

422

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 1878.



PRESENTED TO COUNCILS JUNE 19, 1879.

Philadelphia:

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1879.

Compliments of



WILLIAM H. MCFADDEN,

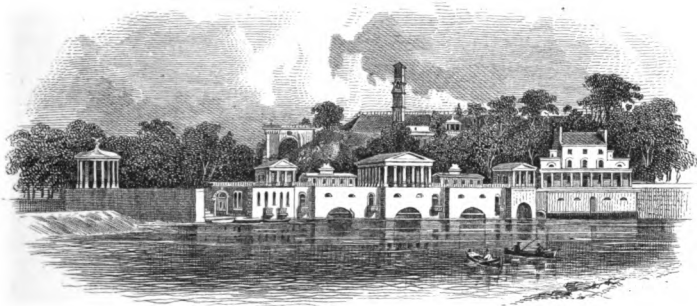
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COMMITTEE ON WATER WORKS, 1878.

CHARLES THOMSON JONES, *Chairman.*

John W. Baker,	George S. Graham,	John Rink,
Louis H. Donnelly,	Charles K. Merkle,	Hugh Copeland,
John Kennedy,	John G. Brooke,	Joseph B. Hacker,
George W. Bumm,	Isaac J. Griffiths,	A. Seitz,
George Eno,	Edw. W. Patton,	Henry C. Dunlap,
David Mouat,	John Bardley,	Robert A. Jamison,
John C. Bickel,	E. Hicks Hayhurst,	Benjamin Saeltzer,
Joseph B. Vandusen,	William Wright,	
GEORGE A. SMITH, <i>Ex-officio.</i>		JOSEPH L. CAVEN, <i>Ex-officio.</i>

OFFICERS.

Chief Engineer.—WILLIAM H. McFADDEN.

Assistant Engineers.

JOHN L. OGDEN, CHARLES G. DARRACH, D. Mc. N. STAUFFER.

General Superintendent of Works,
ROBERT McFADDEN, Jr.

Chief Clerk.—JOHN J. PRENTZEL.

John E. Codman, <i>Draughtsman.</i>	George W. Eckert, <i>Pipe Clerk.</i>
J. T. Hickman, <i>Assistant Clerk.</i>	William J. Innes, <i>Muster Clerk.</i>
William H. Mettam, <i>Telegraph Operator.</i>	Thomas J. Lister, <i>Messenger.</i>

Superintendent of City Shop.—JAMES F. NEALL.

Purveyors.

1st District.—James L. Brown, Wharton St., above Eleventh.	4th District.—William Ewing, 810 Corinthian Avenue.
2d " David A. Craig, 918 Cherry Street.	Germantown.—D. B. Morrell.
3d " Alex. S. Crawford, 1420 Frankford Road.	Manayunk.—Henry Dawson. Lyceum Building, Roxbo'h.

Engineers at Works.

Fairmount—Joseph Moyer, A. C. Bonsall. *Belmont*—Abraham Stott, John Smith
Schuylkill—Joshua Bartley, David Pyke. *Roxborough*—William A. Smith, Lewis Culp.
Delaware—John Penn, Jos. Thompson. *Frankford*—Chas. H. Douglass, Geo. W. Wright.
Chestnut Hill—William Gaffey.

REGISTRAR'S DEPARTMENT.

Registrar.—W. MARSHALL TAYLOR.

JOHN S. WARNER, *Chief Clerk.* A. N. KEITHLER, *Receiving Clerk.*

Permit Clerks.

WILLIAM J. HALLIDAY, A. BUCKHEISTER.

General Clerks.

CHARLES ZELL,	GEORGE MACAULEY,	R. F. MUSTIN, JR.,
JOSEPH FISHER,	J. M. STACKER,	JOHN CALDWELL.

Inspectors.

John F. Scheidt,	E. D. Thomas,	H. G. Butler,
James H. Graham,	W. H. Hergesheimer,	Thomas Stewart,
S. D. Woodington,	James Carr,	H. Marshall,
Lewis Obermiller,	William A. Agnew,	William Erwin,
E. M. Rowe,	C. J. Lowry,	

COMMITTEE ON WATER WORKS, 1879.

CHARLES THOMSON JONES, *Chairman.*

Benjamin Allen, James J. Barr, John C. Bickel,
George W. Bumm, Daniel Blair, Frank Dundore,
Daniel Gilbert, John McCullough, David Moutat,
John Rink, Benjamin Saeltzer, William Wright,
Charles K. Merkle, Joseph Hacker, Robert A. Jamison,
John Hunter, Alexander Russell, W. Killwood Rowan,
John A. Anck, W. E. Rex, Thomas B. McAvoy,
Robert R. Hall, Benj. F. Dotts.
GEORGE A. SMITH, *Ex-officio.* JOSEPH L. CAVEN, *Ex-officio.*

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Thomas J. Lister, *Messenger.*

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Wharton St., above Eleventh. 81¹/₂ Corinthian Avenue.
2d “ David A. Craig, Germantown.—D. B. Morrell,
918 Cherry Street. Town Hall, Germant'n.
3d “ Charles Shreeve, Manayunk.—Henry Dawson,
1420 Frankford Road. Lyceum Building, Roxborough.

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Delaware—John Penu, Jos. Thompson *Frankford*—Chas. H. Douglass, Geo. W. Wright.
Chestnut Hill—James M. Glenahan.

REGISTRAR'S DEPARTMENT.

Registrar.—W. MARSHALL TAYLOR.

JOHN S. WARNER, *Chief Clerk.* A. NEWLIN KEITHLER, *Receiving Clerk.*
WILLIAM J. HALLIDAY, *Permit Clerk.* A. BUCKHEISTER, *Registering Clerk.*

Entry Clerks.

George Macauley, Robert F. Mustin, Jr.

Bill Clerks.

Joseph Fisher, John Caldwell, John M. Stacker, H. G. Butler.

Inspectors.

John F. Scheidt, E. D. Thomas, John H. Haines,
James H. Graham, W. H. Hargeshelmer, Thomas Stewart,
S. D. Woodington, James Carr, H. Marshall,
Lewis Obermiller, William A. Agnew, William Erwin,
E. M. Rowe, C. J. Lowry.

REPORT
OF THE
CHIEF ENGINEER.

REPORT.

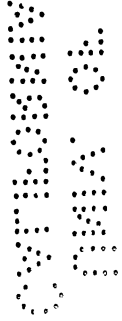
To the Presidents and Members of the Select and
Common Councils of the City of Philadelphia.

GENTLEMEN:—For the sixth time I have the honor of submitting the Annual Report of the Water Department. Herein will be found the operations for the year ending December 31, 1878.

RECEIPTS.

The total receipts from all sources amount to \$1,376,532.05, an increase over 1877 of \$148,550.95. The total revenues amount to \$1,416,645.85, of which \$40,113.80 is collected by the City Solicitor. The following table is a comparison of the receipts and revenues for a series of years; and the sources whence derived.

Years.	Delinquent rents.	Penalties.	Water rents.	Penalties.	Fractional rents.	Water pipe.	Chief Engineer's office.	Total receipts.	Amounts returned to City Solicitor for fees.	Amounts collected by City Solicitor.	Revenues.
1872.....	\$22,138 00	\$2,188 59	\$815,982 50	\$17,014 05	\$54,467 01	\$131,822 96	\$10,668 40	\$1,054,281 51	\$77,467 36	\$21,108 90	\$1,075,390 41
1873.....	22,705 50	2,824 93	865,696 50	18,095 73	51,974 12	116,997 17	4,691 06	1,082,985 01	75,882 09	26,601 71	1,109,586 72
1874.....	31,104 25	4,483 02	909,899 50	18,434 48	60,108 56	198,896 99	6,994 58	1,229,881 38	152,593 11	31,130 17	1,261,011 55
1875.....	23,106 25	3,329 93	938,337 25	17,625 52	54,667 66	123,258 53	9,321 14	1,169,666 28	122,533 39	65,870 28	1,235,536 56
1876.....	31,971 75	4,321 91	970,514 25	17,202 85	54,711 96	115,034 27	5,694 98	1,199,754 97	81,151 48	52,259 95	1,252,014 92
1877.....	62,104 75	7,957 45	1,003,248 60	16,309 65	53,470 48	73,253 88	6,636 29	1,227,981 10	38,581 54	56,233 57	1,284,214 67
1878.....	136,123 93	19,779 24	1,065,838 41	25,975 19	49,391 90	55,631 89	3,871 49	1,376,532 05	32,223 75	40,113 80	1,416,615 85



EXPENDITURES.

From annual appropriations, - - - - -	\$414,955 45
From special appropriations, - - - - -	3,746 31
From loans (extension of Works), - - - - -	63,946 40
	<hr/>
Total expenditures for 1878, - - - - -	\$482,648 16
	<hr/>
Total receipts of Department, - - - - -	\$1,376,532 05
Total expenditures, - - - - -	482,648 16
	<hr/>
Receipts in excess of all expenditures, - - - - -	\$893,883 89
	<hr/>
Total receipts, - - - - -	\$1,376,532 05
Less annual and special appropriations, - - - - -	418,701 76
	<hr/>
Profits of the Department for 1878, - - - - -	\$957,830 29
	<hr/>
Profits, - - - - -	\$957,830 29
Add amount collected by City Solicitor, - - - - -	40,113 80
	<hr/>
Revenue in excess of expenditures, - - - - -	\$997,944 09
	<hr/>

The Department furnishes water for public purposes gratuitously and for charitable institutions, at 15 per cent. of the legal rates; this, if paid for would amount to the interest on the cost of plant, leaving the profits as above, fairly to the credit of the Department.

PUMPAGE.

The total pumpage for the year amounts to 19,101,664,332 gallons, an increase over 1877 of 1,224,519,540 gallons, or nearly 7 per cent., a daily average increase of 3,354,848 gallons.

The pumpage at Fairmount by water power was 8,332,288,784 gallons, a decrease on pumpage of 1877 of 1,160,130,649, or over 12 per cent., a daily average decrease of 3,178,440. The daily average for the first six months in the year was 29,461,949, while for the last six months it was 16,219,742, and for the months of

August, September and October, the daily average was only 12,928,016. At Fairmount the daily average for the year was 22,800,791 gallons, nearly 80 per cent. greater than during the three months of least daily average pumpage, and at which time there was the greatest demand, or minimum average pumpage for three months is nearly 57 per cent of the daily average for the year.

This total pumpage of 19,101,664,332 gallons, when equated to a lift of one hundred feet high, amounts to 26,356,041,307, at an expense of \$3.73 by water power per million gallons one hundred feet high. This does not include the interest on the plant. The amount pumped one hundred feet high by water power was 7,490,059,905, at a total expense of \$27,947.20. The increased expenses due to repairs and the lessened pumpage renders the expense of pumpage 3.73 per million one hundred feet high, greater than in the preceding year. The expense of pumping into the basin, a height of ninety feet, is \$3.35 per million gallons.

The amount pumped by steam power, equated to a lift of one hundred feet, was 16,865,981,402 gallons, at an expense of \$8.60 per million per hundred feet high, or at a total expense of \$145,049.37, which includes every item of expense for attendance, repairs, fuel, supplies, &c., some items of which were not included heretofore. The total expense of pumpage for the year, amounts to \$172,996.57, at an average expense of \$6.56 per million gallons lifted one hundred feet high, by steam and water power combined.

For the future mode of supply and recommendations, I respectfully refer to the report for 1877, on pages 11, 12, 13 and 14.

This Department furnishes a large revenue in excess of expenditures, which excess should be used to place the City beyond a short supply and the contingency of a large conflagration. To this end some definite plan should be adopted and fully carried out. Any plan recommended would embrace power, storage and enlarged means of distribution. The head of a department can only recommend. It is for your honorable bodies to approve and provide the means for the consummation of such a work.

The *useless* waste of water in all American cities demands a supply double that of European cities, to maintain which, requires



either great outlays, or the introduction of meters to control this useless if not criminal waste.

The following table shows the comparison between Philadelphia water rates and those of other American cities.

A comparative statement of water rates for 1877, as charged in some of our principal cities, compiled from the official rate schedules

Cities.	TOTAL WATER TAX, PRIVATE DWELLING.		Water rates per 100 gallons.
	Value of house..... \$8,000 Frontage..... 18 to 20 feet. Stories high..... 3 Rooms..... 10 <i>Attachments.</i> Hydrant in yard. Kitchen—hot and cold water. One bath—hot and cold water. One water closet.	Value of house..... \$20,000 Frontage 20 to 25 feet. Stories high..... 4 Rooms..... 14 <i>Attachments.</i> Hydrant in yard. Kitchen—hot and cold water. Two baths—hot and cold water. Two water closets. One pave wash.	
Philadelphia.....	\$9 00	\$16 00	\$0.01 $\frac{46}{100}$
New York.....	8 00	18 00	0.02 $\frac{1}{2}$
Brooklyn.....	10 00	21 00	0.02 $\frac{6}{100}$
Chicago.....	12 00	22 00	0.01
Baltimore.....	16 00	25 00	
Milwaukee.....	16 00	29 00	0.02
Providence.....	20 00	31 00	0.02 $\frac{1}{2}$
St. Louis.....	18 00	35 00	0.01 $\frac{3}{4}$
Boston.....	18 00	40 00	0.02 $\frac{1}{2}$
Cincinnati.....	19 00	34 00	0.01 $\frac{1}{2}$
Buffalo.....	25 00	36 00	
Pittsburgh.....	33 67	57 59	

NOTE.—For the purpose of comparison houses of two different classes are taken as a standard of the dimensions, value, and attachment, as above given, they being supposed to be a private dwelling, containing one family only.

FLOW OF THE RIVER SCHUYLKILL.

The Summer flow of the river was less in 1878 than in any year since the erection of the turbines. The rain-fall, at the head-waters in 1878, for the months of June, July, August, and September, was $7\frac{74}{100}$ inches, while for the same months in 1869—during the drought—it was $12\frac{40}{100}$ inches.

In 1878, in the month of July, there were three days when it was impossible to pump 10,000,000 gallons per day. In August there were nine days, in September fourteen days, in October twenty days, and one day in each of the months of September and October when no water could be pumped at Fairmount with the flow of the river.

PUMPAGE DIAGRAM.

A study of the pumpage diagram shows the daily rain-falls, and those which are local in character, and of little value for pumpage, and those in the valley of the water-shed which are of value for power. It also shows the daily pumpage by water power, and the great variations in the valuation of the Fairmount Works for pumping water at different seasons of the year. Thus, for the months of January, February, March, April, May, and June, the daily average was 29,461,949 gallons; for July, August, September, October, November, and December it was 16,219,742, while for August, September, and October it was only 12,928,016, and the month of October 11,227,077.

THE WORKS.

FAIRMOUNT.

The pumps of Nos. 7, 8, and 9 were repaired with new yokes ; new steps and pipes to Nos. 3 and 5. No. 4 was stopped on November 4, 1878, under the contract with Mr. Emile Geyelin, to detach the gearing from the walls of the building and to introduce a duplex wheel with an automatic gate—these alterations will increase the running capacity from $5\frac{1}{2}$ to 8 million gallons per day. The pump rods of No. 7 were packed by the United States Metallic Packing Company, an improvement over the packing hitherto used. A velocity of 240 feet per minute, piston speed at 20 revolutions per minute, developed but a trifling vibration in the side rods.

SPRING GARDEN.

The pump valves of Cornish Engines Nos. 4 and 5 were changed, that of No. 5 having broken, and of No. 4 badly worn. The springs of the steam piston of No. 4 were renewed, and those in No. 5 set out.

New valve seats were put into the inlet chamber of No. 6 pump, and a hand wheel on the expansion gear.

New foot valves, with automatic balance, brass guard plates and caps, were put on the pump of No. 7 Engine ; the pass-over valve repaired, and a non-conductor placed on the top of the high pressure cylinder.

This engine was disabled September 26 (broke the pump chamber under the high pressure cylinder), and is being repaired by the Messrs. Cramp under their contract.

The boilers, steam pipes, and valves were repaired and cleaned. A pass-over pipe was connected around the 48-inch stop on the pumping main of No. 7 Engine.

A stand-pipe was erected on a trestle in the northwest corner of the Spring Garden Reservoir, at the end of the 36-inch pumping main from the No. 6 Engine, to an elevation of 150 feet above City Datum ; this main was connected at Thirty-third and Master Streets with the 30-inch distributing main from the Belmont Works. By this connection the No. 6 Engine at Spring Garden Works was made to supplement the supply of Belmont east of the river ; another connection should be made between these mains near the Spring Garden Works, and the Belmont main connected directly with the stand-pipe at the Spring Garden Basin ; these connections will make the Belmont distributing main useful as a pumping main. The No. 6 Engine works well under the additional head, although slower.

BELMONT.

Engines Nos. 1 and 2 (Worthington) received but few repairs. The slide valve and seats of No. 3 (Worthington) were faced, and the valve, piston rods, air-pump links, and crosshead brasses were renewed.

The boilers at these works were badly encrusted with scale, owing to excessive firing, and unless they are relieved will become dangerous ; they were cleaned, as usual, mouth-pieces renewed, furnace fronts stayed and braced, furnaces lined with fire-brick, and check-walls put in back. All steam-pipe joints and valves were repaired.

The small storage for coal (but 900 tons) and the sharp curvature of the siding to the coal bins, has been the cause of both expense and inconvenience. During the year a new siding, bridge and track 976 feet long has been built, as well as coal bins, lined with an 18-inch stone wall, capable of holding 2,500 tons of coal, and of being increased to 3,500 tons.

DELAWARE.

The Worthington Engine was thoroughly overhauled, valves and seats faced, plunger turned down, air pump pistons, guide brasses, expansion rings, guard plates and caps renewed.

The only repairs to the high pressure engine was the renewal of piston spring packing.

The low pressure engine was repaired and put in good running order. The air pump was bored out, foot valves, brasses, piston rings and all packing, steam and water, was renewed.

The boilers were cleaned, steam pipe and valves repaired.

The wharf at these works was partially rebuilt, and a bulk-head placed in the dock.

In the basin a stand pipe was erected on one of the outlets of the 36-inch pumping main, and connections made with it to the 30-inch main from Corinthian basin; by this arrangement Delaware can be made to supplement Corinthian, when the Frankford Works supply Kensington and Bridesburg.

ROXBOROUGH.

The Worthington Engine, after receiving ordinary repairs, broke the rock-shaft February 6, which was immediately replaced by a new one. An old steam pipe, formerly in use at the Belmont Works was utilized as an independent steam pipe for the Cornish Engine.

The boilers were cleaned as usual, mouth pieces and furnaces renewed, steam pipes and valves repaired.

The new 30-inch pumping main from these works will in a short time pay for itself. By its use the Worthington Engine can pump 26½ feet higher than through the old 20-inch main with the same pressure per square inch on the plunger.

Advantage has been taken of this loss of frictional head, and a short stand pipe (376,274 C. D.) erected at the Roxborough basin, connected with the 20-inch pipe to Mt. Airy; the surplus water flows over the stand pipe and supplies the Roxborough basin, while the head, without expense, is increased 8½ feet on the connecting main to Mt. Airy reservoir, keeping it full. This stand pipe may be raised, increasing the supply to Germantown without the necessity of laying an additional main of three (3) miles across the Wissahickon.

ROXBOROUGH AUXILIARY.

Two tanks, each 30 feet diameter and of 100,000 gallons total capacity, were built and erected upon trestle work on a lot back of the Manatawna Church.

The surface of the water in these tanks, when filled to their maximum height, is 440 feet City Datum.

The 10-inch pipe on the Ridge Road was extended to the Manatawna Church, and from the road to the tanks 12-inch pipe laid, governed by the proper stops.

The storage in these tanks supplies the limited district of high ground on the Roxborough ridge, and requires pumping at the Auxiliary Works but one day in six, and reduces the great cost of pumping daily, as formerly.

THE CHESTNUT HILL WORKS.

These works are in their usual condition. Neither the engines, the boilers, nor the springs, are sufficient to supply the demand. The erection of a stand pipe and engines at Mt. Airy basin, to take their place, has become a necessity.

FRANKFORD WORKS (Lardner's Point).

An air injector was put on the pump to supply the air vessel. The engine broke her pump cylinders July 15th, and was immediately taken charge of by the contractors, who will renew the parts broken with stronger and better castings.

The supply from Wentz Farm Reservoir was confined to Frankford, and within ten days the small Worthington Engine transported from Fairmount and erected on brick foundations ready to pump.

Connections have been made to all of the cylinders and pumps for indicators.

The springs on all the Worthington pump valves were replaced by weights.

The storm of August 1st broke a dam at Thirtieth and Master Streets, undermining the 30-inch main from Belmont, and the 36-inch pumping main from Spring Garden Basin. This storm also burst the culvert at Twenty-fifth and Poplar Streets, underlying the 48-inch, 30-inch, and 16-inch mains. Immediate attention at midnight only saved the City from deluge from the Belmont, Spring Garden, and Corinthian Basins.

The chasm at Twenty-fifth and Poplar was so great that it was necessary to support the suspended mains on piles, which were driven without obstructing the highway, and which will prevent further trouble at that point.

THE TELEGRAPH.

During the year 1878, 2,916 messages were sent from and 2,683 received at this office, making a total of 5,599 messages passing through the office. Of these 196 were in reference to leaks in mains, stops, plugs, and hydrants.

First and Third Districts being without the telegraph, reports of leaks, &c., had to be sent by mail, thereby causing a delay of several hours.

Frankford Works should be connected by telegraph, which could be done at but little expense.

The workings of the line, with a few exceptions, have been satisfactory.

By having our battery removed to this office, and placed under our immediate control, a great deal of unnecessary trouble might be obviated.

RECEIPTS AND EXPENDITURES

OF THE

Water Department

FOR

1878.

Receipts of the Department and sources whence derived, as exhibited by statement of W. M. Taylor, Registrar,	-	\$1,372,660 56
Receipts at Chief Engineer's office, as per statement,	-	3,871 49
		<u>\$1,376,532 05</u>

RECEIPTS AT CHIEF ENGINEER'S OFFICE FOR 1878.

For old iron,	-	-	-	-	-	-	\$1,124 67
For rents,	-	-	-	-	-	-	735 00
For brass scraps and turnings,	-	-	-	-	-	-	706 54
For bronze turnings,	-	-	-	-	-	-	47 94
Pennsylvania Railroad Company, attachment,	-	-	-	-	-	-	374 93
Pennsylvania Railroad Company, relaying 16 inch pipe,	-	-	-	-	-	-	199 40
Stewart, Ralph & Co., attachment,	-	-	-	-	-	-	100 22
H. Krauff, attachment,	-	-	-	-	-	-	121 59
House of Refuge, attachment,	-	-	-	-	-	-	44 00
Thomas Schofield, attachment,	-	-	-	-	-	-	20 00
J. M. Preston, attachment,	-	-	-	-	-	-	20 00
S S. Keely & Son, attachment,	-	-	-	-	-	-	125 14
H. Miller, attachment,	-	-	-	-	-	-	20 00
The Campbell Manufacturing Company, attachment,	-	-	-	-	-	-	29 91
J. & J. Dobson, attachment,	-	-	-	-	-	-	99 52
Thos. Dolan & Co., new stop-cock,	-	-	-	-	-	-	35 17
J. & P. Baltz, new stop-cock,	-	-	-	-	-	-	5 00
W. C. Allison, repairs,	-	-	-	-	-	-	3 75
H. Dehan, repairs,	-	-	-	-	-	-	8 50
Girard Trnst Company,	-	-	-	-	-	-	36 76
House of Refuge,	-	-	-	-	-	-	13 45
							<u>\$3,871 49</u>

Receipts and Expenditures since Consolidation.

Year.	REGISTRAR'S OFFICE.			RECEIPTS.		Yearly increase of receipts.	EXPENDITURES.				Annual profits.
	For water rents.		For pipe laid.	At Chief Engineer's Office.	Totals.		From annual appropriation.	From special appropriation.	From loans for construction.	Totals.	
1855...	\$360,659 16	\$21,351 01	\$626 55	\$382,036 72	Decrease.....	\$168,765 22	\$82,130 15		\$250,896 37	\$131,141 35	
1856...	320,013 88	31,922 61	960 11	352,896 60	\$73,067 54	138,293 60	21,174 42		160,468 02	192,438 58	
1857...	395,298 39	30,373 58	302 20	425,964 14	31,684 09	177,459 93	23,145 96		200,605 89	225,358 25	
1858...	430,372 87	37,145 91	129 75	467,648 23	93,531 85	194,823 44	30,258 59		187,978 09	269,670 14	
1859...	484,879 08	63,249 13	3,081 89	551,180 08	5,911 69	193,528 64	4,767 74		411,737 09	326,093 05	
1860...	494,824 22	62,297 54	1,403 77	558,531 53	Decrease.	161,277 58	1,447 36	\$186,650 06	252,508 23	360,385 15	
1861...	498,599 40	34,495 36	885 30	533,980 06	11,813 01	159,023 43	21,069 81		293,989 54	371,256 12	
1862...	516,602 94	28,164 31	1,021 82	545,783 07	23,885 22	187,486 49	23,273 43		217,966 18	368,669 83	
1863...	538,075 68	30,715 02	937 69	569,678 29	41,434 28	251,851 13	21,325 68		213,749 20	358,918 37	
1864...	596,746 40	34,141 07	855 29	610,112 57	26,275 85	270,401 83	13,487 80		273,156 81	386,955 76	
1865...	634,263 84	32,031 11	3,927 18	670,222 13	33,833 71	273,606 24	4,552 93		616,712 92	392,062 96	
1866...	684,621 08	76,938 39	5,891 44	767,450 89	9,558 70	301,595 23	37,584 24		575,844 49	406,931 35	
1867...	707,646 73	64,969 03	4,404 83	777,009 59	36,461 24	388,742 15	86,777 44		802,217 46	498,637 92	
1868...	747,443 17	61,065 06	4,962 60	813,470 83	121,901 13	448,947 54	52,499 47		969,768 28	372,229 21	
1869...	810,716 83	117,319 12	7,335 01	935,370 96	27,863 12	430,406 38	2,687 29		1,141,073 51	486,766 13	
1870...	859,939 06	96,110 98	10,648 40	963,254 08	91,047 43	430,406 38	5,887 85		1,069,193 43	517,969 83	
1871...	911,790 15	131,822 96	10,648 40	1,044,261 51	28,703 50	471,219 80	10,218 35		1,063,576 28	572,843 36	
1872...	961,296 78	116,997 17	4,691 06	1,082,985 01	146,896 37	669,506 89	1,063 66		1,225,102 48	648,631 56	
1873...	1,023,989 81	186,806 90	6,984 54	1,222,881 38	Decrease.	632,086 89	1,018 92		1,564,418 48	572,843 36	
1874...	1,057,086 61	123,258 53	9,321 14	1,169,666 28	30,088 69	674,693 51	35,139 56		938,336 74	539,353 57	
1875...	1,079,025 72	115,034 27	5,694 98	1,199,754 97	28,226 13	713,518 02	11,519 83		1,101,023 81	475,107 12	
1876...	1,148,690 93	73,293 88	6,636 29	1,227,981 10	148,950 95	484,613 87	3,058 18		670,849 88	740,309 03	
1877...	1,317,028 67	55,631 89	3,871 49	1,376,532 05	.....	414,935 45	3,740 31		481,691 16	891,840 89
Totals	\$17,131,329 64	\$1,659,453 49	\$98,268 36	\$18,892,051 49	.....	\$8,229,843 42	\$611,348 10	\$6,262,609 00	\$14,953,198 52	\$10,088,372 57

EXPENDITURES OF THE DEPARTMENT FOR 1878.

FROM ANNUAL APPROPRIATION.

Salaries of Chief Engineer, Assistants, Purveyors, and Clerks,	\$27,990 00
Salaries of Engineers, Firemen, &c., at Works,	60,075 00
Salaries of Registrars and Clerks,	24,553 80
Stationery, advertising, and office expenses,	4,998 19
Supplies to Works :	
Coal and wood,	\$54,913 98
Tallow, oil, and gas,	6,970 89
Small stores, packing, &c.,	2,995 71
	<hr/>
	64,880 58
Repairs to Works.	
Fairmount,	\$11,312 86
Schuylkill,	848 91
Belmont,	740 39
Delaware,	551 61
Roxborough,	1,028 26
Frankford,	416 18
	<hr/>
	14,898 21
For drilling and making new attachments :	
Wages, First District,	\$1,785 25
" Second " "	2,205 75
" Third " "	2,221 50
" Fourth " "	2,246 00
" Manayunk,	1,214 00
" Germantown,	326 00
	<hr/>
	9,998 50
For keeping pipes, plugs, stops, and fixtures in good order :	
Wages, First District,	\$3,304 25
" Second " "	3,966 49
" Third " "	4,914 00
" Fourth " "	5,673 86
" Manayunk,	2,418 25
" Germantown,	2,314 00
" Pressure Inspector,	785 25
Paving around plugs,	1,235 10
Plumbing,	157 17
Sundries,	22 65
	<hr/>
	24,791 02
Amount carried forward,	<hr/>
	\$232,185 30

Amount brought forward,	-	-	-	\$232,185 30
For labor in laying pipes, setting and fitting fire-plugs, stop-cocks, &c.:				
Wages, First District,	-	-	-	\$3,785 50
" Second "	-	-	-	11,375 62
" Third "	-	-	-	10,648 75
" Fourth "	-	-	-	8,735 62
" Manayunk,	-	-	-	2,009 24
" Germantown,	-	-	-	844 80
" Shop,	-	-	-	19,895 21
" Assistant Engineers,	-	-	-	5,713 25
" Fairmount,	-	-	-	6,299 74
Measuring over pipe,	-	-	-	2,288 14
Hauling, -	-	-	-	1,545 34
Inspecting pipe, -	-	-	-	1,088 41
Draughting, -	-	-	-	300 00
Paving around plugs,	-	-	-	118 25
Transportation, -	-	-	-	120 00
Diver, -	-	-	-	100 00
Castings, -	-	-	-	46 95
Repairs, -	-	-	-	43 70
Messenger service,	-	-	-	19 97
Coke, -	-	-	-	11 80
Gas fitting,	-	-	-	3 75
				<hr/>
				74,994 04
For keeping buildings, grounds, and reservoirs in good order.				
Wages, -	-	-	-	\$19,866 83
Repairs to Delaware wharf,	-	-	-	2,525 61
Lumber, -	-	-	-	2,241 27
Hardware,	-	-	-	1,374 51
Dredging,	-	-	-	719 60
Iron safe, -	-	-	-	355 00
Grading, -	-	-	-	301 93
Stone, -	-	-	-	278 60
Seeds and Plants,	-	-	-	260 59
Iron castings, -	-	-	-	224 63
Repairs to office, -	-	-	-	229 10
Repairs to track, -	-	-	-	195 05
Gas fitting and plumbing,	-	-	-	127 80
				<hr/>
Amounts carried forward, -	-	-	-	\$28,700 52 \$307,179 34

Amounts brought forward, -	-	\$28,700 52	\$307,179 34
Scales, - - - -	-	134 15	
Tubing, - - - -	-	129 68	
Heater, - - - -	-	175 00	
Lime, - - - -	-	93 80	
Roofing, - - - -	-	84 00	
Hauling, - - - -	-	87 00	
Bricks, - - - -	-	80 05	
Cement, - - - -	-	67 55	
Ice, - - - -	-	54 35	
Brass castings, - - - -	-	45 75	
Awning, - - - -	-	59 70	
Ventilators, - - - -	-	35 50	
Transportation, - - - -	-	23 19	
Boiler cleaner, - - - -	-	30 00	
Valves, - - - -	-	22 33	
Gauges, - - - -	-	21 00	
Wire work, - - - -	-	20 00	
Oil, - - - -	-	38 30	
Block and fall, - - - -	-	20 84	
Drain pipe, - - - -	-	17 04	
Brooms, - - - -	-	15 82	
Paint and glass, - - - -	-	10 79	
Cleaning cess pool, - - - -	-	8 50	
Tolls, - - - -	-	11 61	
Salt hay, - - - -	-	3 48	
Iron and steel, - - - -	-	1 96	
			29,991 91
For purchase of iron pipes, fire plugs, stop-cocks, lead, brass, iron castings, &c.			
Iron pipe, - - - -	-	\$41,039 85	
Iron castings, - - - -	-	4,831 71	
Lead, - - - -	-	3,841 41	
Hardware, - - - -	-	2,425 54	
Hauling, - - - -	-	2,400 30	
Brass castings, - - - -	-	2,260 06	
Lumber, - - - -	-	1,693 92	
Wages, - - - -	-	1,465 49	
Iron and steel, - - - -	-	1,435 42	
Plug valves, - - - -	-	1,343 30	
Annual report, - - - -	-	1,140 96	
Amounts carried forward, -	-	\$63,877 96	\$337,171 25

Amounts brought forward, -	-	\$63,877 96	\$337,171 25
Water meters, -	-	935 00	
Coal, -	-	729 70	
Transportation, -	-	340 00	
Gum goods, -	-	700 74	
Pipe maps, -	-	310 00	
Gasket, -	-	287 61	
Valves, -	-	257 62	
Oil and tallow, -	-	229 66	
Packing, -	-	240 00	
Rent, -	-	185 00	
Wharfage, -	-	167 40	
Coke, -	-	80 75	
Powder, -	-	79 45	
Repairs, -	-	78 92	
Machine work, -	-	30 45	
Wire work, -	-	22 00	
Brooms, -	-	16 00	
Varnish, -	-	31 50	
Tubing, -	-	39 33	
Wood, -	-	22 50	
Galvanizing, -	-	65 48	
Covering steam pipe, -	-	86 00	
Plumbing, -	-	8 40	
List, -	-	4 00	
Adjusting scales, -	-	18 40	
Ice, -	-	16 48	
Rope, -	-	7 63	
Lime, -	-	2 00	
			68,869 98
For carriage hire and keep of horse for Superintendent and Assistant Engineers, -	-		750 00
For carriage hire and keep of horse for Chief Engineer, -	-		650 00
For care and maintenance of the Chestnut Hill Water Works, -	-		1,692 76
For expenses of public fountains of the Philadelphia Fountain Society, -	-		988 19
TRANSFER.			
By transfer from item 22, November 23, 1878, to item 10½, for preparing a new set of books and records for Registrar's Department.			
Wages, -	-	\$1,294 00	
Books, &c., -	-	3,539 27	
			4,833 27
			<u>\$414,955 45</u>

SPECIAL APPROPRIATIONS.

(Appropriation approved October 12, 1875.)

For new boilers, settings, and connections at Chestnut Hill Works; for relining south division of the Roxborough Reservoir; for repairing the Wissahickon Aqueduct, to extend the 10 inch main on Ridge Avenue, and for the purchase of a lot of ground on the Roxborough Ridge at Manatawna:

Wages, - - - -	\$981 50
Building tank, - - - -	996 88
Lot of ground, - - - -	600 00
Roofing, - - - -	245 27
Iron castings, - - - -	125 63
Lime, - - - -	79 75
Incidentals, - - - -	44 50
Lumber, - - - -	15 49
	<hr/>
	3,089 02

(Appropriation approved December 3, 1878.)

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

657 29
<hr/>
<u>\$3,746 31</u>

EXTENSION OF WORKS.

AMOUNT PAID FROM WATER LOANS.

(Appropriation approved April 17, 1865.)

Item 15.

For bursting of mains and other emergency:

Wages, - - - -	\$401 50
Hardware, - - - -	89 42
	<hr/>
	\$490 92

Amount brought forward, \$490 92

(Appropriation approved April 7, 1870.)

Item 10.

For bursting of mains, and other emergency :

Wages, - - - - -	\$1,956 50	
Repairs, - - - - -	446 81	
Hoisting machine, - - - - -	226 10	
Bricks, - - - - -	105 80	
Tubes, - - - - -	93 48	
Incidentals, - - - - -	89 00	
Hardware, - - - - -	47 54	
Hauling, - - - - -	51 00	
Transportation, - - - - -	44 45	
Carriage hire, - - - - -	38 50	
Brass castings, - - - - -	37 65	
Rope, - - - - -	12 75	
Cement, - - - - -	10 00	
	<hr/>	3,159 58

(Appropriation approved November 6, 1871.)

Item 1.

For new engine No. 3, at Schuylkill Works :

Foot valves, - - - - - 957 00

Item 8.

For mains to connect large storage reservoir,

East Park, with engine at Fairmount Works :

Wages, - - - - -	\$3,231 25	
Iron pipe, - - - - -	1,177 33	
Hardware, - - - - -	491 09	
Stone, - - - - -	288 20	
	<hr/>	5,187 87

Amount carried forward, - - - - - \$9,795 37

Amount brought forward, - - - - \$9,795 37

(Appropriation approved May 19, 1873.)

Item 1.

For engine house and stack at Harrison's Landing (Lardner's Point):

Lumber, - - - -	\$575 17
Hardware, - - - -	77 80
Valves, - - - -	30 80
Repairs, - - - -	18 00
Lime, - - - -	4 50
	<hr/>

706 27

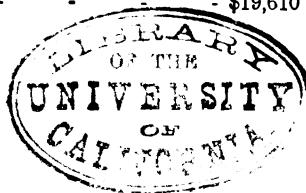
Item 2.

For new engine and boilers, and setting same, Frankford Works:

Neaffie & Levy's contract, - - -	\$5,598 00
Wages, - - - -	987 00
Firing, and inclined cars, - - -	614 00
Foot valves, - - - -	501 37
C. B. Address, services as expert, - - -	150 00
Thomas Gamon, " " - - -	150 00
Lumber, - - - -	231 94
Repairs, - - - -	213 44
Steam valves, - - - -	130 00
Transportation, - - - -	92 95
Covering steam pipe, - - - -	78 40
Hardware, - - - -	75 03
Bricks, - - - -	61 20
Iron castings, - - - -	60 78
Stone, - - - -	30 00
Lime, - - - -	26 72
Steam gauge, - - - -	26 40
Hauling, - - - -	21 00
Roofing, - - - -	20 14
Brass castings, - - - -	17 40
Boiler, - - - -	12 00
Adjusting scale, - - - -	7 50
Machine work, - - - -	3 40
	<hr/>

9,108 67

Amount carried forward, - - - - \$19,610 31



Amount brought forward, - - - \$19,610 31

Item 4.

For reservoir, Frankford Works:

Malone's contract, - - -	\$11,433 03	
Wages, - - - - -	948 50	
Cement, - - - - -	208 50	
Lumber, - - - - -	192 83	
Vases, - - - - -	180 00	
Iron railing, - - - - -	147 00	
Hardware, - - - - -	121 94	
Fencing, - - - - -	102 36	
Incidentals, - - - - -	89 37	
Carriage hire, - - - - -	84 00	
Transportation, - - - - -	70 40	
Hauling, - - - - -	13 00	
Richards & Ingram's contract, - - -	9 55	
Sand, - - - - -	1 50	
		13,599 98

Item 6.

For 30-inch ascending main stop-cocks, fixtures,
&c.

Wages, - - - - -	\$9,760 37	
Covering pumping mains, - - -	4,126 86	
Iron pipe, - - - - -	3,230 13	
Land damages, - - - - -	3,010 00	
Painting, - - - - -	406 60	
Hauling, - - - - -	313 63	
Lumber, - - - - -	158 20	
Grading, - - - - -	125 00	
Iron basin, - - - - -	120 00	
Repairs, - - - - -	112 50	
Incidentals, - - - - -	81 55	
Inspecting pipe, - - - - -	62 10	
Brass castings, - - - - -	51 84	
Cement, - - - - -	48 75	
Transportation, - - - - -	33 56	
Carriage hire, - - - - -	39 50	
Hardware, - - - - -	33 65	
		\$21,714 24
Amounts carried forward, - - -		\$33,210 29

Amounts brought forward, -	-	\$21,714 24	\$33,210 29
Powder, - - - -	-	30 50	
Tubing, - - - -	-	22 13	
Tolls, - - - -	-	14 67	
Sand, - - - -	-	6 50	
Fire brick, - - - -	-	5 24	
Iron castings, - - - -	-	2 80	
		<hr/>	21,796 08

Item 7.

For 20-inch descending main :

Iron pipe, - - - -	-	\$4,188 40	
Wages, - - - -	-	2,683 50	
Hauling, - - - -	-	1,856 98	
Land damages, - - - -	-	70 25	
Lumber, - - - -	-	49 50	
Excavating for pipe, - - - -	-	38 31	
Transportation, - - - -	-	30 96	
Inspecting pipe, - - - -	-	15 97	
Rope, - - - -	-	6 16	
		<hr/>	\$8,940 03
			<hr/>
			<u>\$63,946 40</u>

RECAPITULATION.

Expended from annual appropriation, - - -	-	\$414,955 45
“ “ special “ - - -	-	3,746 31
“ “ loans (extension of works), - - -	-	63,946 40
		<hr/>
Total expenditures for 1878, - - -	-	\$482,648 16
		<hr/>
Receipts at office of Registrar, - - -	-	\$1,372,660 56
“ “ Chief Engineer, - - -	-	3,871 49
		<hr/>
		\$1,376,532 05
Expended as per annual and special appropriations, -	-	418,701 76
		<hr/>
Profits, - - - -	-	\$957,830 29
		<hr/>

OPERATIONS
OF THE
REGISTRAR'S DEPARTMENT,
FOR
1878.

DEPARTMENT FOR SUPPLYING THE CITY WITH WATER.

REGISTRAR'S OFFICE,
N. W. cor. Thirteenth and Spring Garden Sts.,

Philadelphia, January 1, 1879.

DR. WM. H. MCFADDEN,
Chief Engineer.

DEAR SIR:—I herewith transmit the report of receipts at this office for the year 1878. The total amount derived from all sources was \$1,372,660.56, which has been paid daily, as received, into the office of the City Treasurer; this is an increase over the previous year of \$151,315.75.

The collections from water rents for the year 1878 amounted to \$1,085,838.41, an increase over the previous year of \$77,589.81, and the receipts from delinquent rents amount to \$136,123.93, an increase of \$74,019.18.

The receipts from fractional rents, penalties, and other sources, amounted to \$95,066.43, an increase over the previous year of \$17,328.75.

The receipts from water pipe amounted to \$55,631.89, a decrease of \$17,621.99.

Pipe bills to the amount of \$32,223.75 were returned to the City Solicitor for lien, and the amount collected by him was \$40,113.80, as appears of record in that department.

Respectfully referring to the annexed itemized tables, I remain

Yours, very respectfully,

W. M. TAYLOR,
Registrar.

Receipts at the Registrar's office for the year 1878.

Months.	Delinquent rents.	Penalties.	Rents of 1878.	Penalties.	Fractional rents.	Water pipe.	Totals.
January.....	\$6,024 25	\$797 13	\$22,386 75		\$1,887 37	\$5,164 00	\$36,259 50
February.....	3,493 25	461 55	70,713 25		4,611 53	2,546 98	81,826 56
March.....	4,706 00	653 56	102,358 40		4,756 45	7,210 82	209,691 23
April.....	17,447 00	2,513 90	541,309 75		5,725 64	6,312 42	573,308 71
May.....	9,907 00	1,469 25	47,920 50	\$2,347 66	5,644 88	4,061 16	71,350 45
June.....	30,490 35	4,558 65	74,548 30	3,708 90	3,957 77	5,622 49	122,886 46
July.....	21,249 33	3,166 09	17,747 28	2,411 54	3,824 81	4,438 05	52,837 10
August.....	15,574 75	2,277 36	22,395 15	3,307 98	4 022 89	4,149 48	52,627 61
September.....	8,607 75	1,258 74	46,667 63	6,859 63	3,902 21	7,495 18	74,791 14
October.....	7,609 00	1,124 27	33,312 15	4,932 32	3,726 91	3,231 45	53,936 10
November.....	5,292 25	630 40	10,656 75	1,485 06	3,238 22	2,766 03	24,068 71
December.....	5,723 00	848 34	5,822 50	862 10	3,193 22	2 627 83	19,076 99
Total.....	\$136,123 93	\$19,759 24	\$1,085,838 41	\$25,915 19	\$49,391 90	\$55,631 89	\$1,372,660 56

Amount of claims for water pipe returned for lien in 1878..... \$32,223 75
 Amount of claims for water pipe collected by City Solicitor in 1878..... 40,113 80

Comparative Statement of Receipts for the years 1877 and 1878.

	Delinquent rents.	Penalties.	Water rents.	Penalties.	Fractional rents.	Water pipe.	Totals.
1878.....	\$136,123 93	\$19,759 24	\$1,85,838 41	\$25,915 19	\$49,391 90	\$56,631 89	\$1,372,660 56
1877.....	62,104 75	7,957 45	1,008,249 60	16,309 65	53,470 48	73,253 88	1,221,344 81
Increase.....	\$74,019 18	\$11,801 79	\$77,589 81	\$9,605 54			\$151,315 75
Decrease.....					\$4,078 58	\$17,621 90	

Items of Receipts under head of "Fractional Rents."

	Rents.	Ferrules.	Repaving.	Repairs.	Totals.
1878.....	\$35,136 14	\$7,068 00	\$5,823 50	\$1,424 26	\$49,391 90
1877.....	36,812 86	8,504 00	6,864 50	1,289 12	53,470 48
Increase.....				\$135 14	
Decrease.....	\$1,676 72	\$1,496 00	\$1,041 00		\$4,078 58

Estimated receipts in statement to City Controller.....	\$1,246,000 00
Actual receipts, as above.....	1,372,660 56
Increase over estimate.....	126,660 56

List of Dwellings, Factories, Horse-power, &c., charged on Registers for 1878.

	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			
Baths.....	294	116	951	593	696	491	247	2278	1776	2155	305	892	1410	1392	4427	646	514	1204	3544	5613	349	1790	400	3695	988	2335	1757	3592	5290	2434	1923	60125		
Bakeries.....	56	37	4	37	33	20	26	31	23	37	29	29	27	45	32	36	32	42	62	71	9	14	7	26	28	44	7	25	45	31	50	1031		
Banks.....					15		3												2	1												24		
Bars.....	155	132	112	184	338	226	88	142	343	152	185	137	12	132	251	141	142	147	264	208	71	47	53	143	134	123	71	107	146	120	166	4840		
Barber shops.....	39	35	24	18	40	41	27	25	35	16	20	14	27	33	44	25	21	28	44	43	11	7	3	29	17	20	13	20	28	27	31	803		
Biddets.....						1	2	96	18	11					8					12		6		4				2				162		
Billiard saloons.....								1												2		1										5		
Blacksmith shops.....	1		6	14	3	5		11	9	5	8	7	4	9	9	14			24	27	1		7	18	14	13	3	19	16	12	16	272		
Bleaching establish't.....		1																		3												4		
Bottling.....	1	4		2	3	3			2			4			3		3	3	11	3					4				3	3	2	1	55	
Boards.....					85	210		500	600	330	190	103	20						45										20			2010		
Boilers.....	45	26	12	4	68	223	27	39	100	6	76	42	29	47	60	96	77	68	158	64	23	43	33	24	57	37	31	19	35	44	102	1676		
Breweries & distiller's.....	1	1	1		2							8	3	2	3		11	1	11	9	1	1	1	5				7	18			88		
Brickyards.....							1												9	1						1	1		7	1		23		
Carriages.....	26	61	55	73	42	41	48	208	217	333	28	214	356	251	382	52	81	125	111	309	19	257	96	117	34	40	163	116	85	80	64	4087		
Carpenter shops.....	2	1	9	14	6	1	6	9	6		3	4	9	23	14	13	8			6	17		1	1	1	4	3	8	5	1	5	3	183	
Car shops.....									1																								3	
Cars.....	9											15	81		117				59	26				191			63	129	45	55	133	913		
Chemical works.....																																	1	
Churches.....	10	3	6	7	2	8	2	9	7	4		2	1		10	2		3	12	16	11	14	7	23	12	9	13	2	19	3	1	218		
Children's homes.....																																	7	
Coal yards.....		22	2	3				1					9	2	8				1	10	10	2	1	2	1	3		7	4		5	93		
Cooper shops.....			2			2					7									1	3												16	
Coffee roasters.....	1		1																	1	2												6	
Depots.....											4									2			6	1	4	2		3	2	3	2	2	31	
Drove yards.....																																		4
Drug stores.....	22	15	15	9	11	7	20	18	9	21	5	13	17	13	21	5	12	14	27	29	7	10	6	27	8	19	9	19	26	17	16	467		
Dwellings & Hydrants.....	7554	4315	2394	2297	2769	2811	6086	2908	243	3529	1745	1974	2905	3451	7140	2375	2376	3934	6699	7602	2198	2570	2570	7012	4651	5955	2379	4782	7262	5075	5644	127292		
" 3/4.....	28	44	2	34		6	30	48	79	27	16	21	18	8	128	93	121	199	56	75	13			1	19	34	7	17	66	25	2	73	1316	
" 1/2.....	217	1868	1113	1116	545	233	770	453	138	810	795	716	492	491	734	1087	1190	679	272	402	7	3	48	42	185	92	43	37	41	247	107	15083		
Dye houses.....						7	5	3	3		3	15		4	1		3	15	4	2	4	2	1	9								110		
Dye vats.....					52																												52	
Eating saloons and restaurants.....						46	5	4	28	16	27		3	12	3	21		3	3	5	4	1		1	8		7	9		7	4	5	220	
Engines.....	46	22	11	3	5	184	12	29	85	50	44	31	34	34	88	40	36	50	120	50	11	43	34	19	37	24	31	13	22	44	71	1276		

List of Dwellings, &c.—Continued.

	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				
Engine houses.....																					1														4
Factories.....			2	1		9		2	26	49		7	15	2	50	24	9	32	28	13	17	14	4	16	12	11	12	10	13	11			389		
Feed stores.....	3	3		6	1			2										4	13				1	5									6	49	
Fire plugs.....		1	2		4								7	1	3					1			2										1	23	
Fish stands.....			1		1		1	1	6		4								2	6				4			2		10	2			2	110	
Firebrick works.....	1																					1													2
Foot baths.....															6							4										21			31
Foundries.....	5	1			3										20	1	1		8	11			1		1	2	1					2	1	67	
Fountains.....	8	2	4		7	10	9	31	21	17	1	6	3	15	20	5		6	4	17	5	26	5	34	4	5	39	11	24	18	6		363		
Forges.....	4	3	8	20	3	18	3	6	4	34	28	2	22	3	48	32	19	160	14	61			16	3	17	15	3	8	6	34	24		645		
Furnaces.....	4																																	4	
Galvanizing works.....						1																												1	4
Gas works.....								1													1											1		1	4
Glass works.....																					2				1									2	5
Green houses.....	13						12	4	2			4	2	1			7	6	12	16	55	26	17	48	8	46	66	27	12	1			383		
Grindstones.....					5									13	30					17			2		5									72	
Hatter's planks.....			2		12	20		2	2						21					17														76	
Halls.....	3		2	1		1		2	2											1			3	1	1		1	1		6			26		
Hay markets.....																					1													1	
Horse troughs.....	22	9	16	3	15		8	4	4	5	9	5	4	4	42	3	13	30	38	18	17	8	10	50	32	11	13	38	4	14	33		472		
Horse power of boilers.....	494	743	181	319	1314	2006	315	470	1264	929	597	512	568	940	264	1675	1014	1267	2643	1243	462	621	723	285	803	740	566	294	666	750	1926		30024		
Hotels.....					7			11	1	4											3			6			3						35		
Hospitals.....																						1			5	1	1							8	
Ice cream saloons.....	2	7	9	2	3		25		13		10		15		16	6	3	1		16			12		1			7	5	1	1		157		
Kitchens.....								8	2	5																								15	
Laboratories.....								1	1					1	1								1										1	6	
Laundries.....		1			5	3		13	13	8			3	6	4							6		2		1			2	1	2	3		83	
Lime vats.....												36																						162	
Lime yards.....		1																			1	1												3	
Lumber yards.....		1				1	1		4				1				1			3			1	1	1						1	2		18	
Machine shops.....						1		2										3		6			1	6	1	2	5	3	1	4	4	1		40	
Marble yard & stores.....	1	1	2			1	4	5	6	4			3	4			2	2	7		3													75	
Market stalls.....			629	52				77	1263		602		19						39	325				326										4996	
Market houses.....			2		1	2	1	1	3		3				4					2	4	1			4		1							38	
Malt houses.....				2		1		1	3					1																					23

List of Dwellings &c.—Continued.

	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	
Mills.....	2		1		1	2	1			2										15		8	9	5	1	4	6	3		1	1	62
Offices.....	7	1													5		6	10	27		3		24	8	5	21	2	11		2	139	
Openings.....																				1											1	
Oyster houses.....	5	1		19	32	5						5					9	1	18		1			2		2		4		104		
Paint shops.....			1					2																							3	
Paper factory.....								1																							1	
Photograph galleries.....		1	1	1	7	3	5	9	15	5	7	1	6	2			2	1		2	2	1			1		1	1		1	76	
Polishing wheels.....						1		1					1	2																	3	
Pools.....	2			1			1	1	1	3			1		6	11		1							1			2		1	31	
Potteries.....	1																		2											2	5	
Printing offices.....					1	3		2	9	2													1								18	
Rectify'g establish't.....					3	1		3																							7	
Roofing establish't.....			1																												1	
Schools.....	2		2	1	4	1		9	6	2			1	1	1	5		1	1	4	2	2	6	1			9	1	10	2	77	
Scholars.....	1320		1859	690	100	500	485	576	230	1295			90	35	240	1400	600	600	1490	375	500	320		180		534	100	401	330	1800	17160	
Scouring establish't.....													1						1			1	1								4	
Shower baths.....							26		1			174		452	1					1	37	3	1	2			40	21	143	1	903	
Shot towers.....		1																													1	
Shoe factories.....							1																								1	
Sinks.....	4	2		4	29	176	116	710	121	86	26	10	23	35	132	3		2	4	83	10	166	1	120		36	301	14	101	26	2341	
Skin dress'g estab't.....				1												2	2		3													4
Slaughter houses.....	42	1									1	2	2	5	14	15	8	56	17	66	15			4	49	17	2		81	19	2	441
Soap factories.....	2		1		1		1												2	2											9	
Stables.....	113	61	72	79	48	45	143	190	88	134	86	73	54	54	225	61	171	66	88	232	32	207	26	202	33	128	61	50	120	104	139	3178
Stalls.....	1024	753	412	672	259	881	598	566	1101	853	565	625	623	1008	1906	680	732	1502	1304	146	241	575	539	2632	590	1065	1415	2156	2335	1014	1230	31770
Steam heaters.....				20	30		3	4					5	4	7	2					3	3										8
Steam Saws.....					2		5			2										1												14
Stills.....								1	2																							3
Stores and shops.....	19	24		14		36		4				11					26	23	90	33		6	23	56	29	3	32	10	10	25	110	683
Store houses.....			1	9		7														4												21
Sugar houses.....	2	1	2			2								1																		8
Tanneries.....											1	16					4	5		1	3										30	
Theatres & opera h's.....					2			2	1	1														1							7	
Tin shops.....			1																													1
Turbine wh'ls organs.....							1							1		1						1	1		1						7	

Permits issued during the year 1878.

	WARDS.																															Totals.					
	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.....	181	30	6	14	3	10	46	29	19	13	2	1	16	6	72	8	23	59	230	146	135	116	101	481	255	323	117	314	540	67	54	3417					
“ ½ and ¾																			27	20													50				
Baths	94	35	3	11	6	5	43	42	27	15	5	3	19	11	73	16	6	42	168	157	43	74	29	292	117	219	122	269	496	65	41	2548					
Wash paves.....	24	16	1	10	7	5	16	24	19	12	3	2	11	12	51	6	3	14	64	134	20	40	21	172	40	60	73	232	275	40	29	1426					
Water closets, urinals, and biddets	18	4	1	8	55	56	38	113	99	58	7	16	20	15	76	7	1	7	23	103	22	65	4	235	12	6	187	246	272	12	5	1741					
Basins, sinks, and wash tubs.....	7		1	1	32	14	57	108	75	33	6	6	12	13	93	6	4	6	12	62	9	35	3	185	2	1	144	205	189	2	5	1328					
Bars.....	1	2			2		1	1							4	1	1	3	1	2	2	1	10	10	4	3	3	3	5	1	4	2	1	68			
Watering horses.....	1			1		1	1			1				3	3	1		4	4	3			1		2	2	2	2	2	2	1	1	36				
Stores, shops, and offices.....	2		1		5	3		1	10	5	1	2	8	2	1	2	3	4	3	2	5	5	3	3	5			2	4	3	1	2	88				
Engines and boilers.....	2				3	8		2	7	3	4			2	4	2	3	2	7	4	1	2	2		5	1			4		3	71					
Horse power.....	20	2			15	51		18	206	40	9		17	51	13	8	30	47	28	1	29	5		58	10			23		58	737						
Stables.....	2	2	1		1	2			1	5					4	1		1		5	2	6	2	7	5	3	1	8	3		5	65					
Factories.....	2											1		1	3	1	1		3				1		3	2					2	2	28				
Churches and schools.....	2																		1	1													4	9			
Bakeries.....			1										1							1					1		2						1	1			
Photograph gallery.....				1																1														1	1		
Hotels and restaurants.....					2			1	1																										4	4	
Markets.....					1			1				2								1															5	5	
Fountains.....								2	1																										12	12	
Slaughter houses.....										2										1															1	4	
Breastries.....																				2															3	3	
Hot-houses.....																				3															6	6	
Organs.....																					1	2	1												4	4	
Hospital.....																									1										2	2	
Brick-yards.....																																				1	1
Building purposes.....	7	3			1		2	3	1	7	3		3	2	8	2	2	6	18	13	56	24	9	47	27	9	26	42	35	1	14		371	371			
Water for ships.....		54		3								4																							61	61	
Sprinkling streets.....																																				26	26
Total.....	363	145	14	50	132	151	204	316	470	191	48	31	90	87	440	67	58	179	624	690	300	403	181	1430	537	634	626	1334	1845	189	221	12116					

Amount of Duplicates for years 1878 and 1879.

Wards.	January, 1878.	January, 1879.
First.....	\$59,322 25	\$64,188 35
Second	36,209 75	36,745 25
Third.....	21,744 75	23,185 33
Fourth.....	21,249 50	26,639 75
Fifth.....	35,061 09	35,331 50
Sixth.....	41,549 50	46,019 08
Seventh	42,074 25	43,643 34
Eighth.....	44,923 75	47,445 50
Ninth.....	36,348 95	39,552 05
Tenth	39,639 75	42,504 90
Eleventh	18,984 25	21,588 25
Twelfth	21,703 75	23,190 75
Thirteenth.....	32,123 75	35,117 35
Fourteenth	38,649 15	39,052 20
Fifteenth	79,498 00	94,086 88
Sixteenth.....	25,316 50	29,075 78
Seventeenth.....	24,015 75	32,316 42
Eighteenth.....	39,391 50	42,112 20
Nineteenth.....	70,591 25	73,104 50
Twentieth.....	76,207 75	85 343 25
Twenty-first.....	11,289 00	18 286 45
Twenty-second	27,841 60	30,226 30
Twenty-third	10,773 00	19,672 25
Twenty-fourth.....	53,789 00	67 276 06
Twenty-fifth	31,863 50	35,774 00
Twenty-sixth	40,704 75	46,327 00
Twenty-seventh.....	26,066 25	31,510 00
Twenty-eighth.....	42,044 50	55,150 70
Twenty ninth.....	73,512 40	87,503 35
Thirtieth.....	44,008 00	46,446 35
Thirty-first.....	46,541 00	51,868 00
	\$1,212,837 00	\$1,370,284 88

Subject to revision by re-inspection.

Amount collected by City Solicitor from liens.

Years.	Feet of pipe laid.	Frontage collected by Registrar.	Returned for lien.	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	117,819 12	61,640 99	11,959 82
1871.....	158,972	96,110 98	62,341 24	14,764 42
1872.....	146,221	131,882 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	116,034 27	81,151 48	52,259 95
1877.....	84,624	73,253 88	38,581 54	56,233 57
1878.....	61,650	55,631 89	32,223 75	40,113 80
Total.....	1,838,352	\$1,294,822 15	\$786,701 26	\$372 595 18

Purposes for which water is supplied free of charge.

Wards.	CITY PROPERTY.				FOUNTAINS.			
	School houses.	Police stations.	Fire stations	Other buildings.	Fountain Society.	Society P. C. A.	Other Associations.	City.
First	8	1	1		1	1		
Second.....	7				2			
Third.....	6	1			2			
Fourth.....	6		1		2			
Fifth.....	5	2	2	2	11	1	1	
Sixth.....	2	1	1		5			1
Seventh.....	2	1	3		3			
Eighth.....	2	1	1		12			1
Ninth.....	3	1	1	1	8			
Tenth.....	5	1	1		1			
Eleventh.....	4	1	1					
Twelfth.....	6		1					
Thirteenth.....	3							1
Fourteenth.....	6	1	1	1	2			1
Fifteenth.....	8	1	3			1	3	
Sixteenth.....	4				1			
Seventeenth.....	3	1						
Eighteenth.....	8	1	1		2			
Nineteenth.....	8		3		2	1		2
Twentieth.....	7	1	1		2			
Twenty-first.....	7		2					
Twenty second.....	7	2			1	1		
Twenty-third.....	4	1	2					
Twenty-fourth.....	10	1	1	2	7	1	1	1
Twenty-fifth.....	11	1						
Twenty-sixth.....	4		1	1	3			
Twenty-seventh.....	10	1	1	1	4	1		
Twenty eighth.....	5	1						
Twenty-ninth.....	8	1	1		3			
Thirtieth.....	5	1			1			
Thirty first.....	5							
Totals	181	26	30	8	76	7	5	7

The City properties, classed under the head of other buildings, are:

Independence Hall and Annexes, New Court House, New Public Buildings, Broad and Market street; Spring Garden Hall, Park offices, Memorial Hall, Moyamensing Prison, and Philadelphia Almshouse. Water is also furnished, free of charge, for sprinkling Fairmount Park drives and supplying its fountains.

The following are the locations of fountains in Fairmount Park.

EAST OR OLD PARK.

- Two (2) new fountains on Flat Iron.
- Three (3), group of fountains near Brown street entrance.
- Fish pond fountains near Brown street entrance.
- Fountain in front of Art Gallery, near Green street entrance.
- One drinking fountain near Lincoln Monument.
- Two drinking fountains near Lemon Hill Mansion.
- One drinking fountain near Grant's Cabin.
- One drinking fountain at Sedgeley Guard House.

WEST PARK.

- Catholic fountain, west end of Republic avenue.
- One small drinking fountain on Lancaster drive, east side of Belmont.
- One small drinking fountain, at Children's Play-ground, Sweet Briar.
- Three small fountains at Horticultural Hall.
- One inside the Hall in flower-bed.
- Two in flower-beds outside of the Hall, west side.
- Fountain in lake near Machinery Hall.

OPERATIONS
OF THE
WATER DEPARTMENT SHOP,
918 CHERRY STREET,
FOR 1878.

STOCK ACCOUNT.

*Statement of the operations of Cherry street shop, from January 1, 1878, to
December 31, 1878.*

DR.	
To stock on hand January 1, 1878,	- \$13,287 14
324,215 lbs. iron castings,	- 5,407 76
12,339½ lbs. brass castings,	- 2,048 61
1,216½ lbs. copper and tin,	- 246 55
1,377½ lbs. malleable castings,	- 103 31
2,057½ lbs. steel, (assorted),	- 272 35
46,181½ lbs. wrought iron, (assorted),	- 1,148 43
102 tons coal,	- 457 20
12,109 feet of lumber, (assorted),	- 472 84
6 cords wood,	- 45 00
Bolts and nuts,	- 1,929 86
Gum rings, valves, and (assorted) gum,	- 1,840 97
Wrought pipe and fittings,	- 81 20
Hardware,	- 1,193 14
Rope and gasket, 3,822 lbs.,	- 303 44
Sponge cloths,	- 240 00
Paints and oils,	- 330 78
Water meters, (assorted),	- 935 00
Railroad tickets,	- 626 25
Machine work,	- 294 93
Cartage,	- 12 50
50,000 lbs. lead,	- 1,919 99
Wages paid hands,	- 23,061 20
665 stop-boxes,	- 1,995 00
Plumbing,	- 26 42
Brooms and brushes,	- 16 00
Leather belting,	- 50 75
Gauges and repairs to same,	- 59 45
Brass fittings,	- 475 09
Wire work,	- 50 00
Galvanizing,	- 76 20
Boiler work,	- 119 31
Ice,	- 63 70
	<hr/>
	\$59,190 37
Balance,	- 21,163 00
	<hr/>
	\$80,353 37

Cr.				
By repairs and supplies, First District,	-	-	-	\$3,606 46
“ “ Second “	-	-	-	11,516 64
“ “ Third “	-	-	-	7,070 56
“ “ Fourth “	-	-	-	16,518 23
“ “ Germantown,	-	-	-	1,609 73
“ “ Manayunk, -	-	-	-	1,392 12
Buildings and grounds,	-	-	-	146 14
Fairmount Works, -	-	-	-	813 65
Schuylkill Works, -	-	-	-	3,896 53
Belmont Works, -	-	-	-	4,066 40
Delaware Works, -	-	-	-	4,815 80
Roxborough Works,	-	-	-	3,607 06
30-inch pumping main,	-	-	-	868 31
Chestnut Hill Works,	-	-	-	1,096 22
Frankford Works, -	-	-	-	1,699 98
Frankford Reservoir,	-	-	-	270 47
Water meters,	-	-	-	1,762 12
Main office, -	-	-	-	376 01
Old metals, -	-	-	-	395 46
3,425 ferrules, -	-	-	-	1,712 50
Stock on hand, as per inventory, January 1, 1879,	-	-	-	13,112 98
				<u>\$80,353 37</u>

INVENTORY OF STOCK ON HAND, January 1, 1879.

6	8-inch socket screws,	at	\$6 00	\$36 00	
14	10-inch	“	6 50	91 00	
15	11-inch	“	7 00	105 00	
11	12-inch	“	8 00	88 00	
18	13-inch	“	8 00	144 00	
2	14-inch	“	8 00	16 00	
10	15 inch	“	9 00	90 00	
7	16 inch	“	9 00	63 00	
11	17-inch	“	10 00	110 00	
					<u>\$743 00</u>
16	4-inch square top screws,	“	5 00	\$80 00	
4	6-inch	“ “	5 00	20 00	
2	8-inch	“ “	6 50	13 00	
5	10-inch	“ “	8 00	40 00	
					<u>\$743 00</u>
	Amounts carried forward,	-	-	\$153 00	\$743 00

Amounts brought forward,	-	- \$153 00	\$743 00
6 12-inch square top screws at	10 00	60 00	
16 16-inch " " "	12 00	192 00	
11 20 inch " " "	14 00	154 00	
8 30-inch " " "	20 00	160 00	
2 36-inch " " "	25 00	50 00	
		<hr/>	769 00
11 6 inch new style screws, "	5 00	\$55 00	
5 12 inch " " " "	10 00	50 00	
		<hr/>	105 00
5 20-inch phosphor bronze, old style, at	30 55	\$152 75	
3 20 inch " " new " "	31 25	93 75	
		<hr/>	246 50
2 30-inch copper and tin screws, at	32 61		65 22
20 4-inch spindles, at	5 00	\$100 00	
40 6-inch " "	5 00	200 00	
13 8-inch " "	5 00	65 00	
		<hr/>	365 00
129 frames and covers, "	6 00	\$774 00	
11 steam plugs, "	28 00	308 00	
12 steam plug cases, "	7 50	90 00	
3½ dozen caulking and gasket irons,		32 70	
5 " chisels with handles,		75 00	
12 " assorted chisels,		144 00	
6½ " " drills,		78 00	
8 sledges,		32 00	
16 assorted reamers, at	\$2 87	45 92	
6 plug monkeys, complete, "	6 00	36 00	
46 " " frames, "	65	29 90	
26 " " screws, "	3 28	85 28	
6,326 lbs. unfinished brass castings, at	15½	980 53	
597 " finished " " "	50	298 50	
880 " brass scraps, "	09	79 20	
200 " " turnings, "	06	12 00	
75 " Muntz metal, "	50	37 50	
25 assorted brass springs, "	50	12 50	
140 plug waste valves, "	30	42 00	
54 " " " with rods, "	50	27 00	
625 ferrules, assorted, "	50	312 50	
1,379 feet lumber, "		106 72	
		<hr/>	3,639 25
Amount carried forward, -	-	-	\$5,932 97

	Amount brought forward, -	-	-	\$5,932 97
12	4-inch stop-cocks,	at	22 00	\$264 00
28	6-inch "	"	25 00	700 00
1	12-inch "	"	75 00	75 00
3	20-inch "	"	142 65	427 95
5	30-inch "	"	254 45	1,272 25
				<hr/>
				2,739 20
172	dozen sponge cloths,	"	50	\$86 00
20	lbs. listing,	"	08	1 60
299	wood plugs,	"	50	149 50
6½	dozen pick handles,	"	1 75	11 37
2½	" assorted	"		3 00
5	car jacks,	"	12 00	60 00
7	stop boxes,	"	3 00	21 00
1	1-inch water meter,	"	35 00	35 00
3	3 inch " "	"	175 00	525 00
	Bolts and nuts, assorted,			342 71
15,520	lbs. lead,	"	3 84	596 80
				<hr/>
				1,831 98
	Hardware,			\$272 66
	2 sets of gearing for derrick,			100 00
	Paints and oils,			77 43
765	lbs. gasket,	"	07½	59 29
234	pure gum rings,	"	1 00	234 00
330	" " plug valves,	"	1 90	627 00
96	lead rings,	"	50	48 00
25,893	lbs. iron castings,	"	1 65	427 23
	Steam fittings,			98 25
				<hr/>
				1,943 86
2	8-inch globe valves,	"	78 65	\$157 30
5,370	lbs. wrought iron, assorted,	"	02½	147 67
500	" steel, assorted,	"	13	65 00
24	4-inch bands,	"	5 00	120 00
4	6-inch "	"	5 50	22 00
18	12-inch "	"	7 00	126 00
3	16-inch "	"	9 00	27 00
				<hr/>
				664 97
				<hr/>
				\$13,112 98
				<hr/> <hr/>

*Stop-cocks, stop-cock boxes, frames and covers, fire-plugs, cases, lead, and gasket, delivered from shop,
No. 918 Cherry street, during 1878.*

Districts.	3-inch stops.	4-inch stops.	6-inch stops.	8-inch stops.	10-inch stops.	12-inch stops.	16-inch stops.	20-inch stops.	23-inch stops.	30 inch stops.	36 inch stops.	Total.	Frames and covers.	Fire-plugs.	Plug-cases.	Stop-boxes.	Lead.	Gasket.
First district.....			12									12	23	62	48	56	4,000	200
Second district.....			69	1		4		1				75	124	88	31	231	20,480	1,200
Third district.....		9	71					1		2		83	76	34	36	138		700
Fourth district.....		6	53	8		21		5		2		95	63	130	152	194		800
Germantown.....			12									12	18	12	12	101		500
Manayunk.....		4	2									6	23	15	10		3,200	400
30 inch pumping main, Roxborough.....								3				3						
Third District 20-inch main.....																2		200
Totals.....		19	219	9		25		10		4		286	327	341	339	722	27,680	4,000

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 1878, inclusive.

Years.	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.	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	8	397	226	324	620	409	5,200	100	50	36	5,386
1873.....	12	108	406		7	29	8	10			17	597	833	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
1877.....		25	282		10	6		5		10		388	214	328	670	370	4,100	100		25	4,225
1878.....		26	212			28		9		6		281	332	334	665	393	3,200	150	50	25	3,425

Inventory of Articles Manufactured during the year 1878.

26	4-inch stops,	at	\$22 00,	-	-	-	-	\$572 00
212	6 "	"	at 25 00,	-	-	-	-	5,300 00
28	12 "	"	at 75 00,	-	-	-	-	2,100 00
9	20 "	"	at 175 00,	-	-	-	-	1,575 00
6	30 "	"	at 337 55,	-	-	-	-	2,025 00
332	new fire-plugs	at	28 00,	-	-	-	-	9,296 00
334	" " cases	at	7 50,	-	-	-	-	2,505 00
665	stop boxes	at	3 00,	-	-	-	-	1,995 00
3,425	ferrules,	at	50,	-	-	-	-	1,712 50
Patterns,	-	-	-	-	-	-	-	369 62
								<u>\$27,450 12</u>

OPERATIONS
OF
THE WORKS
FOR
1878.

Actual and comparative amount of coal used by the different pumping engines for the year 1878.

Engines.	Description.	Total gallons of water pumped.	Total tons of coal consumed.	Actual lift in feet.	Tons of coal required to lift 1 million gallons into reservoir.	Cost of coal required to lift 1 million gallons to the height of 100 feet.	Million gallons to be lifted at the price each of the works for the year.	Hours run.	Remarks.
Schuykill No. 4.....	Cornish.....	174,372,250	268		1.48 1.00	1.8 1.00	\$4 31	780	Fires in continuous operation (during the time run.
" " 5.....	" ".....	584,803,230	721	115	1.28 1.00	1.00	3 60	2,205	Fires in continuous operation (during the time run.
" " 6.....	Simpson compound.....	992,534,000	970		1.07 1.00	1.00	2 70	2,939	Fires in continuous operation (during the time run.
" " 7.....	Rotative ".....	1,850,895,200	834		1.06 1.00	1.00	2 09	1,934	Fires in continuous operation (during the time run.
Belmont No. 1.....	Duplex compound Worthington	1,359,645,900	3,106	210	2.26 1.00	1.03 1.00	3 54	6,440	Fires in continuous operation (during the time run.
" " 2.....	" ".....	685,276,488	1,494	202	2.18 1.00	1.03 1.00	3 51	3,166	" " " " " "
" " 3.....	" ".....	2,031,314,800	3,529	202	1.73 1.00	1.00	2 76	5,815	" " " " " "
Delaware No. 1.....	Horizontal high pressure.....	2,133,094,379	3,292	119	1.50 1.00	1.34 1.00	4 28	11,708	" " " " " "
" " 2.....	Beam condensing.....								" " " " " "
" " 3.....	Duplex compoundWorth'gton }								" " " " " "
Roxborough No. 1.....	Cornish.....	53,337,663	374	333	7.01 1.00	2.10 1.00	6 91	491	" " " " " "
" " 2.....	Duplex compoundWorth'gton }	337,587,870	1,379	333	4.08 1.00	1.34 1.00	4 05	1,528	" " " " " "
" " 3.....	" ".....	661,856,950	2,457	344	3.71 1.00	1.04 1.00	3 55	3,096	" " " " " "
Roxborough Aux.....	Duplex compound Worthington	3,303,060	103	80	3.12 1.00	3.20 1.00	12 83	1,573	Fires banked every day.
Fraukford No. 1.....	Rotative compound.....	319,699,725	481	181.4	1.50 1.00	1.34 1.00	3 02	1,154	Fires in continuous operation (during the time run.
" " 2.....	Duplex compound Worthington	213,090,133	621	181.4	2.01 1.00	1.60 1.00	5 82	2,638	Fires in continuous operation (during the time run.
Chestnut Hill.....	Horizontal high pressure.....	78,267,900	439	125	5.63 1.00	4.30 1.00	18 00	3,762½	Fires banked every day.

Comparison of the running expenses of steam and water power.

	Water power.	Per cent.	Steam power.	Per cent.	Total water and steam.	Per cent.
Salaries	\$10,845 00	39	\$50,025 60	34	\$60,870 60	35
Coal	673 75	2	66,698 36	46	67,372 11	39
Lubricating oil lights, &c.....	4,301 94	16	5,558 07	4	9,860 01	6
All repairs.....	12,126 51	43	22,767 34	16	34,893 85	20
Total.....	\$27,947 20	100	\$145,049 37	100	\$172,996 57	100
Gallons of water pumped into basins.....	8,322,288,784	43	10,779,435,548	57	19,101,664,332	100
Cost per million.....	\$3 35		\$13 45		\$9 06	
Gallons of water pumped 100 feet high.....	7,490,059,905	28	16,865,981,402	72	26,356,041,307	100
Cost per million.....	\$3 73		\$8 60		\$6 56	

Percentage of water pumped at each station in the years 1877 and 1878.

Works.	1877.		1878.	
	U. S. Gallons.	Percentage.	U. S. Gallons.	Percentage.
Fairmount water power.....	9,492,419,433	53.2	8,322,288,784	43.569
Schuylkill steam power.....	1,729,810,384	9.2	2,902,600,680	15.196
Belmont steam power.....	3,486,809,917	19.6	4,076,537,188	21.343
Delaware steam power.....	2,149,106,828	12.2	2,133,094,379	11.167
Roxborough steam power.....	957,074,280	5.4	1,052,782,483	5.511
Roxborough auxiliary.....	3,496,100	0.02	3,303,060	0.017
Chestnut Hill steam power.....	58,427,800	0.38	78,267,900	0.409
Frankford steam power.....			532,789,858	2.789
Total pumpage.....	17,877,144,792	100.00	19,101,664,332	100.00

Operations of the Fairmount Water Works for the year 1878.

Months.	Running time.	Number of strokes during the month.	Total number of 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.	
	Days				Pounds.			Pounds.	Quarts.	Rain fall during the month. Inches.	Mean temperature. Degrees.
January	31	2,402,440	838,682,114	7,054,261	.....	26	94	4.56	34.21
February	28	2,339,275	787,537,111	28,126,325	.....	.....	124	2.19	37.78
March.....	31	2,098,113	910,554,377	29,372,721	.....	15	140	3.64	48.52
April.....	30	2,763,426	939,470,480	31,315,682	.....	.....	136	2.59	58.14
May	31	2,833,499	965,535,929	31,146,320	.....	29	108	4.32	62.86
June.....	30	2,575,941	892,691,580	29,766,386	.....	.....	124	4.75	69.68
July	31	1,349,423	507,737,241	16,378,620	.....	50	108	5.31	79.85
August.....	31	1,277,088	475,272,425	15,331,368	.....	.....	112	4.88	75.80
September	29	971,657	306,768,089	12,225,602	.....	28	64	1.41	69.68
October	30	1,020,461	348,039,391	11,227,077	.....	.....	92	2.39	58.77
November	30	1,467,234	504,880,460	16,829,348	.....	.....	16	2.69	44.52
December.....	31	2,416,852	785,110,587	25,326,438	.....	12	124	4.87	33.42
	Total.	Total.	Total.	Average.	Total.	Total.	Total.	Total.	Total.
	363	24,115,409	8,322,288,784	22,800,791	302,000	160	1,942	4.373	.....



Operations of the Schuylkill Works for the year 1878.

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	14	68,499	36,059,970	1,163,000	78,248	114	26
February.....	3	5,985	2,094,750	47,812	7,168	18	8
March.....	1	3,780	1,323,000	42,700	5,156	4	.....
April.....	7	31,432	15,944,520	5,314,840	14,768	59	21
May.....	30	183,528	93,467,130	3,015,070	242,369	169	62
June.....	23	185,965	112,897,870	3,763,262	222,997	234	84
July.....	31	829,020	579,900,760	18,708,411	1,079,892	624	305
August.....	31	880,632	570,078,360	18,583,174	1,124,816	746	311
September.....	30	1,086,958	661,049,280	22,034,976	1,342,320	874	412
October.....	30	1,021,789	463,761,080	14,960,035	1,165,136	833	282
November.....	29	630,264	301,711,420	10,057,047	765,410	606	241
December.....	15	115,540	58,261,530	1,879,400	163,632	185	62
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	244	5,013,378	2,902,600,680	7,955,070	6,238,512	4,466	1,799

Operations of the Delaware Works for the year 1878.

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 & cylinder oil.
	Days.				Pounds.	Pounds.			Quarts.
January.....	30	361,808	121,434,876	3,917,254	446,046	.....	.....	114
February.. ..	25	305,257	104,720,629	3,740,022	336,130	.....	.....	84
March.....	30	557,687	149,962,543	4,187,180	552,216	.....	.....	135
April.....	30	1,007,940	160,574,025	5,352,467	739,899	.....	.....	179
May.....	30	497,821	124,355,725	4,011,475	542,614	.....	.....	127
June.....	26	489,800	161,831,414	5,394,380	423,729	.....	.....	108
July.....	31	619,453	194,302,553	6,267,834	511,022	21	.....	116
August.....	31	566,242	172,581,158	5,567,134	580,620	12	.....	107
September.....	30	882,197	235,965,282	7,865,509	679,181	28	.....	144
October.....	31	1,288,486	317,444,319	10,240,139	946,400	94	.....	180
November.....	30	855,986	227,335,320	7,577,844	794,461	150	.....	113
December.....	31	601,203	162,586,535	5,214,727	619,945	178	.....	92
	Total.	Total.	Total.	Average.	Total.	Total.	Total.	Total.
	355	8,033,880	2,133,094 379	5,844,000	7,172,283	483	.....	1,499

Operations of the Belmont Works for the year 1878.

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	741,923	277,510,275	8,951,944	1,346,910	342	260
February.....	28	777,070	255,122,553	9,111,520	1,205,236	383	268
March.....	31	796,994	292,011,087	9,419,712	1,415,189	491	337
April.....	30	897,499	306,132,039	10,204,401	1,458,617	710	265
May.....	31	881,064	340,674,400	10,989,500	1,584,068	815	178
June.....	30	953,994	375,609,282	12,520,309	1,714,602	681	174
July.....	31	1,079,278	423,068,087	13,650,000	1,900,765	843	270
August.....	31	976,363	380,419,862	12,270,000	1,722,758	812	269
September.....	30	863,627	311,483,748	11,716,000	1,662,660	619	215
October.....	31	1,053,406	413,850,985	13,350,000	1,019,042	727	248
November.....	30	858,861	353,476,275	11,490,000	1,643,813	600	210
December.....	31	950,083	307,179,495	9,910,000	1,543,111	778	247
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	365	10,830,162	4,076,537,188	11,170,000	18,216,771	7,701	2,941

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Operations of the Roxborough Water Works for the year 1878.

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	264,138	77,920,710	2,513,571	767,822	86	103
February.....	28	257,772	47,235,356	1,686,262	694,222	91	98
March.....	31	260,215	78,763,425	2,540,756	746,525	104	89
April.....	29	316,438	89,847,346	2,994,911	789,468	117	89
May.....	30	276,591	81,594,345	2,632,076	751,932	88	85
June.....	30	311,702	91,952,090	3,065,069	807,190	97	56
July.....	31	384,710	110,449,450	3,562,885	909,244	127	128
August.....	31	367,113	108,298,335	3,498,494	822,526	114	116
September.....	30	337,826	99,658,670	3,321,955	737,130	110	118
October.....	31	327,029	96,673,555	3,118,501	880,723	120	122
November.....	30	316,866	84,086,982	2,802,899	780,457	96	96
December.....	31	305,853	86,302,219	2,771,039	745,675	87	89
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	363	3,726,853	1,052,782,483	2,884,336	9,432,914	1,237	1,189

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Operations of the Auxiliary Works at Roxborough, for the year 1878.

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 & cylinder oil.
	Days.				Pounds.		Pounds.	Quarts.
January.....	31	19,160	287,400	9,271	29,120	4	1½
February.....	28	15,701	235,515	8,411	22,400	4	1½
March.....	31	18,320	274,800	8,865	31,380	4	1½
April.....	30	16,731	250,965	8,365	20,160	4	1½
May.....	31	20,960	314,400	10,142	22,400	4	1½
June.....	30	17,420	261,300	8,710	17,920	4	1½
July.....	31	22,071	331,065	10,679	20,160	4	1½
August.....	31	16,630	249,450	8,046	11,200	4	1½
September.....	30	14,925	223,875	7,462	17,920	4	1½
October.....	31	21,450	321,750	10,379	6,720	4	1½
November.....	30	19,626	294,390	9,813	24,640	4	1½
December.....	31	17,210	258,150	8,324	6,720	4	1½
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	365	220,204	3,303,060	9,050	230,720	48	18

Operations of the Chestnut Hill Works for the year 1878.

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 oil.
	Days.				Pounds.	Pounds.	Quarts.
January.....	31	231,600	4,110,900	132,609	56,000	31	5½
February.....	28	217,200	3,855,700	137,700	52,080	28	5½
March.....	31	251,400	4,459,850	143,855	64,720	31	8
April.....	30	275,400	4,888,350	162,945	70,560	45	8
May.....	31	353,000	6,265,750	202,121	75,600	46½	8
June.....	30	373,800	6,634,950	221,165	81,760	30½	8
July.....	31	577,800	10,255,950	330,837	111,410	62	15½
August.....	31	540,600	9,595,650	309,537	104,160	62	15½
September.....	30	468,000	8,307,000	276,900	96,320	60	15
October.....	31	455,400	8,083,350	260,753	100,800	62	15½
November.....	30	312,000	5,538,000	184,600	89,600	60	15
December.....	31	353,400	6,272,850	202,350	80,640	62	15½
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	365	4,409,600	78,267,900	214,433	983,680	580	134½

Operations of the Frankford Works for the year 1878.

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							
February							
March							
April	19	297,678	97,340,706	3,244,690	326,904	45¼	23
May	12	184,669	60,386,763	1,917,960	202,001	24	20
June	14	226,239	73,980,153	2,466,015	229,468	32	5
July	13	255,028	83,394,156	2,690,134	307,322	33	16
August	21	147,064	15,038,682	485,118	247,612	21	8
September	24	741,401	58,199,978	1,999,990	201,346	36	6
October	15	443,600	34,822,600	1,445,890	193,666	34	8
November	26	466,520	36,621,820	1,220,727	286,457	35	8
December	31	930,000	73,005,000	2,355,000	386,504	50	8
	Total.	Total.	Total.	Average.	Total.	Total.	Total.
	175	3,692,199	532,769,858	2,090 000	2,471,286	310¾	102

Total of water pumped for each month during the year 1878.

Months.	Chestnut Hill Works.	Roxborough Works.	Roxborough Auxiliary.	Delaware Works.	Belmont Works.	Schuylkill Works.	Frankford Works.	Fairmount Works.	Total for all the Works.	Percentage of consumption.	Average per day.	Highest number of gallons in one day.	Lowest number of gallons in one day.
January.....	4,110,900	77,920,710	287,400	121,434,876	277,510,275	36,050,970	.....	838,682,114	1,355,997,245	85	43,741,846	51,397,342	37,668,306
February....	3,855,300	47,235,356	235,515	104,720,629	255,122,553	2,094,750	.....	787,537,111	1,200,801,214	76	42,885,757	48,906,765	38,130,333
March	4,459,850	78,763,425	274,800	149,962,543	292,011,087	1,323,000	.....	910,564,377	1,437,349,082	90	46,366,099	51,606,000	38,801,000
April	4,888,350	89,847,346	250,965	160,574,025	306,132,039	15,944,520	97,340,706	939,470,480	1,614,448,431	101	53,814,947	58,708,000	48,132,000
May	6,265,750	81,594,345	314,400	124,355,725	340,674,400	93,467,130	60,386,763	965,535,929	1,672,594,442	105	53,954,659	62,073,000	46,664,000
June	6,634,950	91,952,090	261,300	161,831,414	375,609,232	112,897,870	73,980,153	892,691,580	1,715,858,639	108	57,195,287	67,422,725	41,437,498
July	10,255,950	110,449,450	331,065	194,302,553	423,068,087	579,960,750	83,394,156	507,737,241	1,909,499,252	120	61,596,750	71,708,153	49,517,559
August.....	9,595,650	108,293,335	249,450	172,581,158	380,419,862	576,078,380	15,038,682	475,272,425	1,737,533,942	109	56,049,482	69,605,535	46,962,806
September..	8,307,000	99,658,670	223,875	235,965,282	351,483,748	661,049,280	58,199,976	366,768,089	1,781,655,922	112	59,388,530	75,002,246	48,669,602
October	8,083,350	96,673,555	321,750	317,444,319	413,850,085	463,761,080	34,822,600	348,639,391	1,682,996,130	106	54,290,197	63,905,626	42,342,990
November..	5,538,000	84,086,982	294,000	227,335,320	353,476,275	301,711,420	36,621,820	504,880,460	1,513,944,667	95	50,464,822	67,472,302	41,759,754
December...	6,272,850	86,302,219	253,150	162,586,535	307,179,495	58,261,530	73,005,000	785,119,587	1,478,985,366	93	47,709,205	60,183,670	36,998,864
	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Grand total.	Av.	Average.	Average.	Average.
	78,267,900	1,052,782,483	3,303,060	2,133,094,379	4,076,537,188	2,902,600,680	532,789,856	8,322,288,784	19,101,664,332	100	52,333,326	62,282,222	38,997,726

Amount of water pumped by all the Works from 1854 to 1878, inclusive, in U. S. gallons.

YEAR.	FAIRMOUNT.		DELAWARE.		SCHUYLKILL.		TWENTY-FOURTH WARD AND BELMONT.		ROXBOROUGH AND GERMANTOWN.		CHESTNUT HILL.		FRANKFORD.		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 water pumped.	Daily average.	Total for all the works.	Total daily average.
1854	2,286,422,222	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	3,050,797,730	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	18,738,163
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	20,399,197
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							7,942,886,423	21,733,933
1863	5,586,712,091	15,306,060	1,182,539,680	3,239,835	2,203,769,280	6,037,724	525,754,090	1,449,422							9,498,775,141	26,024,041
1864	5,970,801,329	16,313,665	1,099,884,060	2,990,558	1,725,444,660	4,714,340	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	2,005,938,484	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	1,297,935,060	1,172,425	1,500,248,454	4,356,845	677,717,190	1,856,759	177,104,200	485,217					10,863,421,498	29,762,798
1868	8,724,530,911	21,024,948	705,442,350	1,927,438	2,337,365,642	6,386,245	727,824,780	1,988,592	19,015,200	519,167					11,985,178,883	32,746,390
1869	7,480,611,069	20,619,482	1,042,780,453	2,856,934	2,735,569,020	7,494,709	928,561,494	2,544,004	218,229,800	597,890					12,414,752,336	34,013,020
1870	8,134,985,170	22,287,631	1,186,131,144	3,219,674	3,003,737,166	8,229,417	*850,011,192	2,328,798	227,946,600	624,511					13,492,811,272	36,720,030
1871	8,821,728,593	24,169,065	1,007,378,521	2,759,941	2,201,294,172	6,030,943	1,054,210,990	2,888,249	413,737,205	1,133,664					13,498,399,481	36,981,916
1872	7,366,632,573	20,127,411	1,474,531,940	4,028,773	2,223,287,070	6,074,555	1,466,756,728	3,980,210	251,811,050	1,417,517					13,040,018,461	35,628,465
1873	7,177,538,594	23,883,667	1,364,109,884	3,737,287	1,508,295,800	4,132,317	1,959,966,670	5,369,772	673,287,495	1,844,623					14,223,198,443	38,967,667
1874	7,749,007,798	21,230,158	1,568,518,765	4,269,914	1,536,505,220	4,209,603	2,969,227,504	8,134,870	720,165,810	1,973,057					14,553,425,097	39,817,603
1875	7,911,234,254	21,902,012	1,839,190,470	5,038,878	1,356,295,950	3,715,879	3,055,507,870	8,371,254	618,339,525	2,242,026	33,592,000	92,633			15,097,160,669	41,362,082
1876	8,547,163,024	23,352,906	2,011,301,489	5,495,359	2,179,733,840	5,955,556	3,748,051,929	10,242,218	935,792,907	2,556,565	50,754,860	138,674			17,473,308,039	47,741,279
1877	9,482,419,433	26,015,985	2,149,106,828	5,865,390	1,729,810,384	6,297,697	3,486,809,917	9,594,170	960,670,560	2,648,008	58,427,850	158,912			17,817,141,792	48,983,958
1878	8,322,288,784	22,800,791	2,133,094,379	5,844,000	2,902,600,680	7,965,070	4,076,537,188	11,170,000	1,056,085,543	2,893,386	78,267,900	214,433	532,789,858	2,090,000	19,101,664,332	52,333,326

* 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.

§ The Germantown Works were abandoned September 30, 1872.

DISTRIBUTION
OF THE
WATER DEPARTMENT
FOR THE
YEAR 1878.

DISTRIBUTION.

The Roxborough pumping main was provided for from the Frankford loan, by Ordinance of July 9th, 1877. These pipes were on the ground in the latter part of 1877, and the laying was completed early in 1878, and water passed through on the first of June. The benefit of this long needed main was immediately felt in the reduced frictional head, and permitted the running of both engines. The Department was enabled to extend somewhat further the water supply, temporarily relieving high parts of the City, that can at present be reached only from these works, and in so far to reduce the area supplied by the overtaxed works at Belmont.

4,117 feet of thirty-inch pipe, with 799 feet of twenty-inch connections, were laid at Roxborough, of which 4,000 feet of thirty-inch is pumping main.

From Frankford loan, by Ordinance of June 21st, 1878, a twenty-inch main was authorized to be laid on Twenty-first street from Spruce to Arch, a distance of 2,706 feet. The pipe has been laid and connected with the service pipes at Spruce, Locust, Walnut, Sansom, Chestnut, and the north and south sides of Market streets.

It is contemplated to continue this main to Fairmount reservoir and deliver the water direct to the high ground in the western part of the old City proper.

1,320 feet of twenty-inch pipe was laid on Oxford pike, from Comly to Devereaux street, to connect the Frankford pumping and distributing mains.

In addition to these large mains, 52,708 feet of pipes of various sizes have been laid, making a total during the year 1878, of 61,650 feet, or eleven miles 3,570 feet. This does not include new pipes used for repairs, relays, and connections at intersections.

The relays amounted to 3,651 feet, principally caused by the building of main sewers. 1,151 feet of small pipes were removed and larger substituted.

By Ordinances passed during 1878, 37,351 feet of pipes were directed to be laid.

Ordinances on our books at the end of 1878 amounted to 181,422 feet.

The Department has endeavored to relieve, as far as possible, all places suffering from an insufficient supply of water. Twenty dead-ends and thirty-one intersections have been connected, chiefly in the second district.

The eighteen-inch pumping main from the Delaware Engine House has been connected with the distribution, at Sixth and York, Sixth and Cumberland, and at Fourth and Susquehanna streets, and gives great relief to the people east of Sixth street in the vicinity of these connections. On July 9th, the Roxborough water was supplied to a small section east of German town road, and south of Lehigh avenue, a high part of the City that has been complaining for several years.

A small section between Broad and Thirteenth streets, and from Montgomery to Susquehanna avenues, has been supplied from Belmont.

Broad street, south of Poplar, has been temporarily relieved by aid of a stand pipe attached to the pumping main at Spring Garden reservoir.

To relieve Belmont, a twelve-inch pipe was laid on Ridge avenue, from Thirty-third to Woodford street, connecting with the Roxborough six-inch supply pipe at that point, and on August 20th, that district west of the Connecting Railroad was thrown into the Roxborough distribution.

In the old sections of that part of the City south of South street are a large number (38,000 feet) of pipes less than four

inches in diameter. With few exceptions these were laid previous to consolidation, and are now almost closed by rust and sediment. During the Summer, by examination, it was found that on some days of the week there was just cause for complaint of a short supply of water. Upon some streets there was no pressure whatever, while on others but a few pounds were indicated. This, besides the inconvenience, is dangerous in case of fire. To give relief these small pipes should be removed, and larger ones substituted.

The ordinance, which applies to the old City, directing the Chief Engineer to relay water-pipes in streets about to be repaved, should be made to include all sections of the City.

Bridesburg is supplied by a six-inch pipe on Richmond street, connecting with the eighteen-inch pumping main at Otis street. It is about four miles in length, and from loss of head due to friction, and the draught from the numerous openings, very little water reaches this place. To relieve them it is proposed to lay a twelve-inch pipe on Wheatsheaf lane, from Frankford road to Richmond street—a distance of 5,160 feet—and supply from the Frankford Works.

To give permanent relief to the people on Broad street, south from Poplar, it will be necessary to lay a six-inch pipe on both sides of Broad, from Poplar to Fairmount avenue, and supply from Belmont.

During the Summer, complaints are received from a section of the City south of South street, west of Broad, more especially in the neighborhood of the Naval Asylum. The sixteen-inch main on South street, now the termination of the Fairmount distribution, by connecting it with the thirty-inch main at South and Broad streets, can be made the beginning of the Corinthian avenue distribution to that part of the City south of South street, now depending on the twenty-inch pipe on Washington avenue for its principal supply.

A scarcity of water is also frequently felt along and outside of the line of the Belmont supply, between Spring Garden street on the south and Susquehanna avenue on the north, east from Broad street to Ninth street, and west on Spring Garden street from Broad to Twenty-fifth streets. To relieve this section it is proposed to lay a thirty-inch main on Jefferson street, from Broad to Ninth, and north on Ninth to Susquehanna avenue, and to connect the same with the eighteen-inch pumping and supply mains from the Delaware Works. With suitable connections this will give relief.

The sixteen-inch pipe on Twentieth street, and a ten-inch on Twenty-second street, should be continued of the same sizes to Callowhill street, and at Spring Garden connected with the ten-inch pipe, thus increasing the supply between Callowhill and Spring Garden streets, west of Broad street.

The twenty-inch main on Sixteenth street should be continued from Spring Garden to Callowhill streets. It has but two connections—a twelve and a six-inch pipe—in use at present.

There is on Germantown road a ten-inch pipe connected with the eighteen inch supply main on Norris street by a six-inch pipe, which is only about one-third of its area. It is proposed to lay an additional pipe of twelve inches diameter on Fifth street to connect this ten-inch with the eighteen-inch supply main.

Vine street is the dividing line on the north, between the Fairmount and Corinthian avenue distributions. By making connections with the twenty-inch supply main on Callowhill street, at Sixteenth, Seventeenth, Eighteenth, and Nineteenth streets, the Fairmount distribution could, with great advantage, be carried north to Callowhill street.

DISTRIBUTION.

SERVICE AND SUPPLY MAINS LAID IN 1878.

FIRST DISTRICT.

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

Street.	Location.	Size. Inches.	Distance Feet.
Dorrance,	From Wharton to Lawrence, - -	6	316
Dutton,	" Reed (north), - -	6	255
Groves,	" Wharton (south), - -	6	355
Hicks or Newbold.	" Mifflin to Moore, - -	6	450
Lawrence,	" Dorrance to Ward, - -	6	126
Long,	" Snyder to McKean, - -	6	418
McClellan,	" Fifth to Sixth, - -	6	444
Mercy or Whisner,	" Tenth to Twelfth, - -	6	903
Mifflin,	" Fifteenth to Sixteenth, - -	6	429
Moore,	" " " - -	6	448
Reed,	" Twelfth to Thirteenth, - -	6	448
Twelfth,	" Cantrell (south), - -	6	180
Ward,	" Wharton to Lawrence, - -	6	316
Pipe used for fire plugs, new locations, - -	- -	4	115
Total number of feet of new pipe, - -			<u>5,203</u>
Number of feet of new 4-inch pipe, 115			
" " " 6 " "	5,088		
			<u>5,203 feet.</u>
Pipe used for repairs, - -	- -	3	2
" " - -	- -	4	172
" " - -	- -	6	70
" " - -	- -	8	4
			<u>248</u>

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.
Budd,	From Spring Garden to Baring, -	6	452
Chestnut,	" 43 feet E. of Forty-fourth to 92 feet E. of Forty-fifth, -	8	419
Cuthbert,	" Twenty-second to Twenty-third,	6	336
"	" " "	4	3
Elm,	" Fortieth (west), - -	6	166
Forty-third,	" Walnut to Baltimore avenue,	6	1,968
Forty-fourth,	" Chestnut to Walnut, - -	6	565
Forty fifth,	" Market to Walnut, - -	6	1,118
Forty-eighth,	" Sylvan to Oregon, - -	6	811
"	" Haverford to Silverton, -	6	611
Greenway or Sp' field,	" Forty-sixth to Baltimore ave.,	6	653
Johnson,	" Twenty-third to Twenty-fourth,	6	273
Kershaw,	" Fiftieth to Fifty-first, -	6	312
Oregon,	" Lancaster to Lex, - -	6	951
Rockland,	" Thirty-second (east), - -	6	36
Sansom,	" Forty-third to Forty-fifth,	6	837
Silverton,	" Thirty eighth (west), - -	8	219
Sylvan,	" Fortieth (west), - -	6	230
Twenty fourth,	" Chestnut to Johnson, - -	6	200
Thirty-second,	" West side of Union Place to Locust,	6	142
Thirty-sixth,	" Pine to Almshouse, - -	6	639
"	" Market to Sansom, - -	6	833
Vanilla,	" Preston to Forty-first, - -	6	400
Walden,	" Twenty-first to Twenty-second,	6	427
Westminster,	" East house line of Preston to 245 feet west of Forty-third, -	12	1,790
"	" East house line of Preston to 245 feet west of Forty-third, -	6	8
"	" Belmont ave. to Lancaster ave.,	12	240
Twenty-first,	" Spruce to Arch (supply main),	20	2,706
"	" Connections, - - -	16	12
"	" " - - -	12	10
"	" " - - -	6	56
Amount carried forward,	- - - -	-	17,423

Street.	Location.	Size. Inches.	Distance. Feet.
Amount brought forward, - - - -		-	17,423
Fire connections for Penna. R. R. on Thirty-second street, north of Lancaster avenue, - - - -		4	40
Dead ends connected, Holly with Westminster, -		6	18
" " Forty-second with Westminster, -		6	20
" " Brooklyn with Westminster, -		6	51
" " Osage with Forty-third, - -		6	28
" " Sansom with Forty-third, -		6	7
" " Silverton with Forty-eighth, -		6	27
" " Aspen with Forty eighth, -		6	30
" " Elm with Thirty-eighth, -		6	30
" " Walden with Twenty first, -		6	22
" " Burton with Sixteenth, - -		4	4
Pipe used for fire plugs, new locations, - - -		4	160
" " " " - - -		6	18
" crossing Market street at Nineteenth, -		6	54
" " " Twenty-first, -		6	54
Total number of feet of new pipe laid, - -		-	<u>17,986</u>

Number of feet of 4-inch pipe laid,	207
" " 6 " "	12,383
" " 8 " "	638
" " 12 " "	2,040
" " 16 " "	12
" " 20 " "	2,706

17,986 or 3 miles 2,146 feet.

Relaid.

Aurora,	From Raspberry to Vandev eer (form- erly 3-inch), - -	4	84
Cross,	" St. Mary to Cullen, - -	4	96
Cuthbert,	" Eleventh to Twelfth (formerly 3- inch), - - -	6	450
Forty-third,	" Walnut to Sansom, - -	6	52
Lombard,	" Second to Third (formerly 4-inch),	6	567
Pine,	" Delaware avenue (west), -	6	68
Second,	" Lombard, north (formerly 4-inch),	6	50
Amount carried forward, - - - -		-	<u>1,367</u>

Street.	Location.	Size. Inches.	Distance. Feet.
Amount brought forward,	- - - - -	-	1,367
Thirty-second,	From South of Spring Garden to Rock- land (formerly 4 inch),	6	347
Plug connections,	- - - - -	4	15
Total relaid,	- - - - -		<u>1,729</u>

Intersections Connected.

Sansom and Sixteenth,	- - - - -	6	12
“ and Seventeenth,	- - - - -	6	12
“ and Nineteenth,	- - - - -	6	12
“ and Twenty-first,	- - - - -	6	12
“ and Thirteenth,	- - - - -	6	10
Cherry and Juniper,	- - - - -	6	12
Locust and Juniper,	- - - - -	6	12
Filbert and Twenty-first,	- - - - -	6	6
“ and Twentieth,	- - - - -	6	8
Lombard and Twentieth,	- - - - -	6	8
“ and Twenty-first,	- - - - -	6	12
Locust and Quince,	- - - - -	6	4
“ “	- - - - -	4	4
Naudain and Twenty-fourth,	- - - - -	6	10
Westminster and Markoe,	- - - - -	6	4
Hamilton and Thirty-fourth,	- - - - -	6	8
“ and Thirty-sixth,	- - - - -	6	9
“ and Thirty-seventh,	- - - - -	6	9
“ and Thirty-eighth,	- - - - -	6	9
Second and Market, north and south sides,	- - - - -	6	19
“ and Union,	- - - - -	6	8
“ and New,	- - - - -	6	8
“ and Race,	- - - - -	6	12
Third and New,	- - - - -	6	4
“ and Market, north and south sides,	- - - - -	6	10
Water and Market, north side,	- - - - -	6	6
Forty-second and Baltimore avenue,	- - - - -	6	12
Forty-third and Ludlow,	- - - - -	6	12
Thirty-fifth and Race,	- - - - -	...	.....
Thirty-ninth and Story,	- - - - -	...	.....
Total,	- - - - -		<u>264</u>

Lowered.

Street.	Location.	Size. Inches.	Distance. Feet.
Westminster avenue, east of Preston street,	- -	4	24
Preston street, south of Westminster avenue,	- -	6	24
Total,	- - - - -		48
Pipe used for repairs,	- - - - -	4	82
" "	- - - - -	6	51
" "	- - - - -	8	12
" "	- - - - -	10	5
" "	- - - - -	12	12
" "	- - - - -	16	4
Total,	- - - - -		166

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.
Amber,	From Somerset to Hunts lane,	6	188
American, east side,	" Norris street (south),	6	246
Aubrey,	" Randolph to Sixth,	6	243
Boudinot,	" Cambria street (south),	6	126
Cambria,	" Rohrer street (east),	6	136
Fifth,	" Clearfield to Butler,	6	3,750
Franklin,	" Cumberland (south)	6	342
Kerr,	" Lawrence to Orchard,	6	129
Lawrence,	" York to Huntingdon,	6	1,100
Leamy,	" Kensington av, to Lehigh,	6	524
Memphis,	" Palmer to Deal,	6	319
Orianna,	" Huntingdon to Lehigh,	6	550
Orleans,	" Emerald to Kensington av.,	6.	954
Paethorpe,	" Lehigh to Cambria,	6	1,100
Reese,	" Huntingdon to Lehigh,	6	550
Rosehill,	" Indiana street (south),	6	186
Somerset,	" Frankford road to Garnet,	6	924
Amount carried forward,	- - - - -		11,367

Street.	Location.	Size. Inches.	Distance. Feet.
Amount brought forward,	- - - -	-	11,367
Third,	From Lehigh to Cambria, - -	6	1,100
Tulip,	" Deal to Montgomery, - -	6	270
Willow,	" St. Johns street (west), - -	6	141
Connection, between the Frankford pumping and supply mains, on Oxford pike, from Comly to Devreaux, - - - -	- - - -	20	1,320
Connection, between the 36-inch pumping, and the 30- inch supply main at Sixth street and Lehigh avenue, - - - -	- - - -	30	72
Stand pipe at Lehigh reservoir, - - - -	- - - -	30	58
Pumping main for small engine at Frankford Engine House, - - - -	- - - -	12	97
Extending drain pipe at Delaware Engine House, - -	- - - -	8	54
Connections, to 18-inch pumping main at Sixth and York,	- - - -	6	37
" Sixth and Cumberland, - - - -	- - - -	6	48
" Fourth and Susquehanna, - - - -	- - - -	6	48
Fire connection, Stewart, Ralph & Co.'s Mills, Mascher street, north of Putnam, - - - -	- - - -	4	19
Dead-end connection, Salmon with Allegheny, - - -	- - - -	6	12
Pipe used for fire plugs, - - - -	- - - -	4	205
Total number of feet of new pipe laid, -			14,848

Number of feet of 4-inch pipe laid,	224
" " 6-inch "	13,023
" " 8 inch "	54
" " 12-inch "	97
" " 20-inch "	1,320
" " 30-inch "	130

14,848 or 2 miles 4,288 feet.

Relaid.

Garnet, across Somerset, - - - -	6	56
Indiana, from Hart Lane to Rosehill, - - - -	6	336
Palmer, from Girard to Memphis, - - - -	6	1,096
Fire plug connections, - - - -	4	21
Total, - - - -	-	1,509

Street.	Location.	Size. Inches.	Distance. Feet
Pipe used for repairs,	- - - - -	4	83
“ “	- - - - -	6	137
Total,	- - - - -		220

FOURTH DISTRICT.

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

Street.	Location.	Size. Inches.	Distance. Feet.
Alder,	From Master to Jefferson, - - -	6	500
Belleview,	“ Twenty-first to Twenty-second,	6	465
Dauphin,	“ Twelfth to Broad, - - -	10	1,078
“	“ Philadelphia to Sixteenth, - -	6	223
Fletcher,	“ Twenty-sixth, east - - -	6	342
Huntingdon,	“ Twenty-second to 234 feet west of Twenty-fifth, - - -	6	1,624
Montgomery,	“ Sydenham, east, - - -	6	94
Nassau,	“ Twenty fourth to Twenty-fifth,	6	459
Redner,	“ Twenty-fourth to Twenty-fifth,	6	455
Ridge,	“ Thirty-third to Woodford, - -	12	845
Ringgold,	“ North College avenue to Thompson,	6	344
Seybert,	“ Twenty-third to Twenty-fourth,	6	452
Sixteenth,	“ Cambridge to Girard, - - -	6	238
Susquehanna,	“ Twenty-sixth to 206 feet west of Thirty-first, - - -	6	2,440
Thompson,	“ Twenty-third to Twenty-fourth,	6	460
Twenty-seventh,	“ Brown to Pennsylvania avenue,	6	570
“	“ Dauphin to Herman, - - -	6	265
Warnock,	“ Somerset to Somerville, - -	6	313
York,	“ Glenwood to 153 feet west of house line of Twentieth street, - - -	6	665
Connection of No. 6 Spring Garden pumping main to Belmont supply main at Thirty-third and Master,	- - -	36	11
Do do do	- - -	30	34
Connection to 48-inch main at Spring Garden Reservoir, - - -	- - -	36	14
Extension of No. 6 pumping main at the Spring Garden Reservoir (stand-pipe), - - -	- - -	30	12
Extension of No. 5 pumping main at do., - - -	- - -	30	58
Amount carried forward,	- - - - -		11,961

Name.	Location.	Size.	Distance.
		Inches.	Feet.
Amount brought forward, -	-	-	11,961
Dead ends connected,	Garnet with Jefferson,	6	10
" " "	Opal " "	6	10
" " "	Gratz " "	6	6
" " "	Ingersoll with Twenty-fourth,	6	26
" " "	North College ave. with 24th,	6	26
" " "	Spring Garden with Broad, N. E.,	6	6
" " "	Woodford with Ridge,	6	63
" " "	Franklin with Norris,	6	32
" " "	Sydenham with Montgomery,	6	24
Pipe used for fire-plugs, new locations, -	-	4	230
Total number of feet of new pipe laid, -	-	-	<u>12,394</u>
Number of feet of 4-inch pipe,	230		
" " 6-inch "	10,112		
" " 10-inch "	1,078		
" " 12-inch "	845		
" " 30 inch "	104		
" " 36-inch "	25		

12,394 or 2 miles 1,834 feet.

Relaid.

Spring Garden engine-house pumping main, -	-	36	32
Thirtieth, south of Girard avenue, -	-	10	108
" and Cambridge, -	-	6	6
" " " -	-	10	20
" " Stiles, -	-	10	30
Twenty-seventh and Brown, -	-	6	87
" " Parrish, -	-	6	42
Twenty fourth and Biddle, -	-	4	33
Alder and York, -	-	6	55
Total relaid, -	-	-	<u>413</u>
Connection at intersection of Park avenue and Berks, -	-	6	47
Pipe used for repairs, -	-	3	9
" " -	-	4	161
" " -	-	6	117
" " -	-	8	4
" " -	-	18	4
" " -	-	30	4

346

Street.	Location.	Size. Inches.	Distance. Feet.
Lowered Thompson, from Thirty-first to Thirty-second,		18	630
" " " " "		36	325
" Thirty-third and New York R. R.,	- -	6	50
" " " " "	- -	3	140
" Thirty-third and Columbia,	- -	3	342
Total,	- - - -	-	<u>1,487</u>

GERMANTOWN.

Iron Pipes laid in Germantown District.

Street.	Location.	Size. Inches.	Distance. Feet.
Butler,	From York Pike to Germantown ave.,	6	1,140
Eighteenth,	" Germantown avenue to Cayuga,	6	662
Juniata,	" Germantown avenue to Bristol,	6	709
"	" Germantown avenue to Wayne,	6	531
Lafayette,	" Germantown avenue to Adams,	6	669
Willow avenue,	" Armat (north),	6	408
Connection at Chestnut Hill Works,	- - -	6	20
" " " - - -	- - -	3	99
Pipe used for fire plugs, new locations,	- - -	4	139
Total number of feet of new pipe laid,	- - -	-	<u>4,377</u>

Number of feet of 3-inch pipe,	99
" " 4 " "	139
" " 6 " "	4,139
	<u>4,377</u>

Lowered Chew, from Chelton avenue (southwest),	-	6	86
" " " " (fire plugs),	-	4	24
Armat, west of Cumberland,	- - -	6	100
Armat, east of Cumberland,	- - -	4	75
Cumberland, south of Armat,	- - -	6	94
			<u>379</u>
Pipe used for repairs,	- - - -	6	40
" " - - - -	- - - -	4	64
			<u>104</u>

MANAYUNK.

Iron Pipes laid in Manayunk District.

Street.	Location.	Size. Inches.	Distance. Feet.
Fleming,	From Levering (south), - -	6	225
Keely's avenue,	" Green lane to Centre, - -	6	468
Seville,	" Terrace to Cresson, - -	6	543
Thirty-fifth,	" Bowman (northwest), - -	6	180
Pumping main,	" Roxborough engine house to 'reservoir, - - -	30	4,117
Connections to pumping main, -	- - -	20	799
" " " " - - -	- - -	12	12
Main, from Ridge avenue to tanks at Manatawna, -	- - -	12	372
Fire connection at Campbell's mill, -	- - -	4	12
" Eagle mills, -	- - -	4	24
" Dobson's mill, -	- - -	4	48
" Rice & Bean's mill, -	- - -	4	12
Pipe used for fire plugs, -	- - -	4	30
			6,842

Number of feet of 4-inch pipe,	126
" " 6 " "	1,416
" " 12 " "	384
" " 20 " "	799
" " 30 " "	4,117
6,842 or 1 mile 1,574 feet.	

Pipe used for repairs, -	- - -	4	19
" " -	- - -	6	18
" " -	- - -	12	3
" " -	- - -	30	12
			52

Recapitulation of pipe laid in the several districts during the year 1878.

Districts and Wards.	3-inch.	4-inch.	6 inch.	8-inch.	10-inch.	12-inch.	16-inch.	18-inch.	20-inch.	30-inch.	36-inch.	Total.
First District, 1, 2, 3, 4, 26, and 30.....	115	5,088										5,203
Second District, 5, 6, 7, 8, 9, 10, 24, and 27.....	207	12,383	638	2,040	12	2,700						17,986
Third District, 11, 12, 16, 17, 18, 19, 23, 31, and part of 25.....	224	13,023	54	97	1,320	130						14,948
Fourth District, 13, 14, 15, 20, 29, and part of 28.....	230	10,112		1,078	845					104	25	12,394
German town District, 22 and part of 25 and 28.....	99	4,139										4,877
Manayunk District, 21 and part of 28.....	126	1,416			384				799	4,117		6,842
Totals.....	99	1,041	46,161	682	1,078	3,366	12		4,825	4,351	25	61,650
Pipe used for repairs.....	11	581	433	20	5	15	4	4		16		1,089
Pipe relaid.....		249	3,212		158						32	3,651
Pipe used for connecting at intersections.....		4	307									311
Pipe lowered.....	482	123	354					630			325	1,914
Totals.....	493	957	4,300	20	163	15	4	634		16	337	6,965

	Feet.	Miles.	Feet.
Pipe as per last report.....	3,752,308	710	3,608
Pipe laid during 1878, excluding pipe used for repairs, relays, &c.....	61,650	11	3,570
Total.....	3,813,958	722	4,178

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	2,064
*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
Omitted in 1876.	...	134
1877	16	144
1878	11	3,570
Total . . .	722	1,798

*Purchased.

Purposes for which pipes were laid during the year 1878.

	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	36-inch.	Totals.
On streets for supply.....		3	45,378	638	1,078	2,875					40,972
Connections to close dead ends.....		4	556								560
Connections for fire-plugs.....		879	18								897
Connections for fire purposes.....		155									155
Pumping and supply mains, with their connections.....			189			491	12	4,825	4,351	25	9,893
Drains and connections at Works.....	99		20	54							173
Total.....	99	1,041	46,161	692	1,078	3,366	12	4,825	4,351	25	61,650

Statement of the number of fire plugs in the City, by Districts and by Wards, during 1878.

	First District.					Second District.				Third District.			Fourth District.			German-town.		Manayunk.		Total.												
	Wards.					Wards.				Wards.			Wards.			Wards.		Wards.														
	1	2	4	26	30	Total.	9	10	24	27	Total.	18	19	25	Total.	15	28	29	Total.		22	25	Total.	21	28	Total.						
Prior to 1878.....						982					1499					1625					999					356					232	5693
During 1878.....	5	1	1	6	1	14	1	1	7	3	12	1	4	14	19	1	13	5	19	6	2	8	4	1	5					77		
Totals.....						996					1511					1644					1018					364					237	5770

Number of attachments for fire purposes previously reported.....	172
Made during 1878—Second District.....	1
Made during 1878—Third District.....	1
Made during 1878—Germantown District.....	1
Made during 1878—Manayunk District.....	4
	—
	7
Total.....	179

*Number of holes drilled for making new attachments to
public mains during the year 1878.*

Months.	$\frac{1}{2}$ -inch diam-eter.	$\frac{5}{8}$ -inch diam-eter.	$\frac{3}{4}$ -inch diam-eter.	1-inch diam-eter.	Totals.	Shut-offs.
January.....	64	6	1	.....	71	26
February.....	50	4	.....	.....	54	15
March.....	285	7	1	2	295	23
April.....	395	3	3	4	405	26
May.....	313	6	2	1	322	33
June.....	298	11	3	1	313	25
July.....	343	23	1	4	371	48
August.....	323	6	4	4	337	48
September.....	424	23	6	4	457	59
October.....	390	16	4	2	402	63
November.....	339	18	7	6	370	36
December.....	115	1	.....	2	119	43
Totals.....	3,329	124	33	30	3,516	445

Table of attachments in Wards and Districts.

Wards.	$\frac{1}{2}$ inch diam-eter.	$\frac{5}{8}$ -inch diam-eter.	$\frac{3}{4}$ inch diam-eter.	1-inch diam-eter.	Totals.	Shut-offs.
First District, 1, 2, 3, 4, 26, and 30.....	707	4	1	2	714	114
Second District, 5, 6, 7, 8, 9, 10, 24, and 27.....	666	70	17	12	765	126
Third District, 11, 12, 16, 17, 18, 19, 23, 31, and part of 25.....	748	5	7	10	770	75
Fourth District, 13, 14, 15, 20, 29, and part of 28.....	901	39	7	4	951	78
Germentown, 22, and part of 25 and 28....	162	5	.....	2	169	13
Maneyunk, 21 and part of 28.....	145	1	1	.....	147	39
Totals.....	3,329	124	33	30	3,516	445

Repairs to mains, stops, and plugs during 1878.

Districts.	To mains.	To stops.	To plugs.
First.....	97	163	338
Second.....	32	339	307
Third.....	119	223	357
Fourth.....	133	395	530
Germentown.....	13	120	47
Manayunk.....	10	14	31
Total.....	404	1,254	1,610

Account of new stops and fire-plugs for 1878.

Districts.	No. of stops.	No. of plugs.
First.....	13	14
Second.....	76	12
Third.....	63	19
Fourth.....	48	19
Germentown.....	20	8
Manayunk.....	15	5
Totals.....	234	77

Number of valves raised in the different districts during the year 1878.

Districts.	3 inch.	4-inch.	6-inch.	8-inch.	10 inch.	12-inch.	16-inch.	20-inch.	30-inch.	Totals.
First.....	3	3	19	.....	2	.....	.....	.....	.....	27
Second.....	24	4	34	.....	1	1	.....	1	.....	65
Third.....	.....	2	10	.....	.....	.....	.....	.....	.....	12
Fourth.....	.....	13	35	.....	.....	.....	.....	.....	1	49
Germentown.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Manayunk.....	.....	.....	2	.....	.....	.....	.....	.....	.....	2
Total, 1878.....	27	22	100	.....	3	1	.....	1	1	155
" 1877.....	12	6	50	.....	1	.....	.....	1	.....	70
" 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
Total for five years.....	72	132	430	10	25	6	7	4	3	689

Account of service pipes laid during 1878, and the receipts therefor.

	Pipe laid.	Frontage in feet.	Frontage in dollars.	Amount to be paid.	Amount accounted for.
Total feet of pipe laid.....	61,650.00				
Total feet of non-frontage.....	11,678.00				
Balance.....	49,972.00				
Intersections deducted.....	8,284.18				
Balance.....	41,687.82				
Single fronts, charged at \$1 per foot.....		223.00	\$ 223.00		
Double fronts, charged at \$2 per foot.....		40,845.82	81,691.64		
Frontage for 619 feet.....		619.00	1,320.38		
Amount of feet.....		41,687.82			
Amount of frontage.....			\$83,235.02		
Corner allowances deducted.....			7,423.98		
Net amount of frontage to be collected.....				\$75,811.14	
Amount received by Registrar in 1874.....					\$147.05
“ “ “ in 1875.....					14.90
“ “ “ in 1876.....					16.00
“ “ “ in 1877.....					40.00
“ “ “ in 1878.....					35,337.50
Amount sent to lien.....					10,728.40
Amount owned by the City.....					1,934.25
Amount remaining on books.....					27,617.14
Total amount.....					\$75,834.84
Overpaid.....					23.20
Amount.....					\$75,811.14



Receipts from pipe frontage during 1878.

	Balance on books.	Pipe laid, 1877.	Total receipts.
Balance on books December 31, 1877.....	\$39,189 19		
Less, paid in 1876.....	20 00		
Balance.....	\$39,169 19		
Collected by Registrar for pipe laid in 1877.....		\$16,883 01	\$16,883 01
Sent to lien in 1878, for pipe laid in 1877.....		21,495 35	
Owned by the City.....		790 83	
Total.....		\$39,169 19	
Received by Registrar for pipe laid in 1878.....			\$35,337 50
Received by Registrar on deposit, pipe not laid.....			3,411 38
Total receipts for pipe frontage during 1878.....			\$55,631 89

MISCELLANEOUS TABLES.

TABLE A.

Rain Fall at Philadelphia, from Pennsylvania Hospital Reports.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1810.....													32.66
1811.....													34.97
1812.....													39.30
1813.....													35.63
1814.....													43.14
1815.....													34.67
1816.....													27.95
1817.....													36.01
1818.....													30.13
1819.....													23.35
1820.....													39.61
1821.....													32.18
1822.....													29.86
1823.....													41.85
1824.....													38.74
1825.....	0.84	3.26	4.63	.83	1.72	3.59	2.06	3.70	2.61	1.25	1.36	3.72	29.57
1826.....	1.11	2.13	5.80	3.87	.19	4.655	3.68	2.75	2.00	5.83	1.85	1.28	36.145
1827.....	2.86	3.55	1.23	2.83	2.50	2.09	2.97	5.75	7.79	5.91	4.76	3.26	38.50
1828.....	2.05	2.75	3.35	3.82	3.49	2.69	5.33	1.51	4.62	1.39	6.71	.26	37.97
1829.....	5.37	3.75	2.87	4.99	2.68	3.44	4.35	4.61	2.01	2.30	3.97	1.51	41.85
1830.....	1.63	2.06	4.115	1.815	3.75	5.99	4.07	3.87	5.93	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	2.33	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	2.95	1.75	3.47	2.28	7.31	2.91	1.97	1.52	3.69	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	1.449	4.430	1.354	3.091	3.351	5.284	2.399	4.034	5.025	2.951	2.753	40.173
1845.....	3.760	4.738	2.415	2.580	1.599	3.725	2.763	7.298	2.155	2.529	2.500	3.959	40.721
1846.....	4.630	3.330	4.598	2.112	3.444	3.300	4.604	4.272	.249	2.444	4.970	3.457	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	2.348	5.507	35.024
1849.....	.730	2.610	5.470	1.752	3.995	2.195	2.933	6.975	1.404	5.695	2.000	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	54.540
1851.....	1.230	3.110	3.475	4.565	4.817	3.438	2.524	2.555	1.730	3.025	3.356	2.275	35.500
1852.....	2.011	2.710	4.270	6.445	3.034	4.030	4.060	4.400	1.293	2.267	6.055	5.174	45.749
1853.....	1.845	4.440	2.462	3.835	5.173	1.109	6.296	3.088	4.463	3.470	2.320	2.165	40.557
1854.....	2.331	4.203	1.615	7.750	6.935	2.390	3.024	.842	3.798	1.545	2.834	2.910	40.180
1855.....	2.337	2.352	1.684	2.050	2.965	7.949	6.400	2.786	4.000	4.111	2.937	5.428	44.096
1856.....	4.537	1.237	2.232	3.515	2.595	1.986	1.508	6.000	4.014	1.296	2.077	2.937	33.927
1857.....	3.532	.90	1.831	6.786	5.547	7.500	3.915	7.590	1.105	2.690	1.450	5.550	48.286
1858.....	2.595	2.285	1.087	4.640	5.015	4.495	1.345	4.941	1.492	1.842	5.615	4.500	39.852
1859.....	6.675	3.660	6.985	5.610	2.250	6.013	4.071	4.736	7.681	3.132	3.820	3.490	58.123
1860.....	3.225	2.755	1.415	3.800	3.817	2.875	.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	2.0	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	3.200	4.633	49.189
1864.....	1.705	.561	5.170	3.795	6.685	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	3.950	3.960	6.610	56.255
1866.....	3.145	6.615	2.150	2.930	4.680	2.960	2.520	2.1	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	3.829	5.363	3.381	3.62	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	49.911
1875.....	2.380	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	1.990	6.189	2.209	6.223	1.215	7.776	1.210	9.125	3.169	49.323
1877.....	2.893	1.550	5.097	2.962	1.215	5.512	6.196	1.007	3.882	6.963	6.507	1.363	45.147
1878.....	4.566	2.172	3.641	2.541	4.329	4.750	5.313	4.833	1.418	2.391	2.891	4.873	43.718

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.

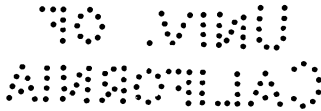


TABLE B.

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

Day of month.	HEIGHT ABOVE THE 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.	17	23	26	21	21	17	19	15	12	21	17	25	-5	1	4	-1	5	-5	-3	-7	-1	-1	-5	3
2.	16	22	25	21	26	19	18	22	13	19	15	25	-6	0	3	-1	4	-4	-4	0	0	-9	-7	3
3.	13	23	26	21	25	18	18	18	15	17	18	34	-9	1	4	-1	3	-4	-4	4	-7	-7	-5	12
4.	14	22	31	19	23	15	19	17	12	18	16	33	-3	0	0	-3	1	-7	-3	-5	-10	-4	-6	11
5.	15	21	29	17	36	14	21	18	12	15	14	29	-7	-1	7	-5	14	-6	-1	-4	-10	-7	-6	4
6.	14	21	35	15	35	13	20	19	25	12	13	27	-3	-1	13	-7	13	-9	-2	-3	-10	-9	-5	4
7.	14	21	26	15	29	17	18	21	20	17	15	26	-3	-1	4	-7	6	-5	-4	-1	-3	-5	-7	4
8.	13	21	24	15	28	12	19	17	12	16	16	25	-9	-1	2	-7	6	-10	-3	-5	-10	-7	-6	3
9.	12	28	24	15	29	17	19	16	17	14	17	24	-10	6	2	-7	2	-5	-3	-6	-5	-6	-5	2
10.	15	42	22	15	29	20	19	15	14	18	16	39	-7	20	0	-7	3	-3	-2	-7	-9	-9	-6	17
11.	37	37	23	20	25	27	20	16	14	12	18	64	15	15	1	-2	2	-2	-2	-6	-8	-10	-4	42
12.	28	31	23	34	24	26	20	16	13	12	16	55	6	9	9	1	12	6	4	-2	-6	-9	-10	33
13.	26	29	34	28	24	23	26	15	16	10	15	41	4	7	12	6	3	1	4	-7	-6	-12	-7	19
14.	36	28	35	25	23	22	24	14	18	13	15	34	14	6	13	3	1	0	2	-8	-4	-9	-7	12
15.	35	27	28	25	23	20	21	16	20	14	15	31	13	5	6	3	1	-2	-1	-6	-2	-8	-7	9
16.	30	26	28	23	22	19	19	17	22	13	14	29	8	4	6	1	0	-3	-3	-5	0	-9	-8	7
17.	28	25	27	23	21	17	17	16	16	15	14	28	6	3	5	1	-1	-5	-5	-6	-6	-7	-6	1
18.	27	25	28	22	19	22	17	16	14	16	16	26	5	3	6	0	0	-5	-6	-8	-7	-6	-4	2
19.	26	24	27	21	17	23	16	15	15	15	13	25	4	2	5	-1	-5	1	-6	-7	-7	-7	-9	3
20.	25	24	25	2	18	22	16	15	13	12	22	25	3	2	3	-2	4	0	-6	-7	-9	-10	0	3
21.	25	23	24	21	24	19	15	14	12	15	19	24	3	1	2	-1	-2	-3	-7	-8	-10	-7	-3	2
22.	26	36	24	20	27	14	17	14	12	16	19	26	4	16	2	-2	5	-8	-5	-8	-10	-6	-3	4
23.	26	48	24	18	22	23	14	14	14	20	19	28	4	26	2	-4	0	1	-8	-8	-8	-9	-3	6
24.	24	36	23	18	19	24	14	14	11	19	22	25	2	16	1	-4	-3	2	-8	-8	-11	-3	0	3
25.	20	34	23	18	18	22	15	13	12	19	22	18	-2	12	1	-4	-4	0	-7	-9	-10	-3	0	4
26.	26	31	22	22	18	20	14	15	12	15	19	21	4	9	0	0	-4	-2	-8	-7	-10	-7	-3	-1
27.	24	29	22	23	18	17	14	16	12	17	16	22	4	0	1	-4	-5	-8	-6	-10	-5	-6	0	2
28.	29	27	21	33	15	14	12	15	13	16	26	24	7	5	-1	11	-7	-8	-10	-7	-9	-6	4	2
29.	27	...	21	28	14	15	17	15	11	17	30	23	5	...	-1	6	-8	-7	-5	-7	-11	-5	8	1
30.	24	...	22	28	12	20	20	15	20	17	27	24	2	...	0	6	-10	-2	-2	-7	-2	-5	5	2
31.	25	...	21	...	15	...	15	13	...	18	...	22	3	...	-1	...	-7	...	-7	-9	...	-4	...	0

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 now twenty-two inches above the old comb.

TABLE C.

Table showing the 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.....	3	4	3	3	3							1	17
2.....	2	2	5		3	1	1					4	18
3.....	3	2	2	2	2				1			6	18
4.....	5	1	3		1	1	1				1	3	16
5.....	2	2	2		2	1					1	1	11
6.....	3	2	3	3	1							2	14
7.....	1	2	1		3							2	9
8.....	1										1		2
9.....	1	2	1									1	5
11.....				1								1	2
12.....		1	1	1								2	5
13.....	1		2		1								4
14.....	1				1								2
15.....	1	1											2
16.....		2											2
17.....												1	1
19.....												1	1
20.....		1											1
26.....		1											1
33.....												1	1
42.....												1	1

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CLXI. (Vol. VII.—May, 1878.)

THE FLOW OF WATER IN PIPES UNDER PRESSURE,
BY C. G. DARRACH, C. E., MEMBER OF THE SOCIETY.

In the well known equation for the flow of water in pipes,

$$h'' = \frac{CLmv^2}{2gS} \text{ or } h'' = \frac{4mLv^{2*}}{2gd}$$

the value of “*m*” has been given by various experimenters for straight clean pipes of different diameters, and for different velocities.

The following tables have been deduced from experiments on the pumping mains of the Philadelphia Water Works, and show the effect produced by abrupt bends, check valves, and foul pipe.

The temperature of the water was about 62°, and its weight has been considered as 62.338 lbs. per cubic foot.

**h*'' = friction head in feet.

v = velocity of flow in feet per second.

g = 32 feet.

m = coefficient of flow.

$\frac{S}{C} = \frac{d}{4}$ = hydraulic mean radius in feet.

C = contour of pipe in feet.

S = sectional area.

L = length of pipe in feet.

d = diameter of pipe in feet.

EXPERIMENT NO. 1.—MAY 23, 1878.

Belmont Works—30-inch main, laid in 1869. Engine, "Worthington," 5 per cent. deducted for slip. One curve of short radius. Gauge on main outside check valve.

$$m = \frac{2gh'd}{4Lv^2}$$

30-INCH MAIN, LAID NINE YEARS.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length of pipe.	m.
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction. $H-h$.		
		<i>d.</i>	<i>s.</i>	<i>v.</i>	<i>lbs.</i>	<i>H.</i>	<i>h.</i>	<i>h''</i>	<i>Ft.</i>	
0				0	82.25	190.	190	0.		
8				1.070	84.00	194.04	"	4.04		.03208
9	357.3			1.205	84.25		"	4.62		.02900
10	397.0			1.340	84.50	195.2	"	5.20		.02633
11	436.7			1.475	84.75		"	5.78		.02416
12	476.4			1.610	85.00	196.85	"	6.35	4,100	.02229
13	516.1	30"=2½ ft.	4.91 sq. ft.	1.745	85.25		"	6.93		.02069
14	555.8			1.880	85.50	197.51	"	7.51		.01931
15	595.5			2.015	85.75		"	8.09		.01811
16	635.2			2.150	86.00	198.66	"	8.66		.01703
17				2.285	86.25		"	9.24		.01609

EXPERIMENT NO. 2.—JUNE 1, 1878.

Spring Garden Works—36-inch main, laid 1871. Engine, "Simpson." All curves, 25 feet radius; no checks.

$$m = \frac{2gh'd}{4Lv^3}$$

36-INCH MAIN, SEVEN YEARS OLD.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length.	m.	
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction head. H-h.			
		d.	S.	v.	lbs.	H.	h.	h''	Ft.		
					43.25	100.00					
10	670			1.58	44.78	103.45		3.45		.01791	
11	737			1.74	45.03	104.03		4.03		.01718	
12	804	36''=3 ft.	7.07 sq. ft.	1.89			100 ft.	4.61	3,700	.01673	
13	871			2.05				5.19			.01601
14				2.21				5.77			.01536
15				2.37				6.35			.01466

EXPERIMENT No. 3.—JUNE 1, 1878.

Roxborough Works—20-inch main, laid in 1867. Engine—
 “Worthington,” 5 per cent. deducted for slip. One-quarter
 turn at basin. Gauge on pump.

$$m = \frac{2gh'd}{4Lv^2}$$

20-INCH MAIN, LAID ELEVEN YEARS.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length of pipe.	n.
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction. $H-h$.		
		d.	S.	v.	lbs.	H.	h.	h''	Ft.	
0					135.5	313.0	313.0			
9				2.71	142.75		"	16.75		.01419
10	894.0			3.01	144.	332.64	"	19.64		.01348
11	433.4			3.31	145.25		"	22.52		.01269
12	472.8	20 ins.— $1\frac{3}{8}$ feet	2.18	3.61	146.50	338.42	"	25.42	4.320	.01204
13	512.2			3.91	147.75		"	28.31		.01147
14	551.6			4.21	149.0	344.19	"	31.19		.01093
15	591.0			4.51	150.25		"	34.08		.01033
16	630.4			4.81	151.5		"	36.96		.00986
				5.11	152.75		"	39.84		.00941

EXPERIMENT NO. 4.—JUNE 5, 1878.

Delaware Works—36-inch main, laid in 1871. Engine, "Worthington," 5 per cent. deduction for slip. Gauge on stand-pipe. Curves in pipe made with 25 feet radius, except at the basin, where 90° are made with a T pipe.

$$m = \frac{2gh'd}{4Lv^3}$$

36-INCH MAIN, LAID SEVEN YEARS.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length of pipe.	m.
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction head $H-h$.		
		d.	S.	v.	lbs.	H.	h.	h''	Ft.	
0					51.25	118.4	118.4	0		
9	423			1.000				13.00		.05033
10	470			1.111 ¹				13.28		.04170
11	517			1.222 ²				13.57		.03596
12	564	36 ins. = 3 feet.	7.07 square feet.	1 $\frac{1}{3}$	57.25	132.25		13.86	12.400	.03021
13	611			1.444 ⁴				14.15		.02626
14	658			1.555 ⁵	57.50	132.83		14.44		.02314
15	705			1 $\frac{5}{8}$				14.73		.02055
16	752			1.777 ⁷	57.75	133.40		15.01		.01847
17				1.888 ⁸				15.30		.01667
18				2.000				15.59		.01509

EXPERIMENT NO. 5.—JUNE 6, 1878.

Frankford Works—30-inch main, laid 1876. Engine, "Cramp,"
 5 per cent. deducted for slip. Grade undulating.
 Curves of 25 feet radius.
 4 check valves on main.
 Area of openings in check, 750 square inches.
 Weight of valve, 320 pounds in 1 check.
 Gauge on air vessel. Weight of 4 checks, 1,280 pounds.

$$m = \frac{2gh''d}{4Lv^2}$$

30-INCH MAIN TWO YEARS OLD.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length of pipe.	m.
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction head $H-h$		
		d.	S.	v.	lbs.	H.	h.	h''	Fl.	
0						167.3	167.3			
10	433			1.47				10.43		.00947
11	476.3			1.62	77.5	179.03		11.73		.00885
12	519.6			1.76	78. $\frac{1}{2}$			13.03		.00833
13	562.9			1.91	78 $\frac{1}{2}$			14.33		.00777
14	606.2			2.06	79 $\frac{1}{2}$			15.63		.00726
15	649.5	30 ins. = 2.5 feet. 4.91 square feet.		2.20	79.75	184.23		16.93	20.200	.00692
16	692.8			2.35	80 $\frac{1}{2}$			18.23		.00653
17	736.1			2.50	80 $\frac{3}{4}$			19.53		.00618
18	779.4			2.64	81 $\frac{1}{2}$			20.83		.00591
19	822.7			2.79	82.	189.42		22.12		.00562
20	866.0			2.94	82 $\frac{1}{2}$			23.42		.00534
21	909.3			3.08	83 $\frac{1}{8}$			24.72		.00516
22	952.6			3.23	83.7			26.02		.00493

DEDUCTION FROM EXPERIMENT NO. 5.

Frankford 30-inch Main.—The check-valves in the main produce a pressure of 1.8 lbs. per square inch, which is equal to a head of 4.16 feet. This amount deducted from the friction head in Table No. 5 gives the corrected friction head :

$$m = \frac{2gh'' d}{4Lv^2}$$

30-INCH MAIN, TWO YEARS OLD.

ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length.	m.
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction head. $H-h$.		
		d.	S.	v.	lbs.	H.	h.	h'.	Feet.	
10	433	.....	.....	1.47	.....	173.57	167.3	0.27	.....	.00575
11	476.3	.....	.....	1.62	75.7	.....	.....	7.57	.....	.00571
12	519.6	.....	.....	1.76	.....	.....	.....	8.87	.....	.00561
13	562.9	.....	.....	1.91	.....	.....	.....	10.17	.....	.00552
14	606.2	.....	.....	2.06	.....	.....	.....	11.47	.....	.00535
15	649.5	.....	.....	2.20	77.95	180.07	.....	12.77	.....	.00522
16	692.8	.....	.....	2.35	.....	.....	.....	14.07	.....	.00503
17	736.1	.....	.....	2.50	.....	.....	.....	15.37	20.200	.00487
18	779.4	.....	.....	2.64	.....	.....	.....	16.67	.....	.00473
19	822.7	.....	.....	2.79	80.2	185.26	.....	17.96	.....	.00452
20	866.0	.....	.....	2.94	.....	.....	.....	19.26	.....	.00441
21	909.3	.....	.....	3.08	.....	.....	.....	20.56	.....	.00429
22	952.6	.....	.....	3.23	.....	.....	.....	21.86	.....	.00415

EXPERIMENT No. 6.—JUNE 11, 1878.

Roxborough 30-inch Main, laid 1878. Engine, "Worthington," 5 per cent. deducted for slip. One quarter turn. All other turns made with curve pipe of 25 feet radius. Two check-valves on main.

The weight of the valves, 1.3 lbs. per square inch, has been deducted from the observed pressure on the gauge.

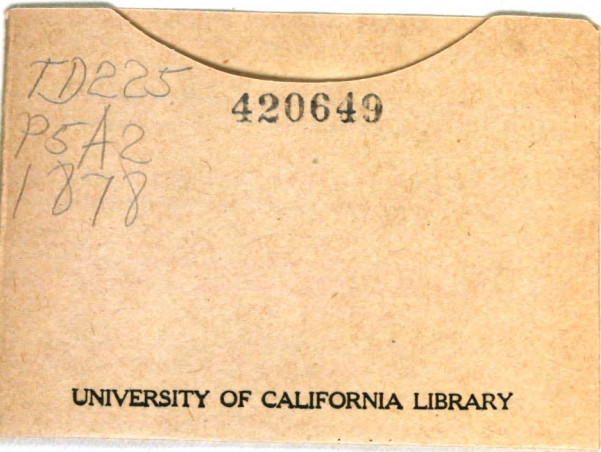
$$m = \frac{2g''hd}{4Lv^2}$$

30-INCH MAIN, NEW.

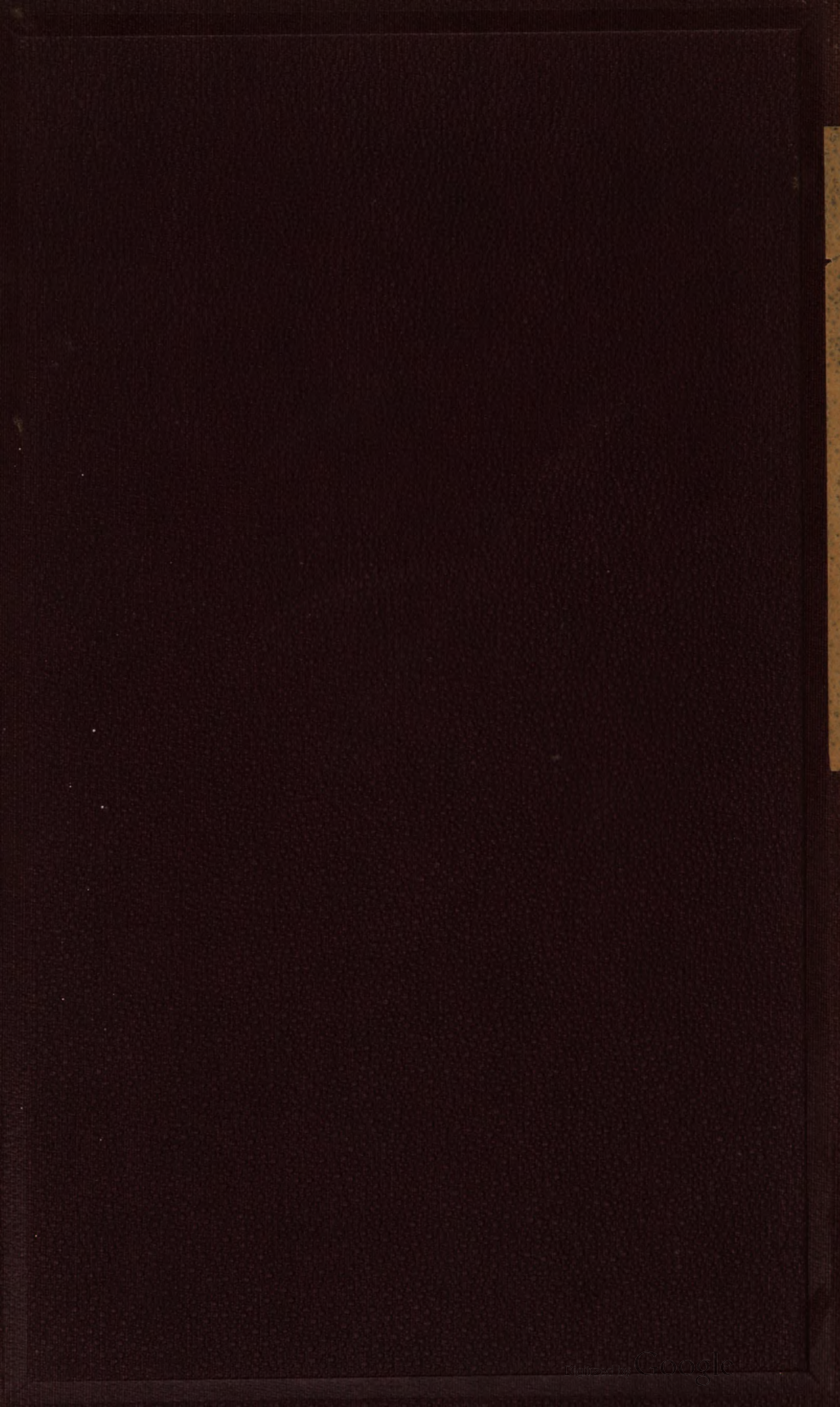
ENGINE.		PIPE.		Velocity in feet per second.	HEAD.				Length.	sq.	
Revolutions per minute.	Cubic feet per minute.	Diam.	Area.		Gauge.	Total head.	Static head.	Friction head. $H-h$.			
		<i>d</i> .	<i>S</i> .	<i>v</i> .	<i>lbs.</i>	<i>H</i> .	<i>h</i> .	<i>h''</i> .	<i>Feet</i> .		
0					140.33	324.16		0			
12	472.8	30-inches=2.5 ft.	4.91 sq. ft.	1.60	141.0	325.71		1.55	4000	.00606	
13	512.2			1.74				324.16		1.53	.00604
14	551.6			1.87	141.25	326.27				2.11	.00603
15	591.0			2.00						2.40	.00600
16	630.4			2.14	141.5	326.64				2.68	.00590



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