89	1,018 92	534,576 27	1,225,102 08	539,355 57
1875....	1,037, 86 61	123,258 53	9,321 14	1,169,666 28	Decrease.	674,693 51	35,139 56	228,503 67	938,336 74	459,834 21
	$13,590,181 32	$1,415,533 45	$82,065 60	$15,087,783 37		$6,616,256 08	$493,411 78	$5,629,965 81	$12,739,633 67	$7,978,115 51

OPERATIONS

OF THE

REGISTRAR'S DEPARTMENT

FOR

1875.

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER.
REGISTRAR'S OFFICE.

Philadelphia, February 1st, 1876.

DR. WM. H. MCFADDEN,
Chief Engineer.

DEAR SIR:—I have the honor to submit the following report of the receipts at this office for the year 1875, amounting in the aggregate to $1,160,345.14, which has been paid daily as received into the office of the City Treasurer.

The receipts for water rents amount to $938,357.25, an increase of $28,457.75 over the previous year.

The receipts for water pipe amount to $123,258.53, a decrease of $75,638.46, to be attributed to the reduced quantity of supply pipes laid, and the financial condition of the times. Pipe bills to the amount of $122,533.39 were returned to City Solicitor for lien, and the amount collected by him for the same was $65,870.28.

The estimated receipts for the year, as submitted to the City Controller were $1,145,500, being $14,845.14 less than the actual receipts.

Respectfully referring to the annexed itemized tables,

I am, very truly yours,

H. C. SELBY,
Registrar.

Receipts at the Registrar's Office for the year 1875.

1875.	DELINQUENT RENTS.	PENALTIES.	RENTS OF 1875.	PENALTIES.	FRACTIONAL RENTS.	WATER PIPE.	TOTAL.
January	$4,440 00	$655 43	$23,397 50	.....	$1,353 75	$15,833 84	$45,680 52
February	1,041 50	153 36	37,859 00	.....	931 00	8,224 65	48,209 51
March	1,192 00	170 07	161,866 50	.....	3,032 50	6,894 32	173,155 39
April	3,474 25	517 25	532,850 25	.....	7,313 50	10,089 66	554,244 91
May	2,593 50	383 07	33,722 00	$1,612 51	6,357 60	4,170 82	48,839 50
June	1,226 00	179 99	53,668 50	2 643 88	5,919 50	7,124 03	70,761 90
July	1,325 75	193 70	9,594 75	1,318 88	3,717 25	10,881 98	27,032 31
August	960 00	139 51	15,328 00	2,250 64	5,442 68	7,675 84	31,796 67
September	1,081 50	154 68	21,990 25	3,186 86	5,095 30	9,831 00	41,339 59
October	1,755 50	203 76	22,429 25	3,055 78	3,882 60	13,934 17	45,261 06
November	1,564 50	233 09	11,364 25	1,605 59	6,919 36	13,054 51	34,741 30
December	2,451 75	346 02	14,287 00	1,951 38	4,702 62	15,543 71	39,282 48
Total	$23,106 25	$3,329 93	$938,357 25	$17,625 52	$54,667 66	$123,258 53	$1,160,345 14

Amount of claims for water pipe returned for lien in 1875 ..... $122,533 39
Amount of claims for water pipe collected by City Solicitor in 1875 ..... 65,870 28

Comparative statement of receipts for the years 1874 and 1875.

	DELINQUENT RENTS.	PENALTIES.	WATER RENTS.	PENALTIES.	FRACTIONAL RENTS.	WATER PIPE.	TOTAL.
1875	$23,106 25	$3,329 93	$938 357 25	$17,625 52	$54,667 66	$123,258 53	$1,160,345 14
1874	31,064 25	4,483 02	909,899 50	18,434 48	60,108 56	198,896 99	1,222,886 80
Increase			$28,457 75				
Decrease	$7,958 00	$1,153 09		$808 96	$5,440 90	$75,638 46	$62,541 66

Items of receipts under head of "fractional rents."

	RENTS.	FERRULES.	REPAVING.	REPAIRS.	TOTAL.
1875	$35,844 56	$9,510 00	$6,951 75	$2,361 35	$54,667 66
1874	43,229 56	9,198 00	6.632 00	1,049 00	60,108 56
Increase		$312 00	$319 75	$1,312 35	
Decrease	$7,385 00				$5,440 90

Estimated receipts in statement to City Controller.....$1,145,500 00
Actual receipts, as above..... 1,160,345 14
An excess over estimate of..... $14,845 14

List of Dwellings, Factories, Horse-power, &c., as charged on Registers of 1875.

	WARDS.																											Total.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Dwellings	7638	3892	2036	1888	2769	2787	3738	2 39	2499	2010	2575	1925	2598	3145	6212	2055	2174	3874	10,608	6627	935	2018	912	4228	2471	8617	1755	2213	5521	103,370
" ½ & ¾	484	1580	1396	1576	543	825	1325	175	513	1066	968	753	619	813	1381	1379	691	1096	1127	566	.....	7	12	50	316	562	73	21	173	19,591
Baths	2113	1016	679	445	833	519	2078	2185	1246	1806	442	848	1718	1643	3796	480	338	819	3458	4717	2087	1451	238	2130	487	3080	1175	5730	3657	51,214
Wash-paves	763	449	323	145	580	343	1084	1224	472	1185	215	500	978	1128	2684	329	266	504	1911	3531	381	631	328	916	280	1436	797	1313	3092	28,283
Water closets, urinals and bidetts	93	62	67	77	144	1809	1235	427	1663	1215	177	21	458	487	1917	115	44	37	274	1272	180	1041	34	649	23	875	941	641	17	3	21,182
Basins, sinks and wash tubs	69	56	63	73	141	1748	137	2530	1621	1231	163	190	398	337	1948	123	40	26	268	1535	210	976	21	502	31	219	1096	697	2518	21,460
Horse power	671	684	135	211	859	1702	387	326	1172	363	517	298	258	202	2210	1331	525	737	2225	721	107	543	298	74	123	244	394	120	195	17,702
Horse stalls	614	975	313	254	525	407	663	1636	1386	1745	1708	1643	625	720	2016	682	212	518	1221	1383	65	162	140	1042	159	810	562	93	897	23,191
Bars	113	160	119	222	300	190	95	115	159	108	287	120	101	59	216	138	170	99	290	181	23	24	24	91	91	314	61	50	77	4,100
Watering horses	28	10	12	11	21	2	11	.....	20	6	4	1	2	7	14	5	12	69	27	31	.....	5	11	32	20	67	13	2	14	450
Factories	11	9	1	2	6	33	24	1	42	11	6	14	11	29	5	37	44	8	128	37	5	13	6	9	6	11	14	7	1	535
Foundries	6	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	5	2	1	.....	.....	2	5	.....	.....	2	1	2	1	3	.....	.....	32
Bakeries	29	38	32	21	14	19	10	9	27	9	13	17	12	16	44	14	17	16	95	60	5	9	5	8	21	17	5	.....	20	604
Dye-tubs	.....	7	.....	.....	9	30	1	.....	5	6	7	.....	3	.....	73	62	59	21	110	.....	.....	24	5	6	31	.....	.....	10	.....	486
Meat packers	10	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
Breweries	1	2	.....	.....	.....	.....	.....	.....	1	.....	1	2	3	.....	6	7	18	1	4	7	.....	3	.....	2	.....	5	1	2	18	84
Sugar-houses	.....	2	.....	2	1	2	.....	.....	.....	2	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
Hot and Green houses	2	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	6	.....	8	5	4	5	.....	11	17	15	75
Fountains	3	1	3	1	17	15	2	27	31	22	3	8	8	15	35	7	7	8	4	22	.....	23	3	23	2	11	25	10	15	345
Distilleries	.....	.....	.....	1	.....	1	3	.....	.....	.....	.....	.....	.....	.....	.....	3	2	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	11
Slaughter houses	15	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	5	13	2	3	4	1	17	13	.....	3	.....	19	3	.....	2	4	16	122
Malt-houses	.....	.....	.....	.....	.....	1	.....	1	.....	1	2	.....	1	.....	1	1	.....	1	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	2	14
Brick-yards	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	1	2	1	4	8	.....	1	5	24
Barber shops	22	31	15	16	33	30	12	11	37	13	13	15	17	25	28	18	24	12	59	28	2	5	4	15	4	12	9	7	19	538
Photographers	.....	.....	1	.....	6	12	2	9	21	2	5	5	7	2	1	.....	2	.....	18	1	.....	1	1	.....	1	.....	1	1	1	100
Miscellaneous	9	8	14	7	3	6	5	3	5	8	6	6	8	6	11	3	5	3	6	40	.....	3	2	7	4	4	18	1	30	234

Permits issued during the year 1875.

	WARDS.																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total.
Dwellings	322	16	8	7	1	2	26	30	11	7	4	3	7	8	142	10	12	79	407	113	244	197	149	472	367	724	69	613	500	4,530
" ½ and ¾	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	4	6	....	....	....	....	1	4	....	....	1	....	17
Baths	81	13	8	7	...	4	47	46	3	15	5	3	12	18	144	11	5	41	293	102	31	91	37	275	47	467	41	380	377	2,604
Wash-paves	37	11	8	7	4	5	25	33	27	17	12	7	13	11	79	5	9	16	146	70	39	66	32	101	23	209	30	291	332	1,665
Water-closets, Urinals and Bidetts	8	2	...	4	5	40	83	106	47	44	9	1	29	24	101	9	2	4	14	59	9	71	5	113	1	74	57	176	237	1 334
Basins, Sinks, and Wash tubs	4	....	..	1	5	37	128	107	48	44	5	1	14	16	119	7	...	1	15	60	5	38	7	83	1	26	41	191	254	1,258
Stores and Shops	2	1	...	1	1	1	1	2	.....	1	1	...	4	2	3	...	...	1	10	7	4	3	4	12	6	3	2	4	2	78
Bars	3	....	....	3	2	8	1	1	4	1	4	1	8	4	2	1	1	1	10	5	4	2	7	18	9	4	2	10	4	120
Engines and Boilers	2	....	....	....	3	14	1	1	10	4	2	1	...	1	3	2	1	4	16	1	3	4	1	1	2	3	2	1	.....	83
Horse-power	25	....	....	...	40	32	25	6	149	24	12	5	...	3	45	21	15	70	316	2	16	20	40	4	27	9	13	20	.....	1,125
Stables	4	1	1	1	..	....	....	3	4	3	....	1	2	3	7	2	...	1	7	6	2	10	2	2	1	7	2	5	6	83
Slaughter-houses	....	....	....	..	....	....	....	....	....	....	....	1	....	....	1	....	1	....	....	....	....	....	....	2	....	....	....	1	.....	6
Horse-troughs	....	..	..	..	1	1	....	....	....	....	....	....	1	1	....	1	1	....	2	....	....	1	1	2	5	3	....	3	.....	23
Bakeries	..	....	....	1	....	....	....	....	....	....	....	1	....	....	1	1	...	2	2	1	1	....	....	2	....	1	....	.....	1	14
Sprinkling streets	....	....	....	....	3	3	3	3	3	3	....	1	....	3	3	....	....	....	....	....	....	2	....	2	....	....	....	.....	.....	29
Watering ships	....	64	...	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	69
Building purposes	16	2	1	1	1	3	5	7	3	3	1	....	...	2	21	1	...	5	43	15	40	38	15	97	25	31	19	41	43	479
Fountains	1	....	....	....	....	....	....	....	1	2	....	....	....	3	2	..	...	1	1	....	....	2	....	2	....	....	1	....	1	17
Market-houses	....	....	1	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Factories and Dye-houses	....	....	....	....	....	2	1	....	2	1	1	....	....	....	4	2	3	2	9	1	1	3	2	.....	....	2	1	.....	.....	37
Photograph galleries	....	....	....	....	....	1	....	....	..	..	....	....	....	....	....	..	..	....	....	....	....	....	....	.....	1	....	....	....	....	2
Laundries	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	.....	....	1
Breweries and Malt-houses	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	1	....	....	....	....	....	....	....	.....	1	4
Churches and Schools	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1	....	....	....	....	1	....	1	....	.....	....	....	....	.....	....	1	5
Hot-houses	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	2	....	2	....	....	4	.....	....	.....	.....	9
Restaurants	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	.....	.....	3
Brick-yards	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	.....	....	.....	1	3
Railroads	2	....	....	....	....	1	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	.....	....	....	1	.....	.....	5
Foundries	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....	....	....	....	.....	....	1
Marble and Stone-yards	....	....	....	....	....	.....	1	1	1	....	....	....	....	....	....	....	....	....	4	....	....	....	....	.....	....	1	....	1	1	10
Total	507	111	28	38	66	253	347	346	314	169	59	26	91	99	679	73	50	232	1302	447	379	551	302	1193	524	1650	281	1738	1761	13,616

Amount of Duplicates for the years 1875 and 1876.

Wards.	1875.	1876.
First	$49,457 25	$51,888 50
Second	36,085 00	35,892 75
Third	21,511 00	21,439 50
Fourth	19,158 75	22,238 75
Fifth	35,160 25	35,221 25
Sixth	36,845 00	37,718 00
Seventh	39,503 75	40,213 75
Eighth	39,444 75	40,105 25
Ninth	34,837 75	35,790 00
Tenth	35,105 75	35,580 25
Eleventh	18,710 75	18,862 25
Twelfth	20,237 50	20,551 50
Thirteenth	29,478 00	29,826 75
Fourteenth	33,824 25	33,706 25
Fifteenth	72,711 25	73,907 00
Sixteenth	25,431 00	25,712 50
Seventeenth	22,888 25	23,370 75
Eighteenth	33,557 00	34,303 25
Nineteenth	100,857 25	67,395 50
Twentieth	69,683 50	70,471 75
Twenty-first	6,686 50	9,328 25
Twenty second	22,308 00	23,978 00
Twenty-third	7,659 00	9,139 00
Twenty-fourth	32,505 50	36,270 00
Twenty-fifth	17,472 25	28,868 50
Twenty-sixth	69,028 25	35,109 25
Twenty seventh	21,122 75	21,874 25
Twenty-eighth	20,704 25	28,187 50
Twenty-ninth	53,304 00	58,647 25
*Thirtieth	.....	43,573 50
†Thirty-first	.....	44,693 00
Total	$1,025,278 50	$1,093,864 00

Increase by reassessments, $68,585.50.
*Formerly part of 26th Ward. †Formerly part of 19th Ward.

Amount collected by City Solicitor from Liens.

YEARS.	Feet of pipe laid.	Frontage collected by Registrar.	Returned for liens.	Collected by City Solicitor.
1863	56,916	$30,715 02	$14,350 70	$16,544 21
1864	35,867	22,278 57	13,630 59	13,535 22
1865	46,994	34,141 07	11,970 42	7,564 68
1866	66,324	32,031 11	4,160 13	12,190 21
1867	84,171	76,938 39	22,830 11	7,892 28
1868	79,348	64,959 03	21,701 68	18,549 86
1869	118,044	61,065 06	24,866 43	16,389 90
1870	139,233	117,319 12	61,640 99	11,959 82
1871	158,972	96,110 98	62,341 24	14,764 47
1872	146,221	131,822 96	77,467 36	21,108 90
1873	210,736	116,997 17	75,882 09	26,601 71
1874	225,271	198,896 99	152,593 11	31,130 17
1875	179,388	123,258 53	122,533 39	65,870 28
Total	1,547,530	$1,106,534 00	$665,968 24	$264,101 71

PROPOSED FORM FOR BACK OF WATER BILLS.

To

You will please examine your bill, with the following schedule of charges, and designate your openings, that a proper bill may be rendered you in accordance therewith.

Registrar.

DWELLINGS.		
¼ dwellings (one room on a floor)	Without an attachment on premises	$2 50
¾ dwellings (the same, and kitchen)	" " "	3 75
All other dwellings	" " "	5 00
" "	With an attachment on premises. Hydrant, yard and kitchen, or either,	5 00
WASH-PAVES.		
Screw nozzle on hydrant or elsewhere		3 00
For watering horses		10 00
WASH-BASINS OR SINKS		
In private dwellings	Each	1 00
In hotels	Each	2 00
In drug stores	Each (separate attachment, $5)	2 50
In public buildings	Each	3 00
In stores	Each	5 00
In barber shops	(Each additional, $1)	3 00
WASH-TUBS. (Stationary)		1 00
BATHS (Hot and cold water, or either.)		
In private dwellings	Each (separate attachment, $5)	3 00
In hotels and public bath houses		6 00
WATER CLOSETS, URINAL OR BIDDETS.		
In private dwellings	Each	1 00
In stores, factories, etc., self-acting	Each (all others, $3)	2 00
In boarding house, hotels, etc., self-acting	Each (all others, $5)	3 00
SLOP-SINKS.		
In boarding house, hotels, etc		4 00
STABLES. (private and livery.)		
Stall and carriage	Each	1 00
Country stall	Each	50
BARS, (with water in, or not.)	Each	10 00
HOTELS AND BOARDING HOUSES. In addition to openings.		
Boarders to 10		5 00
Boarders to 25	(Each additional 25, $5)	10 00
FAMILY BAKERIES AND ICE CREAM SALOONS.		
Additional to dwelling charges		3 00
PHOTOGRAPHERS, (one operator.)	(Each additional, $5)	10 00
HATTERS' PLANKS		
Fours per set		8 00
Sixes "		10 00
Eights "		12 00
BRICK-YARDS	Per gang of men	5 00
STEAM ENGINES	Each horse-power	3 00
STEAM BOILERS	" "	3 00
DYE WORKS	Each 100 hands employed	10 00
DYE WASHERS	Each 100 gallons	02
SKIN DRESSERS	" "	02
MALT HOUSES	" "	02
PACKET SHIPS & VESSELS	" "	05
BREWERIES	Each 100 barrels	3 00
FOUNTAINS		
Counter in stores to 1-16 jet		5 00
One 1-16 jet, 10 hours per day, 6 mos.	(Each additional jet, $1 50)	6 00
One ⅛ " " "	" " " " 2 50)	7 50
One ¼ " " "	" " " " 9 00)	14 00
One ½ " " "		32 00
BUILDING PURPOSES.		
Bricks per 1,000		05
Stone per perch		02
METER RATE.		
Each, 1,000 cubic feet		1 25

EXPENDITURES

OF THE

Water Department

FOR

1875.

EXPENDITURES OF THE DEPARTMENT FOR 1875.

From Annual Appropriation.

Salaries of Chief Engineer, Assistants, Purveyors, and Clerks,		$31,550 00
" Engineers, Firemen, &c., at works,		56,657 50
" Registrar and Clerks,		27,600 00
Stationery, advertising, and office expenses,		8,788 94
Supplies to works:		
Coal and wood,	$75,934 89	
Tallow, oil, and gas,	7,095 42	
Small stores, packing, &c.,	2,998 64	
		86,023 95
Repairs to works:		
Fairmount,	$2,989 88	
Delaware,	3,500 00	
Schuylkill,	3,991 35	
Schuylkill, side lever	12,685 29	
Belmont,	6,698 59	
Roxborough,	1,997 46	
		31,862 57
For drilling and making new attachments:		
Wages, First District,	$2,505 62	
" Second "	2,725 43	
" Third "	2,516 50	
" Fourth, "	2,514 25	
" Germantown,	682 86	
" Manayunk,	1,913 00	
Transportation,	125 00	
		12,982 66
For keeping pipes, plugs, stops, and fixtures in good order:		
Wages, First District,	$6,128 34	
" Second, "	8,072 56	
" Third "	8,187 75	
" Fourth, "	11,680 55	
" Germantown,	2,216 85	
" Manayunk,	2,540 31	
" Pressure Inspector,	800 62	
Amounts carried forward,	$39,626 98	$255,470 62

Amounts brought forward,	$39,626 98	$255,470 62
Lead,	2,823 94	
Iron castings,	1,673 07	
Repaving around plugs,	1,345 25	
Damages for bursts,	370 88	
Plumbing,	271 95	
Hardware,	189 26	
Hauling,	155 00	
Packing,	154 00	
Wood and Coke,	111 50	
Covering pipes,	105 00	
Powder and fuse,	42 23	
Lumber,	31 15	
Tubing,	26 23	
Oil,	13 50	
Sundries,	56 27	
		46,996 21
For labor in laying pipes, setting and fitting fire-plugs, stop-cocks, &c.:		
Wages, First District,	$ 5,522 70	
" Second, "	16,577 53	
" Third, "	12,700 80	
" Fourth, "	14,069 51	
" Germantown,	11,050 25	
" Manayunk,	5,454 21	
" Shop,	20,465 87	
Measuring pipe,	7,111 65	
Hauling,	6,823 27	
Pipe-plans,	2,696 33	
Inspecting pipe,	1,719 50	
Inspecting stops, plugs, &c.,	1,620 28	
Pipe, stops, and plug reports,	1,227 17	
Surveys,	1,084 43	
Transportation,	401 11	
Grade stakes,	366 29	
Paving,	259 00	
Quarrying,	244 00	
Plumbing,	234 80	
Inspecting boilers,	200 23	
Dressing tools,	32 00	
Hardware,	13 25	
Amounts carried forward,	$109,874 18	$302,466 83

Amounts brought forward,	$109,874 18	$302,466 83
Repairs to gauges,	11 78	
Oil,	4 25	
Powder,	3 25	
Sundries,	96 50	
		109,989 96
For keeping grounds, buildings, and reservoirs in good order:		
Wages,	$59,870 87	
Lumber,	4,479 78	
Gas fitting and plumbing,	1,950 81	
Gas,	1,599 19	
Doors, sash, and mouldings,	1,216 01	
Glass, paints, &c.,	958 88	
Building culverts,	927 35	
Hardware,	849 37	
Painting,	597 00	
Iron railing,	571 40	
Heaters and stoves,	417 18	
Cement,	355 45	
Seed and plants,	366 03	
Repairs to railroad track	295 69	
Vulcanite paving,	347 50	
Plastering,	292 00	
Relining inlet chamber,	250 00	
Stairs,	250 00	
Copying frame,	220 00	
Engineer's supplies,	238 50	
Roofing,	214 12	
Chimney tops,	174 00	
Packing,	170 47	
Paper Hanging,	158 69	
Lightning rods,	150 00	
Hauling,	128 00	
Stone,	126 18	
Repairs to scales,	122 17	
Valves,	115 72	
Oil,	113 35	
Uniforms,	110 00	
Stove and tin work,	97 27	
Amounts carried forward,	$77,730 98	$412,456 79

Amounts brought forward,	$77,730 98	$412,456 79
Phosphate,	72 00	
Railroad iron	66 20	
Bricks,	63 70	
Hose &c.,	63 65	
Lamps and globes,	58 92	
Water filters,	56 00	
Brushes and brooms,	50 70	
Awnings,	48 00	
Sundries,	46 60	
Drain pipe,	41 26	
Wood,	37 75	
Sand,	35 75	
Office railing,	36 50	
Lime,	29 70	
Powder and fuse,	27 40	
Coping and steps,	26 10	
Slate shelves,	25 70	
Repairing gauges,	22 66	
Repairs to lighter,	20 00	
Gasket,	11 00	
Tin pump,	8 50	
Roofing felt,	8 25	
Freight,	3 06	
Clay,	8 10	
Paving,	5 25	
Salt hay,	1 75	
		78,607 48

For the purchase of iron pipes, fire plugs, stop-cocks, lead, brass, iron castings, &c.:

Iron pipe,	$115,095 45	
Iron castings,	10,984 24	
Lead,	7,675 76	
Lumber,	3,590 57	
Hardware,	3,096 32	
Brass castings,	2,940 69	
Iron and steel,	1,568 13	
Plug valves,	2,127 24	
Bolts and nuts,	1,363 27	
Amounts carried forward,	$148,441 67	$491,064 27

Amounts brought forward,	$148,441 67	$491,064 27
Plugs,	1,060 00	
Coal,	889 25	
Inspection,	633 50	
Gasket,	591 68	
Railroad scale,	650 00	
Rents,	485 00	
Packing,	471 48	
Oil,	436 25	
Powder and fuse,	427 15	
Tin and Copper casting,	376 25	
Tubing, gauges, &c.,	325 57	
Facing machine,	275 00	
Gum suits and boots,	248 38	
Meters,	209 20	
Level transit, &c.,	175 90	
Coke,	156 63	
White lead, paint, &c.,	148 73	
Galvanized spindles,	154 51	
Wood,	133 00	
Maps and plans,	127 75	
Phosphor bronze,	78 24	
Printing and type,	68 64	
Machine work and material,	57 05	
Copper dippers,	39 00	
Brooms and brushes,	39 15	
Sundries,	38 55	
Belts and lacings,	31 34	
Rope and blocks,	31 28	
Taps and dies,	25 60	
Plumbing,	13 75	
Plating and smith work,	10 50	
		156,850 00
Fitting up Spring Garden Hall, as per Resolution of Councils,	$5,000 00	
Company I, National Guards, as per Resolution of Councils,	200 00	
		5,200 00
For carriage hire and keep of horse for Chief Engineer,		646 00
For the care and maintenance of Chestnut Hill Works,		4,996 70
For Jones & Co., atlas,		128 00
For expenses of public fountains, of the Philadelphia Fountain Society,		812 31
Amount carried forward,		$659,697 28

Amount brought forward,		$659,697 28
For retaining wall, Roxborough Reservoir:		
Wages,	$13,593 98	
Cement,	273 00	
Lumber,	273 51	
Powder,	175 20	
Dressing tools,	161 51	
Hardware,	155 68	
Lime,	140 00	
Bricks,	101 68	
Iron castings,	90 72	
Clay,	15 75	
Transportation,	10 00	
Rope and block,	5 20	
		14,996 23
		$674,693 51

SPECIAL APPROPRIATIONS.

(Appropriation approved September 18, 1874.)

To refund twice paid and over paid water rents, and pipe laying bills,	10 75

(Appropriation approved June 5, 1875.)

To pay the expenses of the Water Commission,	1,000 00

(Appropriation approved July 13, 1875.)

To refund twice paid and overpaid water rents, and pipe laying bills,	725 39

(Appropriation approved November 6, 1875.)

To refund water rent of premises not occupied,	266 80
Amount carried forward,	$2,002 94

Amount brought forward,		$2,002 94

(Appropriation approved October 1, 1875.)

For connecting the Chestnut Hill Works with Mount Airy Reservoir:

Wages,	$8,979 92	
Iron pipe,	2,982 15	
Lead,	1,100 41	
Powder and fuse,	268 85	
Land damages,	200 00	
Carpenter work,	136 04	
Wood,	85 00	
Oil,	27 00	
Iron and steel,	12 45	
Dressing tools,	11 76	
Freight and wharfage,	10 86	
		13,814 44

(Appropriation approved October 12, 1875.)

For new boilers, settings, and connections at Chestnut Hill works; for relining the south division of the Roxborough Reservoir; and for repairing the Wissahickon acqueduct:

Wages,	$13,357 45	
Machine work,	3,260 49	
Lumber,	1,836 06	
Lime,	297 15	
Iron pipe,	250 13	
Freight,	116 38	
Packing,	52 75	
Dressing tools,	48 53	
Hardware,	40 54	
Cement,	35 60	
Rope and blocks,	27 10	
		19,322 18
		$35,139 56

EXTENSION OF WORKS.

AMOUNT PAID FROM WATER LOANS.

(Appropriation approved February 13, 1869, under transfer June 19, 1875.)

Item 5.

For completion of cornish engine, boilers, and connections at the Roxborough Works:

Machine work,	$632 10	
Packing,	415 87	
Transportation,	88 00	
Inspecting boilers,	70 30	
Copper castings,	60 90	
Sulphur,	27 12	
Hardware,	19 37	
		1,313 66

(Appropriation approved April 7, 1870, under transfer June 19, 1875.)

Item 10.

For bursting of mains or other emergency:

Wages,	$1,300 13	
Felting,	299 70	
Boiler compound,	174 56	
Cement,	15 00	
		1,789 39

(Appropriation Approved November 6, 1871.)

Item 1.

For new engine No. 3, Schuylkill Works:

Wages,	$1,744 08	
Printing plans,	560 50	
Engineer's supplies,	219 80	
Advertising for proposals,	119 80	
Sundries,	41 04	
Lumber,	27 40	
Powder,	3 50	
		5,716 12
Amount carried forward,		$8,819 17

Amount brought forward, . . .		$8,819 17
Item 3.		
For re building Fairmount dam:		
Wages, ...	$10,395 54	
Stone steps and flagging, . .	1,306 45	
Cement, ...	112 50	
Lumber, ...	93 47	
		11,907 96
Item 6.		
For completion of Delaware Water Works Reservoir:		
Plans &c., ...		26 58
Item 7.		
For construction of large Storage Reservoir in East Fairmount Park:		
Lumber, ...	$137 20	
Valves, ...	22 54	
Stack, ...	18 00	
Hauling, ...	7 50	
		185 24
Item 8.		
For mains to connect large Storage Reservoir, East Fairmount Park, with Engines at Schuylkill Works:		
Iron pipe, ...	$20,031 06	
Wages, ...	1,136 57	
Hauling, ...	954 51	
Freight, ...	157 68	
Engineer's supplies, . . .	130 35	
		22,410 17
Item 9.		
For incidentals:		
Report of Council Committee, . .	$380 00	
Horse keep for Assistant Engineer, .	180 00	
Car fares &c., ...	50 00	
Packing, ...	14 00	
		624 00
Amount carried forward, . . .		$43,973 12

Amount brought forward, ...		$ 43,973 1

(Appropriation approved May 19, 1873.)

Item 2.

For new engines and boilers and setting same (Frankford Works):		
Printing and plans, . . .	$177 10	
Advertising for proposals, . .	134 55	
		311 65

Item 4.

For Reservoir, (Frankford Works):		
Malone contract, ...	$4,959 00	
Wages for unloading pipes, . .	1,349 75	
Iron pipe, ...	735 45	
Advertising for proposals, . .	528 50	
Testing machine, ...	265 00	
Printing and plans, . . .	231 25	
Hauling, ...	24 00	
Lumber, ...	19 08	
Hardware and Rope, . . .	11 86	
		8,123 89

Item 6.

For thirty-inch ascending main, stop-cocks, fixtures, &c. (Frankford Works):		
Iron pipes, ...	$102,726 47	
Wages, ...	633 00	
Wharfage and storage, . . .	337 28	
Inspecting pipes, ...	331 10	
Advertising for proposals for pipe, .	109 65	
Surveys, ...	16 00	
		104,153 50

Item 7.

For twenty-inch descending main (Frankford Works):		
Iron pipes, ...	$55,149 15	
Wages, ...	653 50	
Wharfage and storage, . . .	492 20	
Hauling, ...	399 10	
Inspecting pipes, ...	335 40	
Lumber, ...	127 27	
Rubber coat and boots, . . .	8 75	
		57,165 37
Amount carried forward, ...		$213,727 53

Amount brought forward, ...		$213,727 53

Items 8, 10, 11, 12.

(Under Ordinance of November 12, 1875.)

For expenses of laying mains:

Iron pipes, ...	$12,956 58	
Lead, ...	788 06	
Hauling, ...	317 00	
Inspection, ...	24 50	
		14,086 14

Item 13.

Incidentals:

Level and transit, . . .	$360 00	
Keep of horse for Assistant Engineer, .	180 00	
Sundries, ...	145 00	
Engineer's supplies, . . .	5 00	
		690 00
		$228,503 67

RECAPITULATION.

Expended from annual appropriation, . . .	$674,693 51
" " special appropriation, . . .	35,139 56
" " loans (Extension of Works), . . .	228,503 67
Total expenditures for 1875, . - . .	$938,336 74
Total Receipts for 1875, ...	$1,169,666 28
" Expenditures for 1875, (Loans included) .	938,336 74
Receipts in Excess of Expenditures, . .	$231,329 54

OPERATIONS

OF

THE WORKS

FOR

1875.

Running Expenses of all the Works for the year 1875.

WORKS.	Salaries of Engineers and Firemen.	Coal.			Lubricating Cylinder and Castor Oil.			Tallow.			Lighting Works.		Repairs.	Packing and Small Stores.	Total Expenses.	Lift.	Cost of Raising Water per Million Gallons.	
		Tons.	Average price per ton.	Amount.	Gallons.	Average price per gallon.	Amount.	Pounds.	Price per pound	Amount.	Oil.	Gas.				Feet.	Into Reservoir.	One foot high.
Fairmount.....	$12,007 50	200	$5 01	*$1,002 00	†350½	$1 93	$676 47	150	16	$24 00	$144 38	$973 82	$1,016 93	$135 95	$15,981 05	90	$2.08\frac{35}{100}$	$.02\frac{15}{100}$
" Worthington pump	1,487 55	389	4 92	1,913 88	17¼	88	15 19	362	16	57 92	25 50	.....	345 60	.....	3,845 64	92	$11.86\frac{10}{100}$	$.12\frac{89}{100}$
Schuylkill.....	13,800 00	1,533	4 92	7,542 36	152¾	75	114 57	2,554	16½	421 41	139 50	855 83	3,603 84	129 17	26,606 68	115	$19.61\frac{71}{100}$	$.17\frac{05}{100}$
Delaware.....	11,750 00	2,695	4 95	13,348 36	109	75	82 25	299	16	47 84	.....	696 21	2,157 41	98 52	28,180 59	118	$15.32\frac{22}{100}$	$.12\frac{98}{100}$
Belmont.....	11,000 00	5,909	5 10	30,135 90	703½	1 15	809 03	1,192	16	190 72	514 50	.....	6,689 97	543 58	49,883 70	208	$16.32\frac{58}{100}$	$.07\frac{84}{100}$
Roxborough.....	8,100 00	3,397	5 35	18,168 60	143	1 28	183 02	422	10	42 20	209 25	.....	1,272 31	193 80	28,169 18	334	$34.42\frac{23}{100}$	$.10\frac{30}{100}$
Chestnut Hill‡...	864 00	250	6 28	1,570 00	20	75	15 00	400	16	54 00	30 00	.....	.....	16 30	2,549 30	125	$75.89\frac{03}{100}$	$.60\frac{71}{100}$
Total.....	$59,009 05	14,373	$5 12	$73,681 10	1,496	$1 27	$1,895 53	5,379	15½	$838 09	$1,063.13	$2,525 86	$15,086 06	$1,117 32	155,216 14	.....	.....	.....

* Heating Mill House. † 139 gallons castor oil. ‡ The intermittent pumpage and other duties of engineer precludes an accurate cost of pumping.

Operations of the Fairmount Works for the year 1875.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped per month.	Coal consumed in heating mill house.	Tallow.	Lubricating and castor oil.	From Penn'a Hospital Reports.	
									Rain fall during the month.	Mean temperature.
	Days.					Lbs.	Lbs.	Qts.	Inches.	Degrees.
January	31	1,550,450	588,507,521	18,984.114	78,677,476	67,200	12	70	2.360	25.72
February	28	1,571,130	593,937,400	21,426,336	80,205,536	67,200	.....	94	3.284	26.22
March	31	1,729,398	660,826,254	21,316,976	88,345,756	67,200	15	91	3.925	35.50
April	30	1,805,753	690,548,567	23,018,285	92 319,327	44,800	14	136	1.360	47.76
May	31	2,218,578	756 276,804	24,396,026	101,106,525	33,600	14	141	1.575	63.16
June	30	1.858,544	619,510,982	20,650,366	82,822,324	.....	.....	134	5 258	72.00
July	31	1,307,594	444.132,431	14,326,853	59,375,994	.....	20	156	4.174	75.50
August	31	2,360,385	803,191,968	25,909,418	107,378,605	.....	17	206	6.584	76.33
September	30	1,396,602	514,812,371	17,16 ,412	68,825 183	.....	14	99	3.035	60.36
October	31	1,525,804	569,274,534	18,363,695	76,106,221	33,600	20	103	1.827	54.25
November	30	2,002,919	712,288,186	23,742,940	95 225,693	67,200	12	97	5.544	39.10
December	31	2,018,294	710,702,180	22,925,877	95,013,660	62,200	12	75	2.918	35.05
Total	365	21.345,751	7,670,009,198	21,013,724	1,025,402,300	448,000	150	1,402	41.844	50.91

	RS WATE		Total Hours.				
	Whei				stopped.		
	Ho						
	For full reservoir.	Total number of hours.	Hours of pumpage.	For Reservoir full.	For high or low water.	For repairs.
Ja						
Fe	42 204	5,952	2,659	2,757	536	.....
Ma	42 167	5,376	2,729	2,324	323	.....
Ap	71 269	5,952	3,009	2,854	71	18
Ma	16 172	5,760	3,212	2,480	.....	68
Ju	35 112	5,952	3,895	1,553	496	8
Ju	79 11	5,760	3,279	359	2,046	76
Au	93	5,952	2,135	1,440	2,377	.....
Sep	47 24	5,952	4,093	1,171	651	37
Oct	29 79	5,760	2,483	1,812	1,429	36
Nov	00 73	5,952	2,636	1,968	1,259	89
Dec	36 130	5,760	3,387	2,287	22	64
	42 102	5,952	3,426	2,358	.....	168
To						
	82 1,343	70,080	36,943	23,363	9,210	564
Ave						
Rev	rage gallon	tage.....	.53	.33	.13	.01
	olutions pe					

FAIRMOUNT.

Theoretical Capacity of Pumps.

Numbers of Wheels.	Kind of Wheel.	Pump.				Piston Rod.			Gallons Capacity.		Strokes per minute.	Gallons per Day.
		Diameter.	Diameter.	Area of Pump in inches.	Stroke in inches.	Diameter.	Displacement. Gallons per stroke.	Displacement. Gallons per revolut'	Pump.	Wheel.		
1	Turbine.....	16	.....	201.06	72	$3\frac{5}{8}$	3.21	3.21	122.11	122.11	12	2,110,060
2	Breast.....	16	.....	201.06	54	$3\frac{1}{2}$	2.25	2.25	91.75	91.75	14	1,387,260
3	Turbine.....	22	22	380.13	72	5	6.12	12 25	230.84	461.68	8	5,318,553
4	Turbine.....	22	22	380.13	72	5	6.12	12.25	230.84	461.68	8	5,318,553
5	Turbine.....	22	22	380.13	72	5	6.12	12.25	230.84	461.68	8	5,318,553
6	Removed.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	Turbine.....	$18\frac{7}{16}$	$18\frac{3}{8}$	266.08	72	4	3.91	7.83	161.95	323.90	11	5,130,576
8	Turbine.....	$18\frac{5}{16}$	$18\frac{1}{2}$	266.08	72	4	3.91	7.83	161.95	323.90	11	5,130,576
9	Turbine.....	$18\frac{9}{16}$	$18\frac{3}{8}$	267.90	72	4	3.91	7.83	163.09	326.18	11	5,166,690
										Total.....		34,880,821

Operations of the Schuylkill Works for the year 1875.

Months.	Running time. Days.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped per month.	Coal.* Pounds.	Tallow. Pounds.	Lubricating and cylinder oil. Quarts.
January		Not pumping.					30	18
February		" "					50	15
March	4	8,885	4,442,500	1,110,625	593,917	65,072	25	14
April	5	8,839	4,419,500	883,900	590,842	50,400	50	12
May	18	209,411	102,287,560	5,682,642	13,674,808	240,912	146	60
June	30	652,288	308,882,080	10.296,069	41,294,396	690,368	479	124
July	31	771,366	360,389,250	11,625,460	48,180,381	786,800	590	146
August	31	303,025	128,283,950	4,138,192	17,150,261	386,848	240	51
September	30	522,886	237,520,260	7,917,342	31,754,045	558,320	394	100
October	31	385,732	194,084,040	6,260,775	25,947,064	574,000	416	54
November	7	31,579	15,986,810	2,283,830	2,137,274	81,424	53	10
December		Not pumping.					81	7
Total	188	2,894,011	1,356,295,950	7,214,340	181,322,988	3,434,144	2,554	611

*The amount of coal given is the total amount consumed for raising steam, banking fires, and without any deduction whatever for ashes or clinker.

the year

PAGE.

	s per y-four rs.	Num ga pur
Janua		
"		
"		
Febru		
"		
"		
March		
"		
"	600	4,4
April		
"		
"	984	4,4
May	880	6,0
"		
"	264	96,0
June	528	45 2
"	264	42,1
"	112	220,2
July	456	65,6
"	040	48,3
"	768	244,5
Augu	968	59,7
"	008	34,7
"	088	32,0
Septe	128	59,8
"	496	1,6
"	816	174,2
Octo	080	4
"	232	70,9
"	472	122,7
Nove		
"	440	10,0
"	664	5,9
Dece		
"		
"		
	585	1,349,
	age.	T

out any ded

Capacity of the Steam Works.

Works.	Engines.	Number of pumps.		Diameter.		Stroke in inches.	Gallons per revolution.				No. of rev's per minute.	Theoretical daily capacity.	Actual daily capac'y.
		Single acting.	Double acting.	Piston.	Plunger.		Theoretical.	Leakage.	Actual.	Former rate.			
Schuylkill...	Old Cornish.....	1	.....	.....	30	120	367.2	17.2	350.	360	10	5,287,680	5,040,000
	Side Lever.....	1	.....	.....	36	120	528.7	18.7	510.	510	10	7,613,280	7,344,000
	Compound.....	.....	2	28½	.....	182	502.6	2.6	500.	500	14	10,132,416	10,080,000
Belmont.....	No. 1 Worthington	.....	2	.....	22 1/16	48	312.5	12.5	300.	306	12	5,400,000	5,184,000
	No. 2 "	.....	2	.....	22½	48	325.24	13.24	312.	322	12	5,620,147	5,391,360
	No. 3 "	.....	2	.....	28	48	505.184	20.18	485.	500	12	8,729,579	8,380,800
Delaware....	Worthington.....	.....	2	.....	24	48	372.004	15.0	357.	352	12	6,428,229	6,168,960
	Beam Engine.....	.....	1	19½	.....	72	181.204	9.204	172.	160	18	4,696,807	4,458,240
	Horizontal Eng...	.....	1	18	.....	72	152.812	7.812	145.	171	18	3,960,887	3,758,400
Roxborough	Cornish.....	1	.....	.....	20¼	120	167.3	8.3	159.	145	10	2,409,120	2,289,600
	Worthington.....	.....	2	.....	22	48	309.344	14.34	295.	295	10	4,454,553	4,248,000
Fairmount.....	Worthington.....	.....	2	.....	16	24	82.092	3.58	78.5	104	20	2,364,249	2,260,800
												67,096,947	64,604,160

Operations of the Delaware Works for the year 1875.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped per month.	Coal.*	Tallow.	Oil.
	Days.					Pounds.	Pounds.	Quarts.
January	24	377,638	95,904,064	3,996,003	12,821,399	359,817	24	20
February	25	428,087	106,870,304	4,274,812	14,287,474	401,305	24	27
March	27	302,079	106,431,808	3,941,919	14,228,851	351,859	25	31
April	29	396,682	133,161,280	4,591,768	17,802,310	397,496	25	25
May	27	619,823	162,802,016	6,029,704	21,764,975	569,555	25	30
June	28	751,885	180,201,362	6,435,763	24,091,091	608,807	25	35
July	31	1,079,926	255,906,132	8,255,037	34,212,050	853,724	26	52
August	29	791,420	196,941,440	6,791,084	26,329,069	595,984	26	50
September	28	763,106	189,575,360	6,770,549	25,342,902	572,140	25	46
October	29	792,108	193,513,344	6,672,874	25,870,768	625,516	26	39
November	23	413,527	110,527,520	805,544	14,776,406	394,793	23	40
December	26	330,402	107,355,840	4,129,071	14,352,385	365,550	25	40
Total	326	7,046,483	1,839,190,470	5,641,688	245,879,740	6,036,576	299	435

* The amount of coal given is the total amount consumed for raising steam, banking fires, and without any deduction whatever for ashes or clinker.

Operations of the Worthington Pump, at Fairmount for the year 1875.

Months.	Running time.	Number of strokes made during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped per month.	Coal.	Tallow.	Oil.
	Days.					Pounds.	Lbs.	Qts.
June	7	149,850	15,584,400	2,226,343	2,083,476	49,280	21	2
July	26	821,166	85,403,264	3,284,741	11,417,549	284,480	84	4
August	12	277,431	28,852,824	2,404,402	3 857,329	71,680	47	8
September	28	797,248	82,912,792	2,961,171	11.084,598	203,840	84	44
October	31	845,912	87,974,848	2,837,898	11,761,343	232,960	93	8
November	11	225,932	23,496,928	2,136,084	3,141,331	29,120	33	3
Total	115	3,117,539	324,225,056	2,819,348	43,345,596	871,360	362	69

Operations of the Belmont Works for the year 1875.

Months.	Running time. Days.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped during the month.	Coal.* Pounds.	Tallow. Pounds.	Lubricating and cylinder oil. Quarts.
January	31	497,070	243,843,658	7,865,924	32,599,419	958,208	50	271
February	28	497,888	227,434,076	8,122,646	30,405,625	941,673	125	160
March	31	539,161	253,894,218	8,190,136	33,943,077	1,071,444	79	228
April	30	502,043	238,955,562	7,631,852	31,945,931	979,412	120	266
May	31	649,250	272,744,178	8,798,199	36,463,125	1,150,019	224	210
June	30	642,404	259,773,846	8,659,128	34,729,124	1,104,024	45	306
July	31	636,760	279,027,842	9,000,898	37,303,187	1,192,489	50	320
August	31	559,219	265,342,372	8,559,431	35,473,579	1,130,430	110	178
September	30	562,491	261,960,276	8,732,009	35,021,427	1,149,342	70	193
October	31	631,785	269,448,386	8,693,173	36,022,512	1,226,220	169	218
November	30	670,172	235,793,000	7,859,767	31,523,128	1,131,779	30	234
December	31	636,742	247,290,456	7,977,111	33,060,221	1,201,157	120	230
Total	365	7,024,985	3,055,507,870	8,371,254	408,490,355	13,236,197	1,192	2,814

*The amount of coal given is the total amount consumed for raising steam, banking fires, and without any deduction whatever for ashes or clinker.

Operations of the Chestnut Hill Works, for the year 1875.

Months.	Running time. Days.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped during the month.	Coal.* Pounds.	Tallow. Pounds.	Lubricating oil. Quarts.
January	31	185,000	1,480,000	47,742	197,861	25,238	25	5
February	28	196,000	1,568,000	56,000	209,626	26,468	25	5
March	31	288,000	2,304,000	74,323	308,021	38,404	30	6
April	30	286,000	2,288,000	76,267	305,882	38,438	30	6
May	31	582,000	4,656,000	150,194	662,460	77,826	40	8
June	30	623,000	4,984,000	166,133	666,310	83,294	50	10
July	31	600,000	4,800,000	154,839	641,711	80,200	50	10
August	31	295,000	2,360,000	76,129	315,508	39,678	30	6
September	30	268,000	2,144,000	71,467	286,631	35,944	30	6
October	31	320,000	2,560,000	82,581	342,246	39,840	30	6
November	30	294,000	2,352,000	78,400	314,438	39,424	30	6
December	31	262,000	2,096,000	67,613	280,214	35,246	30	6
Total	365	4,199,000	33,592,000	92,033	4,490,908	560,000	400	80

*The amount of coal given is the total amount consumed for raising steam, banking fires, and without any deduction whatever for ashes or clinker.

Operations of the Roxborough Works for the year 1875.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Cubic feet of water pumped per month.	Coal.*	Tallow.	Lubricating and cylinder oil.
	Days.					Pounds.	Pounds.	Quarts.
January	29	340,781	53,145,785	1,832,613	7,105,051	482,833	125	27
February	22	173,821	51,277,195	2,330,782	6,855,240	560,816	117	23
March	27	248,935	73,435,825	2,719,845	9,817,624	737,919	141	23
April	26	202,724	59.803,580	2,300,138	7,995,131	557,149	89	22
May	26	238,411	70,341,245	2,705,432	9,403,909	651,956	.....	58
June	26	248,200	73,219,000	2,816,115	9,788,636	616,949	.....	67
July	27	298,511	88,0€0,745	3,261,509	11,772,827	689 564	....	56
August	26	229,294	70,591,630	2,715,063	9,437,384	601,196	.....	60
September	29	254 551	49,637,445	1,711,636	6,636,022	658,851	.....	52
October	30	282,918	83,463,810	2,782,027	11,157,862	704,965	.....	62
November	30	248,234	73,229,030	2,440,968	9,789,977	644,792	.....	57
December	31	244,533	72,137,235	2,327,008	9,644,015	696,176	.....	55
Total	**329**	**3,020,913**	**818,339,525**	**2,487,354**	**109,403,678**	**7,603,166**	**422**	**532**

* The amount of coal given is the total amount consumed for raising steam, banking fires, and without any deduction whatever for ashes or clinker.

Amount of Water pumped by all the Works during the year 1875.

Months.	Gallons of water pumped during the month.	Average number of gallons pumped per day.
January*	982,881,028	32,726,396
February*	987,086,975	36,210,576
March	1,101,334,605	37,353,824
April	1,129,176,489	38,502,210
May	1,369,107,803	47,762,197
June	1,462,155,670	51,249,917
July	1,517,719,664	49,909,337
August	1,495,564,184	50,593,719
September	1,338,562,504	45,324,586
October	1,400,315,962	45,693,023
November	1,173,673,474	43,347,533
December*	1,139,581,711	37,426,680
Total	15,097,160,069	47,639,741

* Schuylkill Works not pumping.

Amount of water pumped by all the Works during the years 1869, 1870, 1871, 1872, 1873, 1874, and 1875.

MONTHS.	1869.		1870.		1871.		1872.		1873.		1874.		1875.	
	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.	Gallons of water pumped during the month.	Average number of gallons pumped per day.
Jan	877,284,223	28,507,994	823,501,020	26,629,192	1,002,008,583	33,421,326	898,095,642	31,789,666	980,447,053	33,600,583	1,029,691,356	35,777,710	982,881,028	32,726,396
Feb.....	857,235,551	30,850,764	816,808,722	29,377,975	907,177,896	33,644,729	905,458,774	32,428,841	916,928,311	34,713,907	939,003,631	35,551,707	987,086,975	36,210,576
March ...	804,817,745	26,219,793	821,476,247	28,676,516	1,038,157,449	34,298,641	910,517,957	30,313,407	1,012,454,477	34,055,188	1,050,806,184	35,117,945	1,101,334,605	37,353,824
April.....	1,044,170,483	35,074,275	1,054,488,246	36,454,860	1,081,525,860	36,496,286	999,794 625	34,103,906	1,066,502,276	36,582,865	1,027,580,470	37,861,731	1,129,176,489	38,502,210
May.....	1,120,558,740	36,530,528	1,204,765,895	37,445,368	1,155,557,242	37,706,406	1,231,409,231	40,899,034	1,207,246,648	39,730,741	1,300,591,787	44,459,135	1,369,107,803	47,762,197
June	1,197,573,103	39,935,103	1,220,092,275	40,669,741	1,241,946,831	41,518,289	1,173,692,567	42 680,065	1,350,050,022	45,826,238	1,436,684,756	50,379,555	1,462,155,670	51,249,917
July.....	1,294,468,963	41,757,063	1,397,614,410	46,008,735	1,266,880,762	41,506,545	1.278,226,160	42,943,079	1,405,737,764	47,676,064	1,562,602,586	54,287,891	1,517,719,664	49,909,337
August..	1,139,394,772	36,754,670	1,328,758,809	43,663,187	1,307,712,052	42,354,705	1,344,344,562	45,954,377	1,378,043,723	45,686,697	1,467,964,135	48,216,281	1,495,564,184	50,593,719
Sept.....	1,111,435,089	37,047,836	1,201,946,583	41,105,307	1,226,827,488	41,156,843	1,185,883,590	40,764,905	1,293,369,018	44,248,521	1,310,861,781	45,962,305	1,338,562,504	45,324,586
Oct	1,098,648,339	35,440,337	1,264,416,410	40,845,543	219,210,376	40,125,119	1,187,763,266	39,777,853	1,297,820,634	43,020,189	1,246,855,152	41,691,929	1,400,315,962	45,693,023
Nov	970,776,989	32,359,234	1,186,284,027	39,880,989	1,098,477,072	37,605,607	1,038,793,747	36,214,583	1,121,617,063	38,891,829	1,107,165,965	40,095,053	1,173,673,474	43,347,533
Dec.....	898,388,339	29,151,189	1,072,655,628	35,035,201	952,917,870	31,742,505	947,008,335	33,133,416	1,192,981,324	39,281,389	1,053,617,294	35,939,461	1,139,581,711	37,426,680
Total ...	12,414,752,336	34,040,409	13,392,808,272	37,249,385	13,498,399,481	37,631,379	13,100,018,461	37,583,594	14,223,198,443	40,276,184	14,533,425,097	42,111,730	15,097,160,069	47,639,741

Amount of Water pumped by all the Works from 1854 to 1875, inclusive, in U. S. Gallons.

Year.	FAIRMOUNT.		DELAWARE.		SCHUYLKILL.		TWENTY-FOURTH WARD AND BELMONT.		ROXBOROUGH AND GERMANTOWN.		CHESTNUT HILL.		TOTAL.	
	Total water pumped.	Daily ave rage.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily aver'e	Total for all the works.	Total daily average.
1854...	2,286,402,222	6,264,115	618,173,121	1,693,625	1,366,011,559	3,742,497	.....	.....	.....	.....	.....	.....	4,270,786,902	11,700,786
1855...	2,783,736,850	7,611,756	56,780,060	1,556 197	1,525,987,725	4,178,096	9,538,170	103,606	.....	.....	.....	.....	4,876,528,635	13,344,323
1856...	2,867,188,965	7,833,849	769,566,040	2,102,639	1,980 637,500	5,500 329	52,577,642	143,654	.....	.....	.....	.....	5,683,361,324	15,528,309
1857...	3,059,797,730	8,383,007	811,462,085	2,223,183	2,315,832,461	6,344,746	121,948,840	334,654	.....	.....	.....	.....	6,317,903,116	17,309,323
1858...	3,058,418,667	8,379,229	757,187,690	2,074,486	2,819,641,992	7.725,044	204,177,624	559.390	.....	.....	.....	.....	6,839,425,969	18,738.153
1859...	3,390,271,757	9,288,415	868,567.100	2,379,635	2,643.736,620	7.243 114	265,456.170	727,277	.....	.....	.....	.....	7,168,031,647	19.638,442
1860...	3,612.989,017	9,867,378	872,144,980	2,379,727	2,696,960,210	7,360,849	283,646,070	774,112	.....	.....	.....	.....	7,465,740.277	20.382,066
1861...	3.731,785,628	10,224,070	983 805,740	2,695,358	2,527,182,710	6,928,788	353,313,900	967.956	.....	.....	.....	.....	7,596,079,938	20.728,985
1862...	3,564,724,753	9,766,369	909,126,440	2,490.757	3.038,527,420	8,324,732	420.507.810	1,152,076	.....	.....	.....	.....	7,932,886,423	21.733,935
1863..	5,586,712,091	15,306,060	1,182,539,680	3,239,834	2.203,769,280	6,037.724	525,754,090	1,440,422	.....	.....	.....	.....	9,498,775.141	26,024,041
1864...	5,970.801,329	16.358,360	1,090,884,060	2 988,723	1.725,444,660	4,727.245	519,877,803	1,420,548	.....	.....	.....	.....	9,307,007,849	25,498,651
1865...	7,082.015.640	19,402.791	1,429,591,700	3,916,689	2,005.038,484	5,493,266	539,923.360	1,468,283	.....	.....	.....	.....	11,050,569,184	30 275,532
1866...	7,721,817,582	21,155,664	1,271,841.020	4 835,897	947.652,428	3,484.016	606,665,380	1,662,099	108,369,060	537,217	.....	.....	10,614,344,464	29,080,396
1867...	7,990 416,594	21 951,694	427,935,060	3,926,010	1.590.248 454	5.502.590	677,717,190	1,856.759	177.104,200	562.236	.....	.....	10,863,421,498	29,771,018
1868...	8,024,530,911	21,929.053	705,442,350	2,475,825	2,337,365,642	6,401,394	727,824,780	1,987,579	190,015,200	584,776	.....	.....	11,985,178,883	33,378,628
1869...	7,4? 9,611,069	20,519,482	1,042,780,953	2,987,911	2,735,569,020	7.494,710	928,561,494	2,544.004	218,223,800	619,971	.....	.....	12,414,752,336	34,040,409
1870...	8 134,985.170	22,253,242	1,186,131,144	3,443,932	3,003,737,166	8,484 688	*850.011,192	2,426,246	227,946,600	641.277	.....	.....	13,3?2,808,272	37,249,385
1871...	8 821,728,593	24.195,782	1,007.378,521	3,038,640	2,201,294,172	6,117,928	1,054,210,990	2,896,748	‡413,787,205	1,379,775	.....	.....	13,498,399,481	37,631,379
1872...	7,220,091,685	19,898,776	1,474,531,040	4,664,265	2.223 287,070	6,328,765	1,456,756,728	3.998,035	‡518 811,050	2,025,076	.....	.....	13,100,018,461	37,583.594
1873...	8,717,538,594	24,077,029	1,361,109,884	4,444.619	1.508.295,800	4,190,625	1,959,966,670	5.360,343	673,287,495	2,203,928	.....	.....	14,223,198.443	40.276,184
1874...	7,582 023,422	21,504,736	1.558,518,765	4 960,709	1,536,505,220	5,226,608	2 969,227,504	8.138,990	720,165,810	2.281,287	.....	.....	14,533,425,097	42,111,730
1875...	7,994,234,254	†23,833,072	1,839,190,470	5,641,688	1,356,295,950	2,214,340	3,055,507,870	8,371,254	818,339,525	2,487,354	33,592,000	92,033	15,079,160,069	47,639,741

* The works at Belmont were started October, 1870, at which date Twenty-fourth Ward Works were abandoned.

† Included in the Fairmount pumpage, is that of the Worthington Pump, amounting to 324,225,056 gallons, and Avg. 2,819,348 gallons.

‡ The Roxborough Works commenced pumping December 21, 1870. ? The Germantown works were abandoned September 30, 1872.

Table showing the number of days in each month when the water was the same height on the dam.

Inches.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1	2	1			2	1	4		3	4			17
2		1			8		5		4	3			21
3	3		1		2	1	5		7	6		1	26
4	1		2	4	1		2		3	3			16
5	2		2	3	1		7	1	2				18
6	1	1					3		3	3			11
7	2	1	1	2	1		1	1	2	1	1		13
8	1		1					1	1		1		5
9	2	1	3	2			1		1	1	1		12
10		1		2	1				1		2	1	8
11	2	1	5								4		12
12	1	2	2	3				1		4	1	1	15
13	2		2	1				2	2	1	4	1	15
14	1	1	2	1		1	1	1			6	1	15
15	1	2	1	3				2		2	1	4	16
16		1		2				1			1	5	10
17		1						2			1	3	7
18			1	1				1			1	5	9
19	1							2				2	5
20			2					1			2		5
21		1						5				1	7
22				1								2	3
23		1	1					2					4
24								2			1	2	5
25		1	1					2				1	5
26			1								1	1	3
27			1	1							1		3
28			1										1
29			1										1
30								2					2
31													0
32		2		1									3
33													0
34				2				1					3
35													0
36				1							1		2
37													0
38		1											1
39								1					1
40													0
41													0
42													0
43													0
44		1											1

Nine inches must be deducted from the corresponding table in the report for the year 1874, to institute a comparison with this one.

Average Daily Height of Water above or below the comb of Fairmount Dam.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	15	-4	15	32	4	.....	14	5	9	2	9	17
2	14	-8	14	36	3	.....	5	8	8	.....	14	16
3	11	11	13	34	2	-1	5	7	7	2	11	15
4	13	38	12	34	2	.....	2	21	3	3	11	15
5	12	23	11	27	2	-4	3	24	2	2	12	15
6	9	17	9	22	2	-3	5	21	5	2	13	19
7	11	14	9	18	2	-2	2	19	3	1	10	22
8	19	15	11	15	2	.....	3	23	1	3	13	25
9	13	12	12	12	2	.....	2	18	5	3	8	26
10	1	6	11	12	1	-5	2	17	4	6	7	24
11	6	16	11	10	.....	-4	.....	15	3	6	18	22
12	9	15	14	9	.....	-5	3	21	3	4	17	21
13	8	12	26	13	-4	-5	1	25	6	12	15	19
14	7	9	20	14	-4	-4	1	34	2	12	14	18
15	7	7	18	15	-3	-5	-1	30	6	6	14	16
16	3	2	28	16	-4	-3	2	24	4	4	14	16
17	-2	-1	20	16	-3	-4	1	20	3	1	14	16
18	3	-3	13	15	-5	-5	9	23	.....	15	13	3
19	-2	-6	9	12	-3	-6	7	39	7	15	11	10
20	-8	-3	5	10	-3	-4	6	30	13	13	10	12
21	3	.....	5	9	-3	-1	5	25	13	12	11	13
22	-9	1	4	7	-5	-2	6	21	10	7	13	14
23	-7	10	8	7	-4	.....	5	21	6	1	14	15
24	-8	25	3	5	-4	-2	4	19	3	3	27	16
25	4	32	4	5	-3	-4	1	17	1	.....	20	17
26	5	44	7	5	5	-3	5	16	1	3	16	18
27	5	32	11	4	10	-5	4	15	4	3	36	18
28	1	21	23	4	7	1	3	14	3	1	26	18
29	-5	.....	25	4	3	3	3	13	2	12	24	18
30	-5	.....	27	4	2	14	6	13	2	9	20	17
31	-6	.....	29	.....	1	.....	5	12	.....	4	.....	24

This table represents the height of the water above the comb of the new dam, but not the overflow, as a temporary plank or flash-board, 11 inches high, is fastened on the dam, above which the water must raise before any is wasted. The level of the old or legal comb is 9 inches below the present comb of the new dam, and where minus 9 appears it denotes the level of the old dam.

Rain Fall at Philadelphia, from Penna. Hospital Reports.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1810	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32.66
1811	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34.97
1812	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.30
1813	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35.63
1814	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43.14
1815	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34.67
1816	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27.95
1817	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.01
1818	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30.13
1819	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23.35
1820	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.61
1821	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32.18
1822	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29.86
1823	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.85
1824	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.74
1825	0.84	3.26	4.63	.83	1.72	3.59	2.06	3.70	2.61	1.25	1.36	3.72	29.57
1826	1.11	2.13	5.80	3.87	.19	4.655	3 68	2.75	2.00	5.83	1.85	1.28	36.145
1827	2.86	3.55	1.23	2.83	2.50	2.09	2.97	5.75	.79	5.91	4.76	3.26	38.50
1828	2.05	2 75	3.35	3.82	3.49	2.69	5.33	1.51	4.62	1.39	6.71	.26	37.97
1829	5.37	3.75	2.87	4.99	2.68	3.44	4.35	4.61	2.01	2.30	3.97	1.51	41.85
1830	1.63	2.06	4.115	1.815	3.75	5.99	4.07	3.87	2.93	4.31	5.35	5.18	45.07
1831	6.22	2.44	3.97	5.20	1.07	3.56	4.17	5.39	5.33	4.51	1.88	1.20	44.94
1832	4.58	2.66	1.90	2.98	5.40	1.55	2.62	5.69	1.40	3.41	2.59	5 09	39 87
1833	3.97	1.24	2.22	.70	5.88	5.28	4.15	3.39	3.82	10.05	2.18	5.67	48.55
1834	2.49	2.22	2.02	2.83	3.52	3.99	4.35	.62	3.57	3.29	3.01	2 33	34.24
1835	2.75	1.81	3.83	4.33	1.99	6.27	6.55	2.05	2.63	1.22	3.19	2.68	39.30
1836	7.62	2.99	1.75	3.47	2.28	7.31	2.91	1.97	1.82	3.59	3.34	3.61	42 66
1837	2.50	3 58	3.76	2.83	4.86	2.83	5.89	4.06	2.28	.66	3.23	2 56	39.04
1838	2.20	2.19	3.171	3.586	3.577	6.600	2.376	2.780	9.519	4.896	3.350	1.044	45.238
1839	5.037	3.424	1.504	1.507	6.073	3.922	2.516	4.644	2.919	2.831	3.100	6.262	48.739
1840	1.841	3.009	2.626	6.827	2 688	5.948	4 538	5.554	2 502	5.734	2.486	3.647	47.400
1841	7 837	1.387	5 821	6.456	3 269	3 114	3.280	9.102	1.895	3.198	4.224	5.917	55.500
1842	1.358	4.265	2 835	5.307	5.865	3.192	11.805	3.786	1.269	1 712	3 487	3.657	48.538
1843	1.440	2.540	4.415	4.723	2.045	1.686	4.543	9.255	4.856	3.220	4.148	4.041	46.912
1844	4.052	1.449	4.430	1.354	3.091	3.351	5.284	2.399	4.034	5.025	2.951	2.753	40.173
1845	3.760	4.738	2.415	2.580	1.599	3.725	2.763	7.298	2.155	2.529	2.500	3.959	40.021
1846	4.630	3.330	4.598	2.112	3.444	3.300	4.604	4.272	.249	2.444	7.970	3.437	44.39
1847	4.730	4.569	4.700	.585	1.567	3.305	2.765	3.182	8.070	3.000	2.836	5.785	45.094
1848	2.030	1.443	2.756	1.541	4.902	4.433	3.281	1.714	1.805	3.747	2.343	5.007	35.004
1849	.730	2.610	5.470	1.752	3.995	2.195	2.933	6.975	1.404	5.595	2 600	5.836	42.095
1850	4,770	2.870	4.750	2.665	6.500	2.030	5.970	8.329	7.732	1.092	3.320	4.515	54.543
1851	1.230	3.110	3.475	4.565	4.817	3.438	2.524	2.555	1.130	3.025	3.356	2.275	35.500
1852	2.011	2.710	4.270	6.445	3.034	4.030	4.060	4.400	1.293	2.267	6.055	5.174	45.749
1853	1.845	4.440	2.462	3.835	5.173	1.100	6.296	3.088	4.463	3,470	2.320	2.165	40.657
1854	2.331	4.203	1 615	7.750	6.935	2.390	3.024	.842	3.798	1.545	2.834	2.910	40.180
1855	2.337	2.352	1.684	2 050	2.965	7.949	6.400	2.786	4.000	4.111	2.037	5.425	44.096
1856	4.537	1.237	2.232	3.515	2.595	1.986	1.508	6.000	4.014	1.296	2.070	2.937	33.927
1857	3.532	.790	1.831	6.786	5.547	7.500	3.915	7.590	1.105	2.690	1 450	5.550	48.286
1858	2.595	2.285	1.087	4.640	5.015	4.495	1.345	4.941	1.492	1.842	5.615	4.500	39.852
1859	6,675	3.660	6.985	5.610	2.250	6.013	4.071	4.736	7.681	3.132	3.820	3.490	58.123
1860	3.225	2.755	1.415	3.800	3.817	2.855	.995	8.401	2.850	4.520	6.130	3.310	44.093
1861	5.245	2.065	3.925	3.705	6.640	3.880	2.560	3.137	4.402	3.797	4.875	2.092	46.44
1862	4.795	4.640	3.553	4.160	2.308	6.975	2 465	.925	3.980	4.770	4.790	1.650	45.011
1863	4.720	4.680	5.885	7.015	4.510	4.250	6.009	1.447	.875	2.465	2.700	4.633	49.189
1864	1.705	.551	5.170	3.795	8.685	2.345	3.770	1.920	7.165	1.820	3.930	5.145	46.001
1865	3.610	5.825	4.710	2.830	7.210	4.750	2.970	3.770	7.960	3.050	3.960	5.610	56.255
1866	3.145	6.615	2.150	2.930	4.680	2.960	2.520	2.181	8.705	4.145	1.760	3.465	45.256
1867	1.762	3.892	5.465	1.810	7.320	11.025	2.387	15.816	1.720	4.320	2.940	2.730	61.187
1868	3.620	2.520	3.360	5.440	7.005	4.370	3.514	2.056	8.908	1.737	5.280	3.595	51.405
1869	4.280	4.760	5.305	2.120	4.235	5.585	2.885	1.280	3.250	6.320	3.725	5.115	48.860
1870	4.075	2.532	4.060	5.605	6.280	2.895	3.947	5.115	1.710	3.895	2.102	1.889	44.105
1871	3.466	3.086	5.814	1.829	3.383	3.773	6.811	5.971	1.772	4.863	4.293	2.259	47.320
1872	1.267	1.185	3.377	2.497	2.808	4.223	11.215	8.319	3.820	5.363	3.381	3.862	51.117
1873	6.048	5.607	2.242	4.191	4.783	.887	5.553	12.289	4.015	5.889	4.995	1.757	58.286
1874	4.218	2.823	1.595	7.509	2.697	2.664	2.759	6.531	3.987	1.650	2.229	2.249	40.911
1875	2.360	3.284	3.925	1.360	1.575	5.258	4.174	6.584	3.035	1.827	5.544	2.918	41.844

Height of gauge at Hospital, 50 feet above the level of the sea.
The observations from 1810 to 1824, inclusive, were taken at Spring Mills, Pennsylvania.

OPERATIONS

OF THE

Department Shop,

918 CHERRY STREET.

Statement of the Operations of Shop from January 1, 1875, *to December* 31, 1875.

DR.

To stock on hand January 1, 1875,		$7,825 43
470,446 lbs. cast iron castings,		12,426 13
32,672 " wrought iron,		1,008 46
3,598½ " steel,		551 85
17,558½ " brass castings,		3,065 22
11,210 " lead,		770 69
550 gum valves,		704 25
437 galvanized spindles,		154 51
116 tons of coal,		846 00
200 lbs. gasket,		34 00
18 " tallow,		3 24
15 " listing,		2 25
26,046 feet lumber, "assorted,"		1,013 08
Hardware,		2,094 83
Bolts, nuts, and washers,		1,363 27
Wrought-iron tubing,		337 83
Paints, oils, &c.,		567 82
Files,		281 40
Wages paid hands,		21,753 38
		$54,803 64

CR.

By 15 stop-cocks, 4 inch,	at $25 00,		$375 00	
397 " 6 "	at 22 00,		8,734 00	
16 " 8 "	at 50 00,		800 00	
38 " 10 "	at 85 00,		3,230 00	
19 " 12 "	at 120 00,		2,280 00	
1 " 23 "	at 380 00,		380 00	
693 " boxes,	at 4 00,		2,772 00	
308 fire-plugs,	at 36 00,		11,088 00	
379 " cases,	at 18 00,		6,822 00	
566 frames and covers,	at 8 00,		4,528 00	
4,100 ½-inch ferrules,	at 50,		2,050 00	
41 1-inch "	at 50,		20 50	
Repairs for First District,			3,513 24	
" Second "			6,389 59	
Amounts carried forward,			$52,982 33	$54,803 64

Amounts brought forward,	$52,982 33	$54,803 64
Repairs for Third District,	3,403 60	
" Fourth "	5,759 83	
" Germantown District,	4,656 05	
" Manayunk "	1,300 12	
" Fairmount Works,	3,069 93	
" Delaware Works,	1,411 01	
" Schuylkill Works,	2,380 71	
" Side-lever engine, Schuylkill Works,	996 27	
" Belmont Works,	2,887 93	
" Roxborough Works,	2,130 42	
" Storage Reservoir,	350 22	
" Buildings and grounds,	687 83	
" Main office,	467 35	
" Water meter,	341 78	
" Pattern account,	1,408 86	
" Fixed stock,	627 93	
" Pipe-bridge,	132 88	
" Stand-pipe, Roxborough,	460 51	
" Retaining wall, Roxborough Reservoir,	145 29	
" Chestnut Hill Works,	157 24	
	$85,758 09	
Stock on hand, as per inventory,	11,318 37	
To balance, nominal profits of shop,		42,272 82
	$97,076 46	$97,076 46

STOCK ON HAND AT SHOP JANUARY 1, 1876.

4	socket screws,	4-inch	at	$5 00	$ 20 00
24	"	6 "	at	5 00	120 00
30	"	8 "	at	6 00	180 00
20	"	10 "	at	7 00	140 00
6	stop screws,	10 "	at	8 00	48 00
3	"	12 "	at	10 00	30 00
10	square thread screws	4 "	at	5 00	50 00
12	" " "	6 "	at	5 00	60 00
4	" " "	3 "	at	5 00	20 00
2	" " "	8 "	at	6 50	13 00
6	" " "	10 "	at	8 00	48 00
5	" " "	12 "	at	10 00	50 00
17	" " "	16 "	at	12 00	204 00
10	" " "	20 "	at	14 00	140 00
2	" " "	30 "	at	20 00	40 00
2	" " "	36 "	at	25 00	50 00
45	spindles,	4 "	at	5 00	225 00
121	"	6 "	at	5 00	605 00
12	"	8 "	at	5 00	60 00
12	"	10 "	at	8 00	96 00
10	"	12 "	at	10 00	100 00
1,000	pounds bolts, nuts, &c.,		at	15	150 00
75,108	" iron castings,		at	03	2,253 24
32,120	" wrought iron, assorted,		at	06	1,927 20
1,500	" steel, assorted,		at	30	450 00
1,140	" forgings,		at	15	171 00
1,210	" finished brass castings,		at	50	605 00
2,908	" unfinished brass castings,		at	25	727 00
100	" leather,		at	50	50 00
2,250	" lead,		at	07½	163 13
1,500	feet lumber,		at	08	120 00
298	wooden plugs,		at	50	149 00
2	kegs nails,		at	4 50	9 00
96	assorted handles,		at	25	24 00
72	eye bolts,		at	50	36 00
36	caulking irons,		at	1 20	43 20
36	flat chisels,		at	1 00	36 00
204	gum valves,		at	1 40	285 60
12	plug monkeys,		at	6 00	354 00
12	lead pots,		at	7 00	84 00
60	plug nuts,		at	2 00	120 00
48	gum rings,				48 00
66	frames and covers,		at	8 00	528 00
	Hardware, &c.,				330 25
	Paints, oils, &c.,				160 75
	Wrought iron tubing,				195 00
					$11,318 37

Stop-cocks, Stop-cock Boxes, Frames and Covers, Fire-plugs, Cases, Lead, and Gasket, delivered from Shop No. 918 Cherry Street, during 1875.

	3-inch stops.	4 inch stops.	6 inch stops.	8-inch stops.	10-inch stops.	12-inch stops.	16-inch stops.	20-inch stops.	23-inch stops.	30 inch stops.	36-inch stops.	Frames and covers.	Fire-plugs.	Cases.	Stop-boxes.	Pounds of lead.	Pounds of gasket.
First District	4	6	96	.....	.....	.....	.....	.....	.....	.....	.....	124	37	86	168	18,428	900
Second District	1	5	51	10	9	18	.....	.....	.....	.....	.....	96	108	124	115	43,139	1,200
Third District	.....	3	126	.....	.....	.....	.....	.....	.....	.....	.....	141	69	84	212	22,687	1,180
Fourth District	9	13	67	7	9	.....	5	3	.....	2	2	50	26	28	175	37,096	1,350
Germantown	.....	4	72	.....	15	.....	.....	.....	.....	.....	.....	107	43	48	45	25,837	1,750
Manayunk	.....	7	19	.....	5	.....	.....	.....	.....	.....	.....	48	33	42	.....	17,139	100
Fairmount Works	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	50
Delaware Works	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	291	.....
Total	14	38	431	17	38	18	5	3	1	2	2	566	316	412	715	164,617	6,530

Stop-cocks, Fire-plugs and Casings, Stop-cock Boxes, Frames, Covers, and Ferrules, made and fitted up at the City shop from the year 1867 to 1875, inclusive.

	3-inch stop-cocks.	4-inch stop-cocks.	6-inch stop cocks.	8-inch stop-cocks.	10-inch stop-cocks.	12 inch stop cocks.	16-inch stop-cocks.	20-inch stop-cocks.	23 inch stop-cocks.	30 inch stop cocks.	36-inch stop cocks.	Total stop-cocks.	New fire plugs.	Fire-plugs, cases.	Stop boxes.	Frames and covers.	½ inch ferrules.	⅝-inch ferrules.	¾-inch ferrules.	1-inch ferrules.	Total ferrules.
1867...	.....	34	108	1	4	5	5	.....	.....	.....	.....	157	148	227	433	164	1,770	460	137	117	2,484
1868...	1	51	94	2	4	5	.....	.....	4	2	1	164	143	222	492	165	2,501	257	84	24	2,866
1869...	8	71	175	4	6	8	2	4	2	2	4	286	202	291	600	279	3,700	431	50	.....	4,181
1870...	7	93	208	4	4	10	5	.....	.....	6	6	343	223	307	600	317	4,200	450	100	100	4,850
1871...	.....	113	218	9	13	17	7	6	2	6	4	395	176	254	641	459	5,025	100	25	.....	5,150
1872...	15	120	226	8	15	6	.....	.....	.....	4	3	397	226	324	620	409	5,200	100	50	36	5,386
1873...	12	108	406	.....	7	29	8	10	.....	.....	17	597	333	423	920	692	4,400	170	104	31	4,705
1874...	15	104	560	18	12	12	6	3	1	3	2	736	423	653	1,102	635	4,400	100	100	64	4,664
1875...	.....	15	397	16	38	19	.....	.....	1	.....	.....	486	308	379	693	566	4,100	.....	.....	41	4,141
Total.	58	709	2,392	62	103	111	33	23	10	23	37	3,561	2,182	3,080	6,101	3,686	35,296	2,068	650	413	38,427

DISTRIBUTION

OF THE

Water Department

FOR

1875.

DISTRIBUTION.

SERVICE AND SUPPLY MAINS LAID IN 1875.

First District.

Iron Pipes laid in the First, Second, Third, Fourth, Twenty-sixth and Thirtieth Wards.

Street.	Location.	Size. Inches.	Distance. Feet
Alter,	From Gray's Ferry Road to Schuylkill Avenue,	6	1,018
Bateman,	" Wharton to Reed,	6	453
Blackburn,	" Mifflin (north),	6	205
Broad,	" Morris to Castle,	6	237
Cantrell,	" Sixth (west),	6	365
Clarion,	" Reed to Dickinson,	6	432
Dickinson,	" Lingo to Twentieth,	6	1,092
Eighth,	" Mifflin to Snyder,	6	910
Enue,	" Seventh to Eighth,	6	439
Evangelist,	" Termination west of Seventh,	4	124
"	" " " "	10	15
Fifteenth,	" Reed to Castle,	6	1,509
Hanly,	" Wharton (south),	6	279
Jackson,	" Sixth to Seventh,	6	426
Juniper,	" Reed to Dickinson,	6	420
Lingo,	" Tasker (north),	6	364
McKean,	" Tenth to Twelfth,	6	892
Mifflin,	" Eighth to Ninth,	6	445
Mildred,	" McKean to Snyder,	6	416
Moseley,	" Twelfth to Thirteenth,	6	455
Oakford,	" Twenty-seventh to Twenty eighth,	6	446
Richardson,	" Federal (north),	6	336
Seventh,	" McKean to Moyamensing,	6	1,250
Seventeenth,	" Tasker (north),	6	348
Sixteenth,	" South of Dickinson to Moyamensing,	6	2,544
Snyder,	" Twelfth to Broad, north and south side,	6	2,072
"	" Eighth to Starr, " " "	6	460
	Amount carried forward,		17,952

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		17,952
Tasker,	From Seventeenth to Eighteenth,	6	434
Tree,	" Moyamensing to Seventh,	6	300
Twelfth,	" McKean to Snyder,	6	474
Twenty-eighth	" Park to Oakford,	6	206
Waln,	" Reed (south),	6	328
Whisner,	" Twelfth to Thirteenth,	6	440
Winton,	" Sixth to Seventh,	6	467
Connections,	Seventh and Emily,	6	48
"	" " Mercey,	6	121
"	" " Tree,	6	55
"	" " Jackson,	6	24
"	Mt. Holly " Tasker,	6	18
"	Seventeenth and Tasker,	6	15
"	Eighth and Dudley,	4	58
"	" " Hoffman,	4	23
"	private pipe,	4	21
"	for Plugs,	4	121
"	" Henry Bower,	3	50
	Total number of feet of new pipe laid,		21,155

Number of feet of new 3 inch pipe laid,		50
" " 4 " "		347
" " 6 " "		20,743
" " 10 " "		15
Total number of feet,		21,155 Or 3 miles 5,265 feet.

Second District.

Iron Pipes laid in the Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Twenty-fourth, and Twenty-seventh Wards.

Street.	Location.	Size. Inches.	Distance. Feet.
Aspen,	From Forty-eighth to Fiftieth,	6	1,042
Atlanta,	" Thirty-eighth to Thirty-ninth,	6	594
Baltimore Av.,	" Forty-second to Fifty-second,	6	5,698
Belmont Av.,	" Elm Avenue (north),	12	396
Cathedral,	" Forty-ninth, (west),	6	460
	Amount carried forward,		8,190

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		8,190
Centre,	From Thirty-sixth to Thirty-seventh,	6	549
Chestnut,	" Forty-fifth to Forty eighth,	8	1,426
Delancey,	" Twenty-third to Twenty-fourth,	6	292
Elm,	" Fortieth to Fifty second,	10	6,266
Fortieth,	Girard Avenue to Pennsylvania R. R.	6	990
Forty-first,	" " " "	6	654
"	" Walnut to Pine,	6	1,285
Forty-ninth,	" Torr to Cathedral,	6	175
Fifty-second,	" Elm to Pennsylvania Railroad,	6	1,430
Girard Avenue,	" Lancaster to Thirty-second,	6	2,238
Grape,	" Thirty-fifth to Thirty-sixth,	6	400
Grape,	" Thirty-ninth to Fortieth,	6	737
Hamilton,	" Thirty-first to Thirty-second,	6	281
Heston,	" Fifty-second (west,)	6	345
Huron,	" Forty-fifth to Markoe,	6	563
Jefferson,	" Belmont to Forty-third,	6	568
Oregon,	" Lex to Markoe,	6	772
Pine,	" Forty-third to Forty-fifth,	6	850
Powelton,	" Forty-first to Forty third,	6	722
Silliman,	" Eadline to Transcript,	6	417
Sixty-third,	" Market to Haverford,	8	3,338
South,	" Thirty-fourth to the Bridge,	6	1,000
Spring Garden,	" Thirty-third to the Bridge,	12	926
Story,	" Thirty-third to Thirty-fourth,	6	398
Sycamore,	" Thirty-ninth east,	8	308
Thirtieth,	" Chestnut to Locust,	6	1,025
Thirty-sixth,	" Woodland to Spruce,	6	334
Thirty-ninth,	" Grape (north),	6	240
"	" Aspen to Myrtle,	6	838
Westminster,	" Forty-eighth to Fifty-fourth,	12	3,325
Connections for	United States Post Office,	4	10
" "	Centennial Board of Finance,	4	150
" "	South Western Market,	4	21
" "	Plugs,	4	1875
For repairs,		2	3
"		3	23
"		4	350
"		6	25
"		8	14
"		10	12
	Amount carried forward,		43,365

	Size. Inches.	Distance. Feet.
Amount brought forward,		43,365
For repairs,	12	33
"	20	7
Total number of feet of new pipe laid,		43,405

Number of feet of new	2-inch	pipe	laid,		3
"	"	3	"	"	23
"	"	4	"	"	2,406
"	"	6	"	"	24,922
"	"	8	"	"	5,086
"	"	10	"	"	6,278
"	"	12	"	"	4,680
"	"	20	"	"	7
Total number of feet,					43,405

Or 8 miles 1,165 feet.

Relaid Kershaw, between Lancaster Avenue and Fiftieth streets,	4	650
" Thirty-ninth north of Grape,	6	180
" Baltimore Avenue, from west of Forty-eighth to east of Fifty-first,	6	1,395
		2,225

Third District.

Iron Pipes laid in the Eleventh, Twelfth, Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twenty-third, Twenty-fifth, and Thirty-first Wards.

Street.	Location.	Size. Inches.	Distance. Feet.
Almond,	From Ann to Westmoreland,	6	2,652
Belgrade,	" Clearfield to Westmoreland,	6	1,579
Boudinot,	" Cambria to Indiana,	6	528
Clearfield,	" Frankford Road to Jasper,	6	936
Cambria,	" Emerald to Hart Creek,	6	428
"	" Front to Reading Railroad,	6	300
"	" Ormes to Tusculum,	6	714
Clifton,	" Neff to Westmoreland,	6	2,262
	Amount carried forward,		9,399

Street.	Location.	Size. Feet.	Distance. Inches.
	Amount brought forward,		9,399
Dickinson,	From Gaul to Almond,	6	210
Eighth,	" Cumberland to Huntingdon,	6	550
Emerald,	" Venango to Erie,	6	768
"	" Hart Lane to Cambria,	6	480
Hart Lane,	" Cambria to Indiana,	6	654
Hancock,	" 250 feet south of Fitler to Berks,	6	615
Hewston,	" Girard Avenue to Wildey,	6	340
Hope,	" Somerset to Cambria,	6	550
Howard,	" Cambria to Reading Railroad,	6	336
Huntingdon,	" Seventh to Eighth,	6	372
Indiana,	" Sixth to Eighth,	6	810
Knorr,	" Cumberland to Huntingdon,	6	378
Kip,	" Indiana to Cambria,	6	550
Leamy,	" Tusculum to Indiana,	6	972
Miller,	" Clearfield to Westmoreland,	6	1,560
Marshall,	" Huntingdon to Lehigh,	6	550
Mercer,	" Alleghany to Division,	6	514
Orleans,	" Frankford road to Emerald,	6	408
Philip,	" Cumberland to Huntingdon,	6	546
Rosehill,	" Cambria to the Creek,	6	372
Sargeant,	" Cedar to Almond,	6	660
Second,	" 150 feet north of Lehigh to Cambria,	6	950
Siloam,	" Otis to Norris,	6	462
Somerset,	" Front to Sixth,	6	3,139
Thompson,	" York to Adams,	6	396
Turner,	" Venango to a school-house,	6	428
Wood,	" Second to New Market,	6	270
Wyoming,	" Ann to Clearfield,	6	738
Connections,	Cambria and Boudinot,	6	24
do	Emerald and Orleans,	6	24
do	Tioga and Frankford road,	6	48
do	for stops,	6	10
do	" Mitchell & Co.,	4	27
do	" Philadelphia & Reading Railroad,	4	40
do	" Plugs,	4	406
For repairs,		4	248
" "		6	154
" "		8	5
" "		10	5
	Total number of feet of new pipe laid, - - -		29,028

Iron pipes laid in Frankford, in the Third District.

Street	Location.	Size. Inches.	Distance. Feet.
Foulkrod,	From Mulberry to Little Tacony Creek,	6	492
Josephine,	" Church to Oxford,	6	540
Orchard,	" Tacony road to Mill,	6	575
do	" Church to Unity,	6	600
Ruan,	" Thomas to Main,	6	233
Thomas,	" Tacony road to Ruan,	6	1,245
Connection,	Tacony, between Thomas and Paul,	6	70
do	for Plug,	4	62
	Total number of feet of pipe laid,		3,817

Number of feet of new 4-inch pipe laid,		62
" " " 6 " "		3,755
Total number of feet in Frankford,		3,817
Total number of ft. in lower part of Dist.,		29,028
Total number of feet in Third District,		32,845
Number of feet of new 4-inch pipe,		783
" " " 6 " "		32,052
" " " 8 " "		5
" " " 10 " "		5
Total number of feet,		32,845 Or 6 miles 1,165 feet.

Relaid Hancock above Huntingdon with 6-inch pipe, 270

Fourth District.

Iron Pipes laid in the Thirteenth, Fourteenth, Fifteenth, Twentieth, Twenty-eighth, and Twenty-ninth Wards.

Street.	Location.	Size. Inches.	Distance. Feet.
Bailey,	From Jefferson to Columbia,	6	1,020
Bambry,	" Poplar to 288 feet south of Parrish,	6	732
Barclay,	" Fifteenth (west),	6	180
Berks,	" Eighteenth to Nineteenth,	6	468
Brown,	" Taney to Twenty ninth,	6	1,176
	Amount carried forward,		3,576

Street.		Location.	Size. Inches.	Distance. Feet.
		Amount brought forward,		3,576
Cambria,	From	Broad to Germantown Road,	6	2,052
Columbia,	"	Twenty-ninth (west),	6	648
Croskey,	"	Berks to Norris,	6	528
Cumberland,	"	Eleventh to Sixteenth,	6	2,832
Dauphin,	"	West side of Broad to Philadelphia,	6	648
"	"	180 ft. E. of Twenty-sixth to Ridge Av.,	6	3,180
Diamond,	"	Sixth to Seventh,	6	444
"	"	Sixteenth to Seventeenth,	6	468
"	"	Twentieth to Twenty-first,	6	531
Edgley,	"	Twenty ninth to Thirtieth,	6	444
Eleventh,	"	York to Cumberland,	6	504
Fontain,	"	Seventeenth to Eighteenth,	6	444
Girard Avenue,	"	Reading R. R. Bridge to Girard Avenue Bridge,	10	900
Gold,	"	Twenty-third to Pennsylvania Ave.,	6	276
Hare,	"	Twenty-fifth to Twenty sixth,	6	444
Huntingdon,	"	Half way between Twenty-fifth and Twenty sixth to Twenty seventh,	6	672
Lambert,	"	Diamond to Norris,	6	528
Mervine,	"	Cambria to Somerset,	6	552
Monument,	"	Seventeenth to Eighteenth,	6	408
Nevada,	"	Eleventh to Twelfth,	6	432
Nicholas,	"	Twenty-sixth (east),	6	252
Norris,	"	Twenty-first to Twenty-second,	6	444
Oxford,	"	Twenty third to Twenty-eighth,	6	2,268
"	"	Twenty-third (east),	6	204
Parrish,	"	Twenty-fourth to Twenty-seventh,	6	1,344
Ringgold,	"	Parrish (south),	6	108
Shamokin,	"	Twenty-first to Twenty-second,	6	456
Somerset,	"	Eleventh to Thirteenth,	6	912
Stillman,	"	Jefferson to Oxford,	6	492
Swain,	"	Twenty-fifth to Twenty-sixth,	6	444
Turner,	"	Twenty-third to Twenty-fourth,	6	444
Thirteenth,	"	Diamond to Susquehanna Avenue,	6	540
Twenty-fourth,	"	Jefferson to Turner,	6	660
Twenty-fifth,	"	Master to Jefferson,	6	504
" "	"	Jefferson to Oxford,	12	504
" "	"	Fairmount Avenue to Hare,	6	540
Twenty-seventh,	"	York to Huntingdon,	6	1,092
Twenty-eighth,	"	Oxford (north),	6	252
		Amount carried forward,		31,971

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		31,971
Twenty-ninth,	From Susquehanna Avenue to York,	6	1,176
Thirtieth,	" Diamond to Dauphin,	12	1,128
Van Pelt,	" Diamond to Berks,	6	1,056
Woodstock,	" Norris to Diamond,	6	516
Widener,	" Nineteenth to Huber,	6	228
York,	" Broad to west of Nineteenth,	6	2,856
Connection,	for Centennial Market,	4	12
"	" Bergdoll & Psotta,	6	6
"	" Fairmount Park Commission,	4	140
"	" Plugs,	4	600
"	" "	10	24
"	at Broad and Master,	6	48
"	" " " Oxford,	6	48
"	" " " Jefferson,	6	48
"	" Twenty-fifth and Oxford,	6	48
"	" Girard Avenue and R. R. Bridge,	6	36
"	" Thirtieth and Susquehanna Avenue,	6	72
"	" Tenth and York,	6	6
"	" Somerset and Germantown Avenue,	6	12
"	" Oxford and Shellmire,	6	24
For repairs,		3	12
"		4	324
"		6	507
"		8	6
"		10	2
"		16	4
Total number of feet of new pipe laid,			40,910

Number of feet of new 3-inch pipe laid,	12	
" " " 4 " "	1,076	
" " " 6 " "	37,254	
" " " 8 " "	6	
" " " 10 " "	924	
" " " 12 " "	1,632	
" " " 16 " "	4	
Total number of feet,	40,910	Or 7 miles 3,950 feet.

	Size. Inches.	Distance. Feet.
Lowered Ridge Avenue and Cambria,	6	48
Nineteenth and Thompson,	6	48
Twenty-fifth and Spring Garden,	6	48
Sixteenth and Poplar,	6	48
Corinthian Avenue and Ogden,	6	48
Broad and Jefferson,	6	48
Twenty-eighth, between Columbia Ave. and Oxford	6	75
Brown, from Taney (east),	6	250
Twenty-sixth, from Brown (north),	6	100
Tenth and York,	6	50
		763

GERMANTOWN.

Iron Pipes Laid in Germantown District.

Street.	Location.	Size. Inches.	Distance. Feet.
Bethlehem Ave.,	From end of old main to the front of the property of the late John Bohlen,	6	797
Cayuga,	" Broad to Seventeenth,	6	1,363
Evergreen Ave.,	" Perkiomen Pike to Twenty fourth,	6	1,031
Eighth,	" Tioga to Rising Sun lane,	6	810
Humbolt,	" Tenth to Eleventh,	6	446
Maplewood,	" Germantown Avenue to Green,	6	770
Morton,	" East Tulpehocken to Washington,	6	550
Nineteenth,	" Ontario to Westmoreland,	6	557
Ontario,	" Seventeenth to Nineteenth,	6	896
Patton,	" Queen to Penn,	6	381
Queen,	" Wayne to Morris,	6	1,217
Stenton Avenue,	" Terminus to Germantown road,	6	2,357
Tioga,	" Seventh to Tenth,	6	1,100
Germantown Ave,	" Eighteenth to Wister,	10	2,685
" "	" Allen's lane to Chestnut Hill,	16	828
" "	" " " " "	10	4,065
" "	" Allen's lane to Chestnut Hill, temporary pipe,	6	5,772
Cross connections on Germantown Avenue, from Eighteenth to Wister,		6	128
Plug connections,		4	441
Repairs,		3	134
"		4	108
"		6	18
Total number of feet of pipe laid,			26,454

Number of feet of new 3-inch pipe laid,	134
" " " 4 " "	549
" " " 6 " "	18,193
" " " 10 " "	6,750
" " " 16 " "	828
	26,454 Or 5 miles 54 feet.

	Size Inches.	Distance. Feet.
Relaid Germantown Avenue, from Duy's lane to Wyoming,	6	1,760
Manheim, west of Green,	3	290
Morton, from Centre to east of Tulpehocken,	6	2,255
East Washington lane, from Germantown Avenue to Chestnut Hill Railroad,	6	2,999
Lowered, West Washington lane to east of Adams,	4	225
		7,529

MANAYUNK.

Iron pipes laid in Manayunk District.

Street.	Location.	Size. Inches	Distance. Feet.
Ann,	Between Andora and Williams Lane,	10	120
Bowman,	From Thirty-fifth to Norristown R. R.,	6	276
Cresson,	" Robeson to Mechanic,	6	288
Connarroe,	" Ridge Avenue to west of Pechin,	6	1,140
Fowler,	" Jefferson to Mount Vernon,	6	276
Hamilton,	" Green Lane to Centre,	6	468
High,	Between Washington and Levering,	6	36
"	" Washington and Walnut,	6	168
James,	From Ridge Avenue to Norristown R. R.	6	936
Jefferson,	" Fowler to Linden,	6	204
Leibert,	" Robeson to Mechanic,	6	252
Lyceum,	Between Pechin and Manayunk,	6	144
Main or River Road,	" Washington and Fountain,	6	228
" "	" " "	10	12
" "	From Foot of Washington over Bridge,	6	122
Mechanic,	Between Cresson and Leibert,	6	36
Mifflin,	From Ridge Avenue, east,	6	600
Robeson,	" Cresson to Tower,	6	348
Ridge Avenue,	" Williams Lane to Car Depot,	10	5,340
Smick,	" Jefferson to Fountain,	6	600
	Amount carried forward,		11,594

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		11,594
Spencer,	From Norristown Railroad, (west,)	6	144
Terrace,	" Adams to Dawson,	6	504
Thirty-fifth,	Between Queen Lane and Bowman,	6	264
Williams Lane,	" Ridge Avenue and Ann	10	252
Wood,	From Levering to Cotton,	6	444
Connection,	Green Lane and Leibert,	6	12
"	For James M. Preston,	4	324
"	" S. J. Solms,	4	24
"	" Fitzpatrick and Holt,	4	17
"	" Thomas Schofield,	4	75
"	" Nixon's Paper Mill,	4	12
"	" Campbell & Co.,	4	12
"	" Plugs,	4	456
Siphon Pipe across Wissahickon Creek,		20	408
Repairs,		4	29
"		6	36
"		20	12
	Total number of feet of pipe laid,		14,619

Number of feet of new 4-inch pipe laid,	949	
" " " 6 " "	7,526	
" " " 10 " "	5,724	
" " " 20 " "	420	
	14,619	Or 2 miles 4,059 feet.

Lowered,	Spence between Ridge Avenue and Norristown R. R.,	6	252
"	at Mechanic and Leibert Streets. between Leibert and Norristown R. R., and Robinson and Mechanic,	6	180
"	Dawson, east of Cresson,	6	96
"	Gay, west of Wood,	6	84
"	Centre, west of Hamilton,	6	96
			708

Recapitulation of Pipe laid in the several districts during the year 1875.

WARDS.	2-inch.	3-inch.	4-inch.	6 inch.	8-inch.	10 inch.	12-inch.	16 inch.	20-inch.	Total.
First District, 1, 2, 3, 4, 26, and 30	.....	50	347	20,743	.....	15	.....	.....	.....	21,155
Second " 5, 6, 7, 8, 9, 10, 24, and 27	3	23	2,406	24,922	5,086	6,278	4,680	.....	7	43,405
Third " 11, 12, 16, 17, 18, 19, 23, 25, & 31	.....	.....	721	28,297	5	5	.....	.....	.....	29,028
Frankford	.....	.....	62	3,755	.....	.....	.....	.....	.....	3,817
Fourth District, 13, 14, 15, 20, 21, 28, and 29	.....	12	1,076	37,254	6	926	1,632	4	.....	40,910
Germantown	.....	134	549	18,193	.....	6,750	.....	828	.....	26,454
Manayunk	.....	.....	949	7,526	.....	5,724	.....	.....	420	14,619
Total	3	219	6,110	140,690	5,097	19,698	6,312	832	427	179,388

	Feet.		Miles.	Feet.
Pipe laid as per report for 1874	3,320,347	=	628	4,507
" during the year 1875	179,388	=	33	5,148
Total	3,499,735	=	662	4,375

Length of pipe laid previous to and since Consolidation.

YEARS.	MILES.	FEET.
To 1855	265	4,084
1855	6	44
1856	10	2,079
1857	12	324
1858	13	3,484
1859	22	784
1860	19	224
1861	11	2,368
1862	9	954
1863	10	4,161
1864	6	4,287
1865	8	4,754
1866	12	2,964
1867	15	4,971
1868	15	148
1869	22	1,884
1870	26	1,953
1871	30	572
1872	27	3,661
1873	39	4,816
1874	42	3,511
1875	33	5,148
Total, - - -	662	4,375

Statement of fire plugs in the different wards.

First District.

Number of plugs, as per last report,	914	
First Ward,	13	
Second "	2	
Twenty-sixth "	9	
Thirtieth "	1	
	—	939

Second District.

Number of plugs, as per last report,	1,325	
Eighth Ward,	1	
Twenty-fourth "	46	
Twenty-seventh, "	19	
	——	1,391

Third District.

Number of plugs, as per last report,	1,531	
Eighteenth Ward,	2	
Nineteenth "	1	
Twenty-third "	6	
Twenty-fifth "	29	
Thirty-first "	2	
	——	1,571

Fourth District.

Number of plugs, as per last report,	905	
Fifteenth Ward,	7	
Twentieth "	2	
Twenty-eighth "	29	
Twenty-ninth "	9	
	—	952
Amount carried forward,		4,853

GERMANTOWN.

Amount brought forward,		4,853
Number of plugs, as per last report,	270	
Twenty-second Ward,	21	
Twenty-fifth "	8	
Twenty-eighth "	3	
	—	302

MANAYUNK.

Number of plugs as per last report,	174	
Twenty-first Ward,	28	
Twenty-eighth "	6	
	—	208
Total fire plugs in all the Wards,		5,363

The following show the number of attachments made in the different districts during the year 1875, for fire purposes only, in places of public amusement, hotels, manufactories, &c., &c.

Number, as per last report,		138
Second District,	3	
Third "	2	
Fourth "	3	
Manayunk District,	7	
	—	15
Total,		153

There are now 74 public drinking fountains supplied by the Department free of charge, as follows:

Erected by the Fountain Society, as per last report,	61	
Added during the year,	6	
	—	67
Erected by the Society for Prevention of Cruelty to Animals, as per last report,		7
Total,		74

The number of holes drilled for making new attachments to public mains during the year 1875.

Months.	½ inch diameter.	⅝ inch diameter.	¾-inch diameter.	1-inch diameter.	Total holes drilled and attachm'ts made.	Shut-offs.
January	36	3	1	2	42	23
February	24	1	1	2	28	46
March	158	2	2	2	164	59
April	601	8	4	5	618	126
May	495	9	2	7	513	69
June	521	4	7	7	539	62
July	376	6	0	3	385	54
August	471	9	1	6	487	43
September	480	10	3	7	500	35
October	459	23	5	3	490	43
November	548	14	7	3	572	43
December	304	2	5	4	315	35
Total	4,473	91	38	51	4,653	638

Table of attachments in Wards and Districts.

Wards.	½-inch diameter.	⅝ inch diameter.	¾ inch diameter.	1-inch diameter.	Total holes drilled and attachm'ts made.	Shut-offs.
First District, 1, 2, 3, 4, 26, 30.	1,000	4	3	4	1,011	80
Second District, 5, 6, 7, 8, 9, 10. 24, and 27	677	42	14	14	747	134
Third District. 11, 12, 16, 17, 18, 19, 23, 25, and 31	1,023	5	4	23	1,055	174
Fourth District, 13, 14, 15, 20, 21, 28, and 29	1,300	35	14	9	1,358	208
Germantown	206	5	2	1	214	38
Manayunk	267	.....	1	.....	268	4
Total	4,473	91	38	51	4,653	638

Repairs to mains, stops, and plugs during the year 1875.

DISTRICTS.	To mains.	To stops.	To plugs.
First	107	467	730
Second	82	283	523
Third	148	239	566
Fourth	182	609	726
Germantown	48	81	162
Manayunk	40	57	76
Total	607	1,736	2,783

Account of new stops and fire plugs for 1875.

DISTRICTS.	No. of stops.	No. of plugs.
First	48	25
Second	77	66
Third	114	40
Fourth	92	47
Germantown	71	32
Manayunk	45	34
Total	447	244

Number of Valves raised in the different districts during the year 1875.

DISTRICTS.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	Total.
First	3	9	27	3	4	.....	.....	.....	.....	46
Second	14	.....	20	1	2	2	4	1	.....	44
Third	.....	40	22	.....	2	.....	.....	.....	.....	64
Fourth	.....	6	50	.....	4	.....	.....	.....	2	62
Germantown	.....	.....	1	.....	.....	.....	.....	.....	.....	1
Manayunk	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total, 1875	17	55	120	4	12	2	4	1	2	217
" 1874	13	32	111	6	6	3	3	.....	.....	174
" 1873	5	16	51	.....	3	1	6	2	2	86
Total for 3 years	35	103	282	10	21	6	13	3	4	477

LIST OF STOPS COVERED BY RAILROAD TRACKS.

Second District.

Third and Vine, west side.
Fifth and Vine, west side.
Seventh and Spruce, north side.
Fifteenth and Arch, east side.
Nineteenth and Arch.
Twenty-second and Market.
Twenty-second and South, south side.
Thirty-second and Market, south side.
Thirty-eighth and Lancaster Avenue.
Fortieth and Haverford.
Sixty-second and Vine.
Sixty-fourth and Vine.

Third District.

Front and York.
Front and Norris.
Frankford Road and Sargeant.
Fourth and Callowhill.

Fourth District.

Seventh and Master.
Thirteenth and Ridge Avenue.
Thirteenth and Spring Garden.
Tenth and Fairmount Avenue.
Broad and Norris.
Fifteenth and Girard Avenue.

Contents of the several Reservoirs, the height above City Datum, and their area.

Name of Reservoir.	Depth of Water when full.	Contents when Reservoir is full, in U. S. Gallons.	Height of water level above City Datum.	Area of ground occupied by the Reservoirs.	Water area of Reservoirs.
Fairmount	12 ft. 3 in.	26,996,636	94 feet.	20 acres—139 perches	7 acres—58 perches.
Corinthian Avenue	27 " 0 "	37,312,000	120 "	18 " 68 "	4 " 50 "
Schuylkill	16 " 0 "	9,800,000	120 "	11 " 151 "	2 " 108 "
Delaware { Old Section	12 " 0 "	25,757,720	114 "	8 " 158 "	6 " 32 "
Delaware { New "	17 " 9 "				
Belmont	25 " 0 "	40,000,000	212 "	9 " 44 "	6 " 46 "
Roxborough	18 " 6 "	11,771,700	365 "	3 " 126 "	2 " 47 "
Mount Airy	15 " 0 "	4,390,000	363 "	2 " 24 "	1 " 22 "
Frankford	23 " 0 "	35,750,000	167 "	18 " 18 "	5 " 112 "
East Park	25 " 0 "	750,000,000	133 "	103 "	89 " 88 "
Total	.....	941,778,056	.....	.....	.....

The map of the water shed of the Schuylkill River showing its various geological formations is numbered according to the original plan of Rogers, in his geological survey of the State, as follows:

Laurentian, Gneiss north of the New Red sandstone.

Huronian, Gneiss and schist south of the New Red sandstone.

I. Potsdam sandstone and slates.

II. Trenton and lower limestones.

III. Utica shale, and Hudson River slate.

IV. Medina sandstones, and Oneida conglomerate.

V. Clinton shale, limestone, and sandstone.

VI. { Water lime. / Onandaga } shale and limestone.

VII. Oriskany sandstone, chert, and shale.

VIII. { Chemung, Portage, and Hamilton groups. { sandstones, lime, and argillacious and ferruginous shales. / Upper Hilderberg group, limestones.

IX. Catskill or old red sandstone.

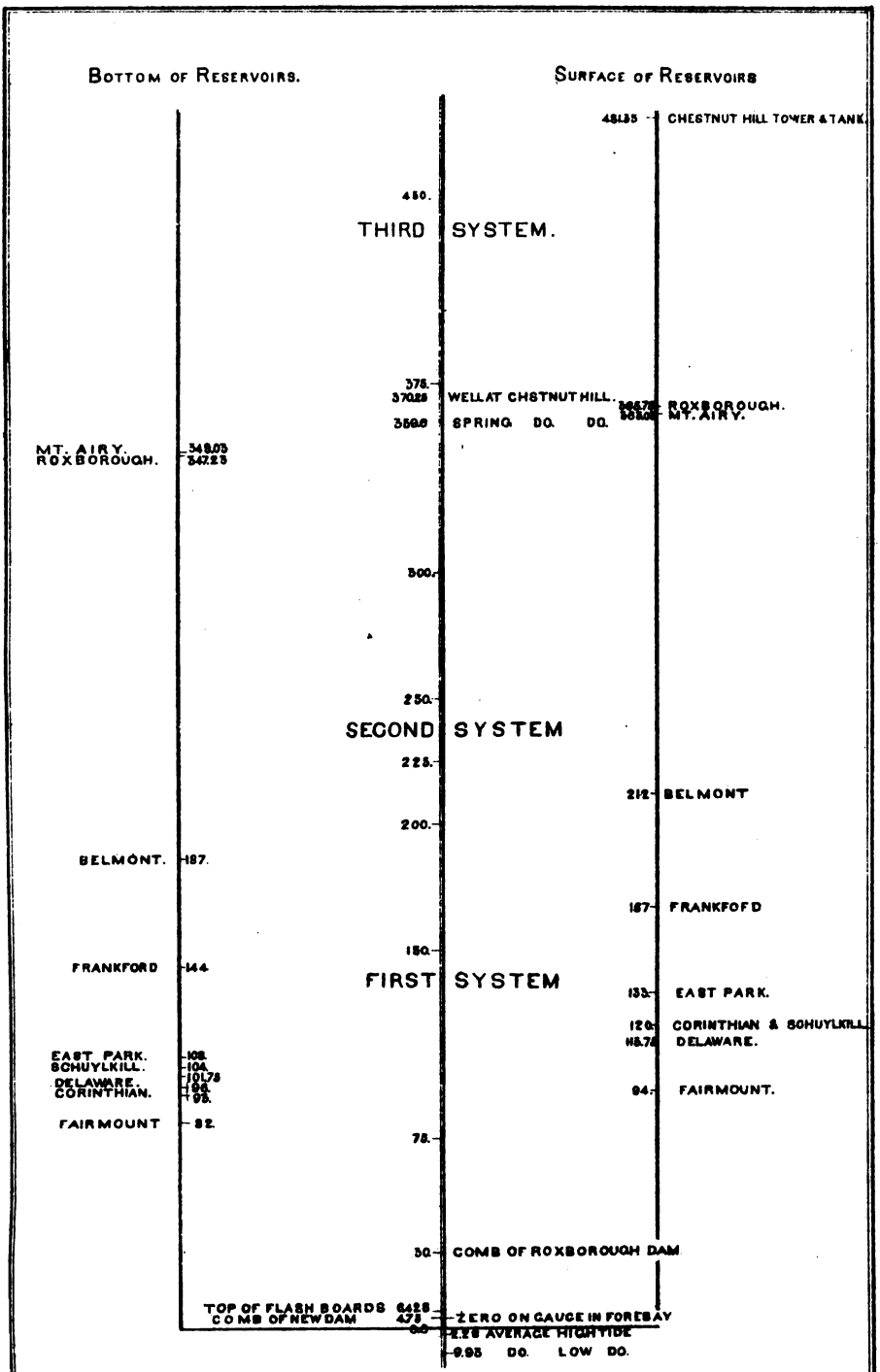
X. Waverly sandstone.

XI. Red shale and limestone.

XII. Coal conglomerate.

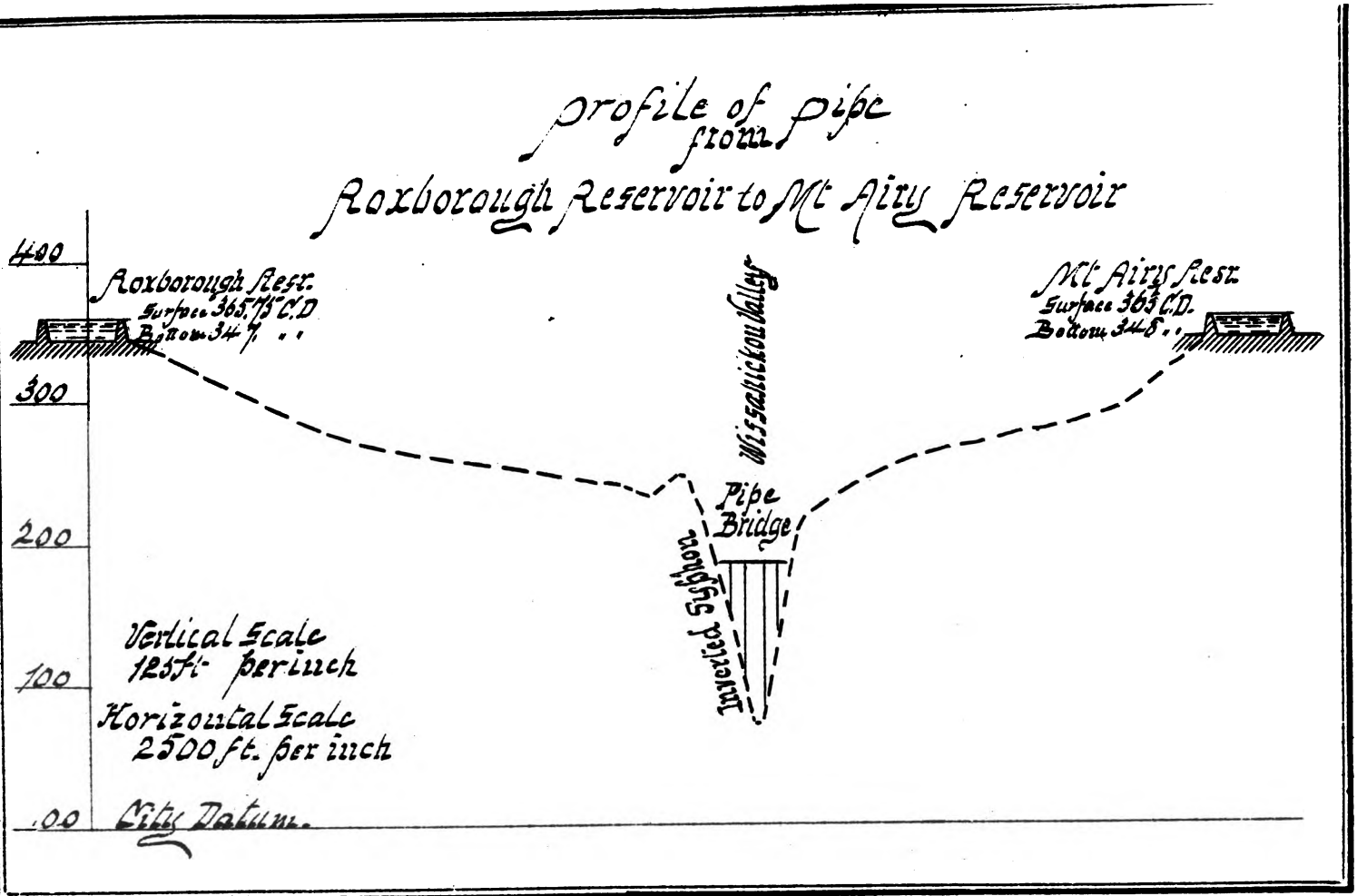
XIII. Coal, conglomerates, sandstones, and shales.

Trias, New Red sandstone. Ferruginous sandstones.



COMPARATIVE HEIGHTS OF RESERVOIRS.

Kryder, 32 S. 7th St., Phila.



OXFORD STREET

STREET

INLET

COLUMBIA AVE.

CAPACITY
62 740 951 GALLONS.

MONTG'Y. AVE. OUTLET

A — B

CAPACITY
526 969 009 GALLONS.

DRAIN

CAPACITY
311 639 614 GALLONS.

TOP OF EMB'K. 136 C. D.
TOP OF DIV'G. EMB'K. 135 C. D.
WATER LEVEL 133 C. D.

BOTTOM OF RES. 108 C. D.
DEPTH OF WATER 25 FT.

NORRIS ST. OUTLET

DRAIN

DIAMOND STREET

TOTAL CAPACITY OF RESERVOIR
701 319 554 GALLONS

THIRTY THIRD

PLAN OF
EAST PARK RESERVOIR

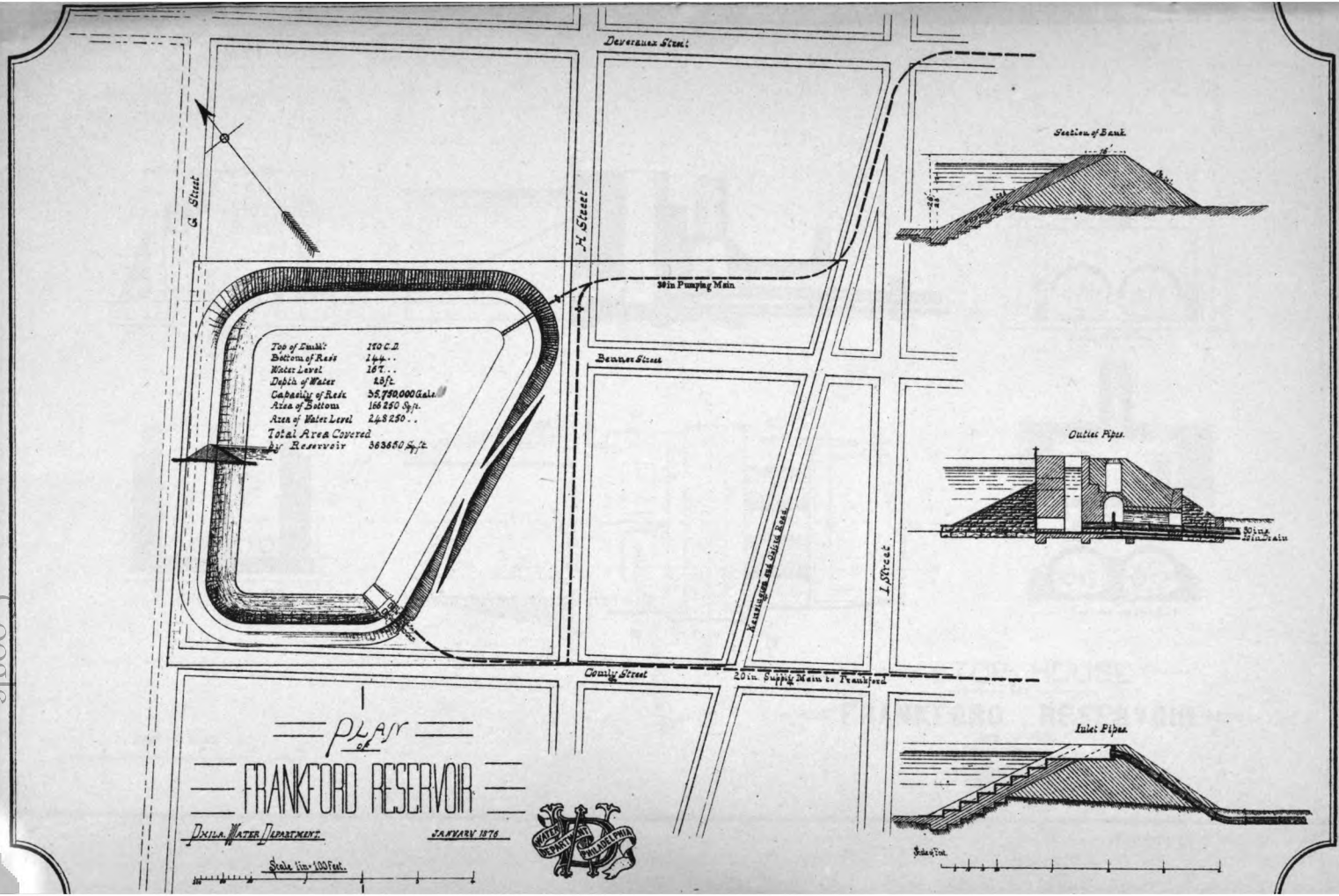
SUSQUEHANNA AVE.

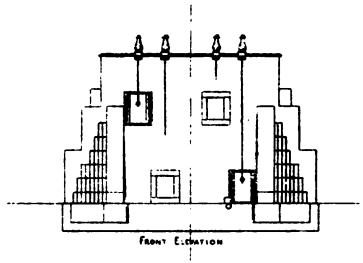
50 100 200 400 Ft.

SECTION THROUGH A—B

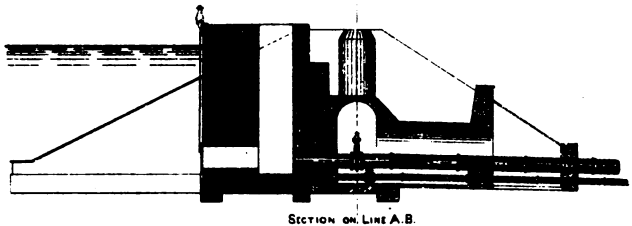
0 10 40 100 Ft.

1875

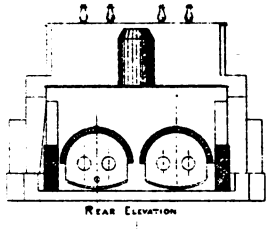

Devereaux Street
G Street
H Street
I Street
30in Pumping Main
Benner Street
Kensington and Oxford Turn.
Comly Street
20in. Supply Main to Frankford
Top of Embk. 110 C.D.
Bottom of Resr. 14ft..
Water Level 18ft..
Depth of Water 43ft.
Capacity of Resr. 35,750,000 Gals.
Area of Bottom 166250 Sq.ft.
Area of Water Level 248250..
Total Area Covered by Reservoir 363650 Sq.ft.
Section of Bank.
Outlet Pipes.
Inlet Pipes.
Scale 1in.=100Feet.
PLAN of FRANKFORD RESERVOIR
PHILA. WATER DEPARTMENT.
JANUARY 1876
WATER DEPARTMENT PHILADELPHIA



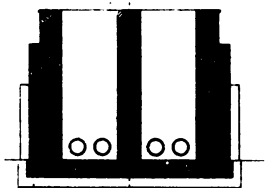
Front Elevation



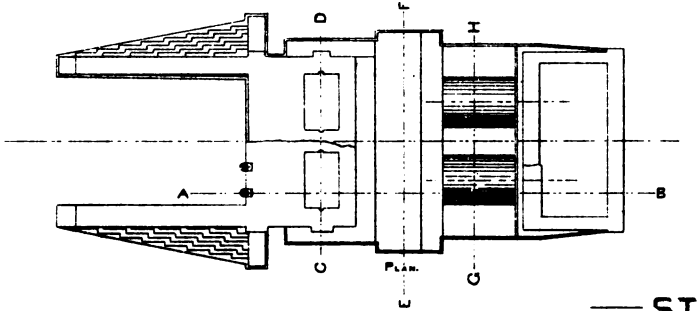
Section on Line A.B.



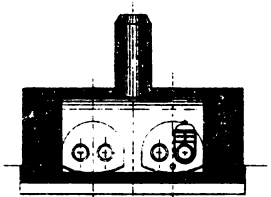
Rear Elevation



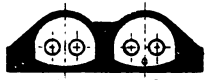
Section on Line C.D.



Plan.



Section on Line E.F.

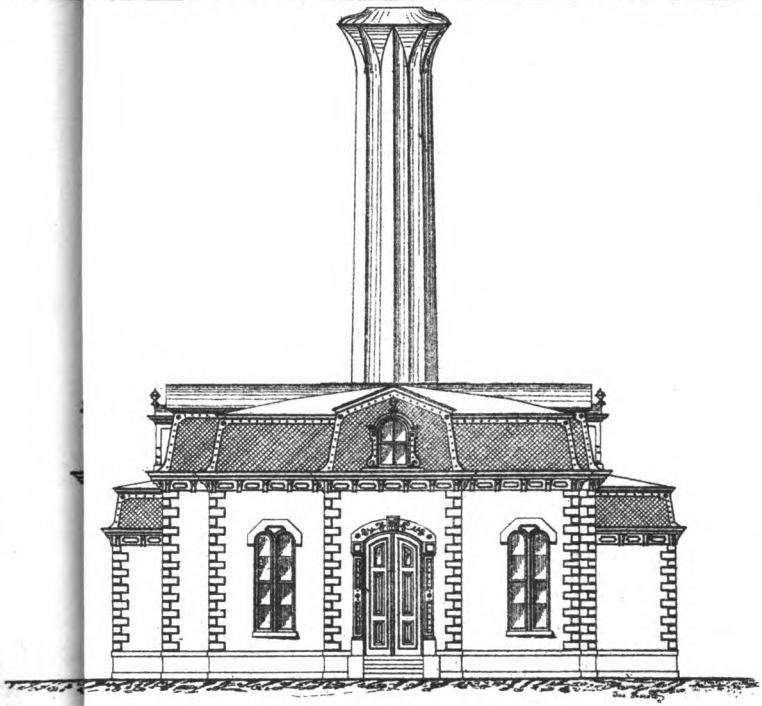


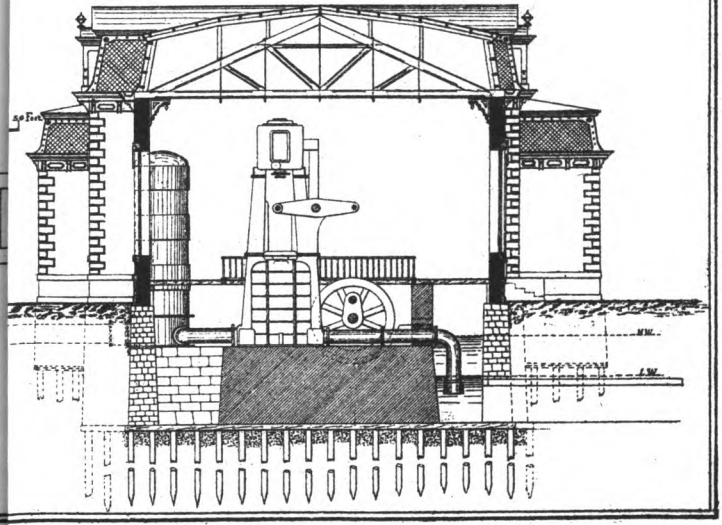
Section on Line G.H.

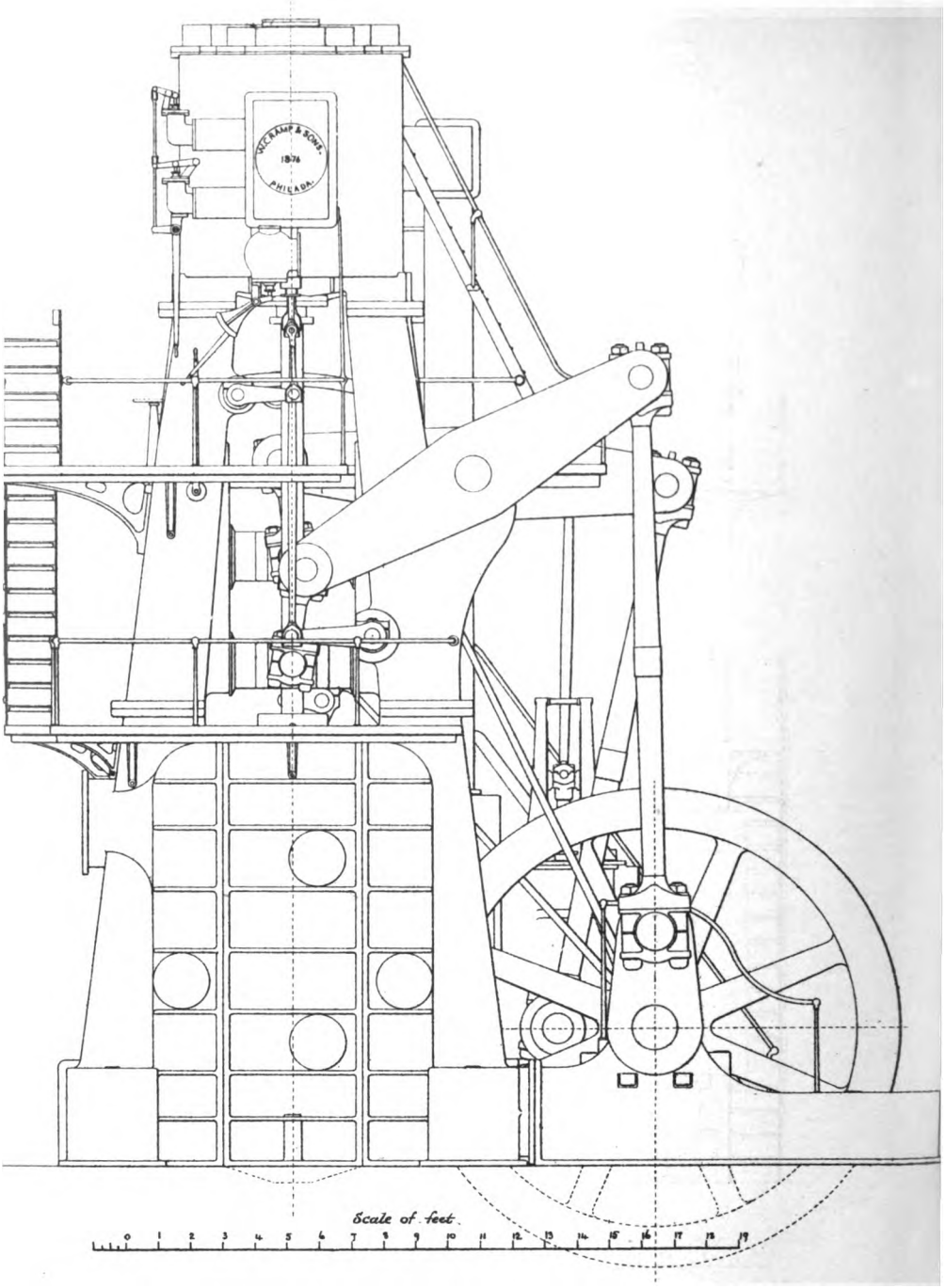
STOP HOUSE
for
FRANKFORD RESERVOIR

Scale of Feet.

Kryder, 32 S. 7th St., Phila.





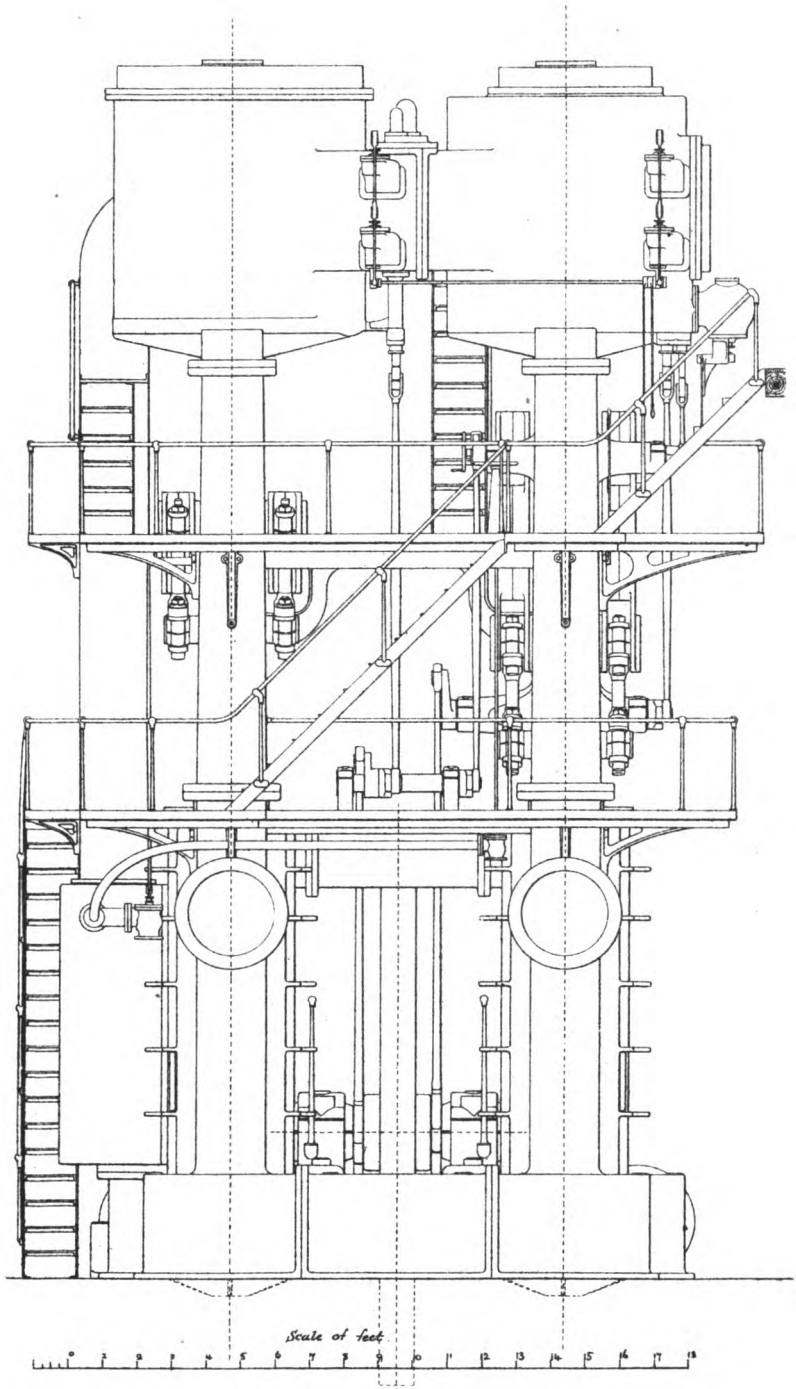


20,000,000, COMPOUND ENGINE, FOR SCHUYLKILL WORKS.

Designed and Contracted for, by the

W. CRAMP & SONS' SHIP & ENGINE BUILDING COMPANY.

DESIGN APPROVED BY W.H.Mc.FADDEN CHIEF ENGINEER WATER DEPT.



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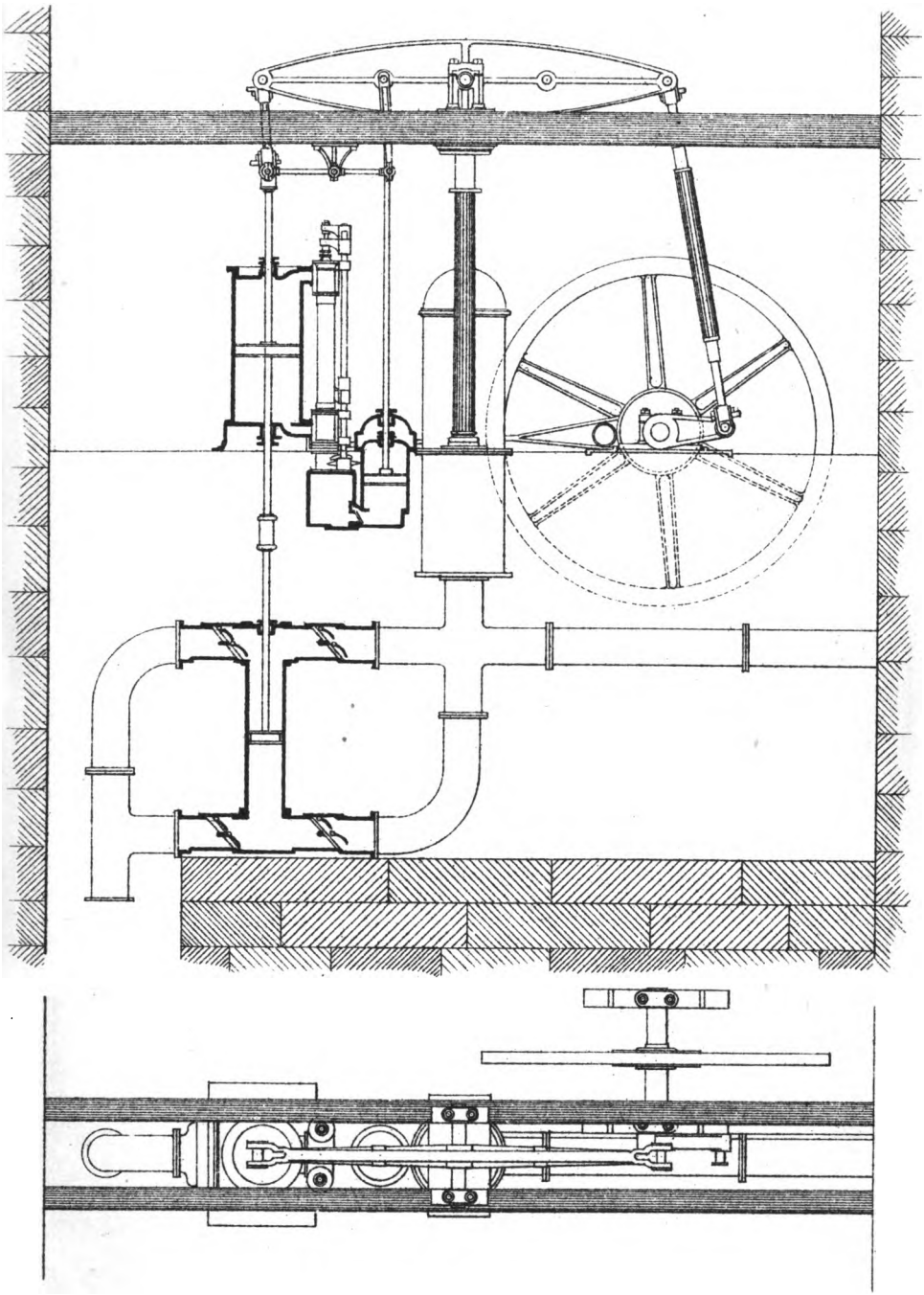
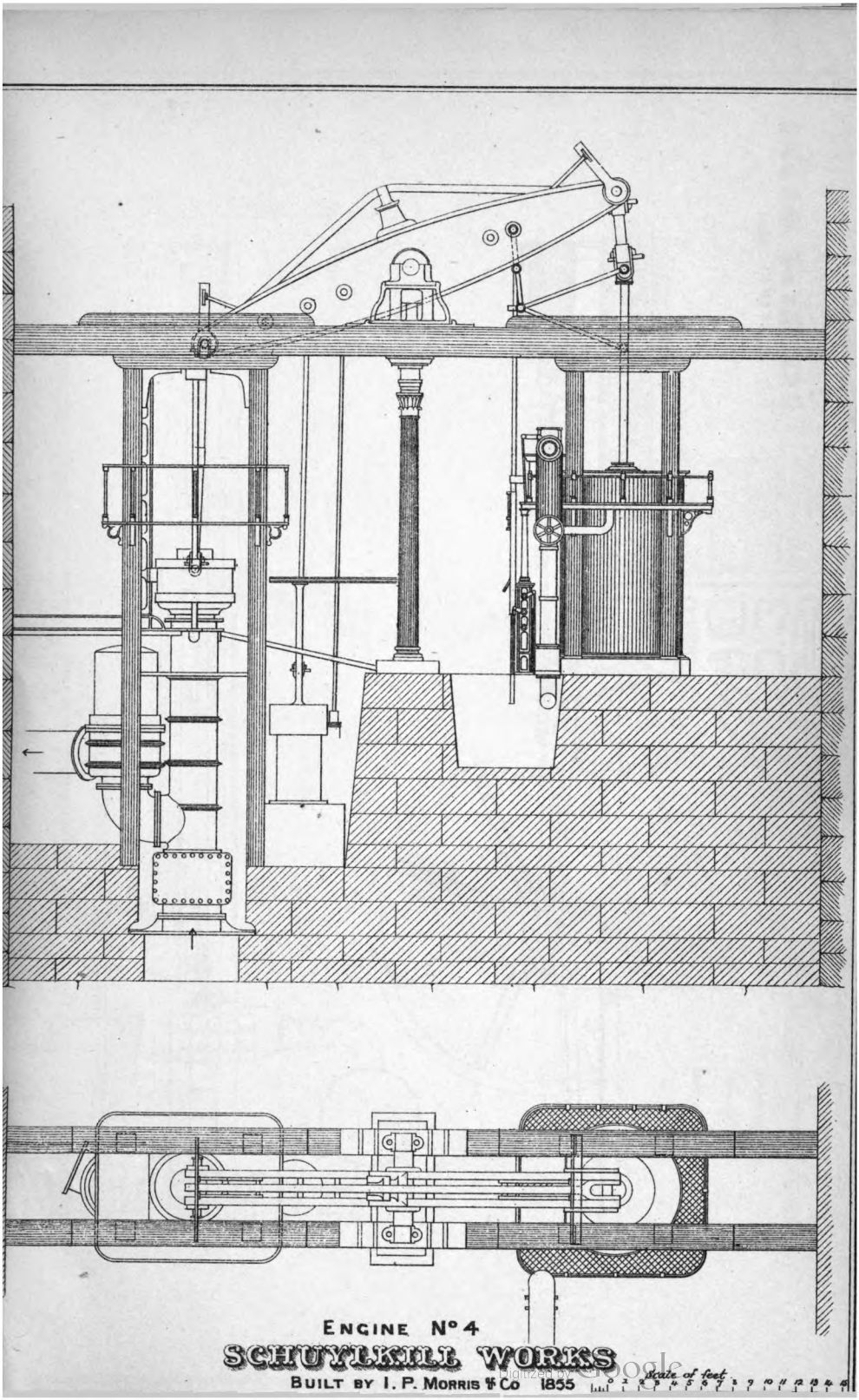


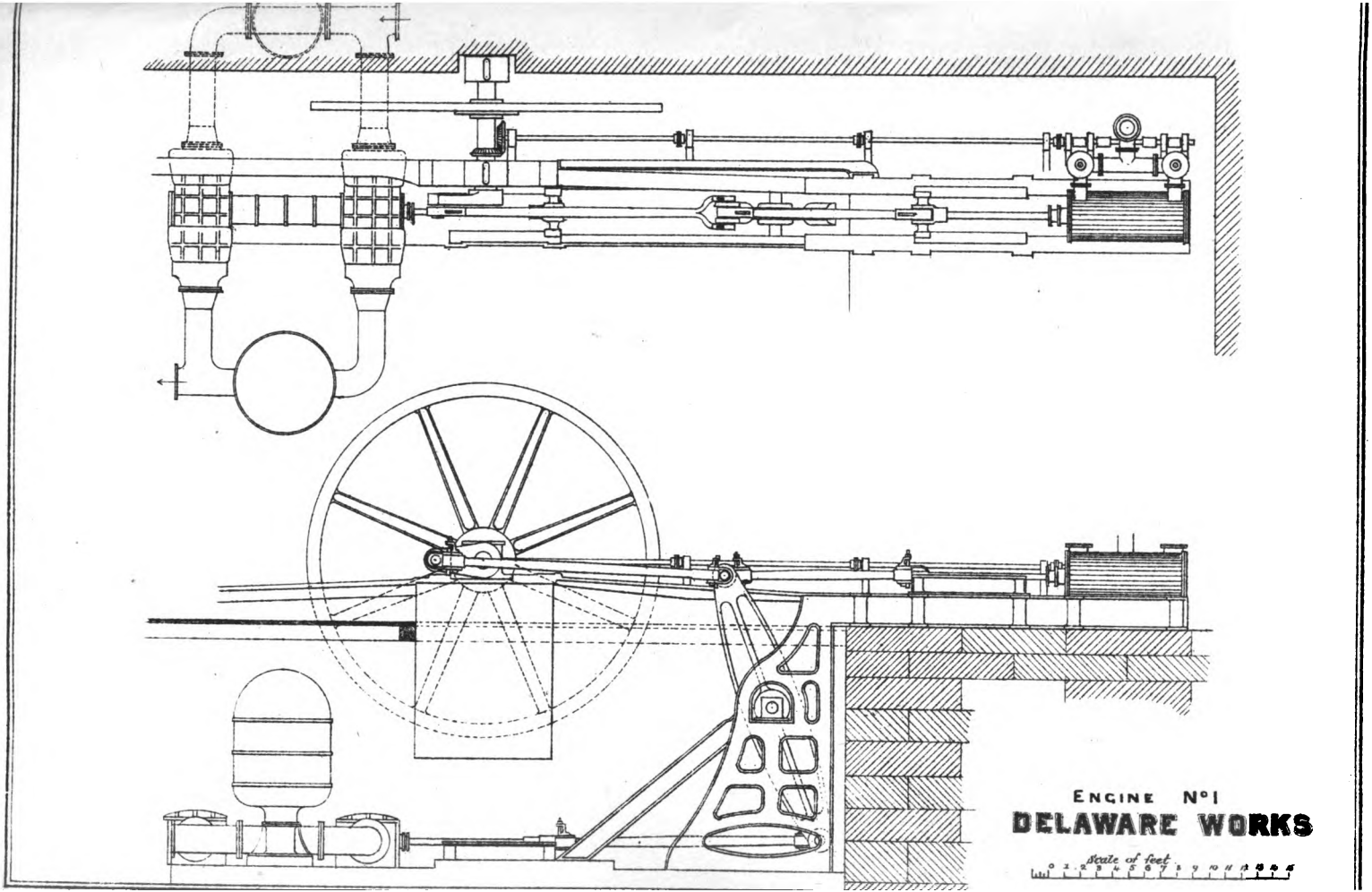
ENGINES Nos 1 AND 2

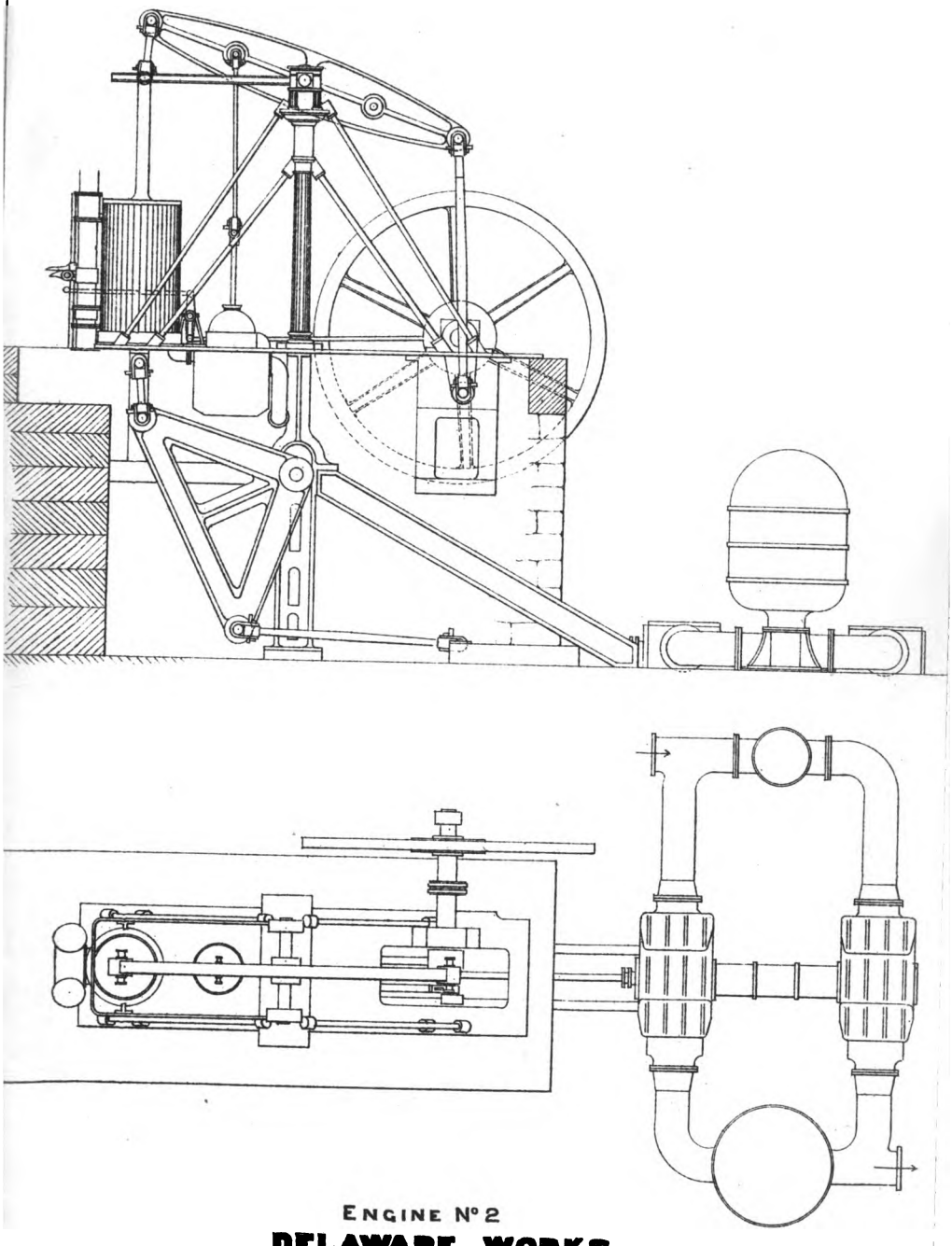
SCHUYLKILL WORKS

BUILT BY MERRICK & TOWNE

1844


ENGINE Nº 4
SCHUYLKILL WORKS
BUILT BY I. P. MORRIS & Co 1855
Scale of feet





ENGINE Nº 2

DELAWARE WORKS

BUILT BY REANEY & NEAFIE

1851

Scale of feet