DEPARTMENT

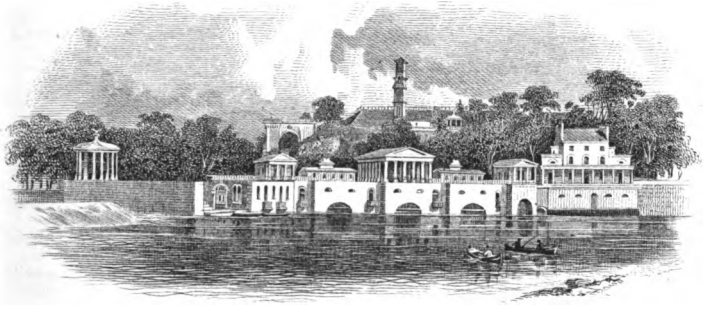
FOR

SUPPLYING THE CITY WITH WATER.

ANNUAL REPORT

OF THE

Chief Engineer of the Water Department



OF THE

CITY OF PHILADELPHIA,

For the Year 1876.

PRESENTED TO COUNCILS OCTOBER 2D, 1877.

PHILADELPHIA:
1877.

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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 Clerk.*
THOMAS J. LISTER, *Messenger.*

Superintendent of City Shop.—JAMES F. NEALL.

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 Sts.
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.

CHARLES D. THOMAS, *Chief Clerk.* JAMES H. WATSON, *Receiving Clerk.*

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,	F. 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, 1877.

C. THOMSON JONES, *Chairman.*

JOHN W. BAKER,
B. FRANK BONHAM,
GEORGE W. BUMM,
JOHN C. BICKEL,
JOHN G. BROOKE,
JOHN BARDSLEY,
SAM'L C. COLLINS,
FRANKLIN DUNDORE,
JOHN FULLERTON,
JOHN FOX,
J. C. GILBERT, M. D.,
ISAAC J. GRIFFITHS,
GEO. E. HALL,
E. HICKS HAYHURST,
SAM'L R. MARSHALL,
JOHN RINK,
AMOS M. SLACK,
BENJAMIN SALTZER,
GEORGE A. SCHAFFER,
JAMES C. SHEDWICK,
JOS. H. TATEM,
CHAS. W. WEYMAN,
EDW. W. PATTON.

GEORGE A. SMITH, *Ex-officio.*
JOSEPH L. CAVEN, *Ex officio.*

OFFICERS.

Chief Engineer.—WILLIAM H. McFADDEN.

Assistant Engineers.

JOHN L. OGDEN, CHARLES G. DARRACH, JOHN TRURAN.

JACOB HEROLD, SURVEYOR.

General Superintendent of Works.

ROBERT McFADDEN.

Chief Clerk.—GEORGE F. KEYSER.

Sam'l P. Ferree, *Assistant Clerk.*
John E. Codman, *Draughtsman.*
William H. Mettam, *Telegraph Operator.*
George W. Eckert, *Pipe Clerk.*
William L. Foreman, *Master Clerk.*
Thomas J. Lister, *Messenger.*

Superintendent of City Shop—JAMES F. NEALL.

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Delaware.—John Penn, Jos. Thompson.
Belmont.—Abraham Stott, C. Betzold.
Roxborough.—J. Hughes L. Culp.
Chestnut Hill.—William Gaffey.

REGISTRAR'S DEPARTMENT.

Registrar.—JOHN N. HAGEY.

CHARLES D. THOMAS, *Chief Clerk.* JAMES H. WATSON, *Receiving Clerk.*

Permit Clerks.

WILLIAM J. HALLIDAY, GEORGE KEARNEY.

General Clerks.

CHARLES ZELL,
ISAAC R. MULOCK,
GEORGE MACAULEY,
R. F. MUSTIN, JR.,
GEORGE BECK,
FRANK FREDERICKS.

Inspectors.

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E. D. Thomas,
Wm. H. Hergesheimer,
Jacob H. Boon,
James M. Rowe,
Joseph Edwards,
Joseph B. Totten,
John H. Neveil,
William Erwin.

REPORT

OF THE

CHIEF ENGINEER.

REPORT.

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

GENTLEMEN:—Honored, for the fourth time, by your suffrage, it becomes my duty, in accord with law, to submit a report of the operations of the Water Department for the year ending December 31, 1876.

In your wisdom, the tenure of office of the Chief Engineer has been extended in its term from one to three years. This should dignify the position, empower the Head, guarantee the obedience of subordinates, command better discipline, insure greater economy and efficiency in the management, and obviate the yearly conflict for a change in administration.

Few can appreciate the difficulties and arduous duties of the position, and no one, in a period less than four or five years, can so grasp the minutiæ of such a department as to apply the proper remedies. This extension of the term of office will afford the opportunity for a thorough study of the complexities of so disjointed and mixed a system of water supply, by means of water power and steam power, and to elevations so varied as are involved in raising water to the first, second, and third systems, with the supplemental lifts. This will allow time for the projection, approval, and consummation of some plan, commensurate with the importance of an adequate, present and future, supply of pure and wholesome water. Philadelphia demands the largest pumpage of any city, except London, which it is destined to rival in population and wealth, if advantage be taken to develop her natural resources.

As in the past, so in the future, my aim shall be to collect and

classify facts, from which to deduce principles for future guidance, and to embody them in the reports of the department for convenience of reference and the intelligent co-operation of the co-ordinate departments of the municipality. This will obviate the necessity for making the departments dependent upon a system of centralization, and that harmony of action will be obtained, which, though wisely denied in law, will be more efficient, inasmuch as it will be voluntary and co-operative, while each department can act independently within its own sphere.

For lack of proper data, rarely of record, a long time is required to get the control of a large department, and constant vigilance is needed to keep it to a proper standard, and much study to co-ordinate the elements of necessity, economy, utility, and efficiency in the growth and development of a large city where private enterprise demands large public works, involving heavy expenditures.

Checks have been and will be introduced from time to time to render the organization of the department more efficient and economic. To this end not only your aid, but the hearty co-operation of intelligent citizens is solicited, whose help and sympathy are invaluable, but whose antagonism is destructive of efficiency.

As a basis for intelligent future action, a topographic map of the city, with its street grades and water mains, has been prepared, and is the first published, I believe, of any of our large municipalities; also, a list of the sizes and lengths of the pumping mains, plans also of the 700 miles of pipes laid, their sizes, the valves used to control the distribution, the fire-plugs erected, stops located, valves raised, and in book form an alphabetical list of the streets in which pipes have been laid, the year when, the size, &c., and the names given to the streets at different periods. Other valuable tables have been included, such as the rainfall, its quantity in twenty-four hours, for a period of 13 years, from 1864 to 1876, as obtained from the reports of the Pennsylvania Hospital, the daily flow of the River Schuylkill, its volume, and overflow at the dam, tables of the daily operations of each of the

machines at the pumping stations, including the cost of coal, wages, and repairs, in lifting water by the million gallons 100 feet high, also into each of the basins, and the cost of pumping by water power and by steam power, a table of the number of feet of pipe laid in different periods, and the yearly average of 36 miles per annum for the last four years, showing the unprecedented growth of the city, and what it is destined to become, under a judicious, enlightened, and far-seeing policy.

The operations of the Cherry Street shop will be found, showing the amount of repairs and work done, and the repairs to the machinery—the most of which has been performed this year, by the employees of the department. This shop is too small for its present purpose, and should be removed to a location that will accommodate the purveyors of the second and fourth districts, with room for storage and a suitable building for a machine shop to meet the necessities of the department. Such a location can be had either north and east of Girard Avenue Bridge, or north and west of Callowhill Street Bridge, on ground under the concontrol of the Park Commission. The former would be the more central location, convenient to all the pumping stations where much of the work has to be done. This I would recommend to your favorable consideration, and hope for its early approval.

Tables will be found showing the receipts of the Registrar's department, sources whence derived, the growth, increase, and prospects, the amount collected by the City Solicitor, and the amount sent to him to be entered of lien for water pipes, and the parties to whom water is furnished gratuitously, or at a merely nominal figure, also the itemized expenditures for maintenance and construction, the latter from loans, the former from taxation as furnished by the annual and special appropriations.

PERCENTAGE OF WATER PUMPED AT EACH STATION IN 1876.

	U. S. gallons.	Percentage.
Total by all the works.....	17,473,308,039	
Total at Fairmount Works.....Water Power.	8,374,657,743	.480
Total at Fairmount Works..... Steam Power.	172,505,781	.009
Total at Schuylkill Works..... " "	2,179,733,340	.125
Total at Belmont Works..... " "	3,748,651,929	.215
Total at Delaware Works..... " "	2,011,301,489	.115
Total at Roxborough Works..... " "	935,702,907	.053
Total at Chestnut Hill Works... " "	50,754,850	.003
		1.000

The total pumpage at all the works was 17,473,308,039, an excess of 2,376,149,970 gallons, or nearly one-seventh more than in any previous year. The daily average was 47,741,279 gallons. The maximun nearly 72 million gallons. The minimum, 27 million.

The above table presents the quantity and percentage pumped at each station.

An examination of the table of the pumpage since consolidation demonstrates that the consumption, as measured by the amount pumped, doubled in 8 years, from 1854 to 1862, and that it will double again in 16 years, or by 1878, upon which we can predicate another doubling of the consumption in 32 years, or in 1910, when the population of the City will be between 1½ and 1¾ million inhabitants, and the daily average demand of water 100 million gallons, the maximum 150 million, and the minimum about 60 million.

From 1810 to 1849, the yearly increment in the amount pumped was 43,600,000 gallons; from 1849 to 1877, it was 540,000,000 gallons, or 12 times as much.

ERRATA.

On page 10, Table of Percentage of Water pumped at each Station in 1876, percentage column, for .480, .009, &c., read 48.0, 00.9, 12.5, 21.5, 11.5, 05.3, 00.3, and 100.0.

Table J, in column "lift in feet," for 121′–96″, read 121.96.

DISTRIBUTION.

Iron Water Pipes laid in Philadelphia.

	No of years.	Total ft. laid.	Average per year in ft.	Average miles per year.
From 1819 to 1854, inclusive.	36	1,278,922	35,526	About 7 miles.
From 1855 to 1872, inclusive.	18	1,628,640	90,480	About 17 miles.
From 1873 to 1876, inclusive.	4	759,988	189,997	About 36 miles.
Total.....	58	3,667,550	63,233	About 12 miles.

During 1876, 144,593 feet, or 27 miles 2,033 feet of pipe were laid, making a total of nearly 700 miles. The above table demonstrates the yearly average in periods since 1819, when cast-iron pipes were first laid, and wooden pipes ceased to be longer used for mains.

Hereafter petitions for the laying of water-pipes should be accompained with a certificate of dedication from the Survey Department, and also a certificate from the Highway Department that the street has been graded, in addition to which the following proviso should be enjoined: "Whenever any one or more of the petitioners call upon the Water Department and pay for the frontage, thereupon, the Chief Engineer be instructed and directed to proceed and lay the same." This would be an earnest of the necessity for the pipe, and would insure a speedy return to the City of the outlay. This would not obstruct citizens in getting accommodated with water-pipe, but would check its introduction where not absolutely necessary. That not paid for in advance could be liened as at present. The number of fire-plugs is 5,567, of which 204 were added during the year. The number of valves is not tabulated, but is estimated at 12,000, 73 of which were raised this year, making 550 in four years.

A schedule of outlets and their water rates accompany the report, whereby each consumer can readily determine his or her water rent, and should be required under penalty to make a cor-

rect return. This would materially increase the receipts of the department and check any collusion between consumers and inspectors, whose duties then would be to detect any violation of the regulations, rather than as now to determine the rental.

Inasmuch as the water rates are very low, considering the amount of water used, an increase of 10 or 20 per cent. could not be regarded as onerous or exorbitant.

As this department is one of profit to the city, the necessary extensions and improvements could and should be provided from its receipts. The surplus over and above its maintenance should be set apart for the purpose of placing the city beyond any contingency in its water supply, and providing the means of furnishing the water in its most palatable form, both to sight and taste, by filtration, either by subsidence or filter beds or both.

The building inspectors, a co-ordinate branch of the municipality, should be required to furnish a daily duplicate of building permits issued, with all the particulars as to location, size and kind of structure to be erected.

Great advantage would accrue to the department if the mercantile appraisers could be induced or required to furnish a list of places where licenses are granted for the sale of liquors, &c. Such recommendations are suggested for your consideration that ordinances may be framed to accomplish the object in view.

RECEIPTS.

The total receipts, for the year 1876, were $1,199,754.97; of which $5,694.98 was received at the office of the Chief Engineer, and $1,194,059.99 at the office of the Registrar, an increase over 1875 of $33,714.85, and an excess of $12,059.99 above the estimate submitted to the City Controller. The amount from liens for water pipe collected by the City Solicitor was $52,259.95, as per report to this department, and $81,181.48 returned to him to be entered of lien for water pipe. The amount for water pipe collected by the Registrar was $115,034.27; and for water rents, delinquents, fractional rents, and penalties, was $1,079,025.72. The

increase by reassessments was $72,010.75, and the duplicate for 1877 is $1,161,520.50.

The total receipts were in excess of total expenditures, loans included, $98,731.16. Of the expenditures $376,375.96 was from loans, leaving $724,647.85 from annual and special appropriations, of which $100,000 should have been from a loan account, but was authorized from the annual appropriation to lay the 48-inch main between the Spring Garden and Corinthian basins, and to provide foundations for the new 20 million engine designed, constructed, and erected by contract for the department, by the Wm. Cramp & Sons Ship and Engine Building Company of this city.

If to the difference between the receipts and the expenditures from the annual and special appropriations, amounting to $475,107.12, the profits, excluding the expenditures from loans, there be added the above $100,000, and the amount sent to liens for pipe, $81,151.48, the profits of the year would amount to $656,258.16. This is a fair statement of the profits of the department for the year, as enough water is furnished gratis or at nominal rates to pay the interest on the loans.

The average economy of the pumping engines at the different works, to lift one million gallons 100 feet high, is as follows, assuming the cost of coal at $4.50 per ton of 2240 pounds:

At Delaware,	$5.94, or 1.32	tons per	million	100 feet high.
At Roxboro,	$5.10, or 1.13	"	"	"
At Belmont,	$5.08, or 1.13	"	"	"
At Sp. Garden,	$4 26, or .95	"	"	"
Cramp Eng.	$3.06, or .68	"	"	"

PLAN.

There cannot be anything more desirable than an abundant supply of pure and wholesome water. Upon such depends the health, growth, and prosperity of a city. To this end there are only three modes of supply,—by gravity, water power, and steam power, if we except artesian wells, which none would re-

commend as an adequate source of supply to furnish a large city, besides the objection to the mineral character of all such waters dependent upon the variety of strata through which they percolate.

Gravity and purity should be, and practically are, synonomous, and this mode becomes a necessity if a pure and healthy water cannot otherwise be obtained. In determining such a question, an Engineer must never lose sight of the size of the check which can be drawn upon the banker, upon whom depends the successful result and profitable issue of every engineering scheme or project. This question demands a careful comparison of the interest on the capital involved, and the expense of operating, which make up the cost of pumping each million of gallons of water each hundred feet high. Gravity demands looking ahead for many years, at least a generation, in which the interest on the outlay becomes a formidable element.

The experience of New York and Boston with the gravity plan proves that, however much there is to recommend it on the ground of the purity of the supply, there cannot be much to favor it on the score of economy, and besides at certain seasons the purity of the supply has been very questionable.

A water power plan, while involving a comparatively small *expense* for pumpage, involves a large element for interest, in providing impounding reservoirs, by flooding large areas, where storage could be obtained to provide for times of minimum rainfall. The same holds against storage reservoirs in cities, as at the head waters, or along the valley of the stream. Moreover, there is no assurance of any greater purity than by a steam supply, which involves maintaining the purity of the source, and the extra amount of machinery to provide against breakage or accident.

Many elements enter into the solution of such a problem, but as all the conditions have been worked out and are known, as it applies to our city, a comparison may clearly demonstrate why as a matter of purity, a gravity source is to be preferred, while,

as a matter of economy, steam power is our only hope, in the present financial condition of the city.

The present consumption averages 50 million gallons per day; one hundred million gallons per day will be required in 30 years. The cost of pumpage at present amounts to $180,000 per annum, half by water power, at an expense of $18,000, the other half by steam power at a cost of $162,000. The cost of one hundred million gallons per day will amount to $504,000 per annum, one-fourth by water power and three-fourths by steam power. A gravity supply for less than one hundred million gallons per day would not be thought worthy of recommendation. The lowest estimate that has been made to obtain this quantity by gravity, is from the Perkiomen, a distance of only 25 miles, $7,500,000, the interest of which is $450,000. The compounding of this interest, it seems to me, would make the gravity plan much more costly than by steam. Moreover, the gravity plan would not deliver the water above an elevation of 135, or at the most 175, C. D., above which pumpage by steam becomes a necessity. If delivered at 135, C. D., one-half the quantity would require pumpage, to supply the second and third systems. If at 175, at least the pumpage for the third system, amounting at present to about 5 per cent.

The next source from whence to get a gravity supply is Belvidere, on the Delaware, a distance of 90 miles, and at the same rate of cost per mile, $300,000, would involve $27,000,000. This route would deliver the water to the same elevations and involve pumpage above them.

The interest on the cost of impounding reservoirs, added to the expense of pumpage, without compounding the interest for the future, makes the cost of pumpage by water power as great as by steam, and the same necessity exists for the maintenance of the purity and the prevention of the pollution of the source of supply.

Incident to the purity of the river, and as a means to its maintenance, a sewer, passing by means of a tunnel under the city, and emptying into the Delaware, has been recommended, and

reference to it will be found in another part of the report. This accomplished, the manufacturing interests along the river would no doubt heartily join in helping to maintain the purity of the stream, as most of them are drinkers of the fluid which they are charged with polluting.

Forced to assume that the motive power will be steam, the next consideration is the means looking to a general system and its unification. The second system, at an elevation of 185 feet, C. D., or thereabouts, is the rapidly growing section of the city, and is the least adequately provided with basins from which to distribute water in quantity sufficient or in quality such as consumers are entitled to. In recommending such a basin means are not only suggested to furnish an adequate supply to portions too high for such relief, but it can be constructed in such a manner as to give the fullest benefits of subsidence, and to distribute a water which will be acceptable to the people.

The first system has five basins, Fairmount, Lehigh, Schuylkill, Corinthian, and East Park Reservoirs; while the second has but two, Belmont and Frankford, so far removed from each other as to be independent. The basin recommended in the neighborhood of Thirtieth and Cambria, will make the chain complete, and the interest on its cost will be saved in the cost of pumping to a higher elevation than necessary, as is now required at Roxborough and Belmont, which works are exhausted, and will involve as large an expenditure to maintain a poor supply, with greater expense of pumping, and without any saving.

By means of a stand pipe, the Spring Garden Works can supply the proposed basin and also Belmont. This accomplished, and an adequate supply guaranteed, then the East Park Reservoir should receive your attention as a feeder and filter to the first system, as it is not high enough to be of any value to the second system. These would be the proper steps to be taken, in my judgment, to provide for the present water supply, with the means of subsidence, and finally filtration, if not sufficiently pure for domestic purposes.

WATER AND ITS IMPURITIES.

Water, though theoretically made up of only two elements, without perceptible taste, color, or smell, is never supplied by nature chemically pure. Analysis proves that it always contains, in a greater or less degree, foreign matter gathered from many sources. It is only where these impurities exceed a certain percentage, that they become dangerous to the health of a community, and make a purifying process necessary to fit the water for domestic use.

These impurities may be classified under three general heads,—

I. Floating debris.

II. Mineral sediment.

III. Organic impurities.

Impurities of the first class are confined mainly to the surface, and are made up of floating wood, leaves, &c. A properly arranged system of screens will arrest them and obviate this trouble.

The second class is made up of such mineral sediment as is derived from the abrasion of rock, and the washing of the different soils forming the river basin. Unless present in very large and unusual quantities, these impurities are seldom injurious to health, but society demands clean-looking water, and the manufacturer often requires it; therefore it is well to get rid of this sediment whenever possible.

Subsidence or gravitation is the simplest plan to pursue, but requires a storage capacity of at least one week's consumption, to give the particles time to settle.

It is in the third class of impurities—those derived from organic bodies— that we find the elements most dangerous to the community; and while their removal is of vital importance, they present the most formidable obstacles to the engineer.

The principal source of organic impurities is decomposing animal and vegetable matter, sewage, dissolved fertilizers, waste from manufactories, &c. These matters remain in suspension until decomposition has removed so much of their volatile natures, that the mineral components can sink, but their really dangerous

elements frequently so unite chemically with the water, that no artificial system of filtration can separate them, and under the guise of pure limpid water they convey the seeds of disease to the consumer.

Subsidence will only partially remove organic impurities; oxydation, by exposing the water in thin sheets to the action of the air, as in running it over weirs, is beneficial; but even an elaborate and costly system of filter beds will not eliminate all those deleterious particles held *in solution* by the water.

The only true method of furnishing pure water is to maintain the purity of the source of supply, by diverting from it as much as possible, all sewage, manufacturing refuse, &c. Economy and common sense should teach us that it is false in principle, to first pour all manner of filth into our water supply, and then attempt to get rid of it by costly and seldom efficient processes. The advice of an eminent hydraulic authority is, "If any water intended for domestic purposes is found to be charged with organic matter *in solution*, the very best plan of treatment is *to let it alone*, and take the required supply from a purer source" The next best plan, when we have no available purer source, is to so perfect the system of sewers—the most fruitful sources of dangerous organic impurities—that they discharge their contents as far as possible from the stream from which we derive our water supply.

A very brief sketch of the methods of artificially purifying water for the use of a community, may not be out of place.

Evaporation and the use of chemicals, though really the most effectual, cannot be applied economically to a large public supply. Simpler and cheaper methods must be relied upon.

Carbon, prepared in large plates, and so placed that the water must percolate through it, especially reacts on all organic matter, but when the demand is heavy this process is very expensive, owing to the large area of filter made necessary by the slow rate of progress of the water through the carbon plates, 3.330 square feet of the *most porous*, being required to supply 1,000,000 gallons of filtered water per day.

In England, *Magnetic Carbide*, made by roasting hæmatite iron ore with granulated charcoal, is used in layers of from 3 inch to 12 inch, in a sand filter bed, and is said to give wonderful results in removing organic matter.

Infiltration Basins are used in a number of our towns and cities. These are simply galleries excavated in the porous margin of a lake or river, or in water-bearing sand formation, as at Brooklyn. These galleries are sunk below the water level, and are supplied by percolation. They are usually formed of two side walls, say 8 feet apart, arched over, and of a length commensurate with the demand. The amount of water furnished by them depends on the porosity of the sand and gravel beneath and around them, and the head of water under which the filtration is maintained. When the location is favorable, and the volume required not too great, they are simple and effective.

Filter Beds purify the water by passing it downwards through intercepting strata of sand and gravel, into a clear water basin beneath, from which it is supplied by pumpage to the consumer. They are much used in England and on the Continent, but their first cost and the constant expense of maintenance have discouraged their use in this country.

The requirements of an efficient sand filter bed may be briefly set down as follows, quoting from the most successful and economical practice:

Kirkwood, in his "Report to the St. Louis Water Commission," recommends as of vital importance to the successful working of a filter bed, and as the first step in the system, the formation of a subsiding basin sufficiently large to hold at least one whole day's consumption of water, thus getting rid of the grosser particles by gravitation; this makes the filtration more economical, and is useful in time of flood, and for storage.

The filter beds themselves are usually located at some convenient point on the river bank, or even in the river, if sufficiently protected from floods and from ice, but the great area required for a large supply, and the consequent expensive nature of the

protecting works, renders the latter or river plan unadvisable to say the least.

The filter area is sub-divided into beds averaging 250 by 150 feet each, and should be not less than 12 feet deep. The sides and bottom must be made impervious by puddle clay or concrete. There are many plans of arranging the interior of the filter bed, but perhaps the best and most economical, is one in which the entire floor area of each individual bed is covered with ranges of small brick piers placed a short distance apart, and sufficiently high to form a storage basin for clean water. Upon these piers rests a flooring of rough flagging laid with open joints, and this flagging supports in turn—the layer of cobble stone, coarse and fine gravel and sand, through which the water must pass by percolation. When the water flows into the filtering bed from the subsiding basin, all its impurities, except those in solution, are intercepted, and remain on the surface of the sand stratum which forms the uppermost of the filtering strata. The finer this sand the more perfect the filter, but at the same time the slower its action. The deposit of impurities on the sand clogs the filter, and must be removed at intervals of from one to eight weeks, depending on the condition of the water to be filtered. It is to make possible this cleaning process, without stopping the supply to the consumer, that the filter is divided into independent beds, but this at the same time requires a surplus area sufficient to keep one or more beds constantly out of service.

Filter beds should be covered over, to protect them from ice in winter, and the heat of summer, which latter especially, acting as it would on shallow and still beds of water, would render the supply unpleasantly warm, and promote vegetable growth in many objectionable forms. Experience has proven that filtered water must be used at once. Unless kept protected it soon spoils, much more readily than turbid water.

Humbar, Kirkwood, and other hydraulic authorities all unite in saying that to be cleansed of its impurities and made potable, water should not pass through the filter bed at a more rapid rate of *descent* than six inches per hour, or twelve feet per day, and

in this simple fact lies the expensive feature of the system, for, to purify one million gallons of water per day, requires, at the above rate, 13,500 square feet of filtering area; and as the *present* maximum demand of Philadelphia is 75,000,000 gallons a day, we should need more than 23 acres of filter beds, without counting the surplus area required for cleaning.

The above is a mere outline of the cheapest form of a sand filter. The actual cost of a perfect system of subsiding basin filter, and clear water basin, will vary with the nature of the site, the material, and the volume of clear water required. The constant expense of attending these basins is likewise a serious item, not to be lost sight of.

Dr. Medlock, of Amsterdam, strongly advocates the use of iron as a purifying agent. In experimenting in the canals of Holland, where the water is very impure, he found that iron grating, and strips of iron placed in the weirs, reacted very energetically on water containing ammonia, or matter capable of yielding it, the organic impurities being precipitated by contact.

In applying the varied experience of other localities to our own water supply, and assuming the Schuylkill River to be the nearest, and under the present arrangement of basins and pump, age stations, the most economical source of supply, it would seem best to first restore the purity of its water by diverting from it the refuse matter poured into the river by the sewers between Flat Rock and Fairmount Dams. This done, a storage capacity equal to several weeks supply would enable us to get rid of much of the remaining impurities by subsidence, and oxydation by exposure to the air.

THE REDISTRIBUTION.

For a systematic, economic, and satisfactory method of distribution several important changes should be made. Belmont should be confined to West Philadelphia, by which arrangement it can be supplied for the next ten or twenty years.

The district east of the Schuylkill, west of Ninth Street, and north of Spring Garden Street, has not within its boundaries any basin at an elevation high enough to give an adequate supply to this large and rapidly improving section of the city, hence the supply of water is now obtained from Belmont and Roxborough.

To meet this demand the capacity of these works is almost exhausted, and will require heavy expenditure of money for their enlargement, unless a basin is provided on the divide between the two rivers, at such an elevation as to furnish the high grounds in the second system east of the river.

Only a careful study of this subject in all its bearings can enable any one to appreciate the value and importance of such a structure erected at the proper elevation. From the elevation and central location of this basin it could supplement, and by subsidence improve the quality or the supply to the Lehigh, Spring Garden, Corinthian, and Fairmount basins. Manayunk could be supplied from the same at a saving in pumpage of $25 per million gallons, as the lift would be 170 feet less than at Roxborough. It could call into constant use the Spring Garden works, at present only in service from six to eight months in the year, and by means of a stand-pipe these works could be united with Belmont.

These two items, the stand-pipe and this basin, would unify our works, and enable at a small cost to furnish water of a better quality and as pure as could be obtained without the use of filter beds.

THE SYSTEMS OF DISTRIBUTION.

The different elevations to be supplied, require the distribution to be divided into three systems.

The first system comprises the Fairmount, Lehigh, Spring Garden, and Corinthian Basins, and the East Park Reservoir.

Fairmount should supply south of South Street, from the Schuylkill to the Delaware.

Lehigh should supply east of Kensington Avenue and east of Fifth Street, from South Street to the Frankford Creek.

Spring Garden and Corinthian, east of the Schuylkill to Fifth Street, between South Street and Spring Garden Street, and between Ninth Street and Fifth Street as far north as Susquehanna Avenue. The East Park Reservoir could be used as a feeder and filter to this system.

The second system comprises the Belmont, the Wentz Farm, and the proposed or Cambria Basins.

Belmont should supply West Philadelphia; Wentz Farm, all the District east of the North Pennsylvania Railroad, except that supplied by the Lehigh Basin.

The outlying Districts of Unionville and Branchtown, too high to be supplied by this basin, can be supplied by means of an auxiliary station similar to those at Roxborough and Chestnut Hill, and such as the high ground in West Philadelphia will soon demand.

When the District between the Oxford Pike and the Delaware River is more thickly settled, economy would suggest a basin on the ridge at an elevation of about +100 C. D. in the first system.

The Cambria or proposed basin, in conjunction with the Wentz Farm, would supply the second system east of the river.

The third system comprises the Roxborough and Mt. Airy Basins, and would be confined to the high ground of Manayunk, Roxborough, and Germantown, with their auxiliary stations.

Table "K" gives the population, the area, the maximum and minimum curb heights, and heads of water on each District with the range of head, as well as the capacity of the works and basins supplying them.

FLOW OF SCHUYLKILL AND RAINFALL.

During the Summer of 1876, the flow of the Schuylkill was at its minimum. In the one hundred days commencing June 9th and ending September 16th, the water flowed over the dam only nine days. The last forty-five days of this period no water was wasted, all having been used as follows:

Water used by the Canal (during this period of forty-five days)	510,500,000
Water pumped by all the Works on the Schuylkill (during this period of forty-five days) .	2,250,000,000
Water used for power at Fairmount (during this period of forty-five days) . .	7,725,000,000
Total flow during forty-five days, . .	10,485,500,000
Daily average for forty-five days, . .	230,788,888

The rainfall during the Summer months of 1876, was only $9\frac{64}{100}$ inches, $\frac{11}{100}$ of an inch less than during the same period of 1869.

By a study of the diagram showing the pumpage and rainfall from 1810 to 1877, we find that the yearly rainfall has increased at the average rate of $\frac{3403}{1000}$ of an inch per annum, and that during the same time the average Summer rainfall has remained about the same.

The minimum Summer rainfall was $6\frac{1}{4}$ inches, in 1854.

The effect of heavy Summer rainfalls upon the consumption, is very apparent from a comparison of the Fairmount Summer pumpage and the Summer rainfall.

In the years 1867 and 1872, the Summer rainfall was heavy, and the consumption of water correspondingly light, showing that the increased consumption in the Summer is due to the use of it for cooling the air, laying the dust, and bathing.

An examination of the pumpage lines, shows that from 1810 to 1849, the pumpage increased at the rate of 43,600,000 gallons per annum, and from 1849 to 1876, at the rate of 540,000,000

gallons, or more than twelve times as much. In eight years, from 1854 (the year of consolidation) to 1862, the pumpage doubled. The pumpage will again double in 1878, or in sixteen years, and in this ratio, after 1878, in thirty-two years, or in 1910.

The work done by the water power works at Fairmount, shows that the introduction of Turbines Nos. 7, 8, and 9, exhausted the power of the natural flow of the Schuylkill river; and the introduction of Nos. 3, 4, and 5, the first of which was started in 1869, did not materially increase the efficiency of the pumpage capacity of these works.

In Summer the demand for water is greatest, when the power at Fairmount is least, which proves that Fairmount is not the main stay of the Department.

On Sunday, August 14, 1876, Fairmount, with the natural flow, pumped only *two* millions of gallons, when the total demand was over forty-eight; the deficit was made up by taxing the steam works to the utmost of their capacity.

PURITY.

The daily average consumption of water at present is about fifty million gallons, at a cost of $180,000 per year. The ratio of increase for the past twenty-five years will not double the demand until 1910, a period of thirty-four years. This would not justify an expensive system, either by gravity or water-power, with its impounding reservoirs, in the present financial condition of the city; therefore, we are compelled to look to steam as our motive-power, and to perfect our present system, which would otherwise be destroyed.

In order to rely upon the rivers as a source from whence to draw our water supply, their purity must be maintained and their pollution prevented.

The great cause of fouling is the sewage emptied into them regardless of sanitary considerations, causing disease and death, not only by the fouling of the water supply, but by the decomposing matter deposited in the docks and along the river fronts.

Various plans have been suggested—one of which by the Park Commission—to prevent the sewage of Manayunk and the Falls Village from emptying into the Fairmount pool, was to construct an intercepting sewer, seven feet in diameter, on the east side of the river, from Manayunk to the head of tide at Fairmount. Its contents would empty into a stream whose Summer flow is of little volume, and would make the Schuylkill, passing through a populous district, little better than an open sewer. This sewer, for about one-third of its length, would be below the surface of the Fairmount dam, and leakage from it would contaminate the pool.

Fairmount pool could be kept pure at little more expense, by driving a tunnel diagonally under the city to Broad and Norris Streets, under a district as yet unimproved, thence along Norris Street, emptying the sewage into the Delaware, as shown by plan "B," on the topographic map.

This sewer would not interfere with the manufacturing interests on the stream. It would intercept the offensive products of their industries and the sewage, and while preventing the fouling of Fairmount dam, it would, by means of the shafts necessary in its construction, drain nearly three square miles of area unprovided with main sewers, and for which area one is already proposed.

The sewer from the Falls to the Delaware River is the basis of a system. This subject belongs to a co-ordinate department, the outlines of which are only presented; the details are of record in this office as incident to the maintenance of the water of the Schuylkill as a source of supply.

A study of the topographic map of the city divides it naturally into three great drainage districts.

The first is West Philadelphia. The second is east of the Schuylkill and southwest of the Germantown Road, which is the divide between the Schuylkill and Delaware. The third is north and east of this ridge. By means of intercepting sewers, provided with overflows for the escape of storm-water in heavy rainfalls, the *sewage* of these districts can be kept out of the Schuylkill and the docks along the Delaware front. The

first district, provided with one of these sewers, west of, and parallel to the Schuylkill, emptying into the Darby Creek, can be drained into the Delaware at the Lazaretto.

The entire Second District can be drained into the Delaware at Greenwich Point. The sewage of the area north of the Falls Village would be carried by the tunnel to Second and Norris Streets, thence down Second Street, intercepting in its course the sewage now emptying into the Delaware along the river front. This sewer to intersect at Second and Packer Streets with an intercepting sewer east of and parallel with the Schuylkill front. The course of this sewer would follow a diagonal, and empty at Greenwich Point. It could be flushed its entire length, either by the Schuylkill River or the Wissahickon Creek.

The Third District is divided into sub-districts, which are provided with intercepting sewers in the valleys of the Frankford, Wissanoming, Pennypack, and Poquessing Creeks, which in turn empty into a main intercepting sewer parallel with the Delaware, and emptying into it at the mouth of the Aramingo Canal. This system relieves the City of sewage, without contaminating the water supply.

By means of the overflows the heavy rainfalls are delivered directly into the large streams; the sewers are small, saving expense in their construction, requiring but little water to flush them, and preventing deposit by a constant flow of at least one-half their capacity.

THE FRANKFORD WORKS.

The Reservoir.

The reservoir at Wentz Farm will be completed by July, 1877. The earthwork was nearly finished in August, and one-half of the bricks required for the lining were delivered before the first of December.

The Pumping Station.

The pumping station at Lardner's Point on the Delaware will be completed about the same time. Unless some unforeseen cir-

cumstance prevents, Frankford can be supplied with water during the coming summer.

The contract for the wharf, inlet conduit, and foundations, was awarded to R. A. Malone April 25th, 1876, who at once commenced work with a view to its early completion. Owing to a difference in the data obtained from the City records, in the Survey Department, and the final survey, it was necessary to start the foundations three and a-half feet deeper, and to build the walls one foot thicker than at first intended.

The inlet conduit was increased in length 106 feet, enlarging the area of the wharf from 5,000 to 13,000 square feet.

The excavation for the foundations developed persistent running sands, which were overcome by driving heavy sheet piling from fifteen to twenty feet deep around the entire excavation. These difficulties and enlargements materially increased the cost over the approximate estimate.

The contract for the engine-house, boiler-house, and stack, was awarded to Messrs. Prior & West, of Trenton, New Jersey, June 13th, 1876, who will be ready to hand over their work in July, 1877.

The Pumping Main.

The pumping main is 30 inches in diameter, and will be 20,250 feet long from the pumping station at Eugene and Robbins Streets to the reservoir at Wentz Farm. This main is laid twenty feet from the south building line of Robbins Street, and along it to the State road. In the State road, sixteen feet from the east building line to Devereaux Street, in which it is twenty feet from the south building line to the old Second Street pike, and thence to the reservoir.

The valley of the Wissanoming Creek is crossed on piles, and that of the Little Tacony on trestle. The main is provided with blow-off cocks at the summits, plugs at the low points and before each check-valve. There are four of these check valves, one at the engine-house, one at Cottage Street, one at Bustleton pike, aud one at the Oxford pike.

A rubber-coated pipe, one inch in diameter, is laid alongside the pumping main, and will be used to indicate at the engine-house the height of the water in the reservoir.

The pipes were tested to stand a pressure of 300 pounds per square inch; those under a head of 75 feet and less are $\frac{9}{10}$ of an inch thick, and those under a maximum head of 170 feet are one inch thick. The pipes are laid by the Department in a trench dug by contract.

The average cost of laying the 30-inch main per foot, including pipe, has been $7.64.

To the close of the year 16,044 feet have been laid. That over the Little Tacony and Wissanoming Creeks will be laid early in the summer.

The Distributing Main.

The distributing main is 20 inches in diameter and 12,850 feet long. It is laid 20 feet from the north building line of Comly Street, between the reservoir and the Oxford Pike, thence along the west side of the pike to Foulkrod Street, which it follows to the Frankford Road. This pipe is laid from its connection with the 12-inch main on the Frankford Road to the Oxford Pike and Comly Street, a distance of 7,848 feet.

As soon as Comly Street is opened the pipe will be laid to the reservoir. Branches are provided at the street crossings, plugs and valves on the 20-inch are laid, ready for the distribution, as soon as these streets are opened and occupied. The pipes were furnished by the Gloucester Iron Company; they are $\frac{11}{16}$ths of an inch thick, and were subjected to the same tests as the 30-inch.

The trenches were dug by contract, and the pipe laid by men from the department at a total cost of $3.87 per running foot.

Condition of Steam Engines, Boilers, and Pumps.

SCHUYLKILL WORKS.

No. 4 engine (Cornish) received considerable repairs, a new cataract pump was attached, valves and seats turned and faced,

and the valve-gear repaired. The outlet pipe from pump to the stand-pipe, which had been a source of trouble for some years, was taken out, and a new connection, including stop valve, put in.

No. 5 engine (Cornish) received slight repairs to valve-gear.

No. 6 engine (Simpson). This engine did good service until the 26th of July, when the pump-chamber under the steam-cylinder was broken. Temporary repairs were made, and the engine kept running for the remainder of the season. A new chest was at once ordered.

During the summer, connections were made to the new engine. A 48-inch main was laid for a distance of 120 feet, leading to the East Park Reservoir. On this 48-inch main, two connections were made; one to the 36-inch main of No. 5 engine, the other to the 36-inch main of the Simpson engine, No. 6. Until the East Park Reservoir is completed, the new engine will pump through the two 36-inch mains into Schuylkill and Corinthian Reservoirs.

Owing to unavoidable circumstances the new engine was not completed until the early part of December. On the 20th of the month the engine was started at 9 A. M., for a trial, and kept running until 3 P. M., of the 22d. The result of this trial, together with the observations taken, will be found elsewhere.

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BELMONT WORKS.

All the engines received slight repairs, new guards and caps of composition were placed on nearly all the pump valves, replacing the old cast iron ones. During the season the machinery was kept working to its full capacity. The five million and the eight million engine were kept in constant operation. The other five million engine was run about half time. The boilers were forced beyond their capacity, but still did not generate sufficient steam to run all the engines. The want of adequate boiler power is a defect most seriously felt at these works.

DELAWARE WORKS.

Slight repairs were made to the horizontal engine (No. 1). The beam engine (No. 2) required a new crank pin, new joints to steam and valve chests, the piston was adjusted, the air pump repaired, and the engine placed in good condition. The Worthington (No. 3) was thoroughly overhauled, valves and faces planed, new joints made, new valves and guards placed in pumps, and the air pumps and attachments repaired. During the summer, all the machines were kept in active operation and did good service. The boilers received the usual cleaning and repairing and new gauge columns were placed on the cylinder boilers. During the extreme hot weather the water was as usual of an impure character, being impregnated with the sewage from Gunner's Run and the refuse from the adjoining wharves. A careful examination led to the conclusion that the impurities floated on the surface of the water. To test this, a stout apron or hood, made of plank well bolted together, was placed over the inlet to the forebay, the mouth of this apron being about six feet below the surface of the river at low tide. This was found to have a beneficial effect, for in a few days the water supplied was found to be much better.

The leak through the reservoir bank was examined. It was caused by the percolation of the water and wasting of the earthwork under the pipe. The bank was repuddled around the pipe, the brick facing replaced, and the leak effectually stopped.

ROXBOROUGH WORKS.

The new inlet valve chamber to Cornish engine has been completed, and some slight repairs and alterations made to the valve gear. This engine now works very smoothly, is in excellent condition, and a fair sample of its type. The Worthington was thoroughly overhauled, the valves and faces planed, new joints made, new valves and guards placed in main and air pumps, and the engine placed in good condition.

The boilers received their usual repairing and cleaning.

At the reservoir, the buildings and grounds of the auxiliary works have been completed, and now present a very creditable appearance. The two Knowles' pumps at this station, were of greater capacity than will be required for many years, and it was deemed advisable to remove one of them to the Chestnut Hill works. A feed pump, formerly in use at the Schuylkill works, was put in its place, and answers all purposes. The boiler has been covered with a suitable non-conductor, and a saving of one-third the fuel effected.

CHESTNUT HILL WORKS.

One of the Knowles' pumps, formerly at the Roxborough Reservoir, has been put in position and connected with the mains. This pump will be held in reserve, to be used in case of accident to the other machinery. During the summer the springs gave a fair supply of good water. On three days only was water permitted to flow from Mount Airy Reservoir to the springs, while at intervals all through the season surplus water was furnished by the springs to Mount Airy Reservoir.

BUILDINGS AND GROUNDS.

The engine house at Delaware Works has been thoroughly renovated both inside and out. The causeway at Fairmount has been repaired, about one-third of the coping stones were taken up, and carefully relaid in cement; the unsightly sheds used by the stone-cutters were removed, and the grounds much improved.

At the Schuylkill Works, the roof over the new engine and the old Cornish was raised about 8 feet; the ceiling has been removed, giving a total gain in height of about 13 feet. On each side, under the new roof, windows were introduced, giving a much better light, and improving the appearance. The old gangway through middle of house will be removed, and suitable galleries placed around the building. The grounds in front of the house have been laid out in terraces, the banks sodded, and the walks gravelled.

At the Chestnut Hill Works, a portion of the floor over machinery has been removed, new brick floors laid, walls plastered, and new windows made in lower part of room.

BOILERS.

Next in importance to the pumping engines, are the boilers. It is evident that should the engines be of an economical type, there would be no actual economy unless the boilers also performed their duty in an efficient manner. Illustrations are given at the end of this report, of all the boilers in the Department, with the exception of the Luder's Patent at Roxborough. The following enumeration of the boilers at the different Works will also serve to explain their nature.

Schuylkill Works.—Four cylinder boilers, four feet three inches, by thirty feet long, each with two drums, twenty-six inches by twenty-two feet long.

Two hog-nose tubular boilers, five feet diameter, by seventeen feet nine inches long, with eighty-three three-inch tubes, twelve feet long; one drum, thirty inches by twelve feet, to each boiler.

Six cylinder boilers, four feet six inches diameter, by thirty feet long, with two drums to each, twenty-eight inches by twenty-two feet.

Five plain tubular boilers, six feet diameter, by fifteen feet long, seventy-five four-inch tubes to each.

Delaware Works.—Eight cylinder boilers, forty-two inches diameter, by twenty-six feet; one drum to each, thirty inches by sixteen and one-half feet.

Five plain tubular boilers, six feet diameter, by fifteen feet long, seventy-five four-inch tubes to each boiler.

Roxborough Works.—Eight cylinder boilers, thirty-six inches diameter by thirty-six feet long; one drum, twenty-four inches by twenty feet to each.

Two Luder's patent boilers of one hundred horse power each.

Roxborough Reservoir.—One fire-box tubular boiler.

Belmont Works.—Six cylinder boilers, forty-two inches by thirty feet, with one drum to each, thirty inches by twenty-two feet.

Eight cylinder boilers, fifty-four inches by thirty feet, each having two drums, twenty-eight inches by twenty-two feet.

Chestnut Hill Works.—Two cylinder boilers, thirty inches by thirty feet; one drum, thirty inches by seven-and-a-half feet, connecting both boilers.

Fairmount.—One return flue boiler of the marine type.

RECAPITULATION.

Plain cylinder boilers,	42
Plain tubular "	10
Hog nose tubular "	2
Luder's patent "	2
Fire box tubular "	1
Return flue "	1
Total,	58

It will thus be seen that the plain cylinder boilers constitute seventy-two per cent. of the boiler power of the Department. These are all arranged in the same manner, having the chimney at the back, and a direct draft from fire place to chimney. All that can be said in favor of these boilers is, that they are strong and easy to clean. Their evaporative power is very low, none of them exceeding five-and-a-half pounds of water to one of coal. When this evaporation is compared with that of modern boilers, which readily evaporate from ten to twelve pounds of water to one of coal, their inefficiency is readily seen.

The plain tubular constitute seventeen per cent. of the boiler power. These are beyond doubt the best in the Department. They are compact, safe, and evaporate eight-and-a-half pounds of water to one of coal. The hog nose tubular boilers are com-

paratively economical, but owing to their extreme age are but seldom used.

The Luder's patent, the fire-box tubular, and the return flue are all fair boilers, evaporating about eight pounds of water to one of coal.

PRACTICAL OPERATIONS OF THE WORKS, AND WATER SUPPLY.

The tables of the practical operations of the Works are given in the same form as last year. By referring to these reports it will be seen that the amount of water pumped by the steam works in 1876, was greatly in excess of that of 1875. This is more particularly observable in the operations of the Delaware, Belmont, and Schuylkill Works. Taking the three months of June, July, and August, the supply of each Works over that of last year, would be as follows:—Delaware, six per cent.; Belmont, forty-eight per cent.; Schuylkill, fifty-three per cent.

The increase at Belmont was obtained by heavy firing, and forcing the machinery. In fact, these Works were forced beyond their proper capacity, the consumption of coal was very great, and the labor excessive.

The increase at Schuylkill Works was obtained by running all the engines. This had never been previously done, owing to the want of mains to carry the water pumped. The forty-eight inch main connecting the Schuylkill and the Corinthian Reservoirs overcame this difficulty, and enabled all the engines to run as occasion required. The total supply shows an excess for each month over the corresponding month of last year. For the three months of June, July, and August, the increase was fourteen per cent.

The lowest amount pumped on any one day was twenty-seven and one-third millions, on the Sixth of February. The highest amount on any one day was nearly seventy-two millions, on the Twentieth of July, being an increase of nearly thirty per cent. over any days pumpage in the history of the works of Philadelphia.

NEW TWENTY-MILLION ENGINE.

This is an upright, rotative, independent, compound engine. The cylinders are placed side by side, with a double-acting plunger-pump underneath each. The fly-wheel is at the back, worked by beams which obtain motion from a cross-head between cylinder and pump. The cylinders are forty-five and eighty inches diameter, and the pumps thirty inches diameter, all six feet stroke.

The contract with the builders stipulated that the engine should be capable of raising twenty million gallons of water to a height of one hundred and thirty feet in twenty-four hours, and that it should perform a duty of seventy-five million foot-pounds per one hundred pounds of combustible, provided, that the boilers evaporated nine and a-half pounds of water per pound of combustible.

On the Twentieth of December, the engine was started at 9 A. M., for a trial to determine if these points had been accomplished. The observations commenced at 1 P. M. of the same day, and continued every hour for forty-eight hours. These observations are given in table "J."

By referring to the table, it will be seen after allowing a percentage of leakage from the theoretical capacity of the pumps, that the delivery of water was 20,299,725 gallons per twenty-four hours.

The height to which the water was raised was $121\frac{96}{100}$ feet, or $8\frac{04}{100}$ feet less than stipulated. This difference in height arises from the fact the engine was constructed to pump into the East Park Reservoir, but there being no pumping main laid as yet, the engine had to pump into the Schuylkill and Corinthian Reservoirs, which are at a lower elevation.

The evaporation of the boilers proved to be $8\frac{62}{100}$ pounds of water to one of coal, or $10\frac{11}{100}$ pounds of water to one of combustible.

The duty performance was 750,656 foot pounds per pound, or 75,065,689 foot pounds per hundred pounds of combustible.

After the expiration of the forty-eight hours, experiments were made to develop the limits of speed, when it was shown that the engine was capable of delivering as low as eleven, and as high as twenty-one and a half millions, per twenty-four hours.

Some defects of detail were developed during this trial, which the builders will at once correct. The time selected for this trial was an unfortunate one; the improvements to the building were in progress, and the temperature exceedingly low. The temperatures of the upper part of the engine room only are given in the table; the lower part was at all times below the freezing point. The steam for supplying the donkey pump for feeding the boilers was brought a considerable distance through an uncovered pipe, and the condensation in this pipe operated against the duty.

No preparations were made to insure a high performance, and the builders made no effort to avail themselves of many privileges to which they were entitled, and which would have made an apparently better duty performance.

With a fair temperature, and a regular feed to the boilers, there can be no doubt that the engine will in every day working give a better duty performance than exhibited by this trial.

RECAPITULATION OF RECOMMENDATIONS.

1st. At the Belmont basin such an arrangement as will separate the inlet and outlet pipes from the same chamber.

2d. At the Belmont Works such an arrangement as will separate the pumping from the distributing main.

3d. The erection of a basin that will supply the second system east of the river, and at the same time, by means of a stand pipe, furnish water to the Belmont basin.

4th. A pumping main from the Spring Garden Works to the proposed basin.

5th. A distributing main from said basin to Broad Street.

6th. An engine at Spring Garden Works to pump into the proposed basin, located in the second system. The estimated cost of the above is about $600,000.

7th. An engine at Roxborough Works.

8th. Another engine at Frankford, as provided in said loan.

9th. Suggestions, pages 9, 11, 12, 26.

RECEIPTS AND EXPENDITURES

OF THE

Water Department

FOR

1876.

Receipts of the Department and sources whence derived, as exhibited by statement of John N. Hagey, Registrar,	$1,194,059 99
Receipts at Chief Engineer's office, as per statement, -	5,694 98
Total receipts from all sources for 1876, - - -	$1,199,754 97

RECEIPTS AT CHIEF ENGINEER'S OFFICE FOR 1876.

For rents, - - - - - - - -	$1,185 00
For old iron, - - - - - - -	924 33
For brass scrap and turnings, - - - - -	714 00
For stone, &c., - - - - - - -	291 50
For gravel, - - - - - - - -	56 20
For old barrels, - - - - - - -	50 88
Pennsylvania Railroad Company, attachments, &c., -	341 36
H. Snyder, attachment, - - - - -	246 23
Thomas Dolan & Co., attachment, - - - -	236 59
Charles Spencer, attachments, - - - -	176 00
Preston & Irwin, attachment, - - - -	169 75
J. B. Lippincott, attachment, - - - -	133 65
Western Market Company, plugs, - - - -	131 78
James Doak & Co , attachment, - - - -	126 45
James Nolan, attachment, - - - - -	118 92
A. Campbell & Co., attachment, - - - -	104 25
M. Meadacroft, attachment, - - - -	110 92
Baldwin Locomotive Works, plug, stop, &c., - -	91 18
Philadelphia and Reading Railroad Co., attachment, stop, &c.,	88 87
Colosseum, attachment, - - - - -	85 95
Martin Nixon, attachment, - - - - -	63 95
Z. T. Dolan, attachment, - - - - -	59 41
D. S. Cresswell, stops, - - - - -	50 00
Knickerbocker Ice Company, attachment, - - -	31 50
R. S. Peabody, pipes, - - - - -	30 00
Midvale Steel Works, repairs, - - - -	18 75
E. Slocomb, plug case, - - - - -	18 00
Centennial Board of Finance, attachments, - -	12 26
W. B. Bement, repairs, - - - - -	25
Eastern Penitentiary, spindles, &c., - - -	10 10
Green and Coates Street Railway Company, repairs, -	7 95
	$5,694 98

Receipts and Expenditures since Consolidation.

YEARS.	RECEIPTS.					EXPENDITURES.				
	REGISTRAR'S OFFICE.		At Chief Engineer's office.	TOTAL.	Yearly increase of receipts.	From annual appropriation.	From special appropriations.	From loans for construction.	TOTAL.	Annual profits.
	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.	139,293 60	21,174 42	....	160,468 02	192,428 58
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 58	1,447 36	76,264 60	238,989 54	371,255 12
1862...	516,602 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	368,169 83
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	6,500 95	636,388 42	26,275 85	270,404 83	13,857 80	138 074 95	422,337 58	352,125 79
1866...	634,263 84	32,031 11	3,927 18	670,222 13	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	413,844 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 66	909,768 28	372,229 21
1870...	810,716 83	117,319 12	7,335 01	935,370 96	121,900 13	445,947 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	532,686 89	1,663 56	1,030.068 03	1,564,418 48	548,634 56
1874...	1,023.989 81	198,896 99	6,994 58	1,229,881 38	146,896 37	689,506 89	1,018 92	534,576 27	1,225,102 08	539,355 57
1875...	1,037,086 61	123,258 53	9,321 14	1,169,666 28	Decrease.	674,693 51	35,139 56	228,503 67	938,336 74	459,833 21
1876...	1,079,025 72	115,034 27	5,694 98	1,199,754 97	30,088 69	713,518 02	11,129 83	376,375 96	1,101,023 81	475,107 12
	$14,669,210 04	$1,530,567 72	$87,760 58	$16,287,538 34		$7,320,774 10	$504,541 61	$6,006,341 77	$13,840,657 48	$8,453,222 63

EXPENDITURES OF THE DEPARTMENT FOR 1876.

From Annual Appropriation.

Salaries of Chief Engineer, Assistants, Purveyors, and Clerks,		$30,741 48
" Engineers, Firemen, &c., at works,		59,442 78
" Registrar and Clerks,		27,600 00
Stationery, advertising, and office expenses,		9,491 67
Supplies to works:		
Coal and wood,	$90,133 34	
Tallow, oil, and gas,	7,608 63	
Small stores, packing, &c.,	4,987 47	
		102,729 44
Repairs to works:		
Fairmount,	$2,237 92	
Delaware,	2,936 82	
Schuylkill,	5,391 74	
Belmont,	3,444 01	
Roxborough,	2,218 06	
		16,228 55
For drilling and making new attachments:		
Wages, First District,	$2,516 75	
" Second District,	2,536 50	
" Third District,	2,504 00	
" Fourth District,	2,511 00	
" Germantown,	717 11	
" Manayunk,	1,799 75	
" Shop,	2,299 00	
Gum goods,	110 00	
		14,994 11
For keeping pipes, plugs, stops, and fixtures in good order:		
Wages, First District,	$7,873 82	
" Second District,	12,074 50	
" Third District,	11,509 00	
" Fourth District,	10,548 55	
" Germantown,	1,947 60	
" Manayunk,	2,895 00	
" Pressure Inspector,	579 06	
Amounts carried forward,	$47,427 53	$261,228 03

Amounts brought forward,	$47,427 53	$261,228 03
Repaving around plugs,	1,566 56	
Plug valves,	387 00	
Plumbing,	149 15	
Damages for bursts,	143 25	
Dressing tools,	133 33	
Sundries,	51 62	
Lumber,	31 56	
Brick work,	25 93	
Wood and coke,	23 22	
Tubing,	14 66	
Glazing,	13 70	
Packing,	10 50	
Hauling,	10 50	
		49,988 51
For labor in laying pipes, setting and fitting fire-plugs, stop-cocks, &c.:		
Wages, First District,	$2,827 26	
" Second District,	23,014 49	
" Third District,	6,588 45	
" Fourth District,	8,798 45	
" Germantown,	14,156 60	
" Manayunk,	5,066 74	
" Shop,	26,579 11	
" Assistant Engineer's roll,	4,737 34	
Measuring pipe,	4,514 95	
Hauling,	3,662 87	
Inspecting pipe,	1,098 50	
Blasting,	432 00	
Covering pipe,	180 00	
Siding charges,	53 00	
Storage,	42 92	
Surveys,	7 92	
Grade stakes,	5 00	
Transportation,	5 00	
For laying 48-inch main between Spring Garden and Corinthian Avenue Reservoirs:		
Wages, Fourth District,	12,754 03	
Paving,	915 88	
Amounts carried forward,	$115,440 51	$311,216 54

Amounts brought forward,	$115,440 51	$311,216 54
Hauling,	827 00	
Inspecting pipe,	193 50	
Dressing tools,	9 50	
For foundations twenty million gallon engine at Spring Garden Works:		
Wages,	$13,423 37	
		129,893 88
For keeping grounds, buildings, and reservoirs in good order:		
Wages,	$58,937 83	
Roofing,	6,236 77	
Lumber,	4,539 86	
Glass, paints, &c.,	2,795 26	
Iron castings,	2,015 58	
Hardware,	1,849 59	
Stone,	1,410 99	
Gas,	969 45	
Steam fittings,	720 00	
Seed and plants,	588 67	
Clay,	500 00	
Cement,	430 10	
Bricks,	422 00	
Iron railings,	402 25	
Engineers' supplies,	288 00	
Plumbing,	228 52	
Hauling,	227 50	
Brooms,	227 35	
Machine work,	195 08	
Repairs,	173 68	
Furnaces,	166 80	
Repairs to track,	161 50	
Lime,	146 60	
Terra cotta pipe,	129 48	
Lubricators,	120 00	
Iron beams,	117 35	
Repairs to scales,	89 85	
Tin work,	75 20	
Sand,	73 05	
Amounts carried forward,	$84,238 31	$441,110 42

Amounts brought forward,	$84,238 31	$441,110 42
Packing,	70 64	
Iron and steel,	70 22	
Paper Hangings,	63 15	
Soap,	57 20	
Cotton waste,	54 36	
Sheet iron work,	46 18	
Derrick poles,	43 00	
Ice,	42 79	
Extension ladder,	36 90	
Transportation,	35 00	
Coal,	31 25	
Sundries,	30 40	
Valves,	24 00	
Flag poles,	20 00	
Sweepers,	15 00	
Spikes,	14 66	
Iron frames,	13 20	
Tubing,	12 47	
Bone-dust,	9 90	
Wheelbarrow,	8 75	
Salt hay,	5 22	
Lamps,	5 00	
Bolts,	2 12	
		84,949 72
For the purchase of iron pipes, fire plugs, stop-cocks, lead, brass, iron castings, &c.:		
Iron pipe,	$84,140 98	
Iron castings,	13,334 97	
Lead,	11,586 70	
Plugs,	3,780 00	
Brass castings,	3,135 12	
Hardware,	2,737 03	
Meters,	1,760 00	
Lumber,	1,707 75	
Cement,	1,118 86	
Stone,	1,034 39	
Iron and steel,	910 06	
Coal,	838 25	
Phosphor bronze,	704 87	
Amounts carried forward,	$126,788 98	$526,060 14

Amounts brought forward,	$126,788 98	$526,060 14
Packing,	647 56	
Valves,	638 87	
Rotary planer,	506 14	
Bolts and nuts,	496 26	
Oil,	404 60	
Powder and fuse,	391 94	
Machine work,	391 63	
Gauges,	235 55	
Rents,	217 50	
Machine cloths,	197 10	
White lead, paints, &c.,	163 59	
Gum suits and boots,	185 00	
Galvanized spindles,	135 75	
Wood,	130 95	
Rope,	111 80	
Tubing,	107 66	
Coke,	105 45	
Shovels,	94 00	
Clay,	61 51	
Steam trap,	59 25	
Core boxes,	57 00	
Repairs,	34 50	
Sundries,	33 59	
Soap,	32 50	
Belting,	31 98	
Rope and blocks,	31 24	
Copper castings,	26 79	
Bench,	25 00	
Oil cups,	17 25	
Fittings,	14 43	
Galvanizing,	14 25	
Lime,	13 25	
Grindstone,	11 80	
Wharfage,	7 30	
For the 48 inch main connecting Spring Garden and Corinthian Avenue Reservoirs:		
Iron pipe,	34,335 82	
Lead,	7,736 76	
Lumber,	112 02	
Amounts carried forward,	$174,606 57	$526,060 14

Amounts brought forward,	$174,606 57	$526,060 14
Powder and fuse,	96 00	
Bilge pump,	75 00	
Hardware,	46 97	
Oils,	45 50	
Shovels,	23 50	
Bricks,	21 00	
Spars,	30 00	
Coke,	18 00	
Iron castings,	18 21	
Lime,	10 26	
Valves,	5 40	
Repairs to tools,	2 70	
		174,999 11
For carriage hire and keep of horses for Superintendent and Assistant Engineers,		746 00
For carriage hire and keep of horse for Chief Engineer,		645 10
For the care and maintenance of the Chestnut Hill Water Works,		4,942 70
For the expenses of public fountains of the Philadelphia Fountain Society,		1,000 00
For repairs to Cornish Engine at Roxborough:		
Wages,	$1,137 66	
Machine work,	2,350 00	
Valve chambers,	1,150 00	
Packing,	142 80	
Oil cups, etc.,	41 34	
Marlins,	3 17	
		4,824 97
For medical attendance and funeral expenses of Owen McCullough, who was injured in the employ of the Department,		300 00
		$713,518 02

SPECIAL APPROPRIATIONS.

(Appropriation approved December 24, 1875.)

To pay Michael Swenk, for the loss of his horse, by falling into an opening on Second street, between York and Cumberland streets, Nineteenth Ward,	$150 00
Amount carried forward,	$150 00

Amount brought forward,		$150 00
(Appropriation approved July 10, 1876.)		
To refund twice paid and overpaid water rents, and pipe laying bills,		885 00

(Appropriation approved October 1, 1875.)

For connecting the Chestnut Hill Works with Mount Airy Reservoir:

Wages,	$935 89	
Powder and fuse,	238 46	
Lumber,	11 21	
		$1,185 56

(Appropriation approved October 12, 1875.)

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

Wages,	$5,146 37	
Machine work,	1,465 83	
Hauling,	345 00	
Lumber,	308 14	
Damages,	300 00	
Covering steam pipe,	207 00	
Iron work,	215 00	
Transportation,	263 00	
Pipe,	187 43	
Valves,	150 00	
Trees and seed,	68 75	
Dressing tools,	45 38	
Bricks,	45 00	
Inspecting pipe,	32 90	
Roofing,	41 40	
Gum goods,	15 00	
Oil cups,	16 00	
Amounts carried forward,	$8,852 20	$2,220 56

Amounts brought forward,	$8,852 20	$2,220 56
Hardware,	13 91	
Wood,	9 00	
Lime,	8 40	
Sheet metal,	6 56	
Paint,	13 67	
Cement,	4 21	
Tubing,	1 32	
		$8,909 27
		$11,129 83

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:

Springs,	$3 10

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

Item 10.

For bursting of mains or other emergency:

Wages,	922 74

(Appropriation approved November 6, 1871.)

Item 1.

For new engine No. 7, Schuylkill Works:

Building engine,	$52,314 13	
Machine work,	518 92	
Wages,	352 25	
Lumber,	25 02	
		53,210 32
Amount carried forward,		$54,136 16

Amount brought forward,		$54,136 16

Item 8.

For mains to connect large Storage Reservoir, East Fairmount Park, with engines at Schuylkill Works:

Iron pipe,	$7,972 50	
Wages,	7,277 39	
Machine work,	6,287 47	
Air vessel,	2,500 00	
Hauling,	818 38	
Valves,	292 60	
Inspection of pipe,	159 10	
Bolts and nuts,	13 32	
Coke,	9 00	
		25,329 76

Item 9.

For incidentals:

Hauling,	2 00

(Appropriation Approved May 19, 1873.)

Item 1.

For engine house and stack at Harrison's Landing (Frankford Works):

Malone's contract,	$31,796 21	
Prior & West's contract,	13,423 95	
Building wharf, &c.,	526 44	
Wages,	445 00	
Machine works,	123 56	
Surveys,	54 00	
		46,369 16

Item 2

For new engines and boilers, and setting same (Frankford Works):

Cramp's contract,	$35,645 01	
Malone's "	3,849 30	
Wages,	294 50	
Foundation walls,	98 40	
Advertising,	39 60	
		39,926 81
Amount carried forward,		$165,763 89

Amount brought forward, ...		$165,763 89

Item 3.

For submerged main and inlet (Frankford Works):

Malone's contract, . . .		6,817 15

Item 4.

For reservoir (Frankford Works):

Malone's contract, . . .	$70,358 54	
Wages, ...	2,611 75	
Iron pipe, ...	1,707 82	
Keep of horse, ...	444 20	
Hauling, ...	198 64	
Lumber, ...	77 09	
Inspecting pipe, . . .	42 00	
Terra cotta pipe, . . .	23 16	
Transportation, . . .	10 00	
		75,473 20

Item 5.

For land damage (engine house and reservoir):

Perot Lardner, . . .		19,152 00

Item 6.

For 30-inch ascending main, stop cocks, fixtures, &c. (Frankford Works):

Iron pipes, ...	$25,953 64	
Lead, ...	15,707 79	
Wages, ...	15,115 27	
McManus & O'Rourke's contract, .	11,566 13	
Hauling, ...	8,629 41	
Lumber and storage, . . .	6,467 15	
Valves, ...	1,445 30	
Stone, ...	1,266 00	
Iron castings, ...	499 18	
Malone's contract, . . .	485 55	
Inspecting pipes, . . .	452 00	
Surveys, ...	216 00	
Amounts carried forward, .	$87,803 42	$266,206 24

Amounts brought forward,	$87,803 42	$266,206 24
Lime,	195 25	
Bolts and nuts,	164 03	
Tripod,	115 37	
Cement,	80 75	
Coal,	61 50	
Rope,	25 95	
Repairs to pump,	17 50	
Hardware,	11 48	
Coke,	8 00	
		88,483 25

Item 7.

For 20 inch descending main (Frankford Works):		
Iron pipes,	$10,268 04	
McManus & O'Rourke's contract,	2,000 70	
Lead,	1,976 25	
Wages,	1,892 31	
Storage,	1,686 30	
Hauling,	1,683 01	
Mason work,	389 62	
Surveys,	287 00	
Lumber and wharfage,	224 30	
Fence and culvert work,	176 13	
Gasket,	118 40	
Inspection of pipes,	103 20	
Hardware,	10 55	
Rope,	5 88	
		20,821 69

Item 13.

Incidentals:		
Advertising,	$392 90	
Sundries,	364 97	
Surveys and maps,	52 50	
Stationery,	37 25	
Tolls,	10 16	
Hauling,	7 00	
		864 78
		$376,375 96

RECAPITULATION.

Expended from annual appropriation, . . .	$713,518 02
" " special " . . .	11,129 83
" " loans (extension of works), . . .	376,375 96
Total expenditures for 1876, . . .	$1,101.023 81
Total receipts for 1876, ...	$1,199,754 97
Total expenditures for 1876, loans included, . .	1,101,023 81
Receipts in excess of expenditures, . .	$98,731 16

OPERATIONS

OF THE

REGISTRAR'S DEPARTMENT

FOR

1876.

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER.

REGISTRAR'S OFFICE,
N. W. Corner Thirteenth and Spring Garden Streets.

Philadelphia, January 2, 1877.

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 1876, amounting in the aggregate to $1,194,059.99, which has been paid daily as received into the office of the City Treasurer.

The receipts for water rents amount to $970,814.25, an increase of $32,457.00 over the previous year.

The receipts for water pipe amount to $115,034.27, a decrease of $8,224.26. Pipe bills to the amount of $81,151.48 were returned to City Solicitor for lien, and the amount collected by him for the same was $52,259.95, as appears of record in that Department.

The estimated receipts for the year, as submitted to the City Controller, were $1,182,000, being $12,059.99 less than the actual receipts.

Respectfully referring to the annexed itemized tables,

I am, very truly yours,

JOHN N. HAGEY,
Registrar.

Receipts at the Registrar's Office for the year 1876.

MONTHS.	DELINQUENT RENTS.	PENALTIES.	RENTS OF 1876.	PENALTIES.	FRACTIONAL RENTS.	WATER PIPE.	TOTAL.
January	$6,843 50	$904 26	$39,694 25	.....	$3,238 10	$16,440 81	$67,120 92
February	3,488 25	478 37	55,421 00	.....	2,240 25	8,956 88	70 584 75
March	2,719 00	390 76	174,812 75	.....	10,582 19	14,338 27	202,842 97
April	4,198 50	593 34	518,103 00	.....	7,792 10	12,170 87	542,857 81
May	3,167 00	424 97	26,431 25	$1,321 69	7,325 60	8,111 28	46,781 79
June	1,629 75	229 49	50,898 50	2,426 39	4,889 35	3,790 78	63,864 26
July	1,276 25	176 05	9,444 50	1,278 16	4,997 25	10,652 89	27,825 10
August	689 50	90 60	17,197 75	2,438 14	3,688 42	6,370 75	30,475 16
September	1,263 00	184 65	20,275 25	2,589 92	3,086 45	6,898 56	34 297 83
October	2,285 00	306 13	33,584 00	4,075 37	2,297 20	8,980 87	52,228 57
November	2,144 00	263 63	16,265 00	1,986 48	2,320 25	8,971 83	31,951 19
December	2,268 00	282 66	8,687 00	1,086 70	1,554 80	9,350 48	23,229 64
Total	$31,971 75	$4,324 91	$970,814 25	$17,202 85	$54,711 96	$115,034 27	$1,194,059 99

Amount of claims for water pipe returned for lien in 1876.....$81,151 48

Amount of claims for water pipe collected by City Solicitor in 1876..... 52,259 95

Comparative statement of receipts for the years 1875 and 1876.

	DELINQUENT RENTS.	PENALTIES.	WATER RENTS.	PENALTIES.	FRACTIONAL RENTS.	WATER PIPE.	TOTAL.
1876	$31,971 75	$4,324 91	$970,814 25	$17,202 85	$54,711 96	$115,034 27	$1,194,059 99
1875	23,106 25	3,329 93	938,357 25	17,625 52	54,667 66	123,258 53	1,160,345 14
Increase	$8,865 50	$994 98	$32,457 00	.....	$44 30	.....	$33,714 85
Decrease	.....	.....	.....	$122 67	.....	$8,224 26	.....

Items of receipts under head of "fractional rents."

	RENTS.	FERRULES.	REPAVING.	REPAIRS.	TOTAL.
1876	$38,420 71	$8,180 00	$6,633 25	$1,478 00	$54,711 96
1875	35,814 56	9,510 00	6,951 75	2,361 35	54,667 66
Increase	$2,576 15	.....	.....	.....	$44 30
Decrease	.....	$1,330 00	$318 50	$883 35	.....

Estimated receipts in Statement to City Controller	$1,182,000 00
Actual receipts as above	1,194,059 99
An excess over estimate of	$12,059 99

List of Dwellings, Factories, Horse-power, &c., as charged on Registers of 1876.

	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	30	31	
Dwellings	7824	4417	2272	2162	2576	2667	4155	2915	2515	3120	2371	1918	2598	3155	6411	2154	2199	4637	6843	6821	1293	2313	1096	4837	4011	4995	1915	3040	5794	4326	5316	112,866
" ½ & ¾	370	963	1127	1198	595	461	1374	217	515	1074	975	951	619	813	1381	1219	1239	716	327	566	23	7	44	57	341	113	68	22	176	281	199	18,031
Baths	2456	1082	748	491	783	441	2299	2345	1246	1966	447	847	1718	1652	3970	615	529	1142	3175	4900	419	1562	393	2569	708	1595	1315	2423	3946	2283	1709	51,777
Wash-paves	941	512	416	234	552	350	1250	1419	1018	1344	238	561	978	1133	2764	384	375	624	1982	3638	330	752	357	1227	337	981	873	2035	3227	1378	982	33,192
Water-closets, urinals, and bidets	115	79	84	80	1597	2214	1257	1735	1713	1322	221	328	458	507	2041	172	61	59	213	1372	229	1301	15	1123	33	136	1173	1528	1819	553	77	23,615
Basins, sinks, and wash tubs	79	65	101	73	1604	2443	1522	2731	1674	1442	181	396	398	318	2113	125	43	69	206	1588	216	1258	74	748	282	132	1304	1015	2637	63	54	24,984
Horse power	934	488	185	452	1048	2360	498	479	1230	490	538	350	258	210	2283	1077	691	1130	2144	731	247	556	274	206	611	626	375	162	205	453	1128	22,419
Horse stalls	1157	132	340	623	645	400	912	1873	1421	1753	1638	1591	625	728	2016	457	643	1563	1444	1383	142	1382	256	1290	586	643	716	267	1149	862	1132	29,709
Bars	139	1815	116	229	291	242	148	145	204	121	261	147	101	62	223	131	152	148	264	184	63	33	84	166	136	122	63	83	107	112	195	6,237
Watering horses	26	10	8	8	15	4	12	7	12	9	17	4	2	7	15	13	15	16	31	31	10	6	6	35	28	27	13	24	19	35	33	508
Factories	16	14	7	3	44	119	24	5	41	11	44	26	11	19	5	26	37	25	78	37	9	21	8	42	12	21	14	4	6	41	49	829
Foundries	11	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	2	5	3	3	8	5	7	.....	2	2	4	.....	4	3	.....	.....	4	70
Bakeries	48	44	29	30	20	20	22	13	33	19	29	22	12	16	44	31	40	44	65	60	23	11	14	12	24	34	3	25	29	34	48	598
Dye tubs	2	2	1	.....	5	4	2	3	5	7	6	.....	3	.....	74	4	17	6	15	.....	13	.....	2	1	9	2	.....	10	.....	2	18	213
Meat packers	4	2	.....	.....	.....	.....	.....	.....	1	1	1	.....	.....	1	1	2	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
Breweries	1	.....	1	2	1	4	.....	.....	1	.....	2	2	3	.....	6	3	10	1	9	8	1	2	2	1	7	1	.....	9	18	.....	.....	95
Sugar-houses	2	2	1	2	.....	2	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	14
Hot and green houses	3	.....	.....	.....	1	.....	.....	3	3	2	.....	.....	1	.....	.....	.....	.....	9	13	7	17	21	3	7	15	1	12	30	17	.....	1	166
Fountains	4	2	4	1	10	5	8	31	34	23	5	9	8	15	36	6	2	12	4	24	6	26	5	27	3	4	26	15	19	15	7	396
Distilleries	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
Slaughter-houses	48	2	.....	.....	.....	1	.....	.....	.....	.....	.....	2	5	13	2	7	51	14	73	13	.....	.....	2	25	24	4	1	27	17	2	46	379
Malt-houses	.....	.....	.....	1	1	.....	.....	1	.....	.....	2	.....	1	.....	1	1	.....	1	.....	3	.....	.....	.....	.....	.....	.....	.....	1	4	.....	.....	17
Brick-yards	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	1	1	2	.....	.....	1	6	3	2	11	7	1	.....	37
Barber shops	24	17	17	17	25	31	12	15	32	15	17	15	17	25	28	16	21	21	39	28	10	5	9	19	16	15	6	17	20	24	22	595
Photographers	.....	.....	2	2	6	3	3	6	27	4	7	4	7	2	1	.....	3	1	3	1	4	1	3	.....	3	.....	2	5	1	.....	1	102
Churches	6	5	9	6	16	5	6	5	4	6	3	6	6	10	8	16	15	17	13	16	13	5	9	15	3	7	13	19	15	5	15	297
Drug stores	17	14	13	12	11	7	12	11	15	12	9	7	12	9	7	8	12	14	20	10	8	11	4	8	6	13	6	9	16	32	15	360
Miscellaneous	29	44	27	39	60	21	2	3	3	3	.....	1	19	71	45	96	48	52	205	63	.....	15	20	35	42	29	29	5	73	40	135	1,254
Boilers and engines	.....	.....	.....	.....	.....	.....	23	25	41	10	18	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	4	.....	130

Permits issued during the year 1876.

	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	30	31	
Dwellings	409	14	10	6	3	4	33	31	4	45	6	1	6	10	179	1	11	120	121	202	118	275	96	655	234	325	94	586	317	68	81	4,065
" ½ and ¾	...	...	...	...	1	.....	.....	.....	.....	.....	.....	.....	1	...	...	...	3	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
Baths	152	16	9	2	7	2	43	76	1	39	3	7	18	13	140	5	4	69	62	201	27	196	32	534	32	176	113	530	267	69	43	2,886
Wash paves	31	9	7	2	6	2	25	33	13	32	6	5	19	9	85	2	7	12	50	102	30	55	24	225	16	47	75	374	150	45	29	1,527
Water closets, Urinals, and Bidets	7	3	3	...	73	52	45	281	63	59	2	5	22	28	181	5	12	5	37	100	9	53	2	551	.....	8	174	255	124	29	.....	2,188
Basins, Sinks, and Wash tubs	3	3	...	...	50	18	55	208	61	74	1	5	8	11	154	3	5	4	11	46	18	45	6	301	1	3	179	211	165	4	1	1,656
Stores, Shops, and Offices	1	1	...	2	1	2	.....	5	4	1	...	...	4	3	4	...	2	.....	3	3	3	2	1	21	1	1	3	1	7	.....	.....	76
Bars	1	1	...	1	1	1	.....	5	1	1	...	...	.....	3	7	...	...	3	3	1	6	4	2	95	8	.....	1	3	6	2	3	154
Wash-paves for watering horses	.....	1	...	...	.....	.....	.....	1	1	.....	...	...	1	...	1	...	1	2	1	1	2	.....	1	11	2	.....	2	1	.....	2	2	33
Engines and Boilers	.....	1	...	...	3	8	1	7	3	3	3	1	3	1	.....	1	1	2	5	1	3	6	2	3	3	1	3	1	1	1	1	69
Horse power	.....	25	...	...	29	96	70	103	11	67	19	15	24	5	.....	4	10	35	24	10	6	18	14	47	15	12	161	6	2	5	3	836
Stables	4	2	...	1	.....	1	1	3	2	.....	...	1	1	1	4	...	1	2	4	3	5	3	.....	9	2	.....	2	6	2	1	2	63
Slaughter-houses	2	...	...	...	.....	.....	.....	.....	.....	.....	...	...	.....	...	.....	...	...	.....	1	.....	.....	.....	.....	4	2	.....	.....	4	.....	.....	.....	13
Bakeries	1	...	...	...	.....	.....	.....	.....	.....	.....	...	...	.....	...	1	...	...	1	.....	.....	.....	.....	.....	.....	.....	2	.....	1	.....	.....	.....	6
Building purposes	6	1	1	...	1	3	1	9	2	2	...	1	1	2	11	1	1	9	17	7	31	31	6	83	18	12	22	47	26	5	6	363
Fountains	.....	...	...	...	.....	.....	1	1	1	.....	...	1	1	1	1	...	...	1	.....	2	2	4	.....	5	.....	.....	1	.....	1	.....	2	25
Factories and Dye houses	.....	...	...	...	.....	1	1	.....	.....	2	2	2	.....	...	.....	2	...	2	6	1	1	5	1	.....	.....	1	.....	.....	1	1	.....	29
Hot houses	.....	...	...	...	.....	.....	.....	.....	.....	.....	...	...	.....	...	.....	...	...	.....	.....	.....	.....	1	4	.....	.....	.....	.....	2	.....	.....	.....	7
Public building	.....	1	...	...	1	.....	.....	2	2	.....	...	...	.....	...	.....	...	...	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	1	.....	.....	9
Watering vessels	.....	...	...	60	.....	4	.....	.....	.....	.....	1	...	.....	...	.....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65
Sprinkling streets	.....	...	...	...	.....	.....	.....	.....	.....	.....	...	...	.....	...	.....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Hotels and Restaurants	.....	...	...	...	.....	1	.....	5	1	.....	...	...	.....	...	1	...	...	.....	.....	.....	.....	.....	.....	28	.....	.....	1	.....	1	.....	.....	38
Breweries & Bottling establishments	.....	...	...	...	.....	1	.....	.....	.....	.....	...	...	1	...	.....	...	...	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	4
Market	.....	...	...	...	.....	.....	.....	.....	.....	.....	...	...	1	...	.....	...	...	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Total	617	78	30	74	176	196	276	770	170	325	43	44	111	87	769	24	58	267	346	681	262	698	191	2573	330	588	831	2029	1071	232	173	14,128

Amount of Duplicates for the years 1876 and 1877.

Wards.	1876.	1877.
First	$51,888 50	$60,419 75
Second	35,892 75	36,154 50
Third	21,439 50	21,687 00
Fourth	22,238 75	21,527 50
Fifth	35,221 25	35,240 00
Sixth	37,718 00	42,721 00
Seventh	40,213 75	41,444 25
Eighth	40,105 25	41,494 75
Ninth	35,790 00	36,429 25
Tenth	35,580 25	39,992 00
Eleventh	18,862 25	18,770 25
Twelfth	20,551 50	21,880 75
Thirteenth	29,826 75	29,075 25
Fourteenth	33,706 25	39,190 75
Fifteenth	73,907 00	77,339 50
Sixteenth	25,712 50	25,526 00
Seventeenth	23,370 75	24,620 25
Eighteenth	34,303 25	40,022 25
Nineteenth	67,395 50	67,838 75
Twentieth	70,471 75	73,459 25
Twenty-first	9,328 25	10,160 50
Twenty second	23,978 00	25,921 50
Twenty-third	9,139 00	10,389 50
Twenty fourth	36,270 00	44,121 00
Twenty fifth	28,868 50	29,645 25
Twenty-sixth	35,109 25	38,044 75
Twenty seventh	21,874 25	24,162 25
Twenty-eighth	28,187 50	34,210 00
Twenty-ninth	58,647 25	62,015 75
Thirtieth	43,573 50	42,954 50
Thirty first	44,693 00	45,162 00
Total	$1,093,864 00	$1,161,610 00

1877, increase $67,746 00.

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 42
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
1876.....	144,593	115,034 27	81,151 48	52,259 95
Total.....	1,692,123	$1,221,568 27	$747,119 72	$316,361 66

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER,

WILLIAM H. McFADDEN, Chief Engineer,

OFFICE, NORTH-WEST CORNER THIRTEENTH AND SPRING GARDEN STREETS.

CONSUMERS OF WATER will please compare their bills with the following schedule of charges, and designa the openings, that a proper bill may be rendered in accordance therewith, and thus check any erro for or against them.

Dwellings,—¼ dwellings (one room on a floor)....without hydrant or sink on premises,	$2
" ½ dwellings (one room on a floor, and kitchen)....without hydrant or sink on premises,	3
" all other dwellings ....without hydrant or sink on premises,	5
" all dwellings with hydrant or sink, or hydrant in yard and sink in kitchen, with hot or cold water	5
Wash Paves.—Screw nozzles on hydrants or elsewhere	3
" for watering horses	10
Wash Basins or Sinks.—In private dwellings (kitchen excepted) each	1
" " " in hotels or boarding houses each	3
" " " in drug stores, attached to dwellings each	2
" " " in stores, " " " each	2
" " " " attachment from main pipes... each	5
" " " in public buildings and halls each	3
" " " in barber shops, one basin or outlet each	3
" " " " " each additional outlet	1
Slop Sinks.—In boarding houses, hotels, etc each	4
Wash Tubs, (Stationary) each partition	1
Baths, (Hot and cold, or either.) In private dwellings each	3
" " " " Attached to main pipe each	5
" " " " In hotels and public bath houses, each	6
" " " " Shower baths in private dwellings, each	1
" " " " " " hotels and public bath houses each	2
Water Closets, Urinals, Biddets and Foot Tubs.—In private dwellings each	1
" " " " " " In stores, factories, &c., self-acting....each	2
" " " " " " " " all others....each	3
" " " " " " In hotels, boarding houses, self-acting....each	3
" " " " " " " " all others....each	5
Stables.—Without water on premises....each stall and each carriage	1
" With " " ....not exceeding 5 stalls or carriages	5
" Accommodating farmers....each stall	0
Bars, (with or without water.)....each	10
Hotels and Boarding Houses, (In addition to opening charges.) For boarders to number of 10	5
" " " " " " " " " 25	10
" " " " " " Each additional 25	5
Boarding and Private Schools, each pupil	
Family Bakeries, in addition to dwelling charges	3
Ice Cream Saloons, " " "	3
Eating and Oyster Saloons, in addition to dwelling charges	5
Market Houses, each stall	
Fish Stalls, each	5
Slaughter Houses, each head killed	
Photographers, one operator	10
" " each additional operator	5
Hatters' Planks.—Fours per set	8
" " Sixes "	10
" " Eights "	12
Brick-Yards, per gang of men	5
Steam Engines, each horse-power	2
Steam Boilers, " "	2
Dye Works, each hand on tubs used	10
Vinegar Establishments, according to capacity from $10 to	20
Dye or Wool Washers, each 100 gallons	
Skin Dressers, " "	
Malt Houses, " "	
Packet Steamers and Vessels, each 100 gallons	
Breweries, each 100 barrels	2
Other Establishments, each 100 gallons	
Fountains.—Counter in stores 1-16 inch jet	5
" Garden, &c., 1-16 inch jet, 10 hours per day, 6 months	8
" " each additional jet, " " " "	1
" " ¼ inch jet, " " " "	7
" " each additional jet, " " " "	2
" " ¼ inch jet, " " " "	14
" " each additional jet, " " " "	2
" " ½ inch jet, " " " "	32
(No Ferrule larger than ½ inch granted for Fountains exclusively.)	
Green or Hot Houses, with or without water, each	5
Building Purposes, bricks per thousand	
" " stone per perch	
Water Meter Rate. each thousand cubic feet	1
For a Flow of Water, Twelve Hours Per Day, from ½ inch ferrule per annum	200
" " " " " " " " ⅝ " " " "	315
" " " " " " " " ¾ " " " "	450
" " " " " " " " 1 " " " "	800
Sprinkling Streets.—Streets less than 60 feet wide, per square, per month	3
" " " more " " " " " " " "	6
" " Country roads " " " " " " " "	6

The following Formulae are used for calculating the Horse Power of Engines and Boilers.

FOR ENGINES.

$$\tfrac{7}{10} \text{ of } \frac{A \times P \times V}{33{,}000} = \text{H. P.}$$

In which A = area of piston in square inches.

P = effective pressure in pounds.

V = velocity of piston in feet per minute.

FOR BOILERS.

Cylinder Boilers $\frac{2}{3}$ circumference of shell $\times$ length $= \frac{H\,S}{10} =$ H. P.

Flue Boilers $\frac{2}{3}$ circumference of all flues $\times$ length $= \frac{H\,S}{12} =$ H. P.

Tubular Boilers $\frac{2}{3}$ circumference of all tubes $\times$ length $= \frac{H\,S}{15} =$ H. P.

OPERATIONS

OF THE

DEPARTMENT SHOP,

918 CHERRY STREET.

STOCK ACCOUNT.

Statement of the Operations of the Cherry Street Shop, from January 1, 1876, *to December* 31, 1876.

Dr.

To stock on hand January 1, 1876,			$11,318 37
396,635 lbs. iron castings,			10,561 33
17,230 " brass castings,			3,202 48
1,633 " copper and tin castings,	@ 32 cts.		522 56
1,923 " phosphor bronze castings,			961 50
28,561 " wrought iron,			743 60
3,332½ " cast steel,	@ 12 cts.		399 90
127 tons coal,			871 25
200 bushels coke,			17 75
66,355 ft. ass'd lumber,			2,186 77
15 cords cord wood,			157 45
Bolts and nuts,			1,061 67
Gum packing and belting,			969 93
Wrought iron tubing,			2,895 41
Hardware,			2,833 19
300 gum valves,			477 00
6,927 lbs. rope and gasket,			753 30
Galvanizing spindles,			14 25
Powder and fuse,			294 00
Sponge cloths,			197 10
Paints and oils,			547 79
15 water meters, "assorted,"			1,760 00
Railroad tickets,			165 00
Machine work,			994 87
Portable planer,			506 00
Hauling stops, &c.,			199 81
Sundries and incidentals,			42 87
522,779 lbs. lead,			38,986 50
Wages paid hands,			29,468 60
Bricks, lime, &c.,			87 80
299 stop boxes received from Manayunk,			1,046 50
			114,244 55
Balance			17,863 21
			$132,107 76

STOCK ACCOUNT.

Cr.

By repairs and supplies to	First District,	$6,540 78
" "	Second "	16,601 81
" "	Third "	6,210 84
" "	Fourth "	25,974 55
" "	Germantown District,	5,880 39
" "	Manayunk "	4,161 00
" "	Fairmount Works,	1,868 48
" "	Schuylkill "	7,934 67
" "	Belmont "	2,789 12
" "	Delaware "	2,944 91
" "	Roxborough "	3,474 29
" "	Chestnut Hill Works,	977 12
" "	Buildings and grounds,	1,745 81
" "	Main office,	244 78
" "	Water meters,	1,060 00
" "	Belmont reservoir,	489 73
" "	Auxiliary, Roxborough Works,	89 93
" "	Pipe bridge,	663 75
" "	Frank'd Works 20 and 30 in. main	17,930 03
" "	48-inch pumping main,	6,819 07
4,140 ferrules delivered to main office,		2,070 00
Stock on hand per inventory, January 1, 1877,		15,636 70
		$132,107 76

INVENTORY OF STOCK ON HAND January 1, 1877.

10 4 inch socket screws,	at	$5 00	$50 00	
32 6-inch " "	at	5 00	160 00	
19 8-inch " "	at	6 00	114 00	
8 10-inch " "	at	7 00	56 00	
4 12-inch " "	at	8 00	32 00	
				$412 00
14 6-inch square top screws,	at	5 00	$70 00	
17 4-inch " "	at	5 00	85 00	
2 8-inch " "	at	6 50	13 00	
12 20-inch " "	at	14 00	168 00	
16 16-inch " "	at	12 00	192 00	
8 12-inch " "	at	10 00	80 00	
10 10-inch " "	at	8 00	80 00	
3 30 inch " "	at	20 00	60 00	
2 36-inch " "	at	25 00	50 00	
				798 00
27 4-inch spindles,	at	5 00	$135 00	
97 6-inch "	at	5 00	485 00	
15 8-inch "	at	5 00	75 00	
12 12 inch "	at	10 00	120 00	
10 10-inch "	at	8 00	80 00	
				895 00
38 plug monkey screws,	at	5 00	$190 00	
70 pairs cross heads,	at	1 50	105 00	
40,941 lbs. iron castings,	at	03	1,228 23	
9 4-inch stop cocks,	at	24 30	218 70	
9 6-inch " "	at	22 00	198 00	
13 8-inch " "	at	55 00	715 00	
17 10-inch " "	at	62 00	1,054 00	
7 12-inch " "	at	70 00	490 00	
				4,198 93
32 frames and covers,	at	7 00	$224 00	
46 steam plugs,	at	28 00	1,288 00	
12 steam plug cases,	at	7 50	90 00	
				1,602 00
169 assorted chisels,			$206 00	
20 rammers,	at	5 00	100 00	
150 eye bolts,	at	50	75 00	
11 hammers,	at	2 00	22 00	
Amounts carried forward,			$403 00	$7,905 93

Amounts brought forward,			$403 00	$7,905 93
2,206 lbs. bolts and nuts,	at	15	330 90	
5,629 " wrought iron forgings,	at	15	844 35	
6,720 " ass'd wrought iron,	at	06	403 20	
500 " " steel,	at	15	75 00	
				2,056 45
Paints and oils,			$131 25	
Hardware,			428 60	
50 lbs. leather,			25 00	
400 gum rings,			400 00	
95 dozen sponge cloths,	at	75	71 25	
33 6 inch boxes,			132 00	
20 10-inch boxes,			80 00	
				1,268 10
Wrought tubing and steam fittings,				215 50
Finished brass, 2,463 lbs.				1,231 50
4,911 lbs. unfinished brass,	at	17		794 87
385 " scrap,	at	10		38 50
3 30-inch finished sides,				372 98
Phosphor bronze boxes,				3 50
10 10-inch phosphor bronze screws,	at	17 55	$175 50	
6 12-inch " " "	at	17 79	107 76	
2 20-inch " " old style	at	30 55	61 10	
2 10-inch " " old style	at	19 50	39 00	
1 30 inch " " screws	at	49 61	49 61	
				432 97
3 30 inch copper and tin screws,	at	32 61	$97 83	
4,049 feet panel lumber,			136 86	
250 feet cherry,			30 00	
379 wood plugs,	at	50	189 50	
5 kegs nails,	at	3 50	17 50	
9 dozen assorted handles,	at	3 00	27 00	
12 gross assorted screws.			9 00	
Patterns, &c.,			808 71	
				1,316 40
				$15,636 70

Stop-cocks, Stop-cock Boxes, Frames and Covers, Fire-plugs, Cases, Lead, and Gasket, delivered from Shop No. 918 Cherry Street, during 1876.

	3-inch stop-cocks.	4-inch stop-cocks.	6-in h 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.	Frames & covers.	Plugs.	Cases.	Stop boxes.	Lead.	Gasket.
First District	.....	6	56	.....	.....	.....	.....	.....	.....	.....	.....	84	20	49	68	7,429	490
Second District	.....	10	55	5	25	5	.....	.....	.....	.....	.....	97	100	118	122	51,930	1,730
Third District	.....	4	73	.....	1	1	.....	.....	.....	.....	.....	103	18	33	85	39,350	800
Fourth District	.....	1	103	.....	1	7	.....	1	.....	.....	1	92	41	90	54	8,525	895
Germantown District	.....	6	20	1	.....	.....	.....	.....	.....	.....	.....	30	42	48	52	13,394	910
Manayunk District	.....	6	18	.....	.....	.....	.....	2	.....	.....	.....	25	27	25	.....	8,650	280
Frankford Works	.....	.....	.....	.....	1	.....	.....	5	.....	7	.....	.....	.....	.....	.....	143,729	2,240
48 Pumping Main	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	4	2	.....	.....	.....	251,181	600
Chestnut Hill Works	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Main Office	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	.....	35	325	7	29	13	.....	8	.....	10	5	433	248	363	381	524,218	7,935

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 1876, 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
1876.....	.....	39	282	20	46	19	.....	8	.....	10	5	429	278	374	494	465	4,000	.....	140	.....	4,140

Inventory of articles manufactured at shop during 1876.

39 4 inch stop cocks, at	$25 00	$975 00
282 6-inch "	22 00	6,204 00
20 8 inch "	50 00	1,000 00
46 10 inch "	85 00	3,910 00
19 12-inch "	120 00	2,280 00
8 20 inch "	225 00	1,800 00
10 30-inch "	520 00	5,200 00
5 36 inch "	750 00	3,750 00
278 steam fire-plugs, at	28 00	7,784 00
374 plug cases, at	7 50	2,805 00
494 stop-boxes, at	4 00	1,976 00
4,000 ½-inch ferrules, at	50	2,000 00
140 ¾-inch "	50	70 00
Patterns, &c		808 71
		$40,562 71

OPERATIONS

OF THE

WORKS

FOR

1876.

Running Expenses of all the Works for the year 1876.

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.....	$12 050 00	211	$4 69	$989 59	319¼	.90	$287 32	96	16	$15 36	$15 44	$1,959 30	$1,672 11	$516 24	$17,505 36	90	2.09 $\frac{03}{100}$	.0232
" Worthington pump	1,864 00	238	4 69	1,116 22	4½	.90	4 05	150	16	24 00	2 20	39 61	315 63	18 60	3,384 31	92	19.61 $\frac{85}{100}$	.2229
Schuylkill.....	13,675 00	2,451	4 31	10,563 81	288¾	.91	262 76	2,675	16	428 00	152 40	772 91	7,163 14	591 81	33 609 83	115	15.41 $\frac{92}{100}$	.1340
Delaware	11,750 00	3,163	4 39	13,885 57	178¼	1.13	211 59	41	16	6 56	23 00	607 30	2,883 82	1,023 46	30,391 30	118	15.11 $\frac{02}{100}$	.1269
Belmont.....	14,000 00	7,579	4 32	32,741 28	659¾	1.00	659 75	1,065	16½	175 72	521 93	.....	3,369 61	2,075 61	53,543 90	208	14.28 $\frac{85}{100}$	.0707
Roxborough	7,217 78	3,728	4 19	15,620 32	189½	1.00	189 50	.....	.....	.....	59 59	.....	5,905 18	650 07	23,642 44	334	31.67 $\frac{93}{100}$	.0951
Roxboro' auxiliary engine.....	1,600 00	133	4 77	634 41	15	1.00	15 00	.....	.....	.....	20 30	.....	357 00	42 90	2,669 61	80	.....	.....
Chestnut Hill....	864 00	287	5 06	1,452 22	34¾	.60	20 85	511	16	81 76	8 75	.....	3 85	221 81	2,653 24	125	.....	.....
	$63,020 78	17,790	$4 33	$77,003 42	1,689¾	.98	$1,650 82	4,538	16	$731 40	$803 61	$3,379 12	$21,670 34	$5,140 50	173,399 99	.....		

Actual and comparative amount of coal used by the different pumping engines for the year 1876.

Engines.	Description.	Total gallons water pumped.	Total tons coal consumed.	Actual lift.	Tons of coal required to lift 1 million galls. into reserv'r.	Tons of coal to lift 1 million gallons to the height of 100 ft.	Cost of coal to pump 1 million gallons to a height of 100 ft., coal being taken at $4.50.	Remarks.
Delaware No. 1.....	Horizontal high pressure.....	2,011,301,489	3,165	119	$1\frac{57}{100}$	$1\frac{32}{100}$	$5 94	Fires in continuous operation.....
" No. 2.....	Beam condensing.....			119				
" No. 3.....	Duplex compound Worthington			119				
Chestnut Hill.....	Horizontal high pressure.....	50,754,850	287	127	$5\frac{66}{100}$	$4\frac{46}{100}$	20 07	Fires banked every day.....
Belmont No. 1.....	Duplex compound Worthington...	819,319,800	$1,900\frac{7}{10}$	202	$2\frac{32}{100}$	$1\frac{14}{100}$	5 13	Fires in continuous operation.....
" No. 2.....	do. ...	290,921,944	$643\frac{5}{10}$	202	$2\frac{21}{100}$	$1\frac{09}{100}$	5 88	" " " .....
" No. 3.....	do. ...	2,638,410,185	5,034	202	$1\frac{90}{100}$	$\frac{94}{100}$	4 23	" " " .....
Fairmount donkey	Duplex Worthington.....	172,505,781	238	88	$1\frac{38}{100}$	$1\frac{57}{100}$	7 06	Fires in continuous operation during the time run.
Schuylkill No. 4...	Cornish	540,691,550	821	115	$1\frac{52}{100}$	$1\frac{32}{100}$	5 94	.04 per cent. of coal used in lighting and banking fires.
" No. 5...	do.	692,849,790	889	115	$1\frac{28}{100}$	$1\frac{11}{100}$	4 99	.06 per cent. of coal used in lighting and banking fires.
" No. 6...	Simpson compound.....	865,101,000	$676\frac{5}{10}$	115	$\frac{79}{100}$	$\frac{68}{100}$	3 06	.09 per cent. of coal used in lighting and banking fires.
" No. 7...	Rotative compound	81,091,000	$64\frac{2}{10}$	115	$\frac{79}{100}$	$\frac{68}{100}$	3 06	.19 per cent. of coal used in lighting and banking fires.
Roxborough No. 1.	Cornish.....	59,841,717	$209\frac{4}{10}$	333	$3\frac{50}{100}$	$1\frac{05}{100}$	4 72	Fires in continuous operation.....
" No. 2.	Duplex compound Worthington...	875,861,188	3,563	333	$4\frac{06}{100}$	$1\frac{22}{100}$	5 49	Fires in continuous operation.....
		Total. 9,098,650,294	Total. $17,491\frac{3}{10}$	Average 167	Average $1\frac{92}{100}$	Average $1\frac{15}{100}$	Average. $5 17	

The coal charged is the full amount with no deductions whatever; at the Schuylkill Works lighting and banking fires is of frequent occurrence; at the other Works the fires are kept in continuous operation.

Operations of the Fairmount Works for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total gallons of water pumped during the month.	Average gallons per day.	Coal consumed in heating mill house.	Tallow.	Lubricating oil.	From Penn'a Hospital Reports.	
								Rain fall dur'g the month.	Mean temperature.
	Days.				Lbs.	Lbs.	Qts.	Inches.	Degrees.
January	31	1,895,666	718,837,495	23,118,306	100,800	12	46	2.023	38.
February	29	1,844,031	660,136,942	22,763,342	56,000	.....	47	3.680	34.
March	31	2,165,260	752,177,260	24,263,782	44,800	14	80	5.605	37.4
April	30	2,608,140	817,169,650	27,238,988	.....	.....	108	1.999	49.
May	31	2,524,471	872,408,197	28,142,199	1,120	14	118	5.189	61.
June	30	2,249,115	827,686,974	27,589,565	1,120	.....	206	2.209	74.2
July	31	1,328,039	473,978,062	15,289,614	.....	.....	146	6.223	79.
August	31	1,115,145	373,049,700	12,033,861	.....	15	69	1.215	74.
September	30	1,733,105	589,132,458	19,637,748	67,200	.....	120	7.776	64.
October	31	2,291,986	806,756,270	26,024,395	67,200	14	137	1.210	51.
November	30	2,214,193	779,763,119	25,992,103	67,200	15	95	9.625	46.
December	31	1,950,789	703,541,616	22,694,890	67,200	12	105	3.169	25.
	Total.	Total.	Total.	Average.	Total.	Total.	Total.	Total.	Average.
	366	23,919,940	8,374,657,743	22,899,066	472,640	96	1,277	49,323	52.7

Operations of the Worthington Pump, at Fairmount, for the year 1876.

Months.	Running time. Days.	Number of strokes made during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal. Pounds.	Tallow. Pounds.	Oil. Quarts.
January							
February							
March							
April							
May							
June	10	269,930	17,005,590	1,700,559	74,000	24	4
July	27	802,381	50,550,003	1,872,222	171,0 0	52	6
August	31	1,058,812	66,705,156	2,151,779	188,000	48	4
September	20	607,064	38,245,032	1,912,251	101,000	26	4
October							
November							
December							
	88	Total. 2,738,187	Total. 172,505,781	Average. 1,909,202	Total. 534,000	Total. 150	Total. 18

Operations of the Schuylkill Works for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal.	Tallow.	Lubricating and cylinder oil.
	Days.				Pounds.	Pounds.	Quarts.
January						1	3
February						12	1
March						3	2
April	6	51,431	18,000,850	600,028	59,808	60	2
May	28	168,559	68,509,630	2,209,988	268 574	89	38
June	29	361,134	162,864,240	5,428,808	568,972	197	79
July	31	1,082,026	499,516,880	16,113,447	1,272,313	658	276
August	31	1,233,738	557,303,830	17,977,542	1,202,308	780	270
September	26	852,242	383,501,520	12,783,384	877,072	475	194
October	26	597,426	264,366,920	8,527,965	662,928	454	155
November	23	261,263	145,372,920	4,845,764	393,232	113	80
December	15	123,445	90,296,550	2,267,630	184,352	122	57
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	215	4,931,264	2,179,733,340	7,926,303	5,489,559	2,675	1,155

Operations of the Delaware Works for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal.	Tallow.	Lubricating and cylinder oil.
	Days.				Pounds.	Pounds.	Quarts.
January	25	304,931	101,877,935	3,286,385	363,285	2	37
February	24	302,013	96,628,857	3,332,029	410,924	6	31
March	28	460,890	106,960,392	3,450,335	493,062	.....	38
April	30	723,913	147,788,886	4,926,296	708,171	.....	53
May	28	682,303	179,594,847	5,793,382	600,668	.....	62
June	28	752,885	194,996,371	6,499,879	629,160	.....	47
July	31	1,024,043	238,140,331	7,681,946	871,586	.....	57
August	31	1,000,529	238,860,016	7,705,161	843,986	7	79
September	28	790,752	205,189,612	6,839,653	594,613	5	80
October	26	681,383	184,386,275	5,947,944	544,555	2	89
November	25	602,234	165,017,478	5,947,944	503,716	8	75
December	26	546,501	151,860,489	4,898,983	522,101	11	66
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	330	7,872,357	2,011,301,489	5,510,415	7,085,827	41	713

Operations of the Belmont Works for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal.	Tallow.	Lubricating and cylinder oil.
	Days.				Lbs.	Lbs.	Quarts.
January	31	609,226	243,065,825	7,840,833	1,231,051	80	186
February	29	490,848	228,615,064	7,883,278	1,071,859	75	188
March	31	490,755	234,497 335	7,564,430	1,092,202	90	182
April	30	518,092	244,891,266	8,163,042	991,716	93	144
May	31	890,024	340,168,961	10,973,192	1,470,136	50	160
June	30	936,155	370,180,134	12,339,337	1,601,802	160	260
July	31	1,052,690	407,470,819	13,144,313	1,807,942	84	301
August	31	1,119,304	430,778,472	13,896,079	2,003,597	50	315
September	30	919,115	365,121,171	12,170,706	1,705,711	60	250
October	31	839,831	329,189,548	10,619,017	1,536,074	110	240
November	30	640,260	281,509,771	9,383,658	1,236,976	106	165
December	31	594,024	273,163,563	8,811,728	1,223,545	107	248
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	366	9,100,324	312,387,660	10,270,282	16,977,611	1,065	2,639

Operations of the Roxborough Works for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal.	Tallow.	Lubricating and cylinder oil.
	Days.				Pounds.	Pounds.	Quarts.
January	31	252,055	74,356,225	2,398,588	724,320	.....	54
February	29	220,484	65,042,780	2,242,854	620,070	.....	34
March	31	224,482	66,322,190	2,139,425	644,963	.....	79
April	30	226,973	66,957,035	2,231,901	600,986	.....	98
May	31	243,501	71,832,795	2,317,187	660,426	.....	78
June	30	373,255	85,247,657	2,841,441	737,016	.....	76
July	31	324,359	95,685,905	3,086,642	809,024	.....	76
August	31	310,325	91,545,875	2,953,092	754,373	.....	74
September	30	280,865	82,855,175	2,761,839	705,402	.....	82
October	31	378,030	85,196,050	2,748,259	714,892	.....	131
November	30	262,299	77,378,205	2,578,940	691,017	.....	24
December	31	248,417	73,283,015	2,363,968	686,142	.....	12
	Total.	Total.	Total.	Average.	Total.		Total.
	366	3,345,045	935,702,907	2,563,569	8,350,140		758

Practical Operations of the Auxiliary Works at Roxborough for the year 1876.

Months.	Running time.	Number of strokes during the month.	Total number of gallons of water pumped during the month.	Average gallons per day.	Coal.	Tallow.	Lubricating and cylinder oil.
	Days.				Pounds.	Pounds.	Quarts.
January							5
February	29	12,100	181,500	6,258	29,000		5
March	31	11,600	174,000	5,613	30,800		5
April	30	11,300	169,500	5,650	26,880		5
May	31	14,150	212,250	6,847	38,080		5
June	30	14,000	210,000	7,000	29,120		5
July	31	106,200	371,700	11,990	26,656		5
August	31	60,800	212,800	6,864	22,400		5
September	30	26,100	91,350	3,045	17,920		5
October	31	27,200	95,200	3,070	27,520		5
November	30	24,000	84,000	2,800	22,064		5
December	31	24,000	84,000	2,709	27,480		5
	Total.	Total.	Total.	Average.	Total.		Total.
	335	331,450	1,886,300	5,622	297,920		60

Operations of the Chestnut Hill Works for the year 1876.

Months.	Running time. Days.	Number of strokes during the month.	Total number of gallons of water pumped during the month	Average gallons per day.	Coal. Lbs.	Tallow. Lbs.	Lubricating oil. Quarts.
January	31	155,600	2,761,900	89,093	35,280	59	15½
February	29	127,800	2,268,450	78,222	32,480	45	14½
March	31	149,200	2,648,300	85,429	52,080	46	8
April	30	150,600	2 673,150	89,105	47,600	45	7½
May	31	183,000	3,248,250	104,782	54,880	46½	7½
June	30	371,000	6,585,250	219,508	56,000	45	10½
July	31	457,000	7,011,750	226,185	99,120	46	15
August	31	420,600	7,465,650	240,827	88,480	47	15
September	30	328,600	5,832,650	194,421	66,640	40	16
October	31	244,800	4,345,200	140,164	30,240	31	12
November	30	169,800	3,013,950	100,465	39,200	30	9
December	31	163,400	2,9 0,350	93,559	40,880	31	9
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	366	2,921,400	50,754,850	139,054	642,880	511½	139½

Amount of Water pumped by the different Works for each month of the year 1876.

Months.	Chestnut Hill Works.	Roxborough Works.	Delaware Works.	Belmont Works.	Schuylkill Works.	Fairmount Works.	Fairmount Donkey.	Total of all the Works.	Average per day.	Highest number of gallons on any one day.	Lowest number of gallons on any one day.
January.....	2,761,900	74.356,225	101,877.935	243,065,825	.....	718,837,495	.....	1,140,899,380	36,803,205	42,176,964	29,608,791
February.....	2,268,450	65,042,780	96.628,857	228,615,064	.....	660,136,942	.....	1 052 692,086	36,299,727	43,257,341	27,391,131
March	2,648,300	66,322,190	106,960,392	234,497 335	.....	752,177,260	.....	1,162,605,477	37,503,402	41,641,878	29,387,806
April.....	2,673,150	66,957,035	147.788,886	244,831,266	18,000,850	817,169,650	.....	1,297,480,906	43,249,363	54,472,506	37,787,964
May.....	3,248,250	71,832,795	179,594,847	340 168,961	68,509,630	872,408,197	.....	1,535,762,680	49,540,731	59.047,039	35,616,491
June	6,585,250	85 247,657	194,996,371	370,180,134	162,164,240	827,686,974	17,005,590	1,664,536,216	55,485,540	62 934,792	48,210,478
July	7,011,750	95,685,905	238,140,331	407,470,519	499,516,880	473,998,062	50,550,003	1,772,373,750	57,173,346	71,591,446	49,105,459
August.....	7,465,650	91 545,875	239,860,016	430,778,472	557,303,830	373,049,700	66 705,156	1,765,708,699	56,958,345	63 057,610	46,512,370
September.....	5,832,650	82,855,175	205,189,612	365,121,171	383,501,52	589,132,458	38,245,032	1,669,877,618	55,662,587	71,171,526	32,313,287
October	4,345,200	85,196,050	184,386,275	323,189,548	264,366,920	806,756 270	.....	1 674,240,263	54,007,750	68,020,388	36,533,919
November	3,013,950	77,378,205	165,017,478	281,503,771	145 372,920	779,763 119	....	1,452,055,443	48,401,848	56,544,52	36,038,720
December	2,900,350	73,283,015	151.860,489	243,163,563	80,296,550	703 541,616	.....	1,285,045,583	41.453,083	53,016,186	28,854,420
	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Grand total.	Average.	Average.	Average.
	50,754,850	935,702,907	2,011,301,489	3,748,651,929	2,179,733,340	8,374,657,743	172,505,781	17,473,308,039	47,741,279	57,271,349	36,446,736

Amount of Water pumped by all the Works from 1854 to 1876, inclusive, in U. S. Gallons.

Year.	Fairmount.		Delaware.		Schuylkill.		Twenty-fourth Ward and Belmont.		Roxborough and Germantown.		Chestnut Hill.		Totals.	
	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total water pumped.	Daily average.	Total for all the works.	Total daily average.
1854	2,286,402,222	6,264,116	618,173,121	1,693,625	1,366,011,559	3,742,497	.....	.....	.....	.....	.....	.....	4,270,586,902	11,700,238
1855	2,787,736,850	7,637,635	567,804,060	1,555,628	1,525,987,725	4,180,788	9,538,170	26,132	.....	.....	.....	.....	4,891,066,805	13,400 183
1856	2,867,188,965	7,833,850	769,566,040	2,102,639	1,980,637,500	5,411,578	52,577,642	143,655	.....	.....	.....	.....	5,669,970,147	15,491,722
1857	3,059,797,730	8,383,007	811,462,085	2,223,184	2,315,832,461	6,344,746	121,948,840	334,106	.....	.....	.....	.....	6,309,041,116	17,285,044
1858	3,058,418,667	8,379,229	757,187,690	2,074,487	2,819,641,992	7,725,047	204,177,624	559,391	.....	.....	.....	.....	6,839,425,973	18,738,153
1859	3,390,271,757	9,288,416	868,567,100	2,379,636	2,643,736,620	7,243,114	265,456,170	727,277	.....	.....	.....	.....	7,168,031,647	19,638,443
1860	3,612,989,017	9,871,555	872,144,980	2,382,910	2,696,960 210	7,368,744	283,646,070	774.989	.....	.....	.....	.....	7,465,740,277	20,398,197
1861	3,731,785,628	10,224,070	983,805.740	2,695,358	2.527,182,710	6,923,788	353,313,900	967,983	.....	.....	.....	.....	7.596,087,978	20,811,200
1862	3,564,724,753	9,766,369	909,126,440	2,490,757	3,038,527.420	8,324,733	420,507.810	1,152,076	.....	.....	.....	.....	7,932,886,423	21,733,933
1863	5,536,712,091	15,306,060	1,182,539,680	3,239,835	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	16,313,665	1,090,884.060	2,980,558	1,725,444,660	4,714,330	519,877,800	1,420,431	.....	.....	.....	.....	9,307,007,849	25,428.983
1865	7,082,015,640	19,402,783	1,429,591,700	3,916,690	2 005,038,484	5,493.256	535,923,360	1,468,283	.....	.....	.....	.....	11,052,569,184	30,281,011
1866	7,721,817,582	21,155,665	1,271,841,020	3,484.496	947,652,428	2,596,308	606,665,380	1,662,097	106 369,060	291,422	.....	.....	10,654,345,470	29,189,987
1867	7,990,416,594	21,891,552	427,935,060	1,172,425	1,590,248 454	4,356,845	677,717,190	1,856,759	177,104,200	485,217	.....	.....	10,863,421,498	29,762,798
1868	8,024,530,911	21.924,948	705,442,350	1,927,438	2,337,365,642	6,386,245	727,824.780	1,988,592	190,015 200	519,167	.....	.....	11.985,178,883	32,746,390
1869	7,489,611,069	20 519,482	1.042,780.953	2,856,934	2,735,569.020	7,491,709	928,561,494	2.514,004	218,229,800	597,890	.....	.....	12,414,752,336	34 013,020
1870	8,134,985,170	22,287,631	1,186,131,144	3,249.674	3.003,737,166	8,229,417	*850,011,192	2,328,798	227,946,600	624,511	.....	.....	13,402,811,272	36,720,030
1871	8,821,728,533	24,169,965	1,007,378,521	2,759,941	2,201,294,172	6,030,943	1,054,210,990	2,888.249	‡413,787,205	1,133,664	.....	.....	13.498,399,481	36,981.916
1872	†7,366,632,573	20,127,411	1,474,531,040	4,028,773	2,223,287,070	6,074,555	1,456,756,728	3,980,210	‡518,811,050	1,417,517	.....	.....	13,040,018,461	35,628,465
1873	†8,717,538,594	23,883,667	1,364,109,884	3,737,287	1,508,295,800	4,132,317	1,959 966,670	5,369,772	673.237,495	1,844.623	.....	.....	14,223,198,443	38.967,667
1874	†7,749,007,798	21,230,158	1,558,518,765	4,269,914	1,536,5 5,220	4,209,603	2,969,227,504	8,134,870	720,165,810	1,973,057	.....	.....	14,553.425,097	39,817,603
1875	†7,994,244,254	21,902,012	1,839,190,470	5,038,878	1,356,295,950	3,715,879	3.055,507,870	8,371,254	818,339,525	2,242,026	33,592.000	92,033	15,097,160,069	41,362.082
1876	†8,547,163,524	23,352,9 6	2,011,301,489	5,495,359	2,179,733,340	5,955,556	3,748,651,929	10,242,218	935,702,907	2,556,565	50,754,850	138,674	17,473,308,039	47,741,279

* 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 Engine, which, in 1872, was 146,540,888; in 1873, 9,711,208; in 1874, 166,984,376; in 1875, 324,225,056; in 1876, 172,505,781 gallons.

‡ The Roxborough Works commenced pumping December 21, 1870.

ȝ The Germantown Works were abandoned September 30, 1872.

DISTRIBUTION

OF THE

WATER DEPARTMENT

FOR

1876.

DISTRIBUTION.

During the year 1876, 116,699 feet of service pipe have been laid. A decrease, owing to the general depression of business, the discontinuance of building operations resulting therefrom, and to the rule adopted by the Department not to lay pipes except where actually required. This does not include the 30-inch pumping, nor the 20-inch supply main, for the Frankford Works, nor the 20-inch syphon pipe across the Wissahickon creek, nor the 48-inch pipe connecting the Corinthian avenue with the Schuylkill or Spring Garden Reservoir, nor the alterations to the pumping mains at the Schuylkill Engine House. These included, make a total of 144,593 feet, or 27 miles 2,033 feet. At the close of the year 1876 the books of the Department show ordinances for the laying of 188,178 feet or 35.6 miles of pipe, very little of which however is ready; some of the streets are not opened, some not on the City Plan, and most of them neither dedicated nor graded.

On the 19th of April Councils authorized, out of the annual appropriation, the use of $60,000, to lay a 48-inch main to connect the Corinthian avenue with the Schuylkill or Spring Garden Reservoir, and thereby render available all the engines at the latter pumping station. The pipes were lined upon the streets and the ground broken on the first of May. Necessity compelled its use before completing all its connections. A single 30-inch connection was made with each reservoir, and the water was passed through on Saturday, July 8, at which time every basin in the Department had lost three feet from the first of the month. Without this main the City would undoubtedly have been subjected to a water famine. The remaining connections will be completed

as soon as possible in order that the entire pumpage of the steam engines may be thrown either into the Spring Garden or Corinthian Avenue Reservoirs, whence it can be distributed to the Delaware and Fairmount Reservoirs.

The length of the 48-inch pipe is 2,990 feet, with 310 feet of connections, varying in size from 6 to 36 inches. The total cost was $57,277.05, or $17.36 per lineal foot of 48-inch pipe, including connections, a very low figure, due to the low price of pipes.

Sixteen thousand and forty-four feet of the 30-inch pumping main and 7,848 feet of the 20-inch supply main for the Frankford Works have been laid.

The rebuilding and enlarging of the bridge, over the Pennsylvania Railroad at the intersection of Belmont and Girard avenues, necessitated the removal and relaying of the 20-inch main through which West Philadelphia receives its supply. A temporary 12-inch pipe was laid over the bridge, on trestle work, which gave a sufficient although a diminished supply.

The pipes on Elm avenue and Lancaster avenue should be connected by a 30-inch pipe laid along Fifty-second street to eventually connect with an outlet at the basin.

The 12-inch pipe on Girard avenue should also be connected with the old pumping main on Thirty-fifth street. These would be of great service in case of accident to the supply pipe on Belmont Avenue, crossing the raiload bridge.

Upon an ample protection against fire depended the success of the Centennial Exhibition. This induced the Centennial Board of Finance, through their president, John Welsh, Esq., to ask that their system of pipes might be connected with the City mains. Their request was granted, and in September, 1875, the attachment was made with a 12-inch pipe, by which, with a 6 and 4-inch pipe, used for park purposes, they were furnished with all the water required until their engine was started in May, 1876, and partially supplied, free of charge, until the 12th day of July, when the valves controlling the connections were closed, but continued under their control to be used in case of fire or necessity, which latter was frequently the case.

By an ordinance of Councils, dated April 10, the ice-water fountain of the Sons of Temperance was attached to and received its supply from the City mains. Also, as directed by ordinance of February 21, the Catholic T. A. B. Society Fountain was connected with the reservoir at George's Hill by a 10-inch pipe. On the 4th of July it was dedicated, and the water turned on. It was in constant service until November 28, when it was shut off by request, to prevent injury from frost. The attachments for both fountains were made at the expense of the Department, and the water furnished free of charge.

During the year an inspector has been engaged in examining pressures throughout the City, from whose report we found but few places, except on the high ground at Frankford, and at a high point near the Kensington Reservoir, that had just cause for complaint. On the 1st of September the latter, a district bounded by Lehigh avenue, Tenth, Dauphin, and Broad streets, supplied from the Kensington Basin, was thrown into the Roxborough District by bringing the water from Sixteenth street through Indiana avenue, Broad street, and Lehigh avenue.

It is not possible to give an adequate supply to Frankford until the completion of their works and reservoir.

At Market and Juniper streets, the pressure is low, owing to the disconnection of the Market street pipes from the 20-inch main on Broad street when it was relaid around the Public Buildings, in 1872.

The old 3-inch pipe on Juniper street should be removed, and a 12-inch pipe laid from Arch to Chestnut street. This would greatly increase the supply, and improve the pressure.

An ordinance for connecting dead ends, where the Chief Engineer shall consider it necessary to secure a better supply and purer water, was passed and approved on the 6th of July. By reference to the reports of pipe laid it will be noticed that a large number of these were connected, principally in the old districts; 3,361 feet of pipe were required for this purpose.

At a number of intersections where pipes overlaid each other they have been connected.

During the summer a 25-inch valve on an outlet pipe of the Schuylkill Reservoir was discovered to be closed, having fallen from its wrought-iron spindle. It will be necessary to empty the reservoir in order to repair it.

Stop-valves, from long use, have become a source of continual annoyance; the threads of the wrought-iron screws in a few years rust entirely away, and allow the valve to fall. A severe strain is also liable to break the stands supporting the lifting-nut. These and other defects have induced their remodelling, and we believe we now have a stronger and better valve than any made, certainly one less liable to be put out of order; at the same time the cost, especially in the larger sizes, has been greatly reduced.

Fire plugs, where subject to great pressure, as at Manayunk, always required repairing after use. The new plugs are so arranged that in the future we think this will be obviated. Some trouble has been experienced from the freezing of fire plugs in private vaults. Property owners seem to be ignorant of the law by which they are required to protect them from freezing and breaking.

According to ordinance of March 14, 1876, the office of the First District Purveyor has been removed to Eleventh and Wharton streets, a portion of the old Parade Ground, where better accommodations and larger storage capacity for pipes, &c., have been furnished.

Most of the City passenger railroad companies after being notified where their tracks covered our stops have had them arranged so that the lids may be raised without tearing up the rails. The following, however, have not been attended to:

SECOND DISTRICT.

Forty-second and Chestnut streets.
Thirty-eighth street and Lancaster avenue.
Twenty-second and South streets.
Seventh and Spruce streets.

THIRD DISTRICT.

Front and Norris streets.

FOURTH DISTRICT.

Eleventh street and Girard avenue.
Sixteenth street and Girard avenue.

DISTRIBUTION.

SERVICE AND SUPPLY MAINS LAID IN 1876.

First District.

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

Street.	Location.	Size. Inches.	Distance. Feet.
Beulah,	From Tasker to Mountain,	6	294
Canal,	" Thirteenth to Juniper,	6	301
Cantrell,	" Tenth (west),	6	223
Clarion,	" Federal (north),	6	206
"	" Tasker to Dickinson,	6	452
Conroy,	" Thirteenth to Juniper,	6	301
Corn,	" Wharton to Wyoming [D. E.],	6	225
Crumback,	" Thirteenth (east),	6	290
Dickinson,	" Thirteenth to Broad,	6	595
Dorrance,	" Dickinson to Tasker,	6	440
Eighteenth,	" Reed to 159 feet south of Tasker,	6	1,060
Emily,	" Seventh to Eighth,	6	440
Federal,	" Ninth to Passyunk road [D. E.],	6	180
Field,	" Twelfth to Thirteenth,	6	457
Fitzwater,	" Ninth to Tenth,	6	422
Gerhard,	" McKean (north),	6	305
Mehan,	" Morris (north),	6	223
Mercy,	" Seventh to Eighth,	6	437
Napa,	" Gray's Ferry road (south) [D. E.]	4	36
Reed,	" Tenth to Eleventh [D. E.]	6	519
Richardson,	" Ellsworth (south),	6	55
Tasker,	" Thirteenth (west),	6	233
Thurlow,	" Twelfth (west),	6	202
Twenty-sixth,	" Deshong to Federal,	6	91
Ward,	" Tasker to Dickinson,	6	452
Connections,	Sixth with Bainbridge, +	6	33
"	Sixth with Fitzwater, +	6	30
"	Seventh with Fitzwater, +	6	31
"	" " Alaska, +	6	4
"	" " " +	4	12
"	" " " +	3	9
"	" " Cantrell, [D. E.]	6	79
	Amount carried forward,		8,637

Street.	Location.		Size. Inches.	Distance. Feet.
	Amount brought forward,			8,637
Connections,	Eighth with May,	[D. E.]	10	3
"	" " "	[D. E.]	4	25
"	" " Passyunk road,	[D. E.]	6	44
"	" " Salter,	[D. E.]	4	32
"	Ninth with Auburn,	+	6	5
"	" " "	+	4	11
"	" " "	+	3	10
"	" " Bainbridge,	+	4	43
"	" " Carpenter,	+	6	31
"	" " Catharine,	+	6	45
"	" " Federal,	[D. E]	6	32
"	" " Fitzwater,	+	6	35
"	Tenth with Bainbridge,	+	4	41
"	" " Catharine,	+	6	43
"	" " Fitzwater,	+	6	41
"	Eleventh with Anita,	+	4	6
"	" " "	+	3	18
"	Twelfth with Bainbridge,	+	6	36
"	" " Carpenter,	+	6	26
"	" " Catharine,	+	6	31
"	" " Fitzwater,	+	6	6
"	" " Temple,	[D. E.]	4	24
"	Twenty-second with Evergreen,	[D. E.]	4	45
"	Bainbridge with Juniper,	[D. E.]	4	34
"	Catharine with Fallon,	+	4	38
"	" " Grubb,	[D. E.]	4	25
"	Dickinson with Clarion,	[D. E.]	6	26
"	" " Watt,	[D. E.]	6	42
"	Fitzwater with Lebanon,	[D. E.]	6	33
"	" " Montcalm,	[D. E.]	4	33
"	" " Stewart,	[D. E]	4	33
"	Passyunk road with Carpenter,	+	6	27
"	" " Ellsworth,	[D. E.]	6	45
"	" " "	[D. E.]	4	6
"	" " Fitzwater,	[D. E.]	6	29
"	Reed with Austin,	[D. E.]	6	10
"	" " "	[D. E.]	4	8
"	" " Silbert,	[D. E.]	4	26
	Amount carried forward,			9,685

Street.	Location.		Size. Inches.	Distance. Feet.
	Amount brought forward,			9,685
Connections,	Tasker with Tudor,	[D. E.]	4	24
"	Wharton with Woodbine,	[D. E.]	4	24
"	Wyoming with Corn,	[D. E.]	4	17
"	for Brown's Mill,		4	13
"	for plugs,		4	165
For repairs,			6	26
"			4	14
"			3	12
	Total number of feet of new pipe laid,			9,980

Number of feet of new 3 inch pipe laid,	49	
" " " 4-inch "	735	
" " " 6-inch "	9,193	
" " " 10-inch "	3	
Total number of feet,	9,980,	or 1 mile 4,642 feet.

[D. E.] Shows a connection of dead ends.
+ Shows a connection at intersections.

Of the above amount, 1,659 feet of pipe were used for dead ends, and 612 feet for intersection connections.

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.
Albion,	From Cherry to Tower	[D. E.]	6	137
"	" Vine to Winter	[D. E.]	6	167
Aspen,	" Thirty-eighth to Union,		6	1,027
Atlanta,	" Thirty-ninth to Union,		6	417
Belmont,	" Westminster to Elm,		12	2,691
Bread,	" New (south),		6	188
Cherry,	" Twenty-third (east),		6	233
Chestnut,	" Fifty fourth to Fifty sixth,		8	1,077
	Amount carried forward,			5,937

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		5,937
Columbia,	From Girard avenue to Belmont,	6	1 744
Dock, S. S.,	" Delaware avenue to Water [D. E.]	6	166
Fallon,	" Westminster to Seneca,	6	556
Filbert,	" 65 ft. E. of Seventeenth, E. [D. E.]	6	255
Forty-second,	" Girard avenue to Elm,	6	992
Forty-third,	" Walnut to Sansom,	6	270
Forty-three & half,	Haverford to Eadline,	6	370
Forty sixth,	" Oregon to Huron,	6	413
"	" Market to Chestnut,	6	555
"	" Baltimore avenue to Kingsessing avenue,	8	1,503
Fifty-second,	" Pennsylvania R. R. to Lancaster avenue,	6	313
Girard,	" Belmont to Lancaster avenue,	10	1,574
"	" " "	6	8
Grape,	" Thirty-eighth (west),	6	300
Haverford,	" Fifty second to Sixty fifth,	12	7,715
Levant,	" Pear (south) [D. E.],	4	176
Lex,	" Aspen to Huron or Seneca,	6	837
Lombard,	" Forty-fourth to Forty-fifth,	6	446
Market,	" Fifteenth to Merrick [D. E.],	6	135
Pear,	" Sycamore to Aspen,	6	417
Pine,	" Thirty-fourth to Woodland,	6	1,946
"	" Forty second to Forty-third,	6	650
Summer road,	" Belmont to 36 feet west of Forty-ninth,	6	2,918
Sycamore,	" 274 feet east of Thirty ninth (east),	8	120
"	" Thirty-ninth to Fortieth,	6	727
Twenty-fifth,	" 158 feet north of Spruce (north),	6	165
Thirty-sixth,	" Spruce to Pine,	6	394
Thirty-seventh,	" Aspen (north)	6	270
Thirty-eighth,	" Woodland to Spruce,	6	273
"	" Elm to Grape,	6	205
Union,	" Sycamore to Aspen,	6	397
Viola,	" 558 feet east of Forty second, to 550 feet west of Forty second,	6	1,108
Walnut,	" west of Fifty-second to Fifty-sixth,	8	1,915
Westminster,	" 97 feet west of Fifty-fourth to Fifty-sixth,	12	857
In Park,	" Belmont Reservoir to T. A. B. Fountain,	10	937
Connections,	Oregon and Lex, [D. E.]	6	11
"	Merrick and Market, [D. E.]	6	29
	Amount carried forward,		31,667

Street.	Location.		Size. Inches.	Distance. Feet.
	Amount brought forward,			31,667
Connections,	Sixty-third and Haverford,	[D. E.]	8	29
"	Aspen and Union,	[D. E.]	6	5
"	Westminster and Haverford,	[D. E.]	12	36
"	for Kiralfy's Theatre,		4	142
"	for Colosseum,		4	18
"	for Hotel, Chestnut above Nineteenth,		4	19
"	for R. D. Wood & Co., Centennial grounds,		10	139
"	" " "		12	2
"	for plugs,		4	1,105
"	"		6	9
"	"		10	6
"	for stops,		6	31
"	"		10	3
	Total number of feet of new pipe laid,			39,148

Number of feet of 4-inch pipe laid,	1,460	
" " 6-inch "	19,084	
" " 8 inch "	4,644	
" " 10 inch "	2,659	
" " 12-inch "	11,301	
Total number of feet,	39,148,	or 7 miles 2,188 feet.

Of the above amount, 1,146 feet of pipe were used for connecting dead ends.

Relaid,	Forty-sixth, from Kingsessing to Woodland avenue,	8	650
"	Bread, from Race to Arch,	6	666
"	Quarry, from Bread (east),	6	14
"	" " " (west),	6	14
"	Fetter's lane, from Bread (west),	6	14
Lowered,	Locust, between Thirty-ninth and Fortieth,	6	353
"	Irving, between Fortieth and Forty-first,	6	442
"	Thirty second, from Lancaster to Arch,	6	535
"	Kingsessing avenue, across Forty-sixth,	6	69
"	Sixty third, from Vine to Arch,	8	1,100
	Amount carried forward,		3,857

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		3,857
Lowered, at	Forty-sixth and Kingsessing,	6	60
"	Thirty-fifth street, or Park drive,	16	282
"	" " "	20	40
			4,239

Fifteenth Street, from Filbert to Cuthbert, 134 feet of 6 inch pipe, is not included in the above, nor in the tables in this report.

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 Cumberland to Commerce,	6	489
Buckius,	" Richmond, to 134 feet above Thompson,	6	1,041
Chatham,	" Clearfield to Allegheny,	6	795
Cumberland,	" Third to Sixth,	6	1,365
Division,	" Richmond to Miller,	6	1,614
Eighth,	" York to Cumberland,	6	550
Emerick,	" Belgrade to 34 feet above Hockley,	6	245
Fillmore,	" Lehigh avenue (north),	6	501
Fox,	" Commerce to Cedar,	6	631
Franklin,	" Cumberland to Huntingdon,	6	550
Gaul,	" Ann to Westmoreland,	6	2,588
"	" Freemont to Reading Railroad,	6	744
Hockley,	" Emerick (west),	6	147
K,	" Kensington to Old Front,	6	1,344
McMurray,	" Wellington to Westmoreland,	6	362
Mercer,	" Allegheny to Wellington,	6	404
Montgomery,	" Cadwalader to Germantown avenue,	6	240
Neff,	" Belgrade to Gaul,	6	336
Tulip,	" Clearfield to Culvert,	6	1,343
Wrekin,	" Memphis to Sepviva,	6	572
"	" Trenton Railroad to Martha,	6	285
	Amount carried forward,		16,146

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		16,146
Connections,	Mascher, above Oxford, for Dolan & Co.,	4	24
"	Columbia, west of Hancock, for Dolan & Co.,	4	24
"	Norris, west of Blair, for Jas. Doak, Jr. & Co.,	4	30
"	Snyder avenue with Lawrence, for Mr. Snyder,	4	156
"	Almond with Dickinson, [D. E.]	6	28
"	Almond with Sargeant, [D. E]	6	24
"	Silver with Fillmore, [D. E.]	6	32
"	Seltzer with Fillmore, [D. E.]	6	30
"	American, below Jefferson, for Knickerbocker Ice Company,	4	18
"	Howard and Jefferson, for James Nolan,	4	15
"	" " "	6	8
"	for plugs,	4	182
"	for stops,	6	27
For repairs,		4	33
"		6	61
"		8	5
	Total number of feet of new pipe laid,		16,843

Iron pipes laid in Frankford, in the Third District.

Street.	Location.	Size. Inches.	Distance. Feet.
Franklin,	From Wakeling to 126 feet above Dyre,	6	665
Gillingham,	" Mulberry to Hedge,	6	473
Jefferson,	" Oxford to 318 feet northeast of Plum,	6	1,401
Melrose,	" 165 feet southwest of Margaretta to Bridge,	6	2,014
Pear,	" Mulberry to Tackawanna,	6	385
Tackawanna,	" Orthodox to Harrison,	6	2,095
Thomas,	" 24 feet north of Green (north),	6	146
Pumping main,		30	16,044
Supply main,		20	7,848
At Frankford Reservoir,		10	36
Connections for plugs,		4	142
	Total number of feet of pipe laid,		31,249

	Size. Inches.	Distance. Feet.
Number of feet of new 4-inch pipe laid, Frankford,		142
" " " 4-inch " Lower section,		482
" " " 6 inch " Frankford,		7,179
" " " 6 inch " Lower Section,		16,356
" " " 8-inch " "		5
" " " 10 inch " Frankford,		36
" " " 20-inch " "		7,848
" " " 30 inch " "		16,044
Total number of feet,		48,092
Or 9 miles 572 feet.		
Relaid, Cumberland, from Third to Bodine,	6	123
Lowered, Venango, from Kensington to K,	6	480

Fourth District.

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

Street.	Location.	Size. Inches.	Distance. Feet.
Broad, E. side,	From Indiana to Allegheny,	6	1,098
Carlisle,	" Norris to Diamond,	6	526
Columbia,	" Railroad bridge or Thirty-first (east),	6	175
"	" " to Thirty-third,	6	914
Darien,	" Diamond to Susquehanna avenue,	6	586
Dauphin,	" Twenty fifth (west),	6	261
Diamond, N. side,	" Twentieth to Woodstock,	6	186
" "	" Broad to Sixteenth,	6	890
" S. side,	" Van Pelt to Twenty-first,	6	107
Edgley,	" Fifteenth to Sixteenth,	6	441
Fifteenth,	" Columbia to Montgomery,	6	552
Fletcher,	" east side of Thirtieth (west),	6	295
French,	" Fifteenth to Sixteenth,	6	441
Huntingdon,	Between Twenty-fifth and Twenty-sixth,	6	12
Indiana,	From Broad to Sixteenth,	6	914
Ninth, E. side,	" Spring Garden to Depot street,	6	150
Nevada,	" Thirtieth (west),	6	257
	Amount carried forward,		7,835

Street.	Location.		Size. Inches.	Distance. Feet.
	Amount brought forward,			7,835
Northland,	From Huntingdon (north),		6	304
Parrish,	" Twenty-seventh to Twenty-eighth,		6	400
Philadelphia,	" York to Cumberland,		6	552
Ringgold,	" Berks to Montgomery,		6	552
Susquehanna,	" Fifteenth to Sixteenth,		6	450
Twelfth,	" Diamond to Dauphin,		6	1,174
Twentieth,	" north side of Diamond to Susquehanna,		6	527
Twenty-first,	" Venango to Allegheny,		6	2,154
Twenty-fourth,	" Montgomery to Berks,		6	552
Twenty-fifth,	" Oxford (north),		12	377
"	" north of Oxford to Ridge,		10	700
Twenty-seventh,	" Mount Pleasant to Master,		6	592
Twenty-eighth,	" Pennsylvania avenue to Poplar,		6	1,108
"	" Master to Jefferson,		12	469
"	" Jefferson to Oxford,		10	531
Thirty-fourth,	" Woodford to Huntingdon,		6	398
Thompson,	" Twenty second to Twenty-third,		6	532
Van Pelt,	" Montgomery to Berks,		6	558
Virginia,	" Twenty-fourth to Twenty-fifth,		6	456
Waldron,	" Twenty-seventh to Twenty-eighth,		6	407
Willington,	" Montgomery (north),		6	216
Woodford,	" Ridge to Thirty fourth,		6	151
Woodstock,	" Diamond to Susquehanna,		6	541
Connections,	Dauphin with Twelfth,	[D. E.]	6	50
"	Nevada with Twelfth,	[D. E.]	6	10
"	Oxford with Twenty-eighth,	[D. E.]	6	31
"	Van Pelt with Diamond,	[D. E.]	6	10
"	Fifteenth with Diamond, north side,	[D. E.]	6	12
"	Fifteenth with Susquehanna,	[D. E.]	6	20
"	Sixteenth with Susquehanna,	[D. E.]	6	78
"	Sixteenth with Diamond, north side,	[D. E.]	6	12
"	Wood with Twelfth,	+	6	6
"	" with Thirteenth,	+	6	6
"	" with Sixteenth,	+	6	6
"	" with Eighteenth,	+	6	6
"	" with Nineteenth,	+	6	8
"	Carlton with Nineteenth,	+	6	8
"	Twenty-fifth with Columbia,		6	10
	Amount carried forward,			21,809

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		21,809
Connections,	Callowhill, above Tenth,	4	30
"	Natrona and Columbia,	6	48
"	Thirty second and Columbia,	6	48
"	Hollinger and Columbia,	6	48
"	Twentieth and Diamond, [D. E.]	6	63
"	Thirty-first and Thompson,	6	56
"	Broad and Indiana, across Broad,	6	42
"	Hamilton, above Fifteenth, for Baldwin's Locomotive Works,	4	3
Main pipe,	connecting Corinthian avenue with the Schuylkill Reservoir, on Taney and Poplar streets,	48	2,990
"	" " " " " "	36	36
"	" " " " " "	30	183
"	" " " " " "	20	25
"	" " " " " "	8	6
"	" " " " " "	6	60
Pumping main,	connections and alterations at Schuylkill Works,	48	122
"	" " " " "	36	102
"	" " " " " "	30	37
"	" " " " "	6	9
For repairs,		8	3
"		6	236
"		4	169
For plugs,		4	312
For new stops,		8	7
" "		6	14
	Total number of feet of pipe laid,		26,458

Number of feet of new	4-inch pipe laid,	514
" " "	6-inch "	20,356
" " "	8 inch "	16
" " "	10 inch "	1,231
" " "	12 inch "	846
" " "	20 inch "	25
" " "	30 inch "	220
" " "	36-inch "	138
" " "	48-inch "	3,112
	Total number of feet,	26,458, or 5 miles 58 feet.

Location.	Size. Inches.	Distance. Feet.
Lowered, Lehigh, south side, from Broad (east).	6	478
" " " from Twelfth to Thirteenth,	6	552
" " north side, from Broad to Thirteenth,	6	505
" Thirty-third and Columbia,	3	60
" Tenth and Oxford,	6	50
Relaid, Poplar, from Twenty-second to Twenty-fourth,	6	785
		2,430
For culvert at Schuylkill Works (old pipe),	20	90
" on Poplar, between Twenty-second and Twenty-fourth (old pipe),	20	99

GERMANTOWN.

Iron Pipes laid in Germantown District.

Street.	Location.	Size. Inches.	Distance. Feet.
Centre,	From Wilson to Evans,	6	2,148
Dounton,	" Germantown avenue to Wayne,	6	443
Eighteenth,	" Tioga to Venango,	6	535
Eighth,	" Rising Sun lane to dead end,	6	24
Fifteenth,	" Ontario to Tioga,	6	550
Highland avenue,	" Public School House (northwest),	4	306
Knox,	" Penn to Coulter,	4	350
Mehl,	" Wakefield (southwest),	4	82
Queen,	" Morris to Wissahickon avenue,	6	1,321
Schiller,	" Tenth to Eleventh,	6	446
Smedley,	" Ontario to Tioga,	6	550
Twenty-second,	" Tioga to Venango,	6	575
Willow avenue,	" Mill to Locust,	6	520
West Walnut Lane,	" Wayne (northeast),	6	498
Wakefield,	" Wister to E. Logan (Fisher),	6	1,159
Wilson,	" Haines to Centre,	6	371
Continuation of main pipe	from Mt. Airy to Chestnut Hill,	10	1,944
"	" "	6	36
"	" "	4	18
"	" "	3	18
	Amount carried forward,		11,894

Street.	Location.	Size. Inches.	Distance. Feet.
	Amount brought forward,		11,894
Connection for	Charles Spenser,	4	30
"	" Philadelphia and Reading Railroad,	4	3
"	" Mr. Livezey,	3	54
"	" Mr. Bromley,	4	17
"	" Plugs,	4	542
Repairs,		3	139
"		4	121
"		6	24
"		8	8
"		10	48
"		20	19
Total number of feet of pipe laid,			12,899

Number of feet of new	3-inch pipe laid,	211
" " "	4-inch "	1,469
" " "	6-inch "	9,200
" " "	8-inch "	8
" " "	10-inch "	1,992
" " "	20-inch "	19
		12,899 or 2 miles 2,339 feet.

	Size Inches.	Distance Feet.
Relaid Hancock, from Armat, south,	6	450
" Armat, from Germantown Road to Cumberland,	6	864
" Centre, from Germantown Road to Evans,	6	390
" East Washington Lane, from end of pipe laid 1875 east,	6	3,919
		5,623
Lowered, Eighth, between Tioga and Venango,	6	100
" Duval, east of Adams,	6	206
" Mechanic, from Floyd, west,	4	310
		616

MANAYUNK.

Iron pipes laid in Manayunk District.

Street.	Location.	Size. Inches.	Distance. Feet.
Airy,	From Lofty (south),	6	267
Boone,	Between Grape and Levering,	6	174
Clearfield,	From Thirty fourth to Ridge avenue,	6	608
Levering,	" Wood to Manayunk avenue,	6	1,308
Leverington,	" Pechin to Ridge avenue,	6	1,164
Lofty,	" Terrace to Airy,	6	158
Main,	" Shurs' lane (south),	6	960
Manayunk ave,	" Lyceum to Green lane,	6	651
Mechanic,	" Main to Leibert,	6	474
Mitchell,	" Riley to Leverington,	6	522
Penn,	" Apple (east),	6	162
Queen lane,	" Thirty fifth (east),	6	336
Terrace,	" Mechanic to Lofty,	6	195
Wabash,	" Centre, (S. E.), [D. E.]	4	123
Connection,	Green lane with Manayunk avenue, [D. E.]	6	33
"	Riley with Mitchell,	4	24
"	Main, south of Shurs' lane, for Platt & Bro.,	4	12
"	From Main street, above Fountain, for Preston & Irwin,	4	60
For plugs,		4	243
" repairs,		4	30
" "		10	12
" "		20	24
Syphon pipe across the Wissahickon Creek,		20	464
Drain for syphon pipe,		4	12
Total number of feet of pipe laid,			8,016

Number of feet of new 4-inch pipe laid,	504	
" " 6-inch "	7,012	
" " 10-inch "	12	
" " " 20-inch "	488	
	8,016,	or 1 mile and 2,736 feet.

Lowered Queen lane, between Thirty-fifth and Reading Railroad,		6	144
" Thirty-fifth, between Queen lane and Bowman		6	276
			420

Recapitulation of Pipe laid in the several districts during the year 1876.

WARDS.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	20-inch.	30-inch.	36-inch.	48-inch.	Totals.
First District, 1, 2, 3, 4, 26, and 30	49	735	9,193	.....	3	.....	.....	.....	.....	.....	9,980
Second District, 5, 6, 7, 8, 9, 10, 24, and 27	.....	1,460	19,084	4,644	2,659	11,301	.....	.....	.....	.....	39 148
Third District, 11, 12, 16, 17, 18, 19, 31, & part of 25	.....	482	16,356	5	.....	.....	.....	.....	.....	.....	16,843
Frankford	.....	142	7,179	.....	36	.....	7,848	16,044	.....	.....	31,249
Fourth District, 13, 14, 15, 20, 29, and part of 28	.....	514	20,356	16	1,231	846	25	220	138	3,112	26,458
Germantown District and part of 25 and 28	211	1,469	9,200	8	1,992	.....	19	.....	.....	.....	12,899
Manayunk District and part of 28	.....	504	7,012	.....	12	.....	488	.....	.....	.....	8,016
Totals	260	5,306	88,380	4,673	5,933	12,147	8,380	16 264	138	3,112	144,593

	Feet.		Miles.	Feet.
Pipe laid as per report for 1875	3,499,735	=	662	4,375
Pipe laid during the year 1876	144,593	=	27	2,033
	3,644,328	=	690	1,128
Purchased from the Chestnut Hill Water Co., 1873, not added in previous reports	23,222		4	2,102
	3,667,550	=	694	3,230

Length of pipe laid previous to and since Consolidation, as per reports.

YEARS.	MILES.	FEET.
To 1855	242	1,162
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
*Germantown.	23	2,922
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
*Chestnut Hill.	4	2,102
1874	42	3,511
1875	33	5,148
1876	27	2,033
Total. - - -	694	3,230

*Purchased.

Statement of the number of fire plugs in the City, by Districts and by Wards, as placed during 1876.

First District.

Number of plugs, as per last report,		939	
First	Ward,	5	
Second	"	1	
Third	"	1	
Fourth	"	1	
Twenty-sixth	"	8	
			955

Second District.

Number of plugs, as per last report,		1,391	
Sixth	Ward,	1	
Eighth	"	1	
Ninth	"	2	
Tenth	"	1	
Twenty-fourth	"	43	
Twenty-seventh	"	16	
			1,455

Third District.

Number of plugs, as per last report,		1,571	
Eighteenth	Ward,	1	
Nineteenth	"	2	
Twenty-third	"	23	
Twenty fifth	"	11	
Thirty-first	"	1	
			1,609

Fourth District.

Number of plugs, as per last report,		952	
Fifteenth	Ward,	3	
Twentieth	"	1	
Twenty-eighth	"	15	
Twenty-ninth	"	8	
			979
Amount carried forward,			4,998

GERMANTOWN.

Amount brought forward,		4,998
Number of plugs, as per last report,	302	
Twenty-second Ward,	31	
Twenty-fifth "	2	
Twenty-eighth "	6	
	—	341

MANAYUNK.

Number of plugs, as per last report,	208	
Twenty first Ward,	17	
Twenty-eighth "	3	
	—	228
Total fire plugs in all the Wards,		5,567

The following show the number of attachments made in the different districts during the year 1876, for fire purposes only, in places of public amusement, hotels, manufactories, &c., &c.

Number, as per last report,		153
First District,	1	
Second "	3	
Third "	4	
Fourth "	1	
Germantown District,	1	
Manayunk "	2	
	—	12
Total,		165

There are now 80 public drinking fountains supplied by the Department free of charge, as follows:

Erected by the Fountain Society, as per last report,	67	
Added during the year,	6	
	—	73
Erected by the Society for Prevention of Cruelty to Animals, as per last report,		7
Total,		80

The number of holes drilled for making new attachments to public mains during the year 1876.

Months.	½-inch diameter.	⅝-inch diameter.	¾-inch diameter.	1 inch diameter.	Total holes drilled and attachm'ts made	Shut-offs.
January	187	4	4	3	198	32
February	124	4	2	.....	130	17
March	344	10	6	3	363	20
April	474	31	9	11	525	29
May	468	8	4	8	488	28
June	387	7	1	6	401	37
July	311	6	2	6	325	29
August	372	19	8	2	401	25
September	355	8	3	1	367	35
October	389	18	6	6	419	45
November	333	8	8	4	353	20
December	71	1	.....	4	76	24
Totals	3,815	124	53	54	4,046	341

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, and 30	728	1	.....	2	731	57
Second District, 5, 6, 7, 8, 9, 10, 24, and 27	803	85	29	36	953	80
Third District, 11, 12, 16, 17, 18, 19, 23, 31, and part of 25	681	9	10	9	709	86
Fourth District, 13, 14, 15, 20, 29, and part of 28	1,211	23	8	6	1,248	97
Germantown and part of 25 and 28	248	6	5	1	260	17
Manayunk and part of 28	144	.....	1	.....	145	4
Totals	3,815	124	53	54	4,046	341

Repairs to mains, stops, and plugs, during the year 1876.

Districts.	To Mains.	To Stops.	To Plugs.
First	86	302	628
Second	74	207	344
Third	106	219	205
Fourth	152	523	644
Germantown	19	118	224
Manayunk	45	56	68
Totals	482	1,425	2,113

Account of new stops and fire-plugs for 1876.

Districts.	No. of Stops.	No. of Plugs.
First	75	16
Second	80	64
Third	123	38
Fourth	58	27
Germantown	51	39
Manayunk	25	20
Totals	412	204

Number of Valves raised in the different districts during the year 1876.

Districts.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	Totals.
First	1	4	8	.....	.....	.....	.....	.....	.....	13
Second	1	1	9	.....	3	.....	.....	1	.....	15
Third	.....	1	10	.....	.....	.....	.....	.....	.....	11
Fourth	1	11	22	.....	.....	.....	.....	.....	.....	34
Germantown	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Manayunk	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total, 1876	3	17	49	.....	3	.....	.....	1	.....	73
" 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 4 years	38	120	331	10	24	6	13	4	4	550

Miscellaneous Tables.

TABLE A.

Rain Fall at Philadelphia, from Pennsylvania 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. 3	.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	3.4	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	43.739
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	1.419	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	35.002
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	.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	.935	2.330	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	1.246	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	1.315	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	2.885	.985	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	2.062	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	3.662	51.117
1873	6.048	5.607	2.242	4.191	4.783	.887	5.553	12.289	4.045	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
1876	2.023	3.680	5.605	1.993	5.189	2.209	6.223	1 215	7.776	1.210	9.025	3.169	49.323

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.

TABLE B.

Rain fall in Philadelphia during 13 years, from 1864 to 1877.

	Rain fall. Inches in 24 hours.	⅛ and less.	⅛ to ¼.	¼ to ½.	½ to 1.	1 to 1½.	1½ to 2.	2 to 2½.	2½ to 3.	3 to 3½.	3½ to 4.	4 to 4½.	4½ to 5.	5 to 5½.	5½ to 6.	6 to 6½.	6½ to 7.	7 to 7½.	Total rainy days in each month.	Percentage of rainy days.	Total inches in each month.	Average rain fall per year.
																			Days.	Days.	Inches.	Inches.
January	Number of rainy days.	36	16	21	24	3	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	103	23.077	41.579	3.198
February		27	11	12	24	7	6	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	88	23.913	46.36+	3.566
March		37	9	23	27	8	5	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110	27.295	52.778	3.060
April		42	21	18	19	12	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	113	29.000	43.915	3.378
May		38	17	27	20	11	5	1	1	1	.....	1	.....	.....	.....	.....	.....	.....	122	30.272	65.850	5.065
June		56	16	28	16	6	7	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	131	33.590	52.944	4.073
July		50	24	20	22	4	8	3	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	132	32.754	58 728	4.517
August		38	16	27	20	5	5	.....	1	.....	.....	.....	.....	1	.....	.....	1	1	115	28.053	73.074	5.321
September		24	15	21	11	14	2	4	2	.....	.....	1	.....	.....	.....	.....	.....	.....	94	24.102	63.853	4.912
October		29	11	12	14	7	3	2	.....	1	1	.....	.....	.....	.....	.....	.....	.....	80	17.866	46.089	3.545
November		38	14	14	17	11	4	3	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	102	26.154	53.164	4.089
December		31	22	19	19	7	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	101	25.062	43.563	3.851
Totals		446	192	242	233	95	52	17	5	4	1	3	.....	1	.....	.....	1	1	1.293	27.206	641.870	49.360
34½ per cent		446																				
49¼ "		.....	538																			
68½ "		.....	.....	880																		
86 "		.....	.....	.....	1113																	
90⅓ "		.....	.....	.....	.....	1208																
94⅓ "		.....	.....	.....	.....	.....	1260															
95⅔ "		.....	.....	.....	.....	.....	.....	1277														
		.....	.....	.....	.....	.....	.....	.....	1282													
		.....	.....	.....	.....	.....	.....	.....	.....	1286												
		.....	.....	.....	.....	.....	.....	.....	.....	.....	1287											
		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1290										
		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1291								
		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....							
		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1292					
100 per cent		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1293				

TABLE C.

Table showing number of days in each month when the inches of water wasted over the Flash Boards of Fairmount Dam were the same.

Inches.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1	1	.....	.....	2	2	1	1	.....	1	5	1	.....	14
2	1	.....	.....	1	1	2	.....	1	.....	.....	1	7	14
3	3	1	2	4	2	1	.....	.....	1	1	.....	2	17
4	9	6	7	4	1	2	1	.....	3	2	2	3	40
5	8	4	2	2	.....	1	.....	.....	1	1	2	.....	21
6	2	1	3	4	.....	1	.....	.....	.....	1	1	.....	13
7	3	1	4	2	.....	.....	.....	.....	1	1	.....	1	13
8	.....	1	.....	2	.....	.....	.....	.....	2	.....	3	.....	8
9	2	2	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
10	.....	4	1	1	.....	.....	.....	.....	.....	.....	.....	.....	6
11	.....	2	.....	1	.....	.....	.....	.....	1	.....	1	.....	5
12	.....	2	.....	1	.....	.....	.....	.....	2	.....	.....	.....	5
13	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	2
14	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1
15	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	3
16	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
17	.....	.....	1	.....	.....	.....	.....	.....	2	.....	1	.....	4
18	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1
21	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
22	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	3
23	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
25	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
28	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
31	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
32	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1
34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1
42	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	2

TABLE D.

Average daily height of water above the comb of the old dam and the average daily overflow over the flash boards.

	HEIGHT ABOVE LEGAL COMB OF DAM.												OVERFLOW OVER FLASH BOARDS.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1..	25	24	24	35	21	17	16	22	11	26	17	24	15	4	4	15	1	-3	-4	2	-9	6	-3	4
2..	29	25	24	33	21	16	16	19	12	27	16	24	9	5	4	13	1	-4	-4	-1	-8	7	-4	4
3..	27	17	24	31	20	15	15	17	7	25	15	23	7	-3	4	11	0	-5	-5	-3	-13	5	-5	3
4..	27	24	23	52	18	13	14	17	14	24	13	22	7	4	3	3	-2	-7	-6	-3	-6	4	-7	2
5..	26	23	24	38	17	24	13	16	11	20	16	22	6	3	4	18	-3	4	-7	-4	-9	0	-4	2
6..	25	24	24	34	14	25	15	16	11	21	17	23	5	4	4	14	-6	5	-5	-4	-9	1	-3	2
7..	25	24	23	32	14	25	14	17	10	21	19	22	5	4	3	12	-6	3	-6	-3	-10	1	-1	2
8..	24	27	24	30	16	22	13	16	13	21	25	22	4	7	4	10	-4	2	-7	-4	-7	1	5	2
9..	24	28	27	28	16	20	12	17	15	21	21	23	4	8	7	8	-4	0	-8	-3	-5	1	4	3
10..	24	30	27	28	24	18	17	17	10	12	22	14	4	10	7	8	4	-2	-3	-3	-10	-8	2	-6
11..	24	32	26	27	23	18	17	16	16	17	21	10	4	12	6	7	3	-2	-3	-1	-4	-3	0	-10
12..	23	31	26	26	22	18	18	15	18	20	16	18	3	11	6	6	2	-2	-2	-5	-2	0	-4	-2
13..	21	30	25	26	19	17	20	12	15	17	18	22	1	10	5	6	-1	-3	0	-8	-5	-3	-2	2
14..	22	29	27	27	18	18	18	16	17	18	14	22	2	9	7	7	-2	-2	-2	-4	-3	-2	-6	2
15..	23	45	25	26	17	18	21	17	14	17	20	20	3	25	5	6	-3	-2	1	-3	-6	-3	0	0
16..	14	51	24	26	17	17	16	16	16	19	18	19	-6	31	4	6	-3	-3	-4	-4	-4	-1	-2	-1
17..	23	42	29	25	16	16	20	17	24	18	20	16	3	22	9	5	-4	-4	0	-3	4	-2	0	-4
18..	24	35	30	25	17	16	17	15	33	17	21	19	4	15	10	5	-3	-4	-3	-5	13	-3	1	-1
19..	24	32	27	24	15	17	16	12	37	17	24	18	4	12	7	4	-5	-3	-4	-8	17	-4	4	-2
20..	29	31	26	24	12	26	20	12	29	17	42	16	9	11	6	4	-8	6	0	-8	9	-3	22	-4
21..	27	30	36	24	10	24	20	14	4	16	54	27	7	10	16	4	-10	4	0	-6	4	-4	34	7
22..	25	29	37	24	14	22	19	14	23	16	42	24	5	9	17	4	-6	2	-1	-6	3	-4	22	4
23..	25	30	29	23	20	21	16	13	21	19	37	17	5	10	9	3	0	1	-4	-7	1	-1	17	-3
24..	24	25	29	23	23	18	18	11	24	19	33	14	4	5	9	3	3	-2	-2	-9	4	-1	13	-6
25..	25	24	43	24	20	18	16	13	37	23	31	16	5	4	23	3	0	-2	-4	-7	17	3	11	-4
26..	24	26	62	23	16	17	17	13	33	24	28	14	4	6	42	3	-4	-3	-3	-7	13	4	8	-6
27..	24	25	48	22	11	16	17	10	32	21	28	15	4	5	28	2	-9	-4	-3	-10	12	1	8	-5
28..	25	25	41	19	8	17	16	11	29	18	28	14	5	5	21	-1	-12	-3	-4	-9	9	-2	8	-6
29..	25	24	62	21	19	17	16	10	28	18	26	14	5	4	42	1	-1	-3	-4	-10	8	-2	6	-6
30..	26	.....	51	21	17	18	16	11	26	19	25	14	6	.....	31	1	-3	-2	-4	-9	6	-1	5	-6
31..	25	.....	41	.....	18	.....	24	10	.....	18	.....	11	5	.....	21	.....	-2	.....	4	-10	.....	-2	.....	-9

This table represents the height of the water above the comb of the old Fairmount Dam, or the legal comb, and the water wasted over the flash board on the new dam, which is twenty inches above old comb.

TABLE E.

Population of Philadelphia.

Year.	Population.	Houses.	Persons to each.
1683	600	80	7.50
1684	2,5 0	357	7.00
1700	5,000	700	7.14
1744	13 000	1,500	8.64
1753	14,563	2,300	6.33
1760	18,756	2,969	6.32
1769	28,042	4,474	6.27
*1777	21,767	5,470	3.98
1783	37,000	6,000	6.16
1790	42,520	6,651	6.39
1800	70,287	11.200	6,27
1810	96,287	15,814	6.11
1820	119,325	.....	.....
1830	167,080	.....	.....
1840	258,037	.....	.....
1850	408,762	52,333	6.67
1860	568,034	89,978	6.28
1870	674,022	112,366	6.01
1876	817,448	143,936	5.68

*Taken by Lord Cornwallis during occupation by the British troops.

TABLE F.

Population of Philadelphia by Wards.

Wards.	1860.	1870.	1876.
First	80,886	25,817	38,794
Second	29,123	30,220	28,242
Third	19,929	19,149	20,255
Fourth	23,461	20,852	20 545
Fifth	24,792	18,736	18,972
Sixth	14,882	12,064	12,070
Seventh	31 267	31 558	33,017
Eighth	27,770	22,286	23,868
Ninth	17,196	16,629	15,915
Tenth	21,849	23,312	24,786
Eleventh	16,681	14,845	14,345
Twelfth	16,681	15,171	15,394
Thirteenth	20,045	19,956	20,027
Fourteenth	24,258	22,643	23,385
Fifteenth	32,091	44,650	48,472
Sixteenth	20,067	19,256	18,903
Seventeenth	23,264	21,347	21,279
Eighteenth	20,441	26,366	28,256
Nineteenth	38,828	45,240	40,604
Twentieth	29,963	56,642	41,854
Twenty-first	17,159	13,861	18,097
Twenty second	17,173	22,605	23,482
Twenty-third	23,985	20,888	25,299
Twenty-fourth	23,738	24,932	41,310
Twenty-fifth	.....	18,639	28,648
Twenty-sixth	.....	36,603	27,905
Twenty-seventh	.....	19,385	22,457
Twenty-eighth	.....	10,370	24,381
Twenty-ninth	.....	.....	33,974
Thirtieth	.....	.....	28,937
Thirty-first	.....	.....	29,895
Totals	568,034	674,022	817,448

Twenty fifth Ward was formed from the Twenty-third and Nineteenth.
Twenty-sixth " " " First.
Twenty-seventh " " " Twenty-fourth.
Twenty-eighth " " " Twenty-first.
Twenty-ninth " " " Twentieth.
Thirtieth " " " Twenty-sixth.
Thirty-first " " " Nineteenth.

TABLE G.—*Horse Power of Engines,*
From the following "Formula,"

$$\frac{\text{Area of Steam Cylinder} \times \frac{1}{7} \text{ the pressure of Steam.}}{110}$$

Pressure of Steam. Pounds.	HORSE POWER.																		
	4-inch Cylinder.	6-inch Cylinder.	8-inch Cylinder.	10-inch Cylinder.	12-inch Cylinder.	14-inch Cylinder.	16-inch Cylinder.	18 inch Cylinder.	20-inch Cylinder.	22-inch Cylinder.	24-inch Cylinder.	26-inch Cylinder.	28-inch Cylinder.	30-inch Cylinder.	32-inch Cylinder.	34-inch Cylinder.	36-inch Cylinder.	38-inch Cylinder.	40-inch Cylinder.
10	.....	.....	1 5	2.5	3.5	4.5	6.	7.5	9.25	11.25	13.5	15.5	18.	21.	24.	27.	30.	33.5	37.
15	.....	1 25	2.25	3.5	5.	7.	9.	11.5	14.5	17.5	20.5	24.	28.	32.	37.	41.	46.	51.	57.
20	.....	1.6	3.	5.	7.	9.	12.	15.	18.5	22.5	27.	31.	36.	42.	48.	54.	60.	67.	74.
25	.....	2.	4.	6.	8.5	11.5	15.	19.	23.	28.5	34.	40.	46.	52.	60.	68.	76.	85.	94.
30	1.	2.5	4.5	7.	10.	14.	18.5	23.	28.5	35.	41.	48.	56.	64.	73.	82.	92.	103.	114.
35	1.3	3.	5.	8.	11.5	16.	21.	29.	33.	40.	47.	55.	64.	74.	84.	95.	106.	118.	131.
40	1.5	3.3	6.	9.5	13.5	18.	24.	30.	37.	45.	53.	62.	72.5	83.	95.	107.	120.	134.	149.
45	1.75	3.75	7.	10.75	15.5	20.5	27.5	35.	43.	52.	62.	73.	84.	96.	110.	124.	139.	155.	171.
50	1.87	4.2	7.5	11.7	17.	23.	30.	38.	47.	57.	68.	80.	92.	105.	120.	136.	152.	170.	188.
60	2.25	5.	9.	14.	20.	28.	37.	46.	57.	70.	82.	96.	112.	128.	146.	165.	185.	206.	228.
70	2.6	6.	10.	16.	23.	32.	42.	53.	66.	80.	94.	110.	129.	148.	168.	190.	212.	237.	262.
80	3.	6.6	12.	19.	27.	36.	48.	60.	74.	90.	107.	124.	145.	167.	190.	214.	240.	268.	297.
90	3.4	7.7	13.6	21.5	31.	41.	55.	70.	86.	104.	123.	145.	168.	192.	220.	248.	278.	310.	342.
100	3.75	8.4	15.	23.5	34.	46.	60.	76.	94.	114.	136.	160.	184.	210.	240.	272.	305.	340.	376.

TABLE K.—*Table showing the Proposed System of Distribution.*

	Basins.	Distribution Districts. Area, square miles.	Distribution Districts. Population, 1876.	Daily Supply. Maximum demand at 100 gallons per head of population.	Daily Supply. Capacity of works at time of maximum demand.	Storage in Reservoirs.	Elevation. Reservoir.	Elevation. Maximum curb.	Elevation. Minimum curb.	Head. Minimum.	Head. Maximum.	Head. Range.	Remarks.
				Gallons	*Gallons.*	*Gallons.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
First System.	Fairmount	13.5	183,650	18,365,000	12,000,000	27,000,000	94	40	10	54	84	30	In this system the pumps and basins will be supplementary.
First System.	Delaware	7.0	189,192	18,919,200	10,000,000	26,000,000	114	40	10	74	104	30	
First System.	Corinthian / Spring Garden.	3.0	178,527	17,852,700	35,000,000	47,000,000	120	60	30	60	90	30	
First System.	East Park	.....	.....	.....	.....	700,000,000	133	.....	.....	.....	.....	.....	Feeder and filter to first system.
	Totals	23.5	551,369	55,126,900	57,000,000	800,000,000							
Second System.	Frankford	51.0	32,440	3,244,000	10,000,000	36,750,000	167	120 / 220	10	47	.....	.....	The Belmont and Cambria basins can be supplementary.
Second System.	Cambria	11.0	126,872	12,687,200	Required.	Required.	165	120	60	45	.....	.....	
Second System.	Belmont	28.0	63,767	6,376,700	13,000,000	40,000,000	212	160 / 300	10	52	.....	.....	
	Totals	90.0	222,079	22,207,900	23,000,000	76,750,000							
Third System.	Roxborough & Mount Airy.	20.0	43,000	4,300,000	6,000,000	16,161,700	365	310 / 440	30	55	.....	.....	
	Totals	20.0	43,000	4,300,000	6,000,000	16,161,700							

N. B.—In the second and third systems the range of head will be governed by valves, and the supply to high and isolated districts by auxiliary pumping stations.

PUMI

Fairmount

Schuylkill

Delaware

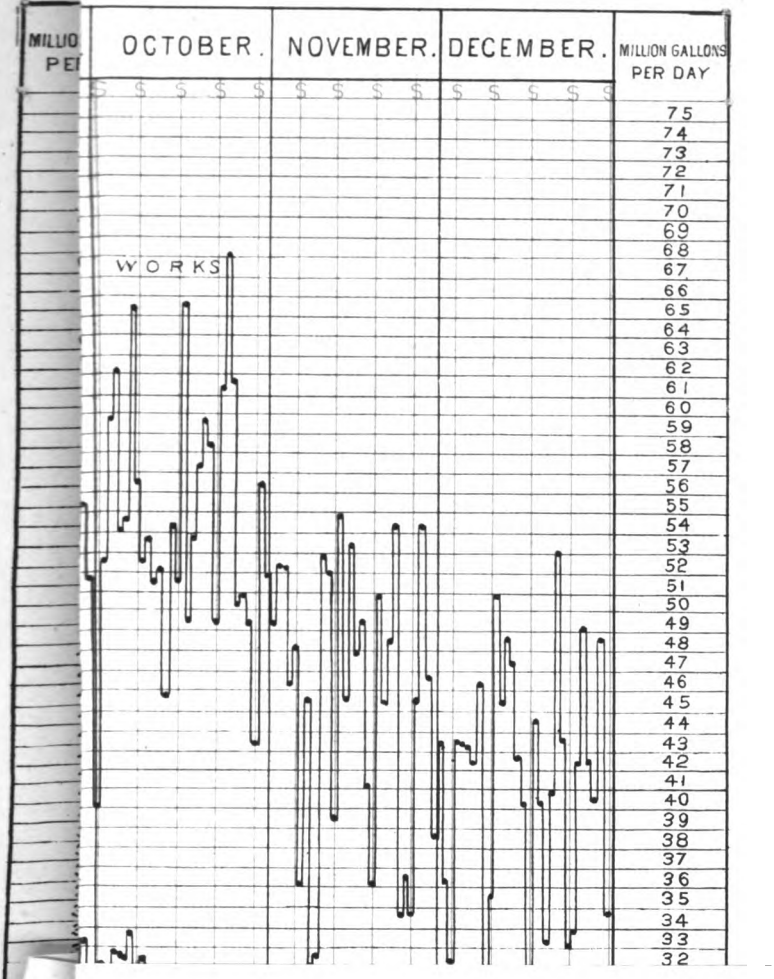
Frankford

Belmont

Roxborou

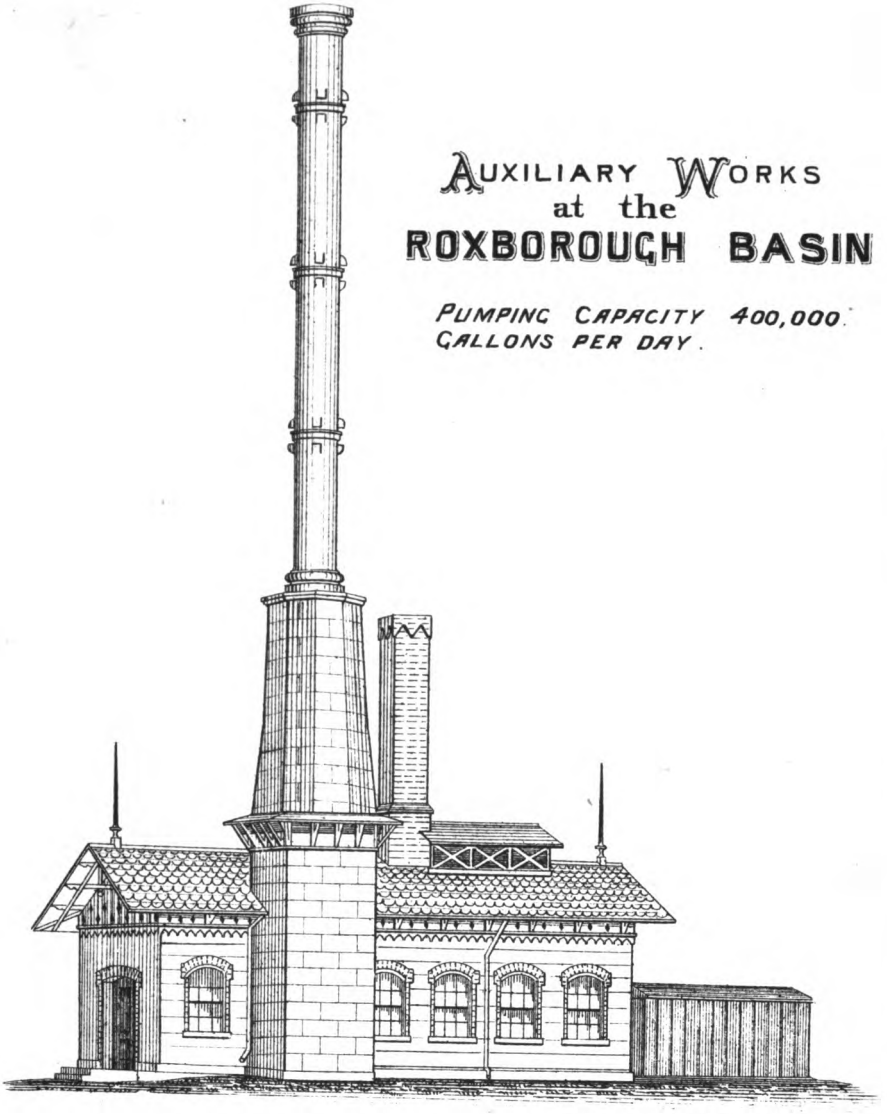
Chestnut

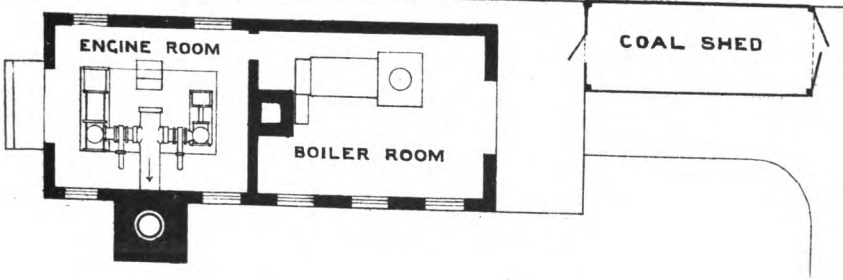
Y FOR THE YEAR 1876

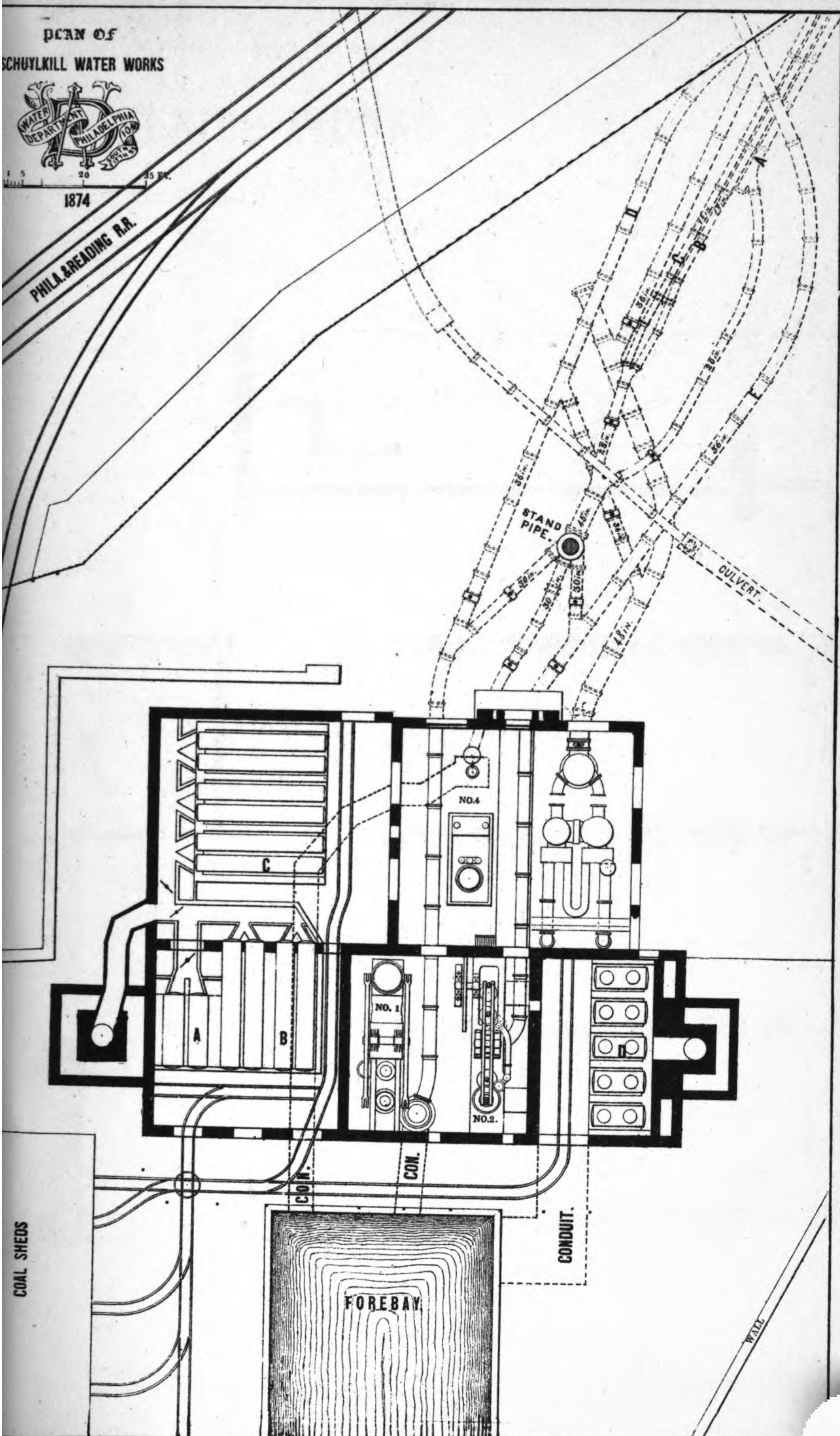


AUXILIARY WORKS at the ROXBOROUGH BASIN

PUMPING CAPACITY 400,000 GALLONS PER DAY.



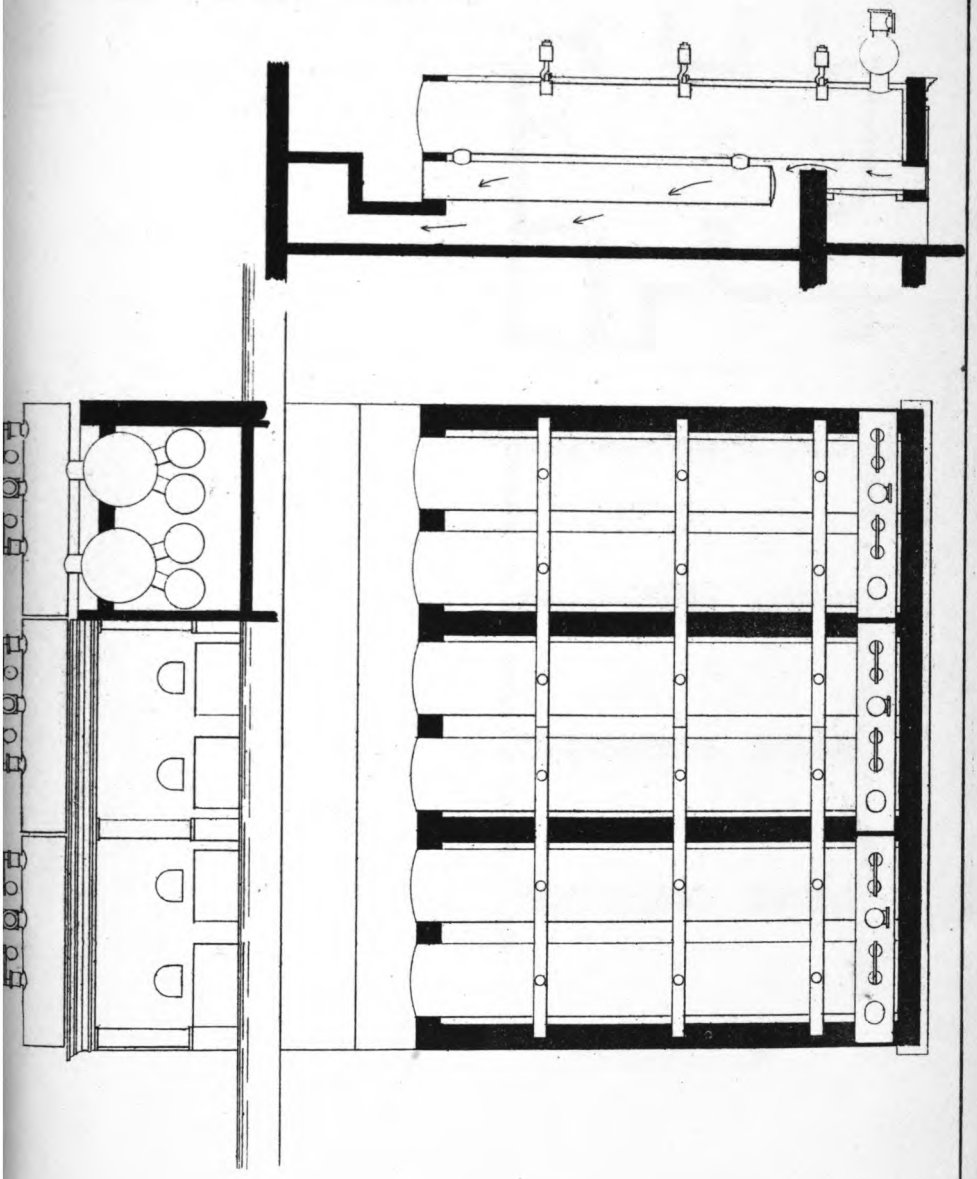




CYLINDER BOILERS
at the
SCHUYLKILL WORKS

Scale of feet

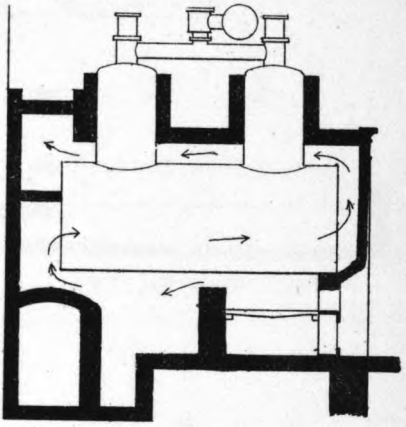
0 5 10 15 20 25 30

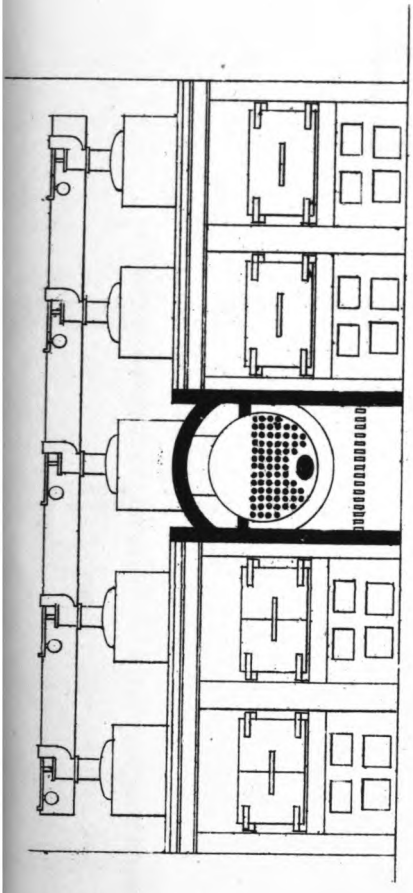


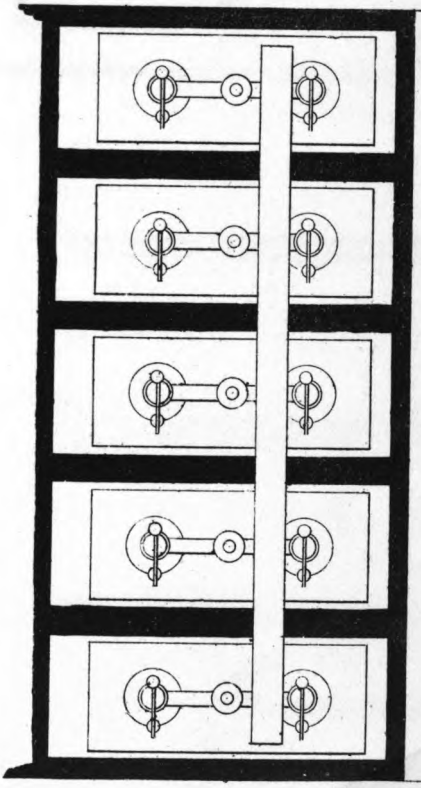
TUBULAR BOILERS
AT THE
SCHUYLKILL WORKS
AND AT THE
DELAWARE WORKS

SCALE OF FEET

0 5 10 15 20



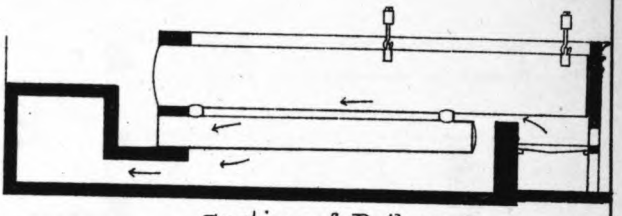




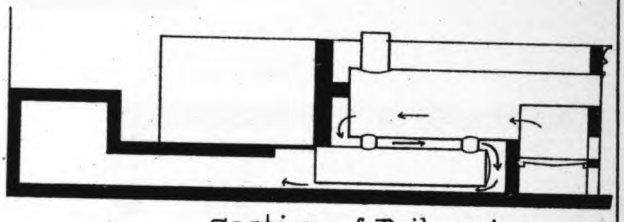
Cylinder Boilers and Hog Nose Tubular Boilers at the **SCHUYLKILL WORKS**

Scale of feet.

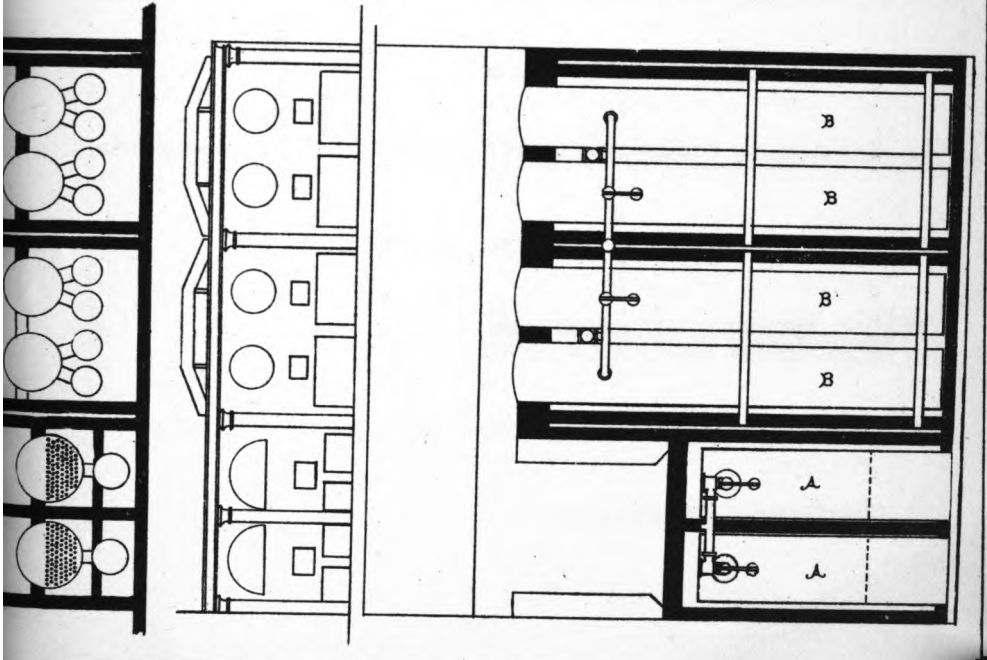
0 5 10 15 20 25 30 35



Section of Boilers B

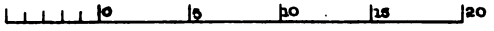


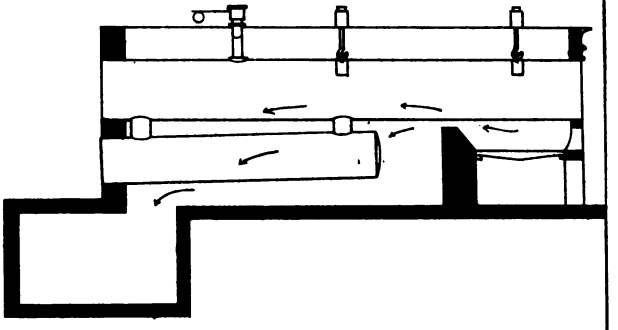
Section of Boilers A

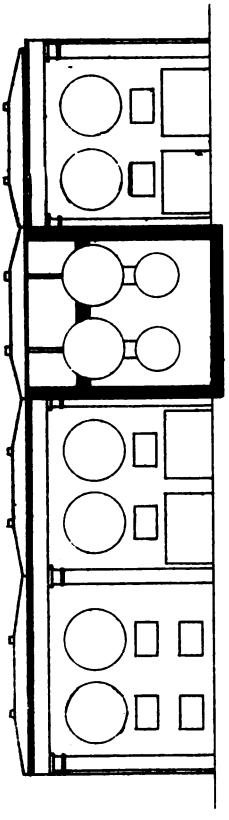


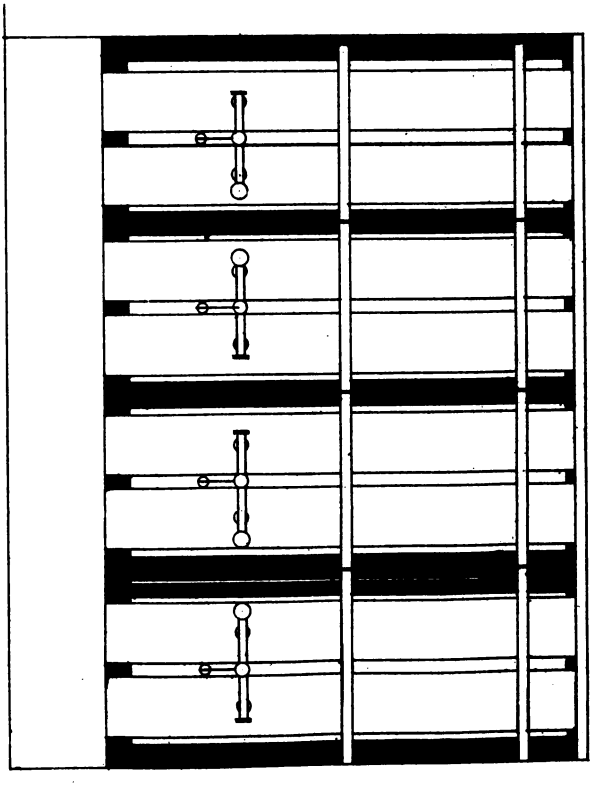
CYLINDER BOILERS
at the
DELAWARE WORKS

Scale of feet

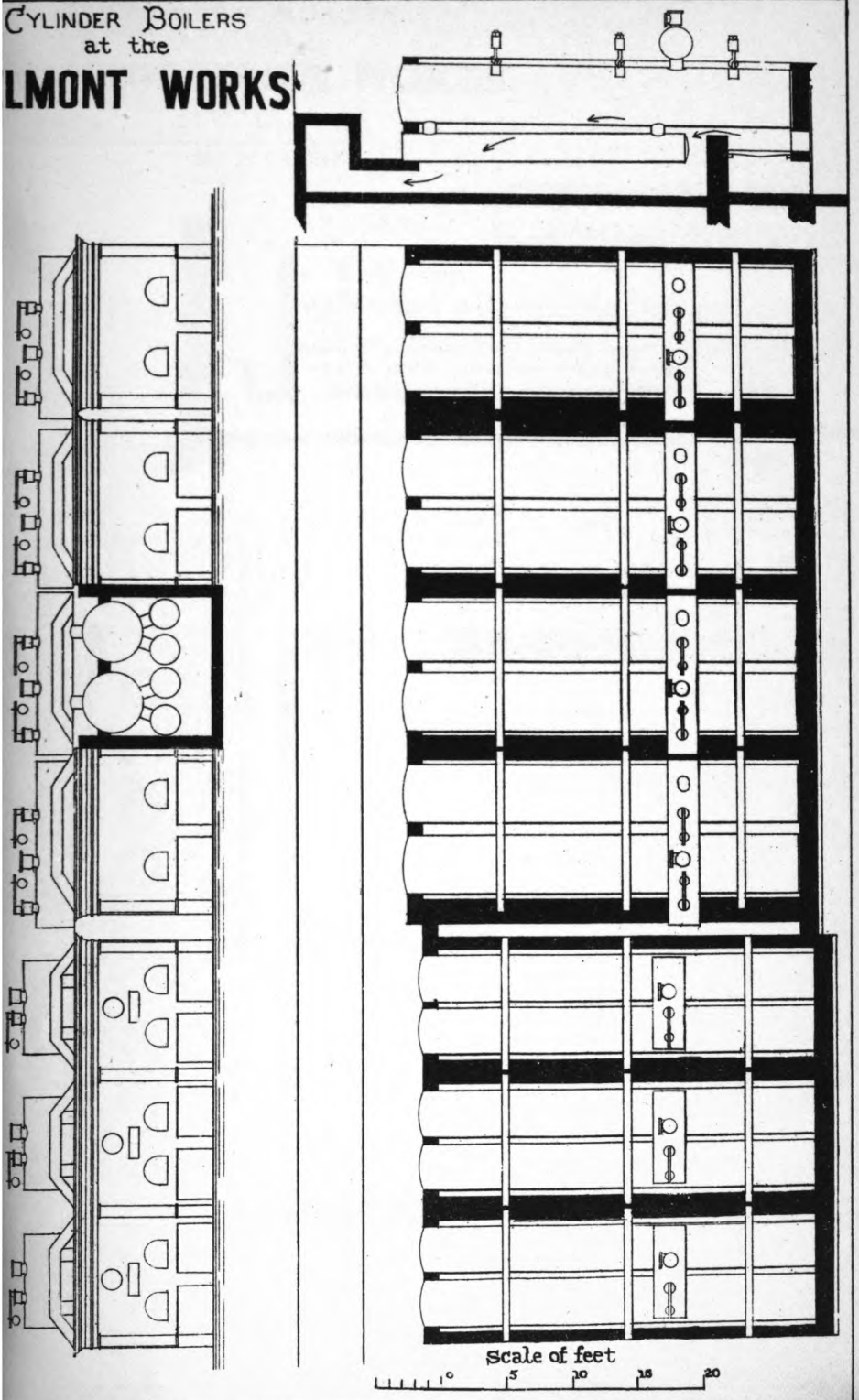




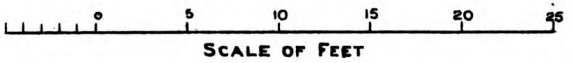


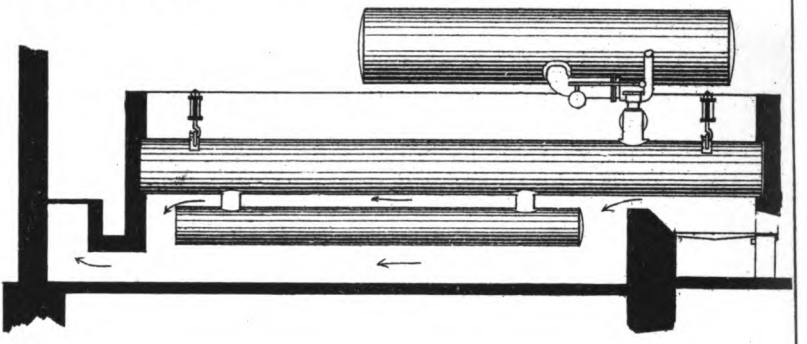


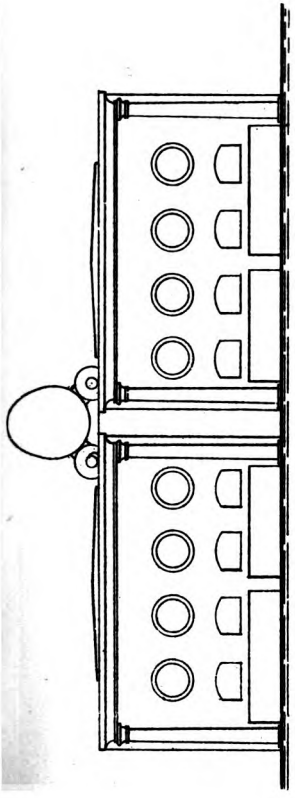
CYLINDER BOILERS
at the
LMONT WORKS

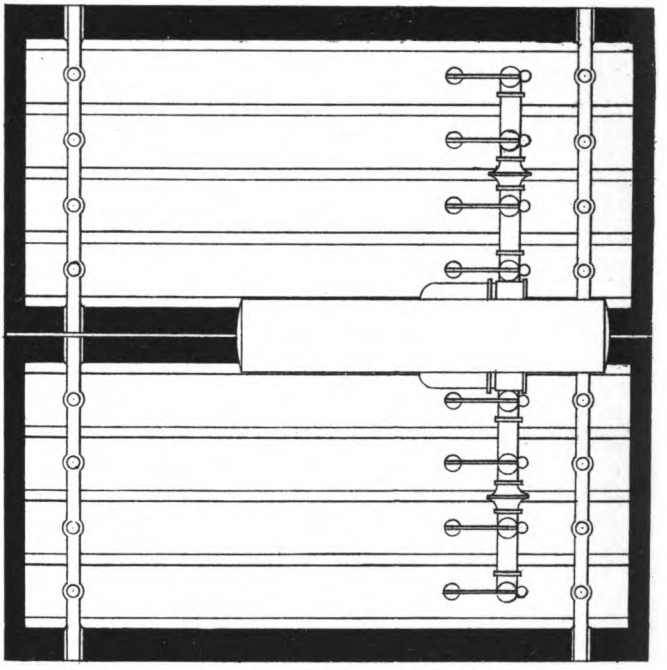


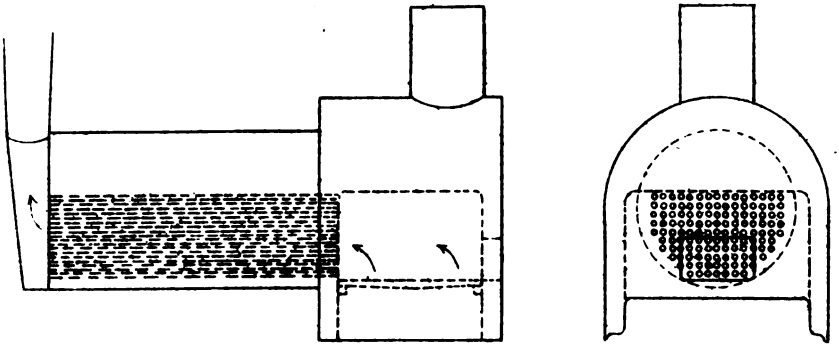
CYLINDER BOILERS
AT THE
ROXBOROUGH WORKS







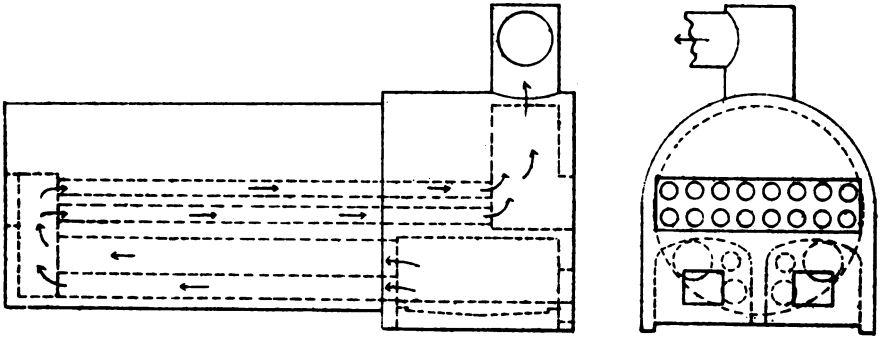




FIRE BOX TUBULAR BOILER AT THE ROXBOROUGH RESERVOIR

SCALE OF FEET

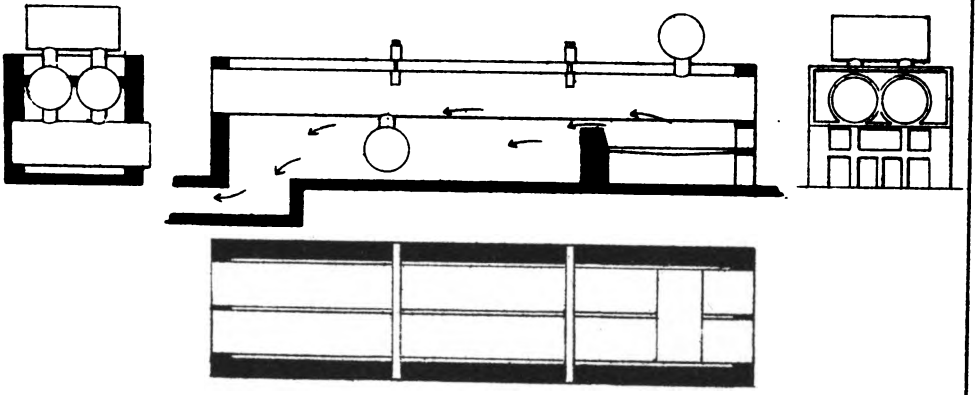
0 5 10



RETURN FLUE BOILER AT FAIRMOUNT

SCALE OF FEET

0 5 10 15 20



CYLINDER BOILERS AT CHESTNUT HILL WORKS

SCALE OF FEET

0 5 10 15 20